



NATIONAL BOARD FOR TECHNICAL EDUCATION

CURRICULUM AND COURSE SPECIFICATIONS

FOR

NATIONAL DIPLOMA (ND)

IN

MECHANICAL ENGINEERING TECHNOLOGY

November, 2020

Foreword

The National Diploma (ND) in Mechanical Engineering Technology curriculum is designed to be used by training institutions to produce manpower for academia and industries nationwide.

The acute shortage of professionally trained manpower in these industries in Nigeria as well as the need to produce professional practitioners with good ethics and career prospects, through the acquisition of desirable knowledge and skills, necessitated the production of this national curriculum.

It is my belief that this curriculum and course specifications which is the minimum required to produce technicians with sound knowledge and skills in Mechanical Engineering Technology, if properly implemented with the required resources (qualified teaching staff in adequate number and mix, adequate equipment/consumables, physical training facilities and teaching aids). Also, with qualified candidates admitted into the programme, will lead to the production of competent and skilled technicians required in the sector.

I wish to express my deep appreciation to those that made the development of this curriculum possible. The invaluable contributions of all the members of the committee and resource persons during the idea generation, pre-critique and national critique workshops are appreciated.

I hope that the curriculum would be properly implemented, so as to produce the required Work Force of our dream.

TPL Ekpenyong E. Ekpenyong, *fnitp*
Ag. Executive Secretary,
NBTE, Kaduna

Table of Content

Foreword.....	2

Table of Content	2
GENERAL INFORMATION	5
Curriculum Table.....	12
FIRST SEMESTER COURSES	16
Technical Drawing.....	18
Engineering Mechanics I (Statics).....	254
Basic Workshop Technology and Practice	309
Introduction to Computing.....	388
SECOND SEMESTER COURSES	4950
Engineering Graphics.....	5151
Thermodynamics I	577
Machine Tools Technology and Practice	633
Engineering Mechanics II (Dynamics).....	7171
Automotive Technology and Practice I.....	7778
Welding Technology and Practice	86
THIRD SEMESTER COURSES.....	9092
Engineering Drawing I	9293
Engineering Measurement	101102
Thermodynamics II	108109
Fluid Mechanics	11314
Foundry and Forging Operations.....	119
Introduction to CAD/CAM.....	12930
Technical Report Writing	13739
FOURTH SEMESTER COURSES	14244
Supervisory Management	14345
Strength of Materials.....	14649

Engineering Drawing II.....	15254
Properties of Materials	Error! Bookmark not defined. 58
Refrigeration and Air-Conditioning.....	16466
Plant Services and Maintenance	171
Automotive Technology and Practice II.....	178
LIST OF WORKSHOPS, LABORATORIES AND STUDIOS	18487
REQUIRED MINIMUM LIST OF EQUIPMENT IN THE WORKSHOPS AND LABORATORIES	18588
IDEA GENERATION WORKSHOP TEAM LIST	200201
PRE-CRITIQUE WORKSHOP TEAM LIST	202202
NATIONAL CRITIQUE WORKSHOP TEAM LIST	203203

GENERAL INFORMATION

1.0 CERTIFICATION AND TITLE OF THE PROGRAMME:

The certificate to be awarded and the programme title shall read: “**NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY**”

2.0 GOAL AND OBJECTIVES

Goal

The National Diploma (ND) programme in Mechanical Engineering Technology is aimed at producing technicians with knowledge, skills and competencies to carry out installation, operation, troubleshooting and maintenance of mechanical and related systems, components and equipment for the public and private sectors of the economy.

Objectives

On completion of ND Mechanical Engineering Technology programme, the diplomates should be able to:

- Apply basic principles of Science and Mathematics to solve Engineering problems.
- Prepare and interpret engineering drawings of mechanical equipment, their components and systems;
- Carry out machining, welding and fabrication operations.
- Assist in preparing CNC part programs and use CNC machines to make simple jobs as well as interface CAD/CAM machines.
- Produce and assemble machine components.
- Operate, maintain and service mechanical equipment safely.
- Prepare appropriate engineering report.
- Carry out plant installation and maintenance.
- Apply management principles in organising supervisory groups and in the arrangement of sequence of activities.

- Set up and manage an enterprise.
- Use computer and IT tools for creating document, making spreadsheet and presentation.
- Use software like AutoCAD and Solid Works to prepare drawings.

3.0 MINIMUM ENTRY REQUIREMENTS

Candidates for admission into the programme should have a minimum of:

(i) Senior Secondary School Certificate (**SSSC**) with credit passes in at least five subjects at not more than two sittings which must include English, Mathematics, Physics, Chemistry, and one other subject from

- biology,
- agricultural science,
- further mathematics,
- economics,
- statistics, technical drawing, auto-mechanics, metal work and other relevant subject.

(ii) GCE 'O' Level or its equivalent (Teachers Grade II or Senior School Certificate) with credit passes in five relevant subjects as specified in (i) above.

(iii) National Technical Certificate (**NTC**) with credit passes in Mathematics, Physics, Chemistry, English Language and in the Mechanical Trade areas.

4.0 DURATION

The duration of the programme is two academic sessions consisting of four semesters of 18 weeks per semester.

5.0 CURRICULUM

5.1 The curriculum of ND programme is made up of four main components. These are:

- i. General studies/education
- ii. Foundation courses
- iii. Professional courses
- iv. Supervised Industrial Work Experience Scheme (SIWES)

5.2 The General Education component shall include courses in:

- i. Art and Humanities – English Language, Communication, History.

ii. Social Studies – Citizenship Education, Political Science Sociology, Philosophy, Geography, Entrepreneurship, Philosophy and Sociology are compulsory.

iii. Physical and Health Education – One semester credit only.

5.3 The General Education component shall account for not more than 15% of the total contact hours for the programme.

5.4 Foundation courses include courses in Mathematics, Pure Sciences, Technical Drawing, Descriptive Geometry, Statistics, etc. The number of hours for the programme may account for about 10-15% of the total contact hours.

5.5. Professional courses are core courses of the programme that give the student the theory and professional skills he needs to practice his field of calling at the technician/technologist level. These may account for between 60-70% of the contact hours.

5.6. Student Industrial Work Experience Scheme (SIWES) shall be taken during the long vacation following the end of the second semester of the first year. See details of SIWES at section 11.0.

5.7. Personal Logbook: The students to maintain a personal Logbook to record all the daily and weekly summary of all the practical activities in all the semesters.

6.0 CURRICULUM STRUCTURE

The structure of the National Diploma programme consists of four semesters of classroom, laboratory and workshop activities in the college, and a semester (3-4 months) of student Industrial Work Experience Scheme (SIWES). Each semester shall be of 18 weeks duration made up of the following:

a. 15 contact weeks of teaching, i.e. recitation, practical exercise, quizzes, test, etc, and

b. 3 weeks for examinations and registration. SIWES shall take place at the end of the second semester of the first year.

7.0 ACCREDITATION

The Diploma programme shall be accreditation by the National Board for Technical Education (NBTE) before the diplomates can be awarded the National Diploma certificates. Details about the process of accrediting a programme for the award of the National Diploma are available at the office of the Executive Secretary, National Board for Technical Education (NBTE), Plot “B”, Bida Road, P.M.B. 2239, Kaduna, Nigeria.

8.0 AWARD OF NATIONAL DIPLOMA

Conditions for the award of National Diploma include the following:

a. Satisfactory performance in all prescribed course work which may include class work, tests, quizzes, workshop practice and laboratory work which should amount to a minimum of between 72 and 80 semester credit units.

- b. Supervised industrial work experience for four months.
- c. Satisfactory performance at all semester examinations.
- d. Satisfactory completion of final year project work. Normally, continuous assessment contributes 30% while semester examinations are weighted 70% to make a total of 100%. The industrial training is rated on the basis of pass or fail.

The National Diploma certificates shall be awarded based on the Standardized Unified Grading System as follows:

Mark Range (%)	Letter Grade	Weighting
75 and Above	A	4.00
70 – 74	AB	3.50
65 – 69	B	3.25
60 – 64	BC	3.00
55 – 59	C	2.75
50 – 54	CD	2.50
45 – 49	D	2.25
40 – 44	E	2.00
Below 40	F	0.00

Unified Class of National Diploma

National Diploma should be awarded in four classes:

Distinction - CGPA of 3.5 and Above

Upper Credit - CGPA of 3.00 – 3.49

Lower Credit - CGPA of 2.50 – 2.99

Pass -

CGPA of 2.00 – 2.49.

9.0 GUIDANCE NOTES FOR TEACHERS

9.1 The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy on Education, which stress the need to introduce the semester credit units which will enable a student who so wish to transfer the units already completed in an institution similar standard from which he/she is transferring.

9.2 In designing the units, the principle of the modular system by product has been adopted, thus making each of the professional modules, when completed provides the student with technician operative skills, which can be used for employment purposes, self-reliance and otherwise.

9.3 As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the curriculum content has been written in behavioural objectives, so that it is clear to all the expected performance of the student who successfully completed some of the courses or the diplomates of the programme. This is slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which performance can take place and to follow that with the criteria for determining an acceptable level of performance. The Academic Board of the institution may vet departmental submission on the final curriculum. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the Polytechnic system.

9.4 The teaching of the theory and practical work should, as much as possible, be integrated. Practical exercises, especially those in professional courses and laboratory work should not be taught in isolation from the theory. For each course, there should be a balance of theory to practical in the ratio of 50:50 or 60:40 or the reverse.

10.0 LOGBOOK

A personal Log-book to be kept by the students shall contain all the day-to-day, weekly summary, and semester summary of all the practical activities from day one to the end of the programme. This is to be checked and endorsed by the lecturers concerned at the end of every week.

11.0 GUIDELINES ON SIWES PROGRAMMES

For the smooth operation of the SIWES, the following guidelines shall apply:

11.1 Responsibility for placement of students.

a. Institutions offering the National Diploma programme shall arrange to place the students in industry. By April 30 of each year, six copies of the master-list showing where each student has been placed shall be submitted to the Executive Secretary, National Board Technical Education, which shall, in turn, authenticate the list and forward it to the Industrial Training Fund, Jos;

b. The placement officer should discuss and agree with industry on the following:

(a) A task inventory of what the students should be expected to experience during the period of attachment. It may be wise to adopt the one already approved for each field.

(b) The industry-based supervisor of the students during the period. It should be noted that the final grading of the students during the period of attachment should be weighted more on the evaluation by his industry-based supervisor.

11.2 Evaluation of students during SIWES.

In the evaluation of the student, cognizance should be taken of the following:

1. Punctuality
2. Attendance
3. General Attitude to work
4. Respect for Authority
5. Interest in the field/technical area
6. Technical competence as a potential technician in his field.

11.3 Grading of SIWES: To ensure uniformity of grading scales, the institution should ensure that the uniform grading of students' work that has been agreed to by all polytechnics is adopted.

11.4 The Institution-Based Supervisor: The institution-based supervisor should initial the logbook during each visit. This will enable him to check are being met and to assist students having any problems regarding the specific assignments given to them by their industry-based supervisor.

11.5 Frequency of Visit: Institution should ensure that students placed on attachment are visited within one month of their placement. Other visits shall be arranged so that:

- 1) there is another visit weeks after the first visit; and
- 2) a final visit in the last month of the attachment.

11.6 Stipend for Students in SIWES: The rate of stipend payable shall be determined from time-to-time by the Federal Government after due consultation with the Federal Ministry of Education, the Industrial Training Fund and the National Board for Technical Education.

11.7. SIWES as a component of the curriculum: The completion of SIWES is important in the final determination of whether the student is successful in the programme or not. Failure in the SIWES is an indication that the student has not shown sufficient interest in the field or has no potential to become a skilled technician in his field. The SIWES should be graded on a fail or pass basis. Where a

student has satisfied all other requirements but failed SIWES, he may only be allowed to repeat another four months' SIWES at his own expense.

12.0 FINAL YEAR PROJECT

Final year students in this programme are expected to carry out a project work. This could be on individual basis or group work. The project should, as much as possible incorporate basic element of design, drawing and complete fabrication of a marketable item or something that can be put to use. Project reports should be well presented and should be properly supervised.

The departments should make their own arrangement of schedules for project work.

Curriculum Table

NATIONAL DIPLOMA (ND) IN MECHANICAL ENGINEERING TECHNOLOGY

ND I SEMESTER I

COURSE CODE	COURSE/ MODULE TITLE	L	T	P	CU	CH
GNS 101	Use of English I (Grammar)	2	-	-	2	2
GNS 111	Citizenship Education	2	-	-	2	2
MTH 112	Algebra and Elementary Trigonometry	2	1	-	2	3
EEC 115	Electrical Engineering Science I	2	-	2	2	4
MEC 111	Technical Drawing	1	-	3	3	4
MEC 112	Engineering Mechanics I (Statics)	2	-	2	3	4
MEC 113	Basic Workshop Technology and Practice	1	-	3	3	4
MEC 114	Introduction to Computing	1	-	2	2	3
Total		13	1	12	19	26

ND I SEMESTER II

COURSE CODE	COURSE/MODULE TITLE	L	T	P	CU	CH

GNS 201	Use of English II (Essay and Comprehension)	2	-	-	2	2
ENT 126	Introduction to Entrepreneurship I	2	-	1	3	3
MTH 122	Trigonometric and Analytical Geometry	2	1	-	2	3
MEC 121	Engineering Graphics	1	-	2	2	3
MEC 122	Thermodynamics I	2	-	2	3	4
MEC 123	Machine Tools Technology and Practice	2	-	2	3	4
MEC 124	Engineering Mechanics II (Dynamics)	2	-	2	3	4
MEC 125	Automotive Technology and Practice I	2	-	2	3	4
MEC 126	Welding Technology and Practice	1	-	2	2	3
MEC 127	SIWES	-	-	-	-	-
Total		19	1	13	23	30

ND II SEMESTER I

Course Code	Course/Module Title	L	T	P	CU	CH

MTH 202	Logic and Linear Algebra	2	1	0	2	3
EEC 125	Electrical Engineering Science II	2	-	2	2	4
ENT 216	Introduction to Entrepreneurship II	2	-	1	3	3
MEC 211	Engineering Drawing I	1	-	2	2	3
MEC 212	Engineering Measurement	1	-	1	2	2
MEC 213	Thermodynamics II	2	-	2	3	4
MEC 214	Fluid Mechanics	2	-	2	3	4
MEC 215	Foundry Technology and Forging Operations	2	-	2	3	4
MEC 216	Introduction to CAD/CAM	0	-	2	2	2
MEC 217	Technical Report writing	1	-	0	1	1
Total		15	1	14	23	30

ND II SEMESTER II

Course Code	Course/Module Title	L	T	P	CU	CH
MTH 211	Calculus	2	1	0	2	3
MEC 221	Supervisory Management	2	-	0	2	2
MEC 222	Strength of Materials	2	-	2	3	4
MEC 223	Engineering Drawing II	1	-	3	2	4
MEC 224	Properties of Materials	2	-	2	3	4
MEC 225	Refrigeration and Air Conditioning	2	-	2	3	4
MEC 226	Plant Services and Maintenance	2	-	2	3	4
MEC 227	Automotive Technology and Practice II	2	-	2	3	4
MEC 200	Final Year Project	0	-	0	4	0
Total		15	1	13	25	29

FIRST SEMESTER COURSES

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Technical Drawing

COURSE CODE: MEC 111

DURATION: 60 Hours (1 Hour Lecture and 3 Hours Practical)

CREDIT UNIT: 3.0

Course: Technical Drawing	Code: MEC 111	Total Hours:	4 Hours/Week
	Pre-requisite: NIL	Theoretical hours:	1 Hour/Week
		Practical hours:	3 Hours/Week
Semester: First			
Goal: This course is designed to acquaint students with the fundamentals of technical drawing and its applications in engineering technology			

GENERAL OBJECTIVES	
On completion of this course, the students should be able to :	
1	Know different drawing instrument, equipment and materials
2	Understand the essentials of graphical communications
3	Know the construction of simple geometrical figures and sections
4	Know the Construction of isometric and oblique drawing and projection
5	Understand principles of orthographic projections
6	Understand the intersections of regular solids

Technical Drawing

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: TECHNICAL DRAWING				COURSE CODE: MEC 111		CONTACT HOURS: 1-0-3 Hrs/Wk
Goal: This course is designed to acquaint students with the fundamentals of technical drawing and its applications in engineering technology						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Know different drawing instrument, equipment and materials					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 List different types of drawing instruments, equipment and materials. 1.2 Outline the uses of the various instruments, equipment and materials. 1.3 State the precautions necessary to preserve items 1.1 above.	Explain 1.1 - 1.3	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	1.1 Identify the different types of drawing instruments, equipment and materials. 1.2 Observe the precautions necessary to preserve the items identified in 1.1 above. 1.3 Use each of the items in 1.1 above. 1.4 Maintain the various instruments and equipment.	Demonstrate activities 1.1 to 1,4 for students to learn and guide them to perform the activities.	Describe different drawing instrument, equipment and materials
	General Objective 2.0: Understand the essentials of graphical communications					
	2.1 Explain different types of graphic	Explain 2.1 - 2.6	Marker, Whiteboard,	2.1 Illustrate the various conventions	Demonstrate for the students to	Explain the the essentials of

3-4	communications. 2.2 Describe various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. 2.4 State the various standards of drawing sheets. 2.5 Print letters and figures of various forms and characters. 2.6 Describe conventional signs, symbols and appropriate lettering characters		Duster, Textbooks, Complete set of drawing instruments .	present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. 2.3 Prepare drawing sheets with the following (a) Margins (b) Title block etc. 2.4 State the various standards of drawing sheets. 2.5 Print letters and figures of various forms and characters. 2.6 Illustrate conventional signs, symbols and appropriate lettering characters.	learn and guide them to perform the activities.	graphical communications
General Objective 3.0: Know the construction of simple geometrical figures and sections						
	3.1 Explain the purpose of geometrical construction in drawing parallel lines. 3.2 Define geometric figures (circle,	Explain 3.1 – 3.4	Marker, Whiteboard, Duster, Textbooks, Complete set of	3.1 Construct parallel and perpendicular lines.	Demonstrate the activities in 3.1 tofor the students to learn and guide them to perform the activities.	Explain the steps in construction of simple geometrical

5-7	quadrilateral, polygon, etc). 3.2 Explain the properties of geometric figures, e.g. sides, diagonal, radius, diameter, normal, tangent, circumference etc. 3.3 Define an ellipse. 3.4 Explain the following drafting techniques (a) Projection method (b) Measurement method (c) Transposition method.		drawing instruments .	3.2 Construct and bisect lines, angles and areas. 3.4 Divide a straight line into given number of equal parts. 3.5 Identify polygons (regular or irregular). 3.6 Construct regular polygons with N sides in a given circle, given (a) distance across flats (b) distance across corners. 3.7 Carryout simple geometrical constructions on circles e.g. (a) diameter of a circle of a circle of a given circumference. (b) the circumference to a circle of a given diameter (c) a circle to pass through 3 points (d) a circle to pass through 2 points and touch a given line (e) a circle to touch a given smaller circle and a given line (f)	figures and sections

				tangents to circles at various points (g) an arc of radius tangent to two lines at an angle to less than and more than 90 (h) an arc externally tangent to two circles (i) inscribing and circumscribing circles 3.8 Construct ellipse by using (a) trammel method (b) concentric circle method. 3.9 Construct plane scales and diagonal scales, using appropriate instruments.		
	General Objective 4.0: Know the construction of isometric and oblique drawing and projection					
8-10	4.1 Explain isometric and oblique projections.	Explain 4.1	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	4.1 Draw a square in isometric and oblique forms. 4.2 Draw a circle in Isometric and oblique forms. 4.3 Draw an ellipse in Isometric and oblique forms. 4.5 Draw a polygon with a minimum of	Demonstrate for the students to learn and guide them to perform the activities.	Explain steps in construction of isometric and oblique drawing and projection

				eight sides in Isometric and oblique forms. 4.5 Dimension holes, circles, arcs and angles correctly on isometric and oblique projections. 4.7 Use appropriate convention symbols and abbreviations.		
	General Objective 5.0: Understand principles of orthographic projections					
11-13	5.1 Explain the principle of orthographic projection. 5.2 Illustrate the principle planes of projection: (a) Vertical plane (b) Horizontal plane. 5.3 Explain why the first and third angles are used and the second and fourth angles not used.	Explain 5.1 - 5.3	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	5.1 Project views of three-dimensional objects on to the basic planes of projection in both first and third angle to obtain (a) the front view or elevation (b) the top view or plan. (c) the side view	Demonstrate for the students to learn and guide them to perform the activities.	Explain principles of orthographic projections
	General Objective 6.0: Understand the intersections of regular solids					
12 - 15	6.1 Explain interpretation or intersections of solids. .	Explain 6.1		6.1 Draw the lines of intersections of the following regular solids and planes in both first and third angles. a. Two square-prisms meeting at right angles. b. Two dissimilar square prisms meeting	Demonstrate for the students to learn and guide them to perform the activities.	Explain the intersections of regular solids

				at an angle. c. Two dissimilar square prisms meeting to an angle d. A hexagonal prism meeting a square prism at right angles. e. Two dissimilar cylinders meeting at an angle. f. Two dissimilar cylinders meeting at right angle, their centres not being in the same vertical plane		

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Mechanics I (Statics)

COURSE CODE: MEC 112

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Engineering Mechanics I (Statics)	Code: MEC 112	Total Hours: 4 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Semester: First		
Goal: This course is designed to acquaint students with knowledge and skills on the basic principles and laws of statics so as to enable him/her analyse and solve problems related to them		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the basic principles of statics.
2	Understand the concept and effect of forces and their moments
3	Understand the effect of friction and the law governing it.
4	Know the forces in simple frames and structures.
5	Know centroid of solid bodies and plane areas
6	Understand the concept of hydrostatics

Engineering Mechanics I (Statics)

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Engineering Mechanics I (Statics)				COURSE CODE: MEC 112		CONTACT HOURS: 2-0-2 Hrs/Wk
Goal: This course is designed to acquaint students with knowledge and skills on the basic principles and laws of statics so as to enable him/her analyse and solve problems related to them						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Know the basic principles of statics.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 Define scalar quantity 1.2 Define vector quantity. 1.3 Distinguish between 1.1 and 1.2. 1.4 Give examples in 1.1 and 1.2 1.5 Explain the concept of particles and rigid body	Explain 1.1 - 1.5	Marker, Whiteboard, Duster, Textbooks, .			Explain the basic principles of statics
	General Objective 2.0: Understand the concept and effect of forces and their moments					
	2.1 Define force. 2.2 Describe the conditions for the equilibrium of co-planar forces.	Explain 2.1 - 2.10	Marker, Whiteboard, Duster, Textbooks, Graph sheets, drawing	2.1 Construct parallelogram of force 2.2 Draw triangle of forces.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the concept and effect of forces and their moments

3-4	2.3 State the principles of parallelogram of force. 2.3 Explain how to construct parallelogram of force. 2.4 Calculate the resultant of a system of two forces. 2.5 State the principle of triangle of force. 2.6 Resolve forces into components. 2.7 Resolve a force into force and couple. 2.8 Define moment of a force. 2.9 State the principles of moments. 2.10 Solve problems related to 2.1 to 2.9.		instruments and force board .	2.3 Draw polygon of forces. 2.4 Verify Lami's theorem using a force board. 2.5 Verify the parallelogram law of forces		
	General Objective 3.0: Understand the effect of friction and the law governing it.					
	3.1 Define friction. 3.2 State advantages and disadvantages of friction. 3.3 Define coefficient of friction. 3.4 Define limiting angle of friction. 3.5 Define angle of Repose.	Explain 3.1 – 3.6	Marker, Whiteboard, Duster, Textbooks, .	3.1 Determine the co-efficient of friction in a normal and in an inclined plane.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the effect of friction and the law governing it.

5-7	3.6 Solve problems related to 3.1 to 3.5					
	General Objective 4.0: Know the forces in simple frames and structures.					
8-10	4.1 Explain forces in the members (including trusses) using free body diagram (FBD). 4.2 State the general conditions for equilibrium. 4.3 Solve problems related to 4.1 and 4.2	Explain 4.1 – 4.3	Marker, Whiteboard, Duster, Textbooks .	4.1 Apply Boyle’s notation for graphical analysis of simple frame structures. 4.2 Determine the nature of the forces acting on each member of simple frame.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the effect of forces in simple frames and structures
	General Objective 5.0: Know centroid of solid bodies and plane areas					
11-13	5.1 Define centre of gravity solid bodies and plane areas. 5.2 Solve problems related 5.1 above analytically and graphically.	Explain 5.1 - 5.2	Marker, Whiteboard, Duster, Textbooks .	5.1 Locate the centre of gravity of solid bodies and plane areas. 5.2 Determine graphically the centre of gravity of plane areas and solid bodies	Demonstrate for the students to learn and guide them to perform the activities.	Explain centroid of plane areas
	General Objective 6.0: Understand the concept of hydrostatics					
14 - 15	6.1 Define ‘Hydrostatics’. 6.2 State Archimedes Principle. 6.3 Define: (i) density (ii) relative density	Explain 6.1-6.5	Marker, Whiteboard, Duster, Textbooks .	6.1 Perform experiment to verify Archimedes Principles	Demonstrate for the students to learn and guide them to perform the activities.	Explain the concept of hydrostatics

	(iii) volume and (iv) weight of floating bodies. 6.4 Explain the variation of fluid pressure with depth and total force due to liquid pressure on immersed plane surface – horizontal or vertical. 6.5 Solve problems related To 6.1 to 6.4.					

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Basic Workshop Practice and Technology

COURSE CODE: MEC 113

DURATION: 60 Hours (1 Hour Lecture and 3 Hours Practical)

CREDIT UNIT: 3.0

Course: Basic Workshop Practice and Technology	Code: MEC 113	Total Hours:	4 Hours/Week
	Pre-requisite: NIL	Theoretical hours:	1 Hour/Week
		Practical hours:	3 Hours/Week
Semester: First			
Goal: This course is designed to acquaint students with knowledge and skills of workshop safety practices as well as the use and care of basic tools and equipment in workshop operations			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know General Factory Acts, Safety Regulations and safety precautions
2	Understand safety inspection
3	Use basic marking out, metal removal and filing tools
4	Use basic measuring and testing equipment
5	Perform drilling operations
6	Perform various metal joining operations
7	Perform the various wood working tools and operations
8	Perform reaming operations
9	Perform tapping operations
10	Perform basic operations on plastics

Basic Workshop Technology and Practice

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Basic Workshop Technology and Practice			CODE: MEC 113		CONTACT HOURS: 1 - 0 - 3 HOURS PER WEEK	
General Objective 1.0: Know General factory acts, safety Regulations and safety precautions						
COURSE SPECIFICATION: THEORETICAL CONTENT				COURSE SPECIFICATION: PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1-2	1.1 Explain Nigeria Factories Acts and Safety Regulations 1.2 Explain safety Rules and Regulations. 1.3 Explain standard housekeeping and its procedures 1.4 State safety precautions 1.5 Explain Personal Protective Equipment (PPE) such as safety boots, goggles, coverall, hand gloves, etc.	• Provide list of safety precautions in the workshop • Discuss some unsafe acts in the workshop. • List out protective wears in the workshop.	Books, Whiteboard, marker, Videos of safe and unsafe acts Safety charts Personal Protective equipment .	1.1 Demonstrate all safety rules and regulations in the workshop 1.2 Use safety equipment and Personal Protection Equipment 1.3 Follow safety procedures and precautionary measures	Demonstrate for the students for learn and guide them to perform the activities.	Explain the safety regulations in the Nigeria Factories Act State the safety and precautionary measures against accidents in the workshop
General Objective 2.0: Understand safety inspection						
3	2.1 Define safety inspections 2.2 Describe different types of safety inspections 2.3 State frequency of safety inspections and personnel to be involved	Emphasize the use of relevant personal protective equipment while on inspection	Books, Whiteboard, marker, Videos of safety inspections Safety charts	2.1 Inspect the following equipment in the workshops: Air receivers Ropes and Chains Pulley blocks	Guide students to carry out an inspection of the workshop equipment listed in 2.1.	Explain the importance of safety inspection in the workshop

	2.4 Explain how to carry out safety inspections on the following equipment: • Air receivers • Ropes and Chains • Pulley blocks • Forklift carriage • Mobile and overhead cranes • Derricks and gantries		Workshop equipment	Forklift carriage Mobile and overhead cranes Derricks and gantries		
General Objective 3.0: Use basic marking out, metal removal and filing tools						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-5	3.1 Describe types of marking-out tools and how to use it on the bench correctly 3.2 Explain how to maintain files, dividers, saws, gauges, tri squares, bevel edge square etc.	• Explain the need for care in the use of the tools • Explain the effect of not using this tools properly and keeping them in good working condition	Work bench Bench vice, Hammers, Set of drills Steel rule Scribes Scribing blocks, Inside and outside calipers Surface plate Dividers Centre punches, Files, Scrapers, etc	3.1 Use marking-out tools on the bench correctly 3.2 Produce simple objects using bench/hand tools such as files, chisels, scrapers, saws etc. 3.3 Maintain files, dividers, saws, gauges try squares, bevel edge square etc.	• Guide students to differentiate between a. Hand tools and machine tools b. Bench tools and machine cutting tools • Guide students to list out marking out tools used on the bench typical workshop practical exercises. a. Guide students to identify this bench cutting tools b. Guide students to write process sheet or operation layout for the component to be produced.	Explain the role of the following tools in the mechanical workshop: _Scribes _Inside and outside caliper _Centre _Files, _Scrapers _File card
General Objective 4.0: Use basic measuring and testing equipment						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
	4.1 Explain					

6-7	a. the principle of operation and construction of a micrometer screw gauge b. the least count of micrometer c. principle of operation and construction of a Vernier caliper and the least count. d. The types of micrometers e. The types of Vernier calipers f. Accuracy of a steel rule 4. 2 Explain to the students the principle and construction of a dial indicator, their types and their accuracy 4.3 Differentiate between the use of vernier protractor and sine bar and their limitations.	• Explain the methods of using the measuring equipment • Explain the advantage of using the equipment properly and keeping them in good working condition	Micrometers - external & internal Vernier calipers Steel rule Test mandrel/test bar 070 x 300 mm long dial indicator with stand spirit level surface roughness tester (portable type) SURF TEST, 90° angle gauge straight edge vernier protractor.	4.1 Perform simple measuring exercises using steel rules, vernier calipers and micrometers. 4.2 Use dial indicators to (i) set up jobs on the lathe (ii) roundness testing etc. 4.3 Carry out exercises involving flatness, squareness, straightness and surface finish test. Perform taper measurement on jobs using vernier protractor and sine bars. 4.4 Inspect jobs using simple comparators	Demonstrate for the students for learn and guide them to perform the activities.	State the differences and similarities between measuring and testing equipment in mechanical workshop with regards to: i. principle of operation ii. construction iii Use
GENERAL OBJECTIVE 5.0: Perform drilling operations						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8-9	5.1 Explain the nomenclature of a twist drill 5.2 Explain the formulae for calculation of speed of various sizes of drills	• Differentiate between a. drilling and boring operations b. radial drilling	Radial drilling machine Bench drilling machine Pillar	5.1 Operate different types of drilling machine 5.2 Carry out drilling operations such as counter-boring and	Demonstrate for the students for learn and guide them to perform the activities.	Explain the type of drilling operation that can be carried out on the following:

		and sensitive drilling machine • Explain types of drilling machine a. Pillar b. Column c. Multi spindle etc	drilling machine Column type drilling machine Counter boring drills Counter sinking drills Centre drills. Pedestal grinding machine attached with a twist drill grinding attachment	counter-sinking 5.3 Grind drill bits accurately 5.4 Select correct drilling speeds 5.5 Indicate the nomenclature of a twist drill. a. clearance angle b. rake angle c. point angle etc. 5.6 Calculate the speeds of various sizes of drills using appropriate formulae.		Radial drilling machine Bench drilling machine Pillar drilling machine Column type drilling machine

GENERAL OBJECTIVE 6.0: Perform various metal joining operations

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10-11	6.1 Explain the various metal joining methods 6.2 Explain how to carry out soft soldering	Explain activities 6.1 and 6.2	Lecture notes, Various types of Fasteners Brazing rods Flash gas lighter Soldering flux Stock and dies (set) metric	6.1 Fabricate metal container by Knock-up joining 6.2 Join metals by the grooving technique 6.3 Fabricate metal container by knock-up joining 6.4 Carry out soft soldering	• Guide students the various metal joining operations • Guide students to fabricate metal container by Knock-up joining • Guide students to Join metals by grooving technique.	Describe the process of joining metals using the following methods: Brazing Threaded Fasteners Soldering

General Objective 7.0: Perform the various wood working tools and operations

[illegible]

Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
13	8.0 Describe reaming operations 8.1 Explain how to carry out reaming operations	Explain the need for care in the use of the tools and machines for reaming operations • Explain the methods of maintenance of the tools and machines for reaming operations	Hand reamers Machine reamers Tap wrench Jacobs chuck and key Reduction sleeves Radial drilling machine Reamers	8.1 Carry out reaming operations i. on the bench ii. on drilling/lathe 8.2 Select correct speeds for reaming small and large holes.	• Guide students to do reaming operation in a practical workshop exercise • Guide students to ream small; and large holes using correct speeds and feed and appropriate lubricants.	Explain the conditions for using the following tools in reaming operations: _Hand reamers _Machine reamers _Tap wrench _Radial drilling machine
General Objective 9.0: Perform tapping operations						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
14	9.1 Explain tapping and the purpose of tapping operation. 9.2 Explain how to calculate tapping drill sizes 9.3 Explain the characteristics of threaded fasteners a. Pitch b. No. of starts c. Profile of thread d. Direction of thread 9.4 State the correct tapping drill size.	Explain the need for care in the use of the tools and machines for tapping operations	Taps and wrenches Drill chuck and key Lathe machine - medium size Pillar drilling, machine	9.1 Select correct tapping drill size 9.2 Select correct taps 9.3 Carry out tapping operation (i) on the work bench (ii) on drilling machine (iii) on lathe	Demonstrate for the students for learn and guide them to perform the activities.	Explain the purpose of tapping operation and describe the method of calculating tapping drill sizes

	9.5 Explain how to correct taps					
General Objective 10.0: Perform basic operations on plastics						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
15	10.1 Differentiate between thermo-setting and thermo-plastics. 10.2 Use conventional metal cutting tools to perform operations on plastics.	Explain the need for care in the use of the tools and machines for tapping operations • Explain the methods of maintenance of the tools and	Set of drill Wood turning lathe HSS cutting tools Evostic glue Thermo-setting and thermo-plastic	10.1 Identify various types of plastic groups such as thermo-setting and thermo-plastic 10.2 Use conventional metal cutting tools to perform operations on plastics. 10.3 Carryout joining operations using plastics	• Demonstrate the characteristics of each type of plastic. • Explain the result of using conventional metal cutting tools for operation on thermo-setting and thermo-setting plastic. Guide students to join the thermo-setting and thermo-plastic.	Describe the three processes of joining plastics together

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Introduction to Computing

COURSE CODE: MEC 114

DURATION: 45 Hours (1 Hour Lecture, 2 Hours Practical)

UNIT: 2.0

Course: Introduction to Computing		Code: MEC 114	Total Hours:	3 Hours/Week
			Theoretical hours:	1 Hour/Week
		Semester: FIRST	Pre-requisite: NIL	Practical hours:
Goal: This course is designed to acquaint students with knowledge and skills in basic computer applications				
GENERAL OBJECTIVES				
On completion of this module students should be able to :				
1	Understand the history, classification and impact of computers			
2	Understand the concept of computer hardware and software			
3	Know the concept of computer software			
4	Understand security and safety procedures within a computing environment			
5	Understand the use of the internet and contemporary computing			
6	Understand common application features and functions			
7	Understand basic typing skills			
8	Understand word Processing Activities and work with Microsoft Word.			
9	Understand spreadsheet activities and work with Microsoft Excel.			
10	Understand presentation Package and work with Microsoft PowerPoint			
11	Understand apps cultures			

12	Understand common graphics packages

Introduction to Computing

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
Course: INTRODUCTION TO COMPUTING			Course Code: MEC 114		Contact Hours: 1-0-2 HRS/WK	
	Theoretical Content				Practical Content	
	General Objective: 1.0 Understand the history, classification and impact of Computers					
Week	Specific Learning Outcomes	Teachers activities	Resources	Specific Learning Outcomes	Teachers activities	Evaluation
	1.1 Define Computer 1.2 Describe the basic components of the computer systems 1.3 Describe the development of computers, in particular: Abacus, Pascal, Babbage, Hollerith, ENIAC etc. 1.4 Classify computers according to generations from 1st – 5th generation (any subsequent generation)	Define computer and computer systems Trace the history of computer. Classify the computer according to generations	White Board. Charts, PC loaded with Presentation software package and connected to multimedia Projector	1.1 Identify computer systems. 1.2 Identify different classes of computer	Guide students to identify computer systems Guide students in the identification of computer systems	Explain the history and generations of computers. Classify computer by type, size and purpose

	1.5 Distinguish between analogue, digital and hybrid computers 1.6 Classify computer by size and purpose 1.7 List the benefits of computers to the society. 1.8 Explain the social implication of computers on society in particular privacies and quality of life.	Explain types and classes of computers. Explain the benefits and implications of computers to the society.				
	General Objective 2.0: Understand the concept of computer hardware and software					
	2.1 Explain elements of computer systems 2.2 Describe computer hardware Components 2.3 Describe three major components of computer hardware (input, processing and output) 2.4 Describe the functions of the peripheral devices. 2.5 Describe the function of C.P.U.	Explain the meaning of hardware, its various components and functions Explain various peripheral devices and their functions Explain the functions of CPU and its components.	White Board. Charts, PC loaded with Presentation software package and connected to multimedia Projector	2.1 Identify the various components of a computer system 2.2 Identify the various auxiliary units and distinguish between the memory sizes.	Guide students to identify the various component of a computer system Guide the students on how to identify the various auxiliary units	List the components of computer system and their various functions. What are the various measurement units of memory?

	2.6 List some auxiliary Units. 2.7 Describe the function of the auxiliary memory 2.8 Define bits, byte, nibble, and word and storage size.	Explain the auxiliary memory Explain measurement of storage				
	General Objective: 3.0: Know the concept of computer software					
	3.1 Explain software and its various types 3.2 Distinguish between the machine level, low – level and high – level languages. 3.3 Explain source and object programs. 3.4 Define a translator. 3.5 Explain types of translators: assembler, compiler, and interpreter.	Explain system software and application software. Explain the different levels of languages used in computers. Explain the various types of translators and their functions. Explain computer packages and user application software	White Board. Charts, PC loaded with Presentation software package and connected to multimedia Projector	3.1 Differentiate between different levels of languages used in a computer system 3.2 Identify various translators and computer packages on computer system	Guide the students on how to differentiate between different levels of languages. Guide students on how to identify various translators and computer packages on computer systems	What are the levels associated with a source and object code respectively? Differentiate the three translators and be able to identify the different application software.

	3.6 Explain the use of bespoke application packages and user application software programs.					
	General Objective: 4.0: Understand security and safety procedures within a computing environment					
	4.1 Explain Computer Security 4.2 Explain the need for computer room safety and security 4.3 Describe 3 methods of preventing hazards fire, flooding sabotage etc 4.4 Explain Malware infections and Prevention e.g. virus and worms 4.5 Explain standard procedure for installing anti-virus 4.6 Explain data control techniques. 4.7 Explain computer system auditing 4.8 Explain the user passwords and Username 4.9 Explain Computer Ergonomics	Discuss Computer Security and the need for computer room safety and security Explain methods of preventing hazards fire, flooding sabotage etc. Discuss Malware infections and prevention Explain system security using user passwords and username Explain Computer Ergonomics	White Board. Charts, PC loaded with Presentation software package and connected to multimedia Projector	4.1 Identify devices for computer room security 4.2 Identify actions that could lead to fire hazards, sabotage, viral and worm infections etc. 4.3 Formulate passwords (weak, strong and very strong). 4.4 Set up computer system following ergonomics standard	Guide students on how to secure computer room and computer systems Guide students to formulate simple password that they could easily remember Guide students to set up systems to meet ergonomics standard	What are the actions to take in case of fire or sabotage? List some hard to guess passwords

	General Objective: 5.0: Understand the use of the internet and contemporary computing					
	5.1 Define Internet and explain its resources 5.2 Explain the processes involved in browsing, searching the internet for information. 5.3 Explain the concepts of Electronic Mail (e-mail), World Wide Web (www), Uniform Resource Locator (URL) etc. 5.4 Explain the concept of e-mail and acquiring email address 5.5 Explain the process of sending and receiving an e-mail. 5.6 Explain Internet Service Provider (ISP) and their functions	Explain Internet and its resources Explain browsing and searching the internet for information Explain the concept of e-mail, sending and receiving an e-mail. Explain Internet Service Provider (ISP) and their functions Explain Cloud Computing, Internet of Things (IoT) etc.	White Board. PC loaded with Presentation software package and internet browser	5.1 Demonstrate how to browse and search the Internet for information. 5.2 Demonstrate how to compose and send E-mail. 5.3 Demonstrate how to use Cloud and IoT services	Guide students to browse and search the Internet for information Guide students to compose and send E-mail. Guide students to use Cloud and IoT services	Explain how to browse and search the Internet for information Explain how to compose and send E-mail. Explain how to use Cloud and IoT services
	General Objective: 6.0: Understand common application features and functions					
	6.1 Describe the following: System Software, Program	Explain System Software, Program Generators, Applications Packages (Word	PC with Office Software and Apps connected to	6.1 Install software Applications, Web Applications and Apps downloaded from App Store.	Guide students to Install and work with Software and Web Application	Differentiate between Desktop Softwares and Web Applications.

	Generators, Applications Packages and Apps. 6.2 Identify various types of application software and the tasks for which they are suited 6.3 Explain how to install, use, delete and recover web apps. 6.4 Describe the strengths and weaknesses of apps and applications	Processor, Spreadsheet, Database) and Apps Explain various types of application software and the tasks for which they are suited Explain the use of web apps, App store, App Installation, recovery and deletion Describe the strengths and weaknesses of apps and applications	the internet Multimedia Projector Projector Screen	6.2 Identify the various packages and their uses 6.3 Install, delete and recover apps. 6.4 Demonstrate the strengths and weaknesses of apps and applications	Guide students on how to Install and work with Packages Guide the student on how to install and work with an App downloaded from App Store	Explain the various types of application software and the tasks for which they are suited
	General Objective: 7.0: Understand basic typing skills					
	7.1 Describe process of use of keyboard for typing 7.2 List the functions of key board in typing.	Explain keyboards and its layout Explain how to type with a keyboard. Explain keyboards and its layout Explain how to type with a keyboard	PC with Typing Tutor Installed Multimedia Projector Projector Screen	7.1 Demonstrate the use of keyboard for typing. 7.2 Identify the functions of keyboard	Guide students on how to type with a standard keyboard Guide students to Identify the functions of keyboard	List the functions of keyboard. Explain the functions of keyboard

	9.1 Describe spreadsheet package 9.2 Describe the use of Spreadsheet Package 9.3 Explain process of carrying out basic spreadsheet operation 9.4 Use spreadsheet to carry out general statistical functions using cell references in a spreadsheet 9.5 Perform specific mathematical functions using spread sheet 9.6 Highlight data security requirements on spreadsheet data. 9.7 Explain the use of a spread sheet in a forecasting project, financial analysis, production scheduling and control and other forms of modeling	Explain basic terminologies and concepts for spreadsheets such as Cell, Column, Row Range, Worksheet, Workbook etc Describe ways of using spreadsheet to carry out general statistical functions using cell references in a spreadsheet Explain how to perform specific accounting functions and highlight data security requirements on spread sheet data. List the use of a spread sheet in a forecasting project, financial analysis, production scheduling and control and other forms of modeling.	PC with Office Software and Apps connected to the internet Multimedia Projector Projector Screen	9.1 Open a spread sheet document 9.2 Create a spread sheet document 9.3 Carryout some key spreadsheet operations 9.4 Carryout some key spreadsheet operations using cell references 9.5 Carryout some key spreadsheet operations to perform specific accounting functions using spread sheet 9.6 Show data security requirements. 9.7 Carryout some key spreadsheet operations in a forecasting project, financial	Guide students to open, save and close workbooks Guide students to carryout the following activities in Excel: select cells for a variety of purposes; copy and move data; change the column width or row height; create simple formulas and use common built-in functions. Merge and unmerge cells, cut, copy, and paste data. Guide students to format the data in a worksheet, create charts; sort or filter information in a worksheet; work with tables; and how to preview and print a report; insert/delete rows and columns; modify cell sizes; filter and sort data Guide students to use accounting	Explain how to create simple formulas and use common built-in functions Explain how to format the data in a worksheet to enhance it. Explain how to use spreadsheet to carry out general statistical functions using cell references in a spreadsheet. Explain how to sort or filter information in a worksheet Explain how to work with tables. Explain the following: forecasting project, financial analysis, production scheduling and

				analysis, production scheduling and control and other forms of modeling	functions in a workbook	control and other forms of modeling
General Objective: 10.0: Understand presentation package and work with Microsoft PowerPoint						
	10.1 Describe Presentation Package 10.2 Explain how to use a Presentation Package to prepare presentations 10.3 Insert and animate multimedia objects on slides 10.4 Apply transitions to slides, share presentations and publish slides 10.5 Explain file types compatible with presentation	Explain how to plan and design a presentation Explain how to create a presentation and use basic formatting features on a slide Explain how to manipulate text or objects on slides	PC with Office Software and Apps connected to the internet Multimedia Projector Projector Screen	10.1 Create a PowerPoint presentation	Guide students to connect to external/extended monitors to display presentation (Cables, Audio) Guide students to use presentation views and modes Guide Students to add animations, effects, and slide transitions. Guide students to apply transitions to slides, share presentations and publish slides Guide students to file types compatible with presentation	Explain how to apply transitions to slides, share presentations and publish slides

					Guide students to design slides (show how to use templates)	
General Objective: 11.0: Understand App cultures						
	11.1 Explain what App Culture is. 11.2 Explain the different App Genres 11.3 Explain Strength and Limits of Apps	Explain App Culture and how to obtain apps Explain the different app genres (Productivity, Reference, Content Creation, Social media, Music Health)	PC with Office Software and Apps connected to the internet Multimedia Projector Projector Screen	11.1 Differentiate App culture and its trends in the society	Guide students on studies on App Culture	Explain the different app genres.
General Objective: 12.0: Understand common graphics packages						
	12.1 Explain different types of graphic representations e.g. pictures, drawings, charts, animations, etc. 12.2 Explain application areas of graphic packages. 12.3 Explain the interface and design space of Graphic Packages. 12.4 Explain various tools and their functions in graphic application packages.	Define Graphic images Explain types of Digital image file: TIFF, JPEG, GIF, PNG, etc. Explain features of: Greeting cards, flyers, posters, Newsletters, Brochures Explain the Menus and Toolbox of a graphic design application.	PC Multimedia projector Graphic application packages	12.1 Identify different graphic Application Packages. 12.2 Identify different tools in the toolbox. Design a business card that has text and a logo. 12.3 Apply color to an object and create an outline.	Guide students to identify graphic application packages Guide students to explore the toolbox and other features of the interface. Guide students to create and save documents, use fonts, resizing, rotating and moving documents.	What are the most commonly used graphics packages and what are their functions? What is the process of creating and saving a design document? What are the basic tools needed to manipulate text and graphic?

	12.5 Create a simple graphic design.	Explain the process of creating and saving a design document.			Guide students to design a business card	

SECOND SEMESTER COURSES

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Graphics

COURSE CODE: MEC 121

DURATION: 45 Hours (1 Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Engineering Graphics	Code: MEC 121	Total Hours:	3 Hours/Week
	Pre-requisite: NIL	Theoretical hours:	1 Hour/Week
		Practical hours:	2 Hours/Week
Semester: Second			
Goal: This course is designed to acquaint students with knowledge and skills in descriptive geometry and application of graphical techniques.			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the construction of different geometrical figures and shapes
2	Understand orthographic projections.
3	Understand the developments and intersections of regular solids and planes

Engineering Graphics

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Engineering Graphics			CODE: MEC 121		CONTACT HOURS: (1 - 0 – 2) HOURS/WEEK	
Goal: This course is designed to acquaint students with knowledge and skills on descriptive geometry and it application of graphical techniques.						
General Objective 1.0: Know the construction of different geometrical figures and shapes						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1-3	1.1 Define parabola and hyperbola. 1.2 Describe the procedures in constructing a parabola and hyperbola 1.3 Define involute to a square, circle, cycloid and Archimedean spiral. 1.4 Describe the various types of link mechanisms	Explain activities 1.1 to 1.4 with graphics and detailed notes	Marker, Whiteboard ,Duster, Textbooks, Complete set of drawing instruments	1.1 Carry out simple geometrical construction s of an ellipse e.g. Tangent to an ellipse at any given point on the ellipse, tangent to an ellipse from a given point ‘p’ outside the ellipse, etc 1.2 Divide areas of plane/figure. 1.3 Enlarge and reduce from the given areas of plane figure 1.5 Construct parabola and hyperbola using (a) Rectangular method (b) Ordinate method (c) tangent method (d) offset method. 1.6 Locate the directrix and focus of a given parabolic curve. 1.7 Construct a curve of a	Guide students to carryout simple geometrical construction of an ellipse Assist student to divide areas of plane figure Guide student to enlarge and reduce the given areas of plane figures Guide student to construct parabola and hyperbola using (a) Rectangular method (b) Ordinate method (c) tangent method (d) offset method p	Explain the procedures used in constructing different geometrical figures and shapes

				parabolic form through two given points. 1.8 Plot the locus of point e.g. (a) mechanism with a link constrained to pass through a fixed point (mechanism with the end of the link constrained to move in a horizontal link (c) three links mechanism (d) linkages of a mechanically operated lever system mechanism of a printing press (f) mechanism of a pair of secateurs	Guide student to Construct a parabolic curve indicating the directrix and focus Guide students to construct a curve through two points Guide students to plot locus point in different mechanism	
General Objective 2.0: Understand orthographic projections.						
4-8	2.1 Explain the properties of a point, a line and plane in space. 2.2 Describe orthographic projections 2.3 Explain dihedral angle and give examples of where it is commonly used; hipped roofs, hoppers, etc.	Explain activities 2.1 to 2.3 with graphics and detailed notes	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	2.1 Identify the third plane (the auxiliary or side vertical plane) of projection. 2.2 Project the side and end view of a three dimensional object on the third plane . 2.3 Draw from an object (with changer, round hole, stepped, block, etc) the plane and elevations and draw the view in first and third angle orthographic Projections. 2.4 Draw plan, elevations and	Show samples of third plane (the auxiliary or side vertical plane) of projection. Guide students to construct a curve through two points Guide students to plot locus point in different mechanism Guide students to draw orthographic Projections in first and third angle	Explain orthographic projections

				sections of simple object such as hollow sand crate block. 2.5 Locate given point, lines and planes in space on the projection planes. 2.6 Determine the true length of a line in space using (a) auxiliary method (b) rotational Method. 2.7 State practical applications of the methods in 2.6 above. 2.8 Apply successive auxiliary projections to determine the true position of a point to both horizontal and vertical planes the true horizontal and vertical planes the true shape of a plane inclined to both horizontal and vertical planes the shortest distance between the two lines: The angle of inclination of a line inclined to two given planes. 2.9 Determine the dihedral angle of two intersecting surfaces	Guide students to draw plan elevations and sections of a hollow sand crate block Guide students to identify a given points, lines and planes in space Guide students to measure the true length of a line in space using (a) auxiliary method (b) rotational Method. Guide student to use successive auxiliary projections to determine the true position of a point Guide student to determine the dihedral angle of two intersecting surfaces	
	General Objective 3.0: Understand the developments and intersections of regular solids and planes					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

9-15	3.1 Explain development and intersection of regular solids and planes.	Explain activities 3.1 with graphics and detailed notes	Marker, White board Duster, Textbooks, Complete set of drawing instruments	3.1 Develop pattern of regular solids such as truncated prism, prism, circular cylinder, truncated cylinder, frustum of a pyramid, truncated cone, etc. 3.2 Draw the lines of intersections of the following regular solids and plane in both first and third angles i. a cylinder meeting a square pyramid at right angle ii. a cylinder meeting a cone, the cone at an angle iii. a cylinder meeting a cone, the cone enveloping the cylinder iv. a cylinder and a cone, the cylinder enveloping the cone v. A Square prism meeting a rectangular plane at an angle vi. A square prism meeting an ellipse at an angle. vii. A square prism meeting a circle at an angle viii. A cylinder meeting a pentagon at an angle ix. a cylinder meeting an ellipse at an angle x. a cone meeting an ellipse at an angle xi. a circle cutting through a pyramid at an angle xii. an ellipse being	Guide students to develop pattern of regular solid Guide students to draw the lines of intersections of the following regular solids and plane in both first and third angles i. a cylinder meeting a square pyramid at right angle ii. a cylinder meeting a cone, the cone at an angle iii. a cylinder meeting a cone, the cone enveloping the cylinder iv. a cylinder and a cone, the cylinder enveloping the cone v. A Square prism meeting a rectangular plane at an angle vi. A square prism meeting an ellipse at an angle. vii. A square prism meeting a circle at an angle viii. A cylinder meeting a pentagon at an angle ix. a cylinder meeting	Explain the procedures used in constructing developments and intersections of regular solids and planes

				enveloped by a pyramid at an angle, e.t.c. 3.3 Draw the patterns (developments) of the regular solids and planes in 3.2i- 3.2v, 3.2vi-3.2x, .and 3.2xi-3.2xii 3. 3.4 Make models of the patterns referred to in 3.2i - 3.2v, 3.2vi - 3.2x, and 3.2xi -3.3xii	an ellipse at an angle x. a cone meeting an ellipse at an angle xi. a circle cutting through a pyramid at an angle xii. an ellipse being enveloped by a pyramid at an angle, e.t.c Guide student to draw the patterns (developments) of the regular solids and planes in 3.2i- 3.2v, 3.2vi-3.2x, .and 3.2xi- 3.2xii Guide students to make models of the patterns referred to in 3.2i - 3.2v, 3.2vi - 3.2x, and 3.2xi -3.3xii	

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Thermodynamics I

COURSE CODE: MEC 122

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Thermodynamics I	Code: MEC 122	Total Hours:	4 Hours/Week
	Pre-requisite: NIL	Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Second			
Goal: This course is designed to acquaint students with knowledge of basic thermodynamic concepts, laws and processes on perfect gases, fuels and combustion.			

GENERAL OBJECTIVES	
On completion of this course, students should be able to :	
1	Understand fundamental concepts and laws of Thermodynamics
2	Know laws of perfect gases
3	Comprehend thermodynamic processes on gases
4	Understand fuels and combustion processes

Thermodynamics I

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Thermodynamics I			CODE: MEC 122		CONTACT HOURS: 2 - 0 – 2 HOURS PER WEEK	
Goal: This course is designed to acquaint students with knowledge of basic thermodynamic concepts, laws and processes on perfect gases, fuels and combustion.						
General Objective 1.0: Understand fundamental concepts and laws of Thermodynamics						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1-3	1.1 Define the following: system, boundary, surrounding, working fluid and state of a system.	Explain activities 1.1 to 1.4 with graphics and detailed notes	Marker, White board Duster, Textbooks	1.1 Demonstrate boundary, surrounding, working fluid and state of a system.	Demonstrate boundary, surrounding, working fluid and state of a system by using charts etc	Explain the fundamental concepts and laws of Thermodynamics
	1.2 Explain thermodynamic systems – closed, open and isolated with examples.					
	1.3 Define (i) intensive properties (ii) extensive properties with examples.					
	1.4 Define the following thermodynamic properties: Pressure (p), Volume (v), Temperature (T), Enthalpy (H), Internal energy (U) Specific heat at constant pressure (Cp), specific heat at constant volume (Cv) for a gas and their units.					
	1.5 Define quasi-static work, flow-work, specific heat.					

	1.6 State Zeroth, first and second laws of thermodynamics. 1.7 Solve simple problems on conversion of Heat into Work and vice versa. 1.8 Explain steady flow energy equation (without proof).					
	General Objective 2.0: Know laws of perfect gases					
4-8	2.1 Explain the following perfect Gas Laws: Boyle's law, Charles' Law, Gay-Lussac law, Avogadro's law and Joule's law. 2.2 Derive characteristic gas equations, universal gas equation, universal gas constant and their relationship with molecular weight of gas. 2.3 Derive an expression showing the relationship between the two specific heats and characteristic gas constant. 2.4 Solve simple problems on gas equations in 2.1 to 2.3.	Explain activities 2.1 to 2.4 with graphics and detailed notes	Marker, White board, Duster, Textbooks, Boyle gas calorimeter, Air compressor test rig, Thermal conductivity apparatus, Boiler, etc. .	2.1 Perform experiment to verify perfect Gas Laws: Boyle's law, Charles' Law, Gay-Lussac law, Avogadro's law and Joule's law	Guide students to perform experiment to verify perfect Gas Laws: Boyle's law, Charles' Law, Gay-Lussac law, Avogadro's law and Joule's law	Explain the laws of perfect gases.
	General Objective 3.0: Comprehend thermodynamic processes on gases					

12-15	4.1 Define the terms, 'fuel' and 'combustion'. 4.2 List types of fuels: solid, liquid and gaseous fuels with examples. 4.3 Explain various applications of different types of fuels. 4.4 Describe the concept of calorific values (Higher and lower) of fuels, Dulong's formula for calorific value. 4.5 Calculate calorific value of a fuel of given chemical composition. 4.6 Explain the use of Bomb calorimeter unit in determination of calorific value of fuels. 4.7 Define complete, incomplete and stoichiometric combustion. 4.8 Calculate the	Explain activities 4.1 to 4.9 with graphics and detailed notes	Marker, White board Duster, Textbooks, Auto bomb calorimeter .	Determine the calorific values of different types of fuels using bomb calorimeter	Guide students to determine the calorific values of different types of fuels using bomb calorimeter.	Explain the meaning of fuels and combustion

	theoretical quantity of air required in 4.7. 4.9 Define air/fuel ratio, rich mixture and lean mixture.					

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Machine Tools Technology and Practice

COURSE CODE: MEC 123

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Machine Tools Technology and Practice	Code: MEC 123	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Second	Pre-requisite: NIL		

Goal: This course is designed to acquaint students with knowledge and skills in safe operation of lathe, shaping, milling and grinding machines to produce engineering components.

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand cutting action in machining operation.
2	Understand the importance of cutting fluid in machining operation.
3	Appreciate the importance of cutting tool materials
4	Know various types of lathes, their functions and operations.
5	Know various machining operations on the centre lathe
6	Understand the features, functions and uses of shaping machines.
7	Understand the feature, function and uses of milling machines
8	Understand milling operations
9	Understand the features and functions of grinding machines
10	Know the uses of grinding machines
11	Understand testing, mounting, balancing, alignment and trueing of grinding wheels

Machine Tools Technology and Practice

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: MACHINE TOOLS TECHNOLOGY & PRACTICE			COURSE CODE: MEC 123		CONTACT HOURS: (2-0-3) HRS/WK	
GOAL: To acquaint students with knowledge and skills on safe operation of lathe, shaping, milling and grinding machines to produce engineering components.						
General Objective 1.0: Understand cutting action in machining operation						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1	1.1 Explain the theory of metal cutting. 1.2 Define forces acting at a tool point. 1.3 Sketch a diagram of forces acting at tool point. 1.4 Relate the tool angles to cutting efficiency. 1.5 List the types of chip for motion. 1.6 Sketch diagram for 1.4. 1.7 List factors affecting 1.5	Explain activities 1.1 to 1.7 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual, power saw, cutting fluids, mild steel, bars	1.1 Identify cutting fluids used for machining different materials. 1.2 Select cutting tools for various machine operations	Demonstrate the activities in 1.1 and 1.2 and guide the students to carry out all the activities. Assess the students	Explain cutting action in machining operation
GENERAL OBJECTIVE: 2.0 Understand the importance of cutting fluids in machining operation						
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
2	2.1 Explain how heat is generated during cutting.	Explain activities 2.1 to 2.4 with diagrams where	Whiteboard, Marker, textbook, charts, etc.	2.1 Carry out cutting operation.	Demonstrate the activities in 2.1 to 2.3 and guide the students to carry	Explain the importance of cutting fluids in

	2.2 List common types of cutting fluid. 2.3 State functions of cutting fluid. 2.4 Outline the characteristics of cutting fluid	necessary and detailed notes	Practical manual, power saw, cutting fluids, mild steel, bars	2.2 Carry out bending operation. 2.3 Carry out rolling operation.	out all the activities. Assess the students	machining operation
GENERAL OBJECTIVE: 3.0. Appreciate the importance of cutting tool materials						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
3-4	3.1 Outline the properties of cutting tools materials. 3.2 List common types of cutting tools. 3.3 Outline constituents in 3.2	Explain activities 3.1 to 3.3 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual	Identify types of cutting tools used in machine tool operations	Demonstrate the activities in 3.1 and guide the students to carry out all the activities. Assess the students	Explain the importance of cutting tool materials
General Objectives 4.0: Know various types of lathes and their functions						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
5-6	4.1 Describe main types of lathes (such as capstan, turret, centre and bench lathes) and their accessories. 4.2 Describe the different operations that could be carried out on the lathe. 4.3 List the safety precautions necessary while	Explain activities 4.1 to 4.4 with diagrams where necessary and detailed notes	Chalk board, chalk note book, text books, chalk. Mild steel bars, lathe machine, assorted cutting tools and fluids.	4.1 Identify types of lathe machine and its attachment for various operations	Demonstrate the activities in 4.1 and guide the students to carryout all the activities. Assess the students	Explain various types of lathes and their functions

	working on the lathe machine. 4.4 List the various methods of carrying out various operations e.g. taper turning, set screw cutting.					
General Objective 5.0: Know various machining operations on the center lathe						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
7-8	5.1 Describe the following using centre lathe a. facing operation b. Cylindrical turning c. Step turning d. taper turning e. drilling f. boring g. parting h. knurling i. reaming j. thread cutting	Explain activities 5.1 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual	5.1 Perform the following using center lathe: a. Facing b. Cylindrical turning c. Step turning d. Tapper turning e. Drilling f. Boring g. Parting h. Knurling i. Reaming 5.2 Carry out thread cutting operations on the center lathe	Demonstrate the activities in 5.1 to 5.2 and guide the students to carry out all the activities. Assess the students	Explain various machining operations on the center lathe
General Objectives 6.0: Understand the features, functions and uses of shaping machines.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
9	6.1 Describe the main features of shaping machines. 6.2 Adjust the length and position of the stroke of the shaping machine.	Explain activities 6.1 to 6.6 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual, Shaping machine,	6.1 Identify the features functions and uses of shaping machines. 6.2 Carry out the adjustment of length and position of the stroke of a shaping machine. 6.3 Know how to set-up	Demonstrate the activities in 6.1 to 6.4 and guide the students to carry out all the activities.	Explain the features, functions and uses of shaping machines

	6.3 Set the clapper box of a given operation. 6.4 List the advantages of a swan-necked tool on a shaping machine. 6.5 List the advantages of a swan-necked tool on a shaping machine. 6.6 Set up work-pieces on the shaping machine		Assorted tools, and accessories mild steel.	workpiece on the shaping machine. 6.4 Identify appropriate shaping tools and holding devices for different surface forms and carry out shaping operations on mild steel e.g key-way, slots	Assess the students	

General Objectives 7.0: Understand the feature, function and uses of milling machines.

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10	7.1 Describe the main features of milling machines. 7.2 Describe how to mount cutters on the milling machine. 7.3 Describe the various work piece and cutter holding devices and attachments used on the milling machine. 7.4 List and state the use of different types of milling cutters, e.g. arbor cutters - plain cutters, shank cutters - and mills, T-slot side and mill cutters etc. 7.5 Describe the features and working principle of the dividing head.	Explain activities 7.1 to 7.6 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual Milling machine, Assorted cutters including arbor, Plain shank, etc. Dividing Head, Brassm, Mild steel, High carbon steel.	7.1 Identify features and types of milling machines. 7.2 Select and mount different types of cutters for appropriate jobs. 7.3 Select and use various types of work and cutter holding devices for different types of jobs.	Demonstrate the activities in 7.1 to 7.3 and guide the students to carry out all the activities. Assess the students	Explain the feature, function and uses of milling machines

	7.6 Explain various methods of indexing e.g. direct, simple, differential, angular indexing.					

General Objectives 8.0: Understand milling operations

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
11	8.1 Define feed and cutting speed as applied to milling and state factors which influence cutting speed determination for milling work, e.g. material to be cut, use of coolant, type of finish etc. 8.2 Determine cutting speeds and feeds for a given milling work. 8.3 Outline the safety and operational precautions to be observed when milling. 8.4 Describe up and down milling. 8.5 Describe straddle and gang milling. 8.6 Describe the various features of the tool and cutter grinder	Explain activities 8.1 to 8.6 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual Milling machine, Assorted cutters including arbor, Plain shank, etc. Dividing Head, Brassm, Mild steel, High carbon steel.	8.1 Perform milling exercises using the dividing head and index plate. 8.2 Carry out milling using the following methods: i. Up milling ii. Down milling iii. Gang milling 8.3 Using tool grinder to sharpen milling cutters	Demonstrate the activities in 8.1 to 8.3 and guide the students to carryout all the activities. Assess the students	Explain milling operations

General Objectives 9.0: : Understand the features and functions of grinding machines

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

12	9.1 Describe different types of grinding machines. 9.2 Identify the main features of grinding machines in 9.1 9.3 Describe the structure of grinding wheels. 9.4 Identify wheels for grinding different types of materials.	Explain activities 9.1 to 9.4 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical manual, Grinding machines Assorted grinding wheels.	9.1 Identify main features, types of grinding machine and wheels for grinding different types. 9.2 Select work holding devices and use them on grinding machine. 9.3 Carry out different types of grinding operation. 9.4 Select the appropriate shapes, types and sizes of grinding wheels for various applications	Demonstrate the activities in 9.1 to 9.4 and guide the students to carryout all the activities. Assess the students	Explain the features and functions of grinding machines

General Objectives 10.0: Know the uses of grinding machines.

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13	10.1 Explain the surface grinding operation. 10.2 Explain taper grinding operation. 10.3 Explain tool and cutter grinding. 10.4 Explain centreless grinding 10.5 Describe gauge grinding	Explain activities 10.1 to 10.5 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc.			Explain the uses of grinding machines

General Objective 11.0: Understand testing, mounting, balancing, alignment and truing of grinding wheels.

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
14-15	11.1 Explain wheel testing and mounting.	Explain activities 11.1 to 11.3 with	Whiteboard, Marker,	11.1 Balancing grinding wheel.	Demonstrate the activities in 11.1 to	Explain the procedures

	11.2 Explain wheel balancing and alignment. 11.3 Describe wheel dressing and trueing	diagrams where necessary and detailed notes	textbook, charts, etc. Practical manual, Complete kits for wheel balancing, trueing and dressing	11.2 Carry out wheel trueing and dressing. 11.3 Perform grinding exercise involving surface, cylindrical, type, tool, crank shaft and internal grinding.	11.3 and guide the students to carryout all the activities. Assess the students	in testing, mounting, balancing, alignment and trueing of grinding wheels

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Mechanics II (Dynamics)

COURSE CODE: MEC 124

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Engineering Mechanics II (Dynamics)	Code: MEC 124	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Second	Pre-requisite: NIL		
Goal: This course is designed to acquaint students with knowledge and skills on the basic principles and laws of dynamics so as to enable him/her to analyse and solve problems related to them			
GENERAL OBJECTIVES			
On completion of this course students should be able to :			
1	Understand Linear motion of a body		
2	Understand curvilinear motion of bodies		
3	Understand momentum of bodies		
4	Understand the concept of work, energy and power		
5	Understand the general principle of operation of simple machines		
6	Know simple harmonic motion		

Engineering Mechanics II (Dynamics)

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Engineering Mechanics II (DYNAMICS)				COURSE CODE: MEC 124		CONTACT HOURS: (2-0-2) HRS/WK
GOAL: This course is designed to acquaint students with knowledge and skills on the basic principles and laws of dynamics so as to enable him/her to analyse and solve problems related to them						
General Objective 1.0: Understand linear motion of a body						
COURSE SPECIFICATION: THEORETICAL CONTENT				COURSE SPECIFICATION: PRACTICAL CONTENT -		
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
1- 3	1.1 Define displacement, velocity and acceleration. 1.2 State units of displacement, velocity and acceleration. 1.3 Derive the relationship between displacement, velocity and acceleration. 1.4 Draw velocity time graph. 1.5 Add velocities vectorially 1.6 Define relative velocity. 1.7 Solve simple problems related to 1.1 to 1.6 above. 1.8 Define angular motion of a body in a circle.	Explain activities 1.1 to 1.10 with diagrams where necessary and detailed notes.	Whiteboard, Marker, textbook, charts, etc.			Explain linear motion of a body

	1.9 Derive the relationship between angular velocity and acceleration.					
	1.10 Draw angular velocity-time graph					

GENERAL OBJECTIVE: 2.0 Understand curvilinear motion of bodies

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-5	2.1 Develop the relationship between angular and linear motions. 2.2 Define circular motion. 2.3 Explain centrifugal acceleration and centrifugal force. 2.4 Develop expressions for centripetal and centrifugal forces. 2.5 Give examples of centrifugal effects e.g. planetary motion, conical pendulum	Explain activities 2.1 to 2.8 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Practical guide, Centrifugal apparatus. Fletcher's trolley Weights.	2.1 Exhibit that centrifugal force varies with mass, speed of rotation, and the distance of the mass from the center of rotation using centrifugal force apparatus. 2.2 Perform experiment to verify the equation of motion using fletcher's trolley	Demonstrate the activities in 2.1 to 2.2 for the students to learn and guide them to carry out all the activities. Assess the students	Explain curvilinear motion of bodies
	2.6 Calculate banking required for roads and tracks. 2.7 Analyse the motion of a projectile. 2.8 Solve problems related to 2.1 to 2.7.		Whiteboard, Marker, textbook, charts, etc.			

GENERAL OBJECTIVE: 3.0. Understand momentum of bodies

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

6-7	3.1 Define mass and weight. 3.2 State Newton's Law of motion. 3.3 Define Impulse and momentum. 3.4 State the Law of Conservation of momentum. 3.5 Define angular momentum. 3.6 Define radius of gyration. 3.7 Explain moment of inertia. 3.8 Solve problems related to 3.1 to 3.7	Explain activities 3.1 to 3.8 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Fletcher's trolley Force boards	3.1 Determine moment of inertia. 3.2 Perform experiment to verify the law of conservation of moment on fletcher's trolley	Demonstrate the activities in 3.1 and 3.2 for the students to learn and guide them to carry out all the activities. Assess the students	Explain momentum of bodies
GENERAL OBJECTIVE: 4.0. Understand the concept of work, energy and power						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8-9	4.1 Define work, Energy and Power. 4.2 State the units of work, energy and power. 4.3 Develop expressions for 4.1 4.4 Define torque, work done by torque. 4.5 Explain tractive force and driving torque of a system.	Explain activities 4.1 to 4.9 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Dynamometer	4.1 Determine tractive force and driving torque of a system. 4.2 Determine mechanical efficiency in power transmission. 4.3 Determine kinetic energy of rotation	Demonstrate the activities in 4.1 and 4.2 for the students to learn and guide them to carry out all the activities. Assess the students	Explain the concept of work, energy and power

	4.6 Differentiate between kinetic energy and potential energy. 4.7 Explain kinetic energy of rotation. 4.8 Explain mechanical efficiency in power transmission. 4.9 Explain power transmission by flat belts, spur gearing and worm gearing.					

GENERAL OBJECTIVE: 5.0. Understand the general principle of operation of simple machines

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10-11	5.1 Define simple machine 5.2 Give example e.g. Lever, Pulley, Screw Jack 5.3 Explain the operations of 5.2 5.4 Define (i) Mechanical Advantage (ii) Velocity ratio (iii) mechanical efficiency 5.5 Develop the relationship for Mechanical advantage, velocity ratio and efficiency of a wheel, pulley and screw jack 5.6 Solve simple problems related to 5.1 to 5.5 above.	Explain activities 5.1 to 5.6 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Lever, pulley and screw Jack apparatus	5.1 Determine the velocity ratio, mechanical advantage and mechanical efficiency of a screw jack. 5.2 Determine the velocity ratio and efficiency of simple pulley system.	Demonstrate the activities in 5.1 and 5.2 for the students to learn and guide them to carry out all the activities. Assess the students	Explain principle of operation of simple machines

GENERAL OBJECTIVE: 6.0. Know simple harmonic motion

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

12-15	6.1 Describe periodic motion. 6.2 Describe period, frequency and amplitude in simple harmonic motion. 6.3 Define period, frequency and amplitude in simple harmonic motion. 6.4 Develop expressions for 6.3 above. 6.5 Analyze the motion of a simple pendulum 6.6 Solve problems related to the above	Explain activities 6.1 to 6.5 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Force boards and spring apparatus	6.1 Determine experimentally the period and frequency of oscillation	Demonstrate the activities in 6.1 for the students to learn and guide them to carry out all the activities. Assess the students	Explain simple harmonic motion

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Automotive Technology and Practice I

COURSE CODE: MEC 125

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Automotive Technology and Practice I	Code: MEC 125	Total Hours:	4 Hours/Week
	Pre-requisite:	Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Second			
Goal: This course is designed to acquaint students with knowledge and skills in automotive technology so as to be able to service, maintain and repair automotive components and systems.			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the historical developments and framework of automotive
2	Understand engine types, operations and constructional details.
3	Know the fuel systems for SI and CI engines
4	Comprehend engine lubricating and cooling and intake and exhaust system
5	Understand automotive electrical system

Automotive Technology and Practice I

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: AUTOMOTIVE TECHNOLOGY AND PRACTICE I				COURSE CODE: MEC 125		CONTACT HOURS: 5HRS/WK
GOAL: To acquaint students with knowledge and skills on automotive technology so as to be able to service, maintain and repair automotive components and systems						
General Objective 1.0: Understand the historical developments and framework of automotive systems						
COURSE SPECIFICATION: THEORETICAL CONTENT				COURSE SPECIFICATION: PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1- 3	1.1 Narrate the historic development of automotive with emphasis in Nigeria.	Explain activities 1.1 to 1.6 with diagrams where necessary and detailed notes.	Whiteboard, Marker, textbook, charts, etc.			Explain the historical developments and framework of automotive systems
	1.2 List the various types and classification of automotive manufactured in Nigeria their manufacturer and location of their manufacturing plants.					
	1.3 Describe chassis layout, its main components, classifications and					
	1.4 Enumerate the importance of chassis lubrication, Importance of chassis and the					

	lubricants used for its lubrication. 1.5 Explain the functions of frame and different parts of a frame 1.6 List types of frame sections, sub frame, and functions of sub frame.					

GENERAL OBJECTIVE 2.0: Understand engine types, operations and constructional details

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-5	2.1 Define the term, 'Heat Engine'. 2.2 Differentiate between internal combustion (IC) engines and external combustion (EC) engines 2.3 Explain the operations of: 2-stroke and 4- stroke, spark ignition (SI) engines and compression ignition (CI) engines.	Explain activities 2.1 to 2.10 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent models) Vehicles. Complete toolbox and service/maintenance kits.	2.1 Observe safety rules. 2.2 Identify IC and EC engines. 2.3 Identify 4-stroke and 2- stroke, spark ignition (SI) engines and compression ignition (CI) engines. 2.4 Demonstrate the workings of 4-stroke and 2- stroke, spark ignition (SI) engines and	Demonstrate the activities in 2.1 to 2.8 for the students to learn and guide them to carry out all the activities. Assess the students	Explain engine operations and constructional details.

	2.4 Differentiate between 4-stroke cycle engines and 2-stroke cycle engines. 2.5 Differentiate between Petrol and Diesel engines. 2.6 Explain the meaning and necessity for scavenging: Cross flow, back flow and uniform flow scavenging. 2.7 Explain the parts and functions of Diesel and Petrol Engines parts and their functions with the materials used, constructional details and function of cylinder block, cylinder head, cylinder liner (dry and wet type), crank case, crankshaft, camshaft, piston & piston rings, piston pin, connecting rod, gasket, inlet and exhaust manifolds, etc. 2.8 Explain mechanism and classification of valve mechanism 2.9 Classify engines according to valve arrangement and valve types. 2.10 Explain valve timing diagrams (Theoretical and Actual), valve overlap and tappet clearance		Engine test rig for petrol and diesel engines with provision for 2-stroke and 4-stroke test .	compression ignition (CI) engines. 2.5 Identify cylinder block, cylinder head, cylinder liner (dry and wet type), crank case, crankshaft, camshaft, piston & piston rings, piston pin, connecting rod, gasket, inlet and exhaust manifolds, etc. 2.6 Examine each component to locate wear and tear visually and by using measuring instruments. 2.7 Demonstrate the mechanism and classification of valves and valve timing. 2.8 Perform troubleshooting and fault finding practices on an automotive engine.		

GENERAL OBJECTIVE: 3.0. Know the fuel systems for SI and CI engines						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
6-7	3.1 Draw the line diagram of petrol engine fuel system with its components. 3.2 Explain the constructional details of mechanical and electrical fuel pump. 3.3 Explain the terms: atomization, vaporization, carburetion, air fuel ratio, rich mixture, lean mixture, maximum power ratio, economic ratio for average cruising operation. 3.4 Explain the working principle and constructional details of a simple carburettor and its components: choke, venturi, throttle valve, float chamber, needle valve, etc. 3.5 Draw the line diagram of Diesel engine fuel system with its components of Diesel engine. 3.6 Explain the working principles and constructional	Explain activities 3.1 to 3.11 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent models) Vehicles. Complete toolbox and service/maintenance kits. Engine test rig for petrol and diesel engines with provision for 2-stroke and 4-stroke test	3.1 Identify all the component parts of petrol engine and diesel engine fuel systems 3.2 Perform the following auto workshop activities: - Replace fuel filter - Replace faulty fuel pump and adjust/clean carburetor. - Bleed the fuel system - Adjust valve for correct clearance - Carryout a compression test. - Service fuel injectors and filters. 3.3 Demonstrate the working of CRDI system. 3.4 Identify supercharger types (centrifugal, van type, blower type etc) and Turbo-superchargers. 3.5 Demonstrate the working of supercharger and turbo-supercharger.	Demonstrate the activities in 3.1 to 3.6 for the students to learn and guide them to carry out all the activities. Assess the students	Explain engine fuel system

	details of fuel injector (Atomizer). 3.7 List types of fuel injection systems and fuel injection nozzles. 3.8 Explain the function of governors in Diesel engine with emphasis on concepts of common rail direct injection (CRDI) system. 3.9 Explain the concepts of Multi Point Fuel Injection system with emphasis on types of Multipoint Fuel Injection System. 3.10 Explain the concept of supercharging and object of supercharging. 3.11 Explain the working principles and features of Superchargers (centrifugal, van type, blower type etc) and turbo-superchargers with its practical applications.			3.6 Perform troubleshooting and fault finding practices on engine fuel systems (SI and CI).		
GENERAL OBJECTIVE: 4.0. Comprehend engine lubricating and cooling and intake and exhaust systems						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

8-9	4.1 Describe the following: -function of lubricating system, - parts of lubricating system, -constructional details of lubricating system: Pet roil type, splash type, forced feed lubrication, dry sump, wet sump system. 4.2 Explain the following: -functions of engine lubricants, - physical and chemical properties of lubricants, - rating of lubricants, - viscosity, viscosity index, SAE numbers, specific gravity flash point, fire point, pour point etc. - crank case ventilation. 4.3 Explain the necessity of engine cooling system, disadvantages of overheating and under cooling. 4.4 Explain engine cooling system: - air cooling constructional details, fins. - water cooling system: types, thermo-siphon system, forced	Explain activities 4.1 to 4.6 with diagrams where necessary and detailed notes.	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent models) Vehicles. Complete toolbox and service/maintenance kits. Engine test rig for petrol and diesel engines with provision for 2-stroke and 4-stroke test.	4.1 Identify the parts and types of engine lubricating systems 4.2 Perform the following automotive workshop activities: - Change engine oil and oil filter. - Adjust fan belt tension - Change radiator water hose - Flush radiator. 4.3 Perform troubleshooting and fault finding practices on lubricating and cooling and intake and exhaust systems (SI and CI).	Demonstrate the activities in 4.1 to 4.3 for the students to learn and guide them to carry out all the activities. Assess the students	Explain engine lubrication and cooling and intake and exhaust systems

	circulation system, constructional details of the systems. 4.5 Explain the functions of different parts of water cooling system-water pump, radiator, thermostat, fan, water jacket. 4.6 Describe engine air cleaner, its type and functions, intake and exhaust manifolds and silencer.					
General Objective 5.0: Understand automotive electrical system						
	5.1 Enumerate the importance of starting system in an automotive. 5.2 State the functions of battery and Starting motor. 5.3 Explain the relevance of charging system in an automotive. 5.4 Explain the functions of generator (dynamo) and alternator (A.C. generator).	Explain activities 5.1 to 5.11 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent models) Vehicles. Complete toolbox and service/maintenance kits. Hydrometer, Battery Charger and Battery	5.1 Identify the starting, charging and ignition systems of an automotive. 5.2 Perform the following auto workshop activities: - Check battery’s state of charge using hydrometer. - Clean and/or replace battery terminals. - Charge battery. - Remove and replace alternator assembly. - Clean and set contact breaker point - Remove wiper and starter motor and replace the brushes. - Replace fuses in electrical system - Set spark plug with feeler gauge.	Demonstrate the activities in 5.1 and 5.3 for the students to learn and guide them to carry out all the activities. Assess the students	Explain automotive electrical system

	5.5 Explain the purpose of ignition system in an automotive. 5.6 List types of ignition system-battery ignition and magneto ignition system 5.7 Differentiate between system-battery ignition and magneto ignition system with reference to the circuit of the systems. 5.8 Describe the voltage necessary for ignition, ignition in single cylinder and multi cylinder engines. 5.9 Explain the firing order(s) of automotive system. 5.10 State the function of: distributor, coil condenser, spark plug, battery. 5.11 Enumerate the effects of enhancing and retarding of ignition.			5.3 Carryout troubleshooting and fault finding practices on automotive electrical systems (SI and CI).		

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Welding Technology and Practice

COURSE CODE: MEC 126

DURATION: 45 Hours (1 Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Welding Technology and Practice	Code: MEC 126	Total Hours: 3 Hours/Week
	Pre-requisite: NIL	Theory: 1 Hour/Week
		Practical: 2 Hours/Week
Semester: Second		
Goal: This course is designed to equip students with knowledge and skills on the different welding processes, codes, standards, specifications and safety precautions.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand welding processes
2	Know various metal gas welding operations

3	Know various metal arc welding operations
4	Comprehend principles of operations of modern welding processes
5	Inspect various welding joints

Welding Technology and Practice

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Welding Technology and Practice			CODE: MEC 126	CONTACT HOURS: (1-0-2) HOURS/WEEK		
Goal: This course is designed to equip students with knowledge and skills on the different welding processes, codes, standards, specifications and safety precautions.						
General Objective 1.0: Understand welding processes						
COURSE SPECIFICATION: THEORETICAL CONTENT			Learning Resources	PRACTICAL CONTENT		Evaluation
Week	Specific Learning Objectives	Teacher’s Activities		Specific Learning Objective	Teacher’s Activities	
1-2	1.1 Explain the principle of welding 1.2 Classify welding terminologies, welding symbols, types of joints, types of welds 1.3 Mention the advantages of welding 1.4 Mention the limitations of welding 1.5 State the industrial applications of welding	Explain activities 1.1 to 1.9 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, presentation materials, PPEs (Leather apron, safety gloves, Safety goggles, welding helmet, safety shoes, ear plug, safety belt, fume mask etc)	1.1Identify different welding positions. 1.2 Utilize different welding positions during welding 1.3 Use Personal Protective Equipment (PPE)	Demonstrate for the students to learn and guide them to carry out all the activities. Assess the students	Explain the welding principles, types, procedures, codes and standards.

	1.6 Explain welding positions, techniques and symbols 1.7 State general safety precautions in welding 1.8 State codes, standards, specifications and welding qualifications 1.9 Describe requirements for Welding Procedure Specifications (WPS)					
General Objective 2.0: Know various metal gas welding operations						
Week	Specific Learning Outcome:	Teachers Activities	Learning Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
3-6	2.1 Explain the principle of gas welding. 2.2 List the types of gas welding flames and their applications	Explain activities 2.1 and 2.2 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, Safety welding goggles, Gas welding equipment set, Chipping hammer, Wire brush, Flame cutting blow pipe (nozzle), Gas welding set	2.1 Assemble OXY-acetylene welding plant 2.2 Select various welding regulators, clips, blow pipe and nozzles. 2.3 Perform gas welding using various welding techniques.	Demonstrate for the students to learn and guide them to carry out all the activities. Assess the students	Explain gas welding procedures.
General Objective 3.0: Know various metal arc welding operations						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
7-10	3.1 Explain the principle of arc welding	Explain activities 3.1 to 3.4 with	Recommended textbooks, charts,	3.1 Regulate current and determine polarity for metal arc welding	Demonstrate for the students to learn and guide	Explain arc welding procedures.

	3.2 Explain the principle of shielded metal arc welding 3.3 Describe the principle of submerged arc welding 3.4 Explain the classification of Electrodes, compositions and specific applications	diagrams where necessary and detailed notes	lecture notes, presentation tools Electric arc welding Machine, Welding table, Welding chipping hammer, Wire brush, Hand grinder, Pedestal grinding machine, electrode oven, jigs and fixtures, lights, exhaust fans, fire blankets, fire extinguishers, first aid box, PPEs	3.2 Determine polarity and select current 3.3 Demonstrate how to adjust the following SAW welding parameters and their effects on weld: - Voltage - Amperes - Travel speed - Type of Polarity 3.4 Prepare metal edges for various thickness and technique welding 3.5 Demonstrate requirement of a workplace for SMAW welding of specific job: 3.6 Demonstrate preparation of welding machine. 3.7 Show how to adjust SMAW welding parameters and their effects on SMAW welding 3.8 Demonstrate post weld cleaning. - Removal of slag - Removal of jigs and fixtures	them to carry out all the activities. Assess the students	
General Objective 4.0: Comprehend principles of operations of modern welding processes						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation

11-13	4.1 Define the principle of resistance welding (i.e. spot, seam, projection and percussion welding) 4.2 Explain the principle of thermit, electro slag, electron beam, ultrasonic, laser beam, and robotic welding 4.3 Explain the principle of underwater (hyperbaric) welding 4.4 Explain the principle of Tungsten inert gas (TIG) and metal inert gas (MIG) welding	Explain activities 4.1 to 4.4 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, presentation tools GMAW Welding machine and gas cylinders (CO2, Argon) with accessories, , fire blankets, fire extinguishers, first aid box, PPE	4.1 Identify the equipment of MIG process 4.2 Illustrate workplace for MIG welding specific jobs MIG Welding machines, Consumables and accessories 4.3 Practice the use of MIG welding machine. 4.4 Identify the equipment of TIG process.	Demonstrate for the students to learn and guide them to carry out all the activities. Assess the students	Explain the different modern welding processes. Explain TIG and MIG welding procedures.
General Objective 5.0: Inspect various welding joints						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
14-15	5.1 Explain the types of welding distortions 5.2 Explain the types of welding defects 5.3 Identify ways of controlling welding defects 5.4 Ascertain how welded joints are inspected	Explain activities 5.1 to 5.4 with diagrams where necessary and detailed notes	Electric arc welding Machine OXY-acetylene welding plant	5.1 Apply correctly the stop back and skip method of controlling distortion 5.2 Apply pre and post heating technique 5.3 Identify welding distortions and defects	Demonstrate for the students to learn and guide them to carry out all the activities. Assess the students	Explain the process of inspection and verification of the quality of welding jobs.

THIRD SEMESTER COURSES

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Drawing I

COURSE CODE: MEC 211

DURATION: 45 Hours (1 Hour Lecture and 2 Hour Practical)

CREDIT UNIT: 3.0

Course: Engineering Drawing I Semester: Third	Code: MEC 211 Pre-requisite: MEC 111	Total Hours: 3
		Hours/Week
		Theoretical hours: 1 Hour/Week
		Practical hours: 2
		Hours/Week
Goal: This course is designed to develop knowledge and skills on the importance, application and representation of machine elements and apply the skills in preparing machine drawings for manufacture		
GENERAL OBJECTIVES		
On completion of this course, students should be able to :		
1	Know the importance, application and conventional representation of gears in power and motion transmission	
2	Understand the importance, application and conventional representation of CAMs in motion control	
3	Know the application and representation of helices in motion transmission (threads)	

4	Know the application and representation of helical springs in motion transmission
5	Know the method of presenting drawing and free hand sketching for simple machine parts manufacture
6	Understand symbols for representing engineering components.
7	Understand the use of photographs and exploded illustrations in engineering communication and prepare simple exploded illustrations.
8	Understand the need for standards in Engineering Drawing with emphasis on assembly drawings in accordance with BS8888:2020.
9	Understand the use of mechanical accessories and fasteners in assembly design
10	Understand the need for lubrication, electrical and other devices to be represented in drawings
11	Understand and interpret finished assembly drawings of machines which have sub-assemblies
12	Appreciate the process of Engineering Design - Preliminary Design

Engineering Drawing I

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Engineering Drawing I			COURSE CODE: MEC 211		CONTACT HOURS: (1-0-3) HOURS/WEEK	
GOAL: This course is designed to develop knowledge and skills on the importance, application and representation of machine elements and apply the skill in preparing machine drawings for manufacture						
General Objective 1.0: Know the importance, application and conventional representation of gears in power and motion transmission						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation

1	1.1 Define terminologies for parts of a gear tooth e.g. addendum, dedendum, pressure angle, pitch circle, diametric pitch. 1.2 List different types of gear profiles e.g. involute, cycloid, etc 1.3 Represent gears using standard conventions. 1.4 List applications and use of gears.	Explain activities 1.1 and 1.4	White board and markers, Recommended textbooks, etc. Complete drawing instruments and accessories. PCs and licensed AUTOCAD or Solid Works software.	1.1 Construct different gear profiles e.g. involute, cycloid, etc using standard conventions. 1.2 Use AUTOCAD or Solid Works software to draw the profiles in 1.1	Demonstrate the activities for the students to learn and guide students to carry out the activities	Explain the importance, application and conventional representation of gears in power and motion transmission
General Objective 2.0 : Understand the importance, application and conventional representation of CAMs in controlling motion						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
2	2.1 Define cams and cam profile. 2.2 Classify different types of cams such as radial and face cams, etc. 2.3 Enumerate different types of followers and their advantages and limitations	Explain the activities in 2.1 to 2.3	Whiteboard and markers, duster, recommended textbooks. Drawing instruments with accessories, PCs and licensed AUTOCAD or Solid Works software.	2.1 Plot cam displacement diagrams. 2.2 Use AUTOCAD or Solid Works software to draw the profiles in 2.1	Demonstrate the activities for the students to learn and guide students to carry out the activities	Draw CAM, follower and its profile.
GENERAL OBJECTIVE 3.0: Know the application and representation of helices in motion transmission (threads)						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
3	3.1 Define Helix 3.2 Differentiate between a right-hand helix and a left-	Carry out the activities in 3.1 to 3.4	White board, markers duster,	3.1 Construct the following: - a right-hand helix, - a left-hand helix.	Demonstrate the activities for the students to learn	Explain the application and

	hand helix. 3.3 Define (i) single-start thread, and (ii) multi-start thread. 3.4 State the advantages of multi-start helix over single-start helix		recommended textbooks. Drawing instruments with accessories	- Single-start thread - Multi-start thread. 3.2 Use AUTOCAD or Solid Works software to draw the profiles in 3.1	and guide students to carry out the activities	representation of helices in motion transmission (threads)

General Objective 4.0: Know the application and representation of helical springs in motion transmission

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4	4.1 Define helical springs (round or square) 4.2 Represent helical springs using standard conventions. 4.3 List the various applications of various springs e.g. energy storage, vibration isolation etc.	Describe the activities in 4.1 to 4.3	White board, markers duster, recommended textbooks. Drawing instruments with accessories	4.1 Construct helical springs (round and square). 4.2 Use AUTOCAD or Solid Works software to draw the profiles in 4.1	Demonstrate the activities for the students to learn and guide students to carry out the activities	Explain the application and representation of helical springs in motion transmission

General Objective 5.0: Know the method of presenting drawing and free hand sketching for simple machine parts manufacture

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
5	5.1 Outline the standard methods for indicating dimensions, fits, tolerance, allowances, surface finish etc. 5.2 Sketch simple machine components using (i) oblique (ii) isometric (iii) orthographic projections.	Explain activity 5.1.	Recommended textbooks, charts, Drawing instruments with accessories	5.1 Apply the knowledge of 5.1 on drawings 5.2 Use datum of reference planes, lines and points for dimension. 5.3 Use charts and tables to select dimensions of standard machine parts. 5.4 Use standard symbols to represent engineering components.	Demonstrate the activities in 5.1 to 5.5 and guide students to carry out the activities	Explain the method of presenting drawing for manufacture

				5.5 Identify horizontal, vertical and auxiliary planes. 5.6 Construct simple machine components using: (i) oblique (ii) isometric (iii) orthographic projections. 5.7 Use AUTOCAD or Solid Works software to draw the components in 5.1 to 5.6..		
General Objective 6.0: Understand symbols for representing engineering components.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
6	6.1 Identify standard symbols for threads, screws, bolts and nuts, keys, pulleys, gears. 6.2 Draw standard symbols for threads, screws bolts and nuts, etc. 6.3 Draw fastenings using symbols for screws, studs and nuts.	Explain activities in 6.1 to 6.3	Recommended textbooks, charts, lecture notes, etc. white board and markers. Drawing instruments with accessories	6.1 Construct threads, screws, bolts and nuts with studs, keys, pulleys and gears. 6.1 Use AUTOCAD or Solid Works software to draw the components above.	Demonstrate the activities for the students to learn and guide students to carry out the activities.	Explain symbols for representing engineering components
General Objective 7.0: Understand the use of photographs and exploded illustrations in engineering communication and prepare simple exploded illustrations.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
	7.1 Explain the use of photographs in engineering communication.	Explain activities in 8.1 to 8.5	Recommended textbooks, charts, lecture notes, etc.	7.1 Construct spherical surfaces, counter-sunk and counter-bore holes; or flanged out hole, irregular	Demonstrate the activities for the students to learn and guide students to	Explain the use of photographs and

8	7.2 Extract necessary engineering information from given photographs. 7.3 Describe the preparation of exploded views of blue prints, photographs and engineering sketches using free-hand sketches in layout planning and accurate illustration tracing and paste up. 7.4 Describe the basic techniques for making technical illustrations e.g. techniques relating to the construction of spherical surfaces, counter-sunk and counter-bore holes; or flanged out hole, irregular hydraulic lines and wires, rounded edges, intersections and sections etc. 7.5 Demonstrate principles of shading in technical illustrations		white board and markers Drawing instruments with accessories	hydraulic lines and wires, rounded edges, intersections and sections etc. 7.3 Use AUTOCAD or Solid Works software to draw the profiles in 8.1 above.	carry out the activities	exploded illustrations in engineering communication and prepare simple exploded illustrations.
General Objective 8.0: Understand the need for standards in Engineering Drawing with emphasis on assembly drawings in accordance with BS8888:2020.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
	8.1 Describe the various standards used in production of engineering drawings e.g. BS, ISO, DIN, ANSI, etc.	Explain the activities in 9.1 to 9.4	Recommended textbooks, charts, lecture notes, etc.	8.1 Identify various standards used in production of engineering drawings e.g. BS, ISO, DIN, ANSI, etc.	Demonstrate the activities for the students to learn and guide students to	Outline the standards in engineering draing

9	8.2 Recognize the standard used in an engineering drawing 8.3 Explain the need for the following types of drawings i. component drawing ii. sub-assembly drawings iii. general assembly drawings iv. installation drawings v. exploded illustration. 8.4 Recognize and represent various types of fasteners and locking devices to British standard (BS) and state their applications e.g. set screw and bolts, nuts, pins, rivets, lock units, star washers, spring washers, locking wire etc.		white board and markers	8.2 Make the following drawings: i. component drawing ii. sub-assembly drawings iii. general assembly drawings iv. installation drawings v. exploded illustration 8.3 Use AUTOCAD or Solid Works software to execute the drawings in 9.2 above.	carry out the activities	
	General Objective 9.0: Understand the use of Mechanical accessories and fasteners in Assembly design					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
11	9.1 Describe various thread forms 9.2 State the applications of various thread forms 9.3 Recognise and represent various types of packings devices in drawings and state their applications e.g. gaskets, glands, stuffing boxes. etc.	Explain the activities in 9.1 to 9.2	Recommended textbooks, charts, lecture notes, etc. white board and markers. Complete drawing	11.1 Represent various types of packings devices (gaskets, glands, stuffing boxes) and bearings, gears, springs, chains and other load bearing and mechanical power transmission standard component in machines in an engineering drawing.	Demonstrate the activities for the students to learn and guide students to carry out the activities	Explain the use of Mechanical accessories and fasteners in Assembly design

	11.4 Recognise and represent in drawings bearings, gears, springs, chains and other load bearing and mechanical power transmission standard component in machines		instruments and accessories. PCs and licensed AUTOCAD or Solid Works software.	11.2 Use AUTOCAD or Solid Works software to draw the devices above.		
	General Objective 10.0: Understand the need for lubrication, electrical and other devices to be represented in drawings					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
12	10.1 Recognize and represent in drawings conventional lubrication devices e.g. grease cup, nipples, grooves etc. 10.2 Recognize and represent standard electrical components in drawings e.g. transformer, switch gear etc.	Explain the activities in 12.1 to 12.2	Recommended textbooks, charts, lecture notes, etc. white board and markers. Complete drawing instruments and accessories.	10.1 Represent lubrication (grease cup, nipples, grooves), electrical (transformer, switch gear) and other devices. 10.2 Use AUTOCAD or Solid Works software to draw the components in 12.1 above.	Demonstrate the activities for the students to learn and guide students to carry out the activities	Explain the need for Lubrication, electrical and other devices to be represented in drawings
	General Objective 11.0: Understand and Interpret finished Assembly Drawings of Machines which have sub-assemblies					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13	11.1 Recogniz surface finish marks in accordance with the relevant standards. 11.2 Write part list	Explain the activities in 11.1 to 11.2	Recommended textbooks, charts, lecture notes, etc. white board and markers.	11.1 Demonstrate how to apply surface finish marks in accordance with the relevant standards. 11.2 Use AUTOCAD or Solid Works software to apply surface finish marks in	Demonstrate the activities for the students to learn and guide students to carry out the activities	Interpret finished Assembly Drawings of Machines which have sub-assemblies

			Complete drawing instruments and accessories.	accordance with relevant standards..		
	General Objective 12.0: Appreciate the process of Engineering Design - Preliminary Design					
14-15	12.1 Explain in logical sequence engineering product design process i.e. conception, analysis, synthesis, evaluation and implementation. 12.2 Describe the specific roles of the engineering designer in design and production firms. 12.3 Write the initial specifications of designed. 12.4 Provide possible solutions (sketched) in line with the initial specifications in 14.3 above. 12.5 Evaluate all possible solutions (design sketches) in terms of basic design considerations, appearance, serviceability, ergonomics etc.	Explain the activities in 12.1 to 12.5	Recommended textbooks, charts, lecture notes, etc. white board and markers. Complete drawing instruments and accessories. PCs and licensed AUTOCAD or Solid Works software.	12.1 Design a given engineering product using logical sequence engineering product design process. 12.2 Use AUTOCAD or Solid Works software to design a given engineering product using logical sequence engineering product design process.	Demonstrate the activities for the students to learn and guide students to carry out the activities	Explain the process of Engineering Design - Preliminary Design

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Measurement

COURSE CODE: MEC 212

DURATION: 30 Hours (1 Hour Lecture and 1 Hour Practical)

CREDIT UNIT: 2.0

Course: Engineering Measurement	Code: MEC 212	Total Hours:	2 Hours/Week
	Pre-requisite: NIL	Theoretical hours:	1 Hour/Week
		Practical hours:	1 Hour/Week
Semester: Third			
Goal: This course is designed to develop knowledge and skills in basic engineering measuring instruments			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the fundamentals of engineering measurements
2	Know the classes, static and dynamic characteristics of instruments
3	Comprehend the types and sources of errors and how to overcome them
4	Understand the constructional details of simple measuring instruments
5	Know the principle of limit gauging
6	Know strain gauges and its uses
7	Comprehend load cells and piezoelectric devices
8	Know the different instruments for linear measurement
9	Know the different instruments for angular measurement
10	Know the different instruments for non-linear measurement

Engineering Measurement

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Engineering Measurement			COURSE CODE: MEC 212	CONTACT HOURS: 2 HOURS/WEEK		
GOAL: This course is designed to develop knowledge and skills in basic engineering measuring instruments						
General Objective 1.0: Understand the fundamentals of engineering measurement						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1	1.1 Define measurement 1.2 Give brief history of measurement 1.3 Define Systemme International d’Unites (SI units), standard units and derived units 1.4 State elements of measurement 1.5 List factors to consider in choosing an instrument.	Explain activities 1.1 and 1.5	White board and markers, Recommende d textbooks, etc.			Describe the fundaments of measureme nt systems and the standard units of measureme nt
GENERAL OBJECTIVE 2.0 : Know the classes, static and dynamic characteristics of instruments						
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
2	2. 1 Explain the following instruments: • Active and passive instruments • Null and deflection instruments • Analog and digital instruments • Indicating and non-indicating instruments	Explain the activities in 2.1 to 2.2	Whiteboard and markers, duster, recommended textbooks	Identify Active and passive instruments, Null and deflection instruments, Analog and digital instruments, Indicating and non-indicating instruments	Guide student to identify Active and passive instruments, Null and deflection instruments, Analog and digital instruments, Indicating and non-indicating instruments	Explain the different classes of instruments with examples

	2.2 Explain static and dynamic characteristics of instruments					
GENERAL OBJECTIVE: 3.0 Comprehend the types and sources of errors and how to avoid them						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
3 – 4	3.1 Describe the types of errors commonly found in engineering measurement 3.2 Explain sources of errors in measurement such as equipment errors, operational interference, and installation. 3.3 Explain means of overcoming errors mentioned in 3.1 above.	Carry out the activities in 3.1 to 3.3	White board, markers duster, recommended textbooks			Explain the types and sources of errors and how to overcome them
GENERAL OBJECTIVE: 4.0. Understand the constructional details of simple measuring instruments						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
5 – 7	4.1 Explain the principles, construction and operation of the following (a) dynamometer (b) bourdon tube manometers (c) thermometer, pyrometer, thermocouple etc. 4.2 State the precautions to be observed when using the measuring instruments in 4.1 4.3 Differentiate between direct measurement and measurement by comparison 4.4 Apply standardized formulae to calculate some parameters using data from measurements taken	Describe the activities in 4.1 to 4.4	Dynamometer , Burdon tube Manometers, Thermometer, Pyrometer, Thermocouple , metallic diaphragm, fluid expansion, barometer, flow meters, heat flux sensors. accelerometer	Use the instruments in 4.1 to take measurement	Guide the students to use the instruments in 4.1 to take measurements	Describe the constructional details and operation of the instruments

			s, vibration analyzer etc			
GENERAL OBJECTIVE: 5.0 Know the concept of calibration and principle of limit gauging						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8 – 10	5.1 Explain the concept of calibration 5.2 Describe the principles of calibrating (i) pressure gauges (ii) thermometers (iii) flow meters 5.3 State the precautions to be observed during calibration of measuring instruments. 5.4 Define maximum and minimum metal limits 5.5 Describe the limits of gauging 5.6 State Taylor's principle of gauging 5.7 Give examples of principle of gauging	Explain the activities in 5.1 to 5.7	Recommended textbooks, charts,	5.1 Calibrate pressure gauges, thermometer and flow meters 5.2 Demonstrate precautions to be observed during calibration. 5.3 Identify materials for gauges. 5.4 Compare gauging with direct measurement. 5.5 Design a gauge.	Guide students to: Calibrate pressure gauges, thermometer and flow meters Demonstrate precautions to be observed during calibration. Identify materials for gauges Compare gauging with direct measurement. Design a gauge	Describe calibration and recalibration of instruments Explain the principle of limit gauging
GENERAL OBJECTIVE: 6.0 Know strain gauges and its uses						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
11-12	6.1 Describe various forms of strain gauges for measuring strains in radial, axial and biaxial directions 6.2 Discuss the effect of heat and other environmental factors in the use of strain gauges.	Explain activities in 6.1 to 6.2	Recommended textbooks, charts, lecture notes, etc. white board and markers. strain gauges. Load cells, Strain gauges, load cells,	6.1 Identify the following: a. Strain gauges b. Load cells c. Piezoelectric devices 6.2 Make measurement with strain gauges and compare with other gauges.	Guide students to: Identify the following: a. Strain gauges b. Load cells c. Piezoelectric devices	Describe various forms of strain gauges for measuring strains in radial, axial and biaxial

			piezoelectric devices, etc.	6.3 Make measurements with load cells, piezoelectric devices and compare with strain gauge measurement in terms of accuracy	Make measurement with strain gauges and compare with other gauges. Make measurements with load cells, piezoelectric devices and compare with strain gauge measurement in terms of accuracy	directions

GENERAL OBJECTIVE: 7.0 Comprehend load cells and piezoelectric devices

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13	7.1 Explain the use of load cells in tensile and compression testing machines 7.2 Differentiate between load cells and strain gauges in taking of quantity measurement and accuracy	Explain activities in 7.1 to 7.2	White board and markers Load cells and piezoelectric devices	Use load cells in tensile and compression testing machines to test materials Take quantity measurement using load cells and strain gauges to determine accuracy	Guide student to Use load cells in tensile and compression testing machines to test materials Guide students to take quantity measurement using load cells and strain gauges to determine accuracy	Explain the use of load cells and piezoelectric devices

GENERAL OBJECTIVE 8.0: Know instruments for linear measurements

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

7 – 9	8. 1 Describe the constructional details of the following instruments: Vernier caliper, Vernier height gauge, Vernier depth gauge, Micrometer, Steel scale, Dial gauge, Slip gauge 8.2 Explain the working principles of the measuring instruments listed in 8.1 8.3 State the precautions to be observed when using the instruments listed in 8.1.	Explain activities in 8.1 to 8.3	Vernier caliper, Vernier height gauge, Vernier depth gauge, Micrometer, Steel scale, Dial gauge, Slip gauge	8.1 Practice the use of the instruments listed in 8.1 for linear measurements	Guide the students to do the activities in 8.1	Employ the appropriate instruments for linear measurement

GENERAL OBJECTIVE 9.0: Know the different instruments for angular measurements

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10 – 12	9. 1 Describe the constructional details of the following instruments: Universal Bevel Protractor, Plunger Dial Gauge, Spirit Level, Clinometer, Sine bar, Dial indicator, Angle deckor, Autocollimator 9.2 Explain the working principles of the measuring instruments listed in 9.1 9.3 State the precautions to be observed when using the instruments listed in 9.1.	Explain the activities in 9.1 to 9.3	Universal Bevel Protractor, Plunger Dial Gauge, Spirit Level, Clinometer, Sine bar, Dial indicator, Angle deckor, Autocollimator	Use the instruments in 9.1 for angular measurements	Guide the students to make use of the different instruments to take angular measurements	Measure angles using the different instruments listed in 9.1

GENERAL OBJECTIVE 10.0: Know the different instruments for non-linear instruments

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

13 – 15	10. 1 Describe the constructional details of the following instruments: Bore gauge, radius gauge, taper gauge, ring gauge plug gauge, snap gauge 10.2 Explain the working principles of the measuring instruments listed in 10.1 10.3 State the precautions to be observed when using the instruments listed in 10.1. 10.4 Compare the accuracy of the instruments	Explain the activities in 10.1 to 10.4	Bore gauge, radius gauge, taper gauge, ring gauge plug gauge, snap gauge	Use the instruments in 10.1 for linear measurements	Guide students to make use of the different instruments to measure the inside of a hole, radius of an object, the hole diameter, external diameter, check holes of different shapes and sizes and shafts	Measure the values of the following: inside of a hole, radius of an object, hole diameter, external diameter, check holes of different shapes and sizes, shafts

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Thermodynamics II

COURSE CODE: MEC 213

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Thermodynamics II	Code: MEC 213	Total Hours: 4 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Semester: Third		
Goal: This course is designed to acquaint students with knowledge and skills in air standard cycles, property of steam, vapour power cycle and principles of heat transfer		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand air standard cycles
2	Comprehend properties of steam
3	Understand vapour power cycle
4	Understand the principles of heat transfer

Thermodynamics II

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Thermodynamics II			CODE: MEC 213		CONTACT HOURS: 2 - 0 – 2 HOURS PER WEEK	
Goal: This course is designed to acquaint students with knowledge and skills in air standard cycles, property of steam, vapour power cycle and principles of heat transfer						
General Objective 1.0: Understand air standard cycles						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1-4	1.1 Explain the meaning of air standard cycle and its use. 1.2 Describe reversible and irreversible processes,– reversible and irreversible cycles and conditions for reversibility of a cycle. 1.3 Describe Carnot cycle with P.V. and T-S diagrams with air standard efficiency. 1.4 Solve problems on Carnot cycle. 1.5 Explain Otto cycle with P.V. and T-S diagrams with air standard efficiency. 1.6 Solve simple problems on Otto cycle.	Explain activities 1.1 to 1.11 with graphics and detailed notes	Marker, Whiteboard Duster, Textbooks	1.1 Perform simple experiments to demonstrate reversibility and irreversibility. 1.2 Carryout experiments to demonstrate all the air standard cycles: Carnot, Otto, Diesel and Dual cycles. 1.3 Identify heat engines and motion machines that operate on each of the air standard cycles. 1.4 Demonstrate the working of an air compressor	Demonstrate for the students to learn and guide them to perform the activities.	Explain air standard cycles

	1.7 Describe Diesel cycle with P.V. and T-S diagrams with air standard efficiency 1.8 Solve simple problems on Diesel cycle. 1.9 Describe Dual cycle with P.V. and T-S diagrams with air standard efficiency. 1.10 Solve simple problems on dual cycle. 1.11 State the reasons for the highest efficiency of Carnot cycle over other cycles working between same temperature limits. 1.12 Explain the practical relevance of all the air standard cycles above					
	General Objective 2.0: Comprehend properties of steam					
4-7	2.1 Describe the formation of steam under constant pressure, dryness, fraction and degree of superheat, specific volume. 2.2 Explain how to determine enthalpy,	Explain activities 2.1 to 2.3 with graphics and detailed notes	Marker, Whiteboard Duster, Textbooks, Boilers and steam tables .	2.1 Perform simple experiment to demonstrate enthalpy, internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart.	Demonstrate for the students to learn and guide them to perform the activities.	Explain properties of steam

	internal energy, internal latent heat, entropy of wet, dry and superheated steam at a given pressure using steam tables and Mollier chart. 2.3 Solve simple direct problems on 2.2 above using tables and charts.		.	2.2 Demonstrate the mountings and accessories on a boiler		
	General Objective 3.0: Understand vapour power cycle					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8	3.1 Discuss Rankine cycle. 3.2 Explain modified Rankine cycle. 3.3 Solve simple problems on 3.1 and 3.2 above	Explain activities 3.1 to 3.3 with graphics and detailed notes	Marker, Whiteboard Duster, Textbooks. .	Perform experiment to demonstrate Rankine and modified Rankine cycle	Demonstrate for the students to learn and guide them to perform the activities.	Explain vapour power cycle
	General Objective 4.0: Understand the principles of heat transfer					
9-15	4.1 Define heat transfer across the boundaries of a system. 4.2 Describe the 3 methods of heat transfer: conduction, convection and radiation. 4.3 Differentiate between	Explain activities 4.1 to 4.9 with graphics and detailed notes	Marker, Whiteboard Duster, Textbooks. Conductivity apparatus and Heat exchangers .	Demonstrate heat transfer through conduction, convection and Radiation	Demonstrate for the students to learn and guide them to perform the activities.	Explain principles of heat transfer

	thermal conductors and insulators. 4.4 State Fourier's Law of conduction in one dimension. 4.5 State Newton's Law of cooling 4.6 Describe heat exchangers and their practical application. 4.7 Explain natural and forced convection 4.8 Explain black body radiation and grey body radiation. 4.9 Define the Stefan - Boltzman law for the emissive power of a black body.					

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Fluid Mechanics

COURSE CODE: MEC 214

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Fluid Mechanics	Code: MEC 214	Total Hours:	4 Hours/Week
	Pre-requisite:	Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Third			
Goal: This course is designed to equip students with adequate knowledge and skills in fluid mechanics as it is used in solving engineering problems and introduce them to Computational Fluid Dynamics (CFD).			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the classification, types of fluids and their properties
2	Understand the concept of pressure and the principles of its measurement
3	Understand Archimedes Principles
4	Understand energy and motion of fluids for one dimensional flow
5	Know the Momentum equation and its practical applications
6	Know the Characteristics of fluid flow in pipes
7	Know some applications of fluid behavior in fluid Mechanics
8	Understand the Basics of Computational Fluid Dynamics (CFD)

Fluid Mechanics

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Fluid Mechanics			CODE: MEC 214	CONTACT HOURS: (2-0-2) HOURS/WEEK		
Goal: This course is designed to equip students with adequate knowledge and skills in fluid mechanics as it is used in solving engineering problems and introduce them to Computational Fluid Dynamics (CFD).						
General Objective 1.0: Know the classification, types of fluids and their properties						
COURSE SPECIFICATION: THEORETICAL CONTENT			Learning Resources	COURSE SPECIFICATION: PRACTICAL CONTENT		Evaluation
Week	Specific Learning Objectives	Teacher's Activities		Specific Learning Objective	Teacher's Activities	
1-3	1.1 Define a fluid 1.2 List different types of fluids 1.3 Explain the following forms of liquids: Ideal, Real, Newtonian, Non-Newtonian Plastic, Slurry, Suspension 1.4 Explain the following forms of gases: Ideal, Perfect and vapour. 1.5 Explain the following fluid properties for liquids and for gases. Pressure, density, viscosity, adhesion, cohesion, surface tension, compressibility, capillarity. 1.6 State Newton's Law of Viscosity. 1.7 Explain the effects of viscosity in fluids. 1.8 Explain with sketches the	• Define fluid • Define the variances between different types of fluids. • Explain fluid properties and their units.	Recommended textbooks, charts, lecture notes, presentation tools Viscometer, stop clock, Fall sphere apparatus, Hydraulic bench and samples of different fluids.	1.1 Identify different samples of fluid in the laboratory 1.2 Perform Boyle's law experiment to determine pv for perfect gas. 1.3 Draw τ & μ Curves for liquids and gases. 1.4 Obtain experimental viscosities of some liquids.	Guide the students through activities 1.1 to 1.4.	Classify the types of fluids and their properties. Explain how does viscosity affects fluids.

	relations between τ & μ for liquids and for gases.					
General Objective 2.0: Understand the concept of pressure and the principles of its measurement						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-6	2.1 Explain how a fluid exerts pressure due to its own weight 2.2 Derive an expression for the pressure at a point in a fluid. 2.3 Explain why the pressure in a fluid varies with depth 2.4 Explain the concepts of absolute gauge and vacuum pressures in gas. 2.5 Explain vapour pressure 2.6 Explain the principles of pressure measurement in liquids and gases. 2.7 Describe the following Fluid pressure measuring instruments: Common Gauge, Piezometer, Pitot tube, U - tube manometer, Bourdon gauge and Aneroid Barometer.	- Solve simple problems related to pressure measurements - Derive an expression for the total thrust acting on a plane vertical surface submerged in a liquid. Identify the point where the resultant thrust acts. - State parallel theorem - Describe the different fluid pressure measuring equipment.	Recommended textbooks, charts, lecture notes, presentation tools, Pitot tube, Manometer, Hydrostatic forces on plane surfaces, Bernoulli's apparatus, Piezometer, Aneroid barometer, U-tube manometer	2.1 Demonstrate by experiments how a fluid exerts pressure due to its own weight 2.2 Calibrate the bourdon pressure gauge. 2.3 Measure vapour using a simple water vessel. 2.4 Measure fluid pressure with the following: a. Common gauge, b. Peizometer c. Pitot tube d. U-tube manometer e. Bourdon gauge and f. Aneroid Barometer	Guide the students through activities 2.1 to 2.4.	Explain fluid pressure and how it is measured. Explain vapour pressure and how it is measured. Explain the different fluid pressure measuring equipment and how are they used.
GENERAL OBJECTIVE: 3.0. Understand Archimedes principles						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
7-8	3.1 State Archimedes principles 3.2 Define (i) buoyant force (ii) Centre of buoyancy 3.3 Explain the working of a hydrometer 3.4 Explain the three equilibrium states of floating	- Explain Archimedes principle - Apply Archimedes principles to	Recommended textbooks, charts, lecture notes, presentation tools.	3.1 Use the hydrometer to determine the relative density of liquids. 3.2 Carry out simple experiment using Archimedes apparatus to	Guide the students through activities 3.1 to 3.3.	Explain Archimedes principle.

	objects: (i) stable (ii) unstable (iii) neutral 3.5 Explain metacentric height 3.6 Derive an expression for the metacentric height of a floating object	determine the density of a substance (Solids) • Solve problems associated with floating objects	Hydrometer, Archimedes apparatus, Calibration kits.	determine density of substances. 3.3 Calibrate a hydrometer		

GENERAL OBJECTIVE: 4.0. Understand energy and motion of fluids for one dimensional flow

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
9-10	4.1 Explain the principle of conservation of mass. 4.2 State the continuity equation 4.3 State the Bernoulli's theorem	- Derive the energy equation of a flowing fluid - Apply Bernoulli's equation for solving problems in fluid flow - Verify Bernoulli's equation in any flow Situation.	Recommended textbooks, charts, lecture notes, presentation tools. Hydraulic, Bench and accessories, Stopwatch, and weighing balance, impact jets apparatus.	4.1 Carry out experiments to compare different forms of energy for fixed quantities of water. 4.2 Determine the mass flow rate and volume rate using a hydraulic bench or any other apparatus. 4.3 Determine experimentally the force exerted by a jet using impact of jets apparatus.	Guide the students through activities 4.1 and 4.3.	Explain energy and motion of fluids for one dimensional flow.

GENERAL OBJECTIVE: 5.0 Know the momentum equation and its practical applications.

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
11-12	5.1 Explain the momentum equation as a different statement of Newton's second law of motion. 5.2 Derive an expression for the momentum equation for one-dimensional fluid.	Explain 5.1 to 5.3 with solved examples and detailed notes.	Recommended textbooks, charts, lecture notes, presentation tools	5.1 Conduct experiments to investigate critical velocity, laminar and turbulent flows. 5.2 Plot appropriate graphs for 5.1. 5.3 Demonstrate experimentally the effect of water impingement on series of blades on a freely	Guide the students through activities 5.1 to 5.3.	Describe the practical applications of the momentum equation.

	5.3 Apply the momentum equation in solving fluid flow problems		Hydraulic bench with accessories	suspended drum. 5.4 Identify pumps, turbines and compressors		
GENERAL OBJECTIVE: 6.0 Know the characteristics of fluid flow in pipes						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13	6.1 Explain the following types of flow (i) uniform flow (ii) non uniform flow (iii) non steady flow 6.2 Explain laminar and turbulent flows 6.3 Define critical velocity and Reynold's number 6.4 Explain the friction loss along pipes	Illustrate 6.1 to 6.4 with examples and notes	Recommended textbooks, charts, lecture notes, presentation tools Reynolds Apparatus Various fluid machines	6.1 Conduct experiments to study different types of fluid flows in pipes. 6.2 Demonstrate friction loss along pipes.	Guide the students through activities 6.1 to 6.2.	Explain the characteristics of fluid flow in pipes.
GENERAL OBJECTIVE: 7.0 Know some applications in fluid mechanics						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
14	7.1 Explain the principles of energy converters/machines 7.3 Explain the principles of pumps. 7.4 Explain the principles turbines. 7.5 Explain the principles of compressors. 7.6 Explain the principles of hydraulic press and hydraulic jack.	• Explain the principles of energy converters/ machines • Explain the principles of pumps, turbines and compressors	Recommended textbooks, charts, lecture notes, presentation tools Various fluid machines in Laboratory.	7.1 Demonstrate the use of pumps, turbines and compressors. 7.2 Demonstrate the use of hydraulic press and hydraulic jack.	Guide the students through activities 7.1 to 7.2.	Describe applications of fluid mechanics.
GENERAL OBJECTIVE: 8.0 Understand the Basics of Computational Fluid Dynamics (CFD)						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

15	8.1 State the historical perspective of CFD 8.2 Explain how mathematical descriptions of physical phenomena are developed 8.3 Explain discretization methods 8.4 Explain numerical solutions of fluid flow equations.	• Explain the principle and history of CFD • Explain mathematical descriptions of physical phenomena • Explain discretization methods	Recommended textbooks, charts, lecture notes, presentation tools, PCs and licensed CFD software such as ANSYS Fluent, COMSOL, etc	8.1 Use a CFD package to solve a simple fluid dynamics problem	• Guide students on the use of a CFD package with simple examples.	Describe an application of CFD.

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Foundry Technology and Forging Operations

COURSE CODE: MEC 215

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Foundry Technology and Forging Operations	Code: MEC 215 Pre-requisite: NIL	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Third			
Goal: This course is designed to acquaint students with knowledge and skills on basic foundry technology and forging operations			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the development of the foundry Industry
2	Understand the principles of foundry production
3	Understand pattern making processes
4	Know mould and core making materials
5	Know mould and core making
6	Know the technology of melting and casting
7	Know post casting treatment
8	Know safety precautions in foundry work
9	Know the sources of foundry materials
10	Know the process of die casting
11	Know the processes of moulding plastics
12	Understand forging operations

Foundry and Forging Operations

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Foundry Technology And Forging Operations			COURSE CODE: MEC 215		CONTACT HOURS: (2-0-2) HOURS/WEEK	
GOAL: This course is designed to acquaint students with knowledge and skills on basic foundry technology and forging operations						
General Objective 1.0: Know the development of the foundry Industry						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1	1.1 Define foundry technology 1.2 Explain the growth of casting technology in Nigeria and some countries like Great Britain, Germany, Russia, India, and China. 1.3 Explain the role of foundry in technology development 1.4 List some industries that depend on foundry production.	• Explain what is foundry technology • Identify the roles of countries like Nigeria, Britain, Germany, Russia, etc. in the development of the foundry, industry	Recommend ed textbooks, lecture notes, whiteboard, etc.			Explain what is foundry and the role of foundry in technology development
General Objective 2.0: Understand the principles of foundry production						
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
2	2.1 Define alloys 2.2 Explain the advantages of alloys over pure metal as engineering materials 2.3 Explain flowability of molten metals and alloys and the application in foundry	Explain activities 2.1 to 2.5	Charts, Recommend ed textbooks, Lecture notes, whiteboard.			Explain the principles of foundry production

	processes 2.4 Classify foundries based on types of metal cast and production. (a) ferrous foundries (b) Non-ferrous (c) cast Iron foundries (d) malleable Iron foundries (e) independent foundries (f) captive foundries 2.5 Explain the type listed in 2.4					
GENERAL OBJECTIVE: 3.0. Understand Pattern Making						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
3	3.1 Explain the various types of patterns in common use in the foundry 3.2 State some important pattern material characteristics such as machinability; wear resistance, strength, reparability, corrosion, swelling etc. 3.3 Explain the fundamental of pattern designs and common pattern allowances. 3.4 List typical cast alloys and the approximate shrinkage used for such. 3.5 List factors that determine the selection of pattern materials	• Explain patterns and describe them • List some important pattern characteristics • Explain how shrinkage allowance is provided on patterns. • List pattern materials and their properties • Describe various wood seasoning method.	Patterns Recommended textbooks, lecture notes, whiteboard, Complete equipment for making patterns, rules, measuring tool, etc	3.1 Identify factors that determine the selection of pattern materials. 3.2 Select materials for pattern making e.g wood, plaster, plastics etc. 3.3 Design a pattern for a given product. 3.3 Manufacture a pattern for a given product. 3.4 Carryout maintenance and repairs of pattern	Demonstrate the activities in 3.1 to 3.4 for the students to learn and guide them to perform the activities.	Explain the various types of patterns in common use in the foundry List some important pattern material characteristics such as machinability, etc

	3.6 List properties and types of wood for pattern making 3.7 Describe various methods of seasoning timber, e.g. by natural and artificial methods 3.8 List other materials for pattern making e.g. plaster, plastics etc. 3.8 Describe stage and repairs of pattern.					
GENERAL OBJECTIVE: 4.0. Know mould and core making materials						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4	4.1 Explain the characteristics and application of mould materials, e.g. natural sand, quartz, silica and other types of sand e.g. zirconite, olivine and chromate 4.2 Explain the inter-relationship of mould sand characteristics. 4.3 Explain the basic properties of core sand, e.g. refractoriness, permeability, strength collapsibility and surface smoothness. 4.4 Explain the basic characteristics of binders, e.g. particle size, clay content, jolling index. 4.5 List common types of binders e.g. bentonites,	- Describe the required characteristics of Moulding sand. - Explain why Specific sands are sometimes used. - Explain some of the required characteristics of core sand. - Explain the importance of binder - Classify binders into clay-type, organic and inorganic - Explain furan, CO ₂ binder processes.	Recommend textbooks, lecture notes, whiteboard, etc. Wooden flask, metal flasks, parting powder, chaplets, Moulding sand and binders.	4.1 Identify Moulding sand/briners and its characteristics. 4.2 Identify different types of metal and wooden Moulding boxes	Demonstrate the activities in 4.1 to 4.2 for the students to learn and guide them to perform the activities.	1 Explain the following: Characteristics and application of mould materials, - inter-relationship of mould sand - - characteristics. - basic properties and characteristics of core sand. - Explain the

	kaolinites, organic type binders like cereal binders, resins and gums, drying oil, inorganic type of binders. 4.6 State the functions and types of additives, e.g. coal, dust wood flour, cereal, etc.	- State functions of additives				basic characteristics of binders, - List common types of binders

GENERAL OBJECTIVE: 5.0 Know mould and core making

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
5	5.1 Describe different kinds of metal and wooden boxes. 5.2 Explain the use of facing and backing sands including venting and other applied techniques 5.3 Explain the techniques of mould drying. 5.4 Explain techniques of mould closure such as box location, core location, use of chaplets, parting powder. 5.5 Identify types of cores and their applications 5.6 Explain specific precautions in core making operations, e.g. re-enforcement, venting, packing, etc. 5.7 Explain core baking, types of ovens used and core baking time and temperature.	Explain 5.1 to 5.7 with diagrams where necessary.	Recommended textbooks, lecture notes, whiteboard, etc. Metal and wooden boxes, Core making equipment	5.1 Carry out setting of patterns, core assembly, reinforcement, listers, draggers, etc. 5.2 Demonstrate the techniques of mould drying. 5.3 Produce mould by other methods e.g. squeeze Moulding machine. 5.4 Cut down runners and gates. 5.5 Dress mould and cores using the wet and dry methods. 5.6 Demonstrate techniques of mould closure such as box location core location, use of chaplet parting powders. 5.7 Identify the types of cores and its applications. 5.8 Produce different types of cores e.g. small	Demonstrate the activities in 5.1 to 5.10 for the students to learn and guide them to perform the activities.	What are the different kinds of metal and wooden boxes? Explain the use of facing and backing sands including venting and other applied techniques Explain the techniques of mould drying and closure Explain Specific precautions

				cores, wan cores, skeleton cores, etc. 5.9 Demonstrate special precautions in core making operations e.g. reinforcement venting, baking. etc. 5.10 Perform cores test		in core making operations,
GENERAL OBJECTIVE: 6.0. Know the technology of melting and casting						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
6	6.1 Explain different fuels used in foundry melting processes e.g. gas, oil, coke, electricity. 6.2 Explain general properties of refractory materials. 6.3 Give examples and applications of different types of refractory materials e.g. acidic, basic and amphoteric. 6.4 Describe the melting practices and operation of the following foundry furnaces. Crucible furnace, pit furnace, cupula furnace, electric furnace. 6.5 Distinguish between the melting techniques used in various foundries, e.g. cast-iron foundries, steel foundries. 6.6 Describe the types and	• Classify fuels into solid, liquid, and gas. • compare the types of fuel in terms of calorific value, cost, etc. • Distinguish between acid, basic and amphoteric refractories. • Write out the sequence of operation of - crucible, direct-arc, etc • Explain the usefulness of ladles.	Standard component, chart, tables, drawing instrument. Various melting units. Transfer ladles.	6.1 Identify fuels used in foundry melting processes e.g gas, oil, coke, electric, etc. 6.2 Identify different types of furnaces. 6.3 Identify types of binders. 6.4 Prepare ladles in foundry. 6.5 Perform melting treatment operation e.g purging, alloying, inoculating etc. 6.6 Carry out pouring and casting.	Demonstrate activities 6.1 to 3.5 for the students to learn and guide then to perform the activities.	Explain the technology of melting and casting

	preparation of ladles in foundry					
GENERAL OBJECTIVE: 7.0. Know post casting treatment						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
7	7.1 Explain the function of fettling department 7.2 List the machines and tools used in fettling department, e.g. tumbling barrel. 7.3 Explain Hydro-blasting hydro-sand blasting, sand blasting and shot blasting machines Sledge hammer, power saw, abrasive cut-off wheels, spine cutter, cutting torches. 7.4 Explain the function of inspection department. 7.5 List the tools and machines used in inspection department	•Explain the importance of fettling. • Explain the fettling tools and machines available in the foundry	Recommend d textbooks, Lecture note whiteboard Fettling and inspection tools and machines	7.1 Identify fettling and inspection tools available in the foundry shop. 7.2 Carry out fettling operations e.g removal of gates and feeders using flame cutting sawing, grinding, etc. 7.3 Perform cleaning operations e.g tumbling, shot and hydro blasting, trimming, were brushing, chipping by hand. 7.4 carry out destructive and non-destructive, inspection e.g ultrasonic, magnetic particle, x-ray, hardness, elongation, etc.	Demonstrate the activities in 7.1 to 7.4 for the students to learn and guide then to perform the activities.	Explain post casting treatment
	7.7 Explain the functions of quality control departments and list the instruments used for quality control e.g. Sand testing instrument, Carbon Spectrographic equipment or metal analyse, Non-destructive testing techniques etc.	•Explain the importance of quality control department				

GENERAL OBJECTIVE: 8.0. Know safety precautions in foundry work						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8	8.1 Explain factory safety precautions as regards foundry. 8.2 State safety rules and regulations relating to: - movement in the workshop - use of hand tools - clothes and clothing - use of equipment and machinery - adequate ventilation and lighting - use of other protective anti fit e.g. goggles, gloves, boots etc.	• Explain the necessity for safety rules and regulations in the workshop • State some of the basic safety rules and regulations to be observed in the foundry. • Assess the students	Safety manuals, whiteboard. Gloves, boots, fire extinguishers, Overall, goggles, etc.	8.1 Identify and apply safety rules, precaution and regulations relating to:- - Movement in the workshop - Use of hand tools - Clothes and Clothing - Use of equipment and machinery - Use of personal protective equipment (PPE) e.g goggles, gloves, boots, etc.	Demonstrate activities 8.1 for the students to learn and guide then to perform the activities.	Explain factory safety precautions
GENERAL OBJECTIVE: 9.0. Know the sources of foundry materials						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
9	9.1 State the locally available raw materials 9.2 State the imported raw materials 9.3 State the substitute 9.2	• Explain sources of raw materials	Recommend d textbooks, Lecture notes,			Mention some locally available raw materials
GENERAL OBJECTIVE: 10.0. Know the process of die casting						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10-11	10.1 Explain the difference between sand and permanent moulds. 10.2 List the uses of permanent moulds.	• Prepare a comparative table of features and products of sand and permanent	Whiteboard, etc. Plastic injection moulding,	10.1 Identify in the workshop components, which were made by die-casting 10.2 Install and dismantle a mould from the injection	Demonstrate the activities in 10.1 to 10.6 for the students to learn and guide then to	Explain the difference between sand and

	10.3 List the various features of permanent moulds 10.4 Explain the process of pressure die casting in a permanent mould 10.5 List similarities and dissimilarities of die casting of aluminium, zinc and other low melting metals.	moulds • List similarities and differences of die casting of aluminium zinc and other low melting metals.	machine, Blacksmith forge, Anvil and stand Blacksmith hammer. (Slage hammer)	moulding machine and operate the machine. 10.3 Select various hand forging tools and equipment for gorge work. 10.4 Carry out forging operations involving cogging, bending, up-setting twisting and punching. 10.5 Carry out exercises involving the following - (i) hardening (ii) annealing (iii) tempering (iv) normalising and (v) case hardening 10.6 Carry out test on the heat treated internals.	perform the activities.	permanent moulds. Explain the process of pressure die casting in a permanent mould

GENERAL OBJECTIVE: 11.0. Know the presses of moulding plastics

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
12-13	11.1 Know the process of plastic injection moulding 11.2 Estimate the heat require to melt a given quantity of plastic material 11.3 List the parameters for classifying plastic injection moulding machines. 11.4 Describe the essential features of a plastic injection moulding. 11.5 Know the functions of cooling water in a mould. 11.6 Know the functions of compressed air in a mould	Explain the essential features of a plastic injection moulding machine. Illustrate with examples.	Plastic injection moulding machine. Recommende d textbooks, lecture notes, chalkboard, chalk, etc.			Explain the process of plastic injection Moulding

GENERAL OBJECTIVE: 12.0. Understand forging operation						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
14-15	12.1 Explain the functions of various tools used in forging operations. 12.2 Describe various forging operations involving bending, up-setting, twisting and punching	Explain the functions of various tools used in forging. 12.1 Explain various forging operations. .	Recommend textbooks, lecture notes, Whiteboard, etc			Explain various forging operations

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Introduction to CAD/CAM

COURSE CODE: MEC 216

DURATION: 30 Hours (0 Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Introduction to CAD/CAM	Code: MEC 216 Pre-requisite: MEC 114	Total Hours:	2 Hours/Week
		Theoretical hours:	0 Hour/Week
		Practical hours:	2 Hours/Week
Semester: Third			
Goal: This course is designed to acquaint students with knowledge and skills on how to use computer aided design (CAD) to create engineering drawings, parts and interface with computer aided manufacturing (CAM) processes			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the use of computers in the design and drafting processes
2	Know how to construct simple geometric shapes using CAD
3	Understand how to edit CAD drawings
4	Understand how to use layers in CAD
5	Understand dimensioning and annotation
6	Understand engineering drawings in CAD
7	Understand the basics of 3D CAD Modelling
8	Understand the basics of Computer Aided Manufacturing (CAM)

Introduction to CAD/CAM

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Introduction to CAD/CAM			CODE: MEC 216	CONTACT HOURS: (0-0-2) HOURS/WEEK		
Goal: This course is designed to acquaint students with knowledge and skills on how to use computer aided design (CAD) to create engineering drawings, parts and interface with computer aided manufacturing (CAM) processes						
General Objective 1.0: Understand the use of computers in the design and drafting processes						
COURSE SPECIFICATION: THEORETICAL CONTENT			Learning Resources	PRACTICAL CONTENT		Evaluation
Wee k	Specific Learning Objectives	Teacher’s Activities		Specific Learning Objective	Teacher’s Activities	
1	1.1 Explain the advantages and disadvantages of computers in the design process 1.2 Explain the links between CAD and CAM 1.3 Explain the principles, operation capabilities and system requirements of CAD software.	• Explain the advantages and disadvantages of computers in the design process. • Explain the links between CAD and CAM	Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	1.1 1.1 Install a CAD software correctly. 1.2 Identify the main sections of the GUI of a CAD software 1.3 Use different input devices: Keyboards, mouse, digitizers, and scanners. 1.4 Identify the different coordinate systems 1.5 Demonstrate the use of the HELP Menu in solving problems	Guide students to install CAD software correctly Guide students to identify the main sections of the GUI of a CAD software Guide students to use different input devices Guide students to identify the different coordinate system xyz Guide students to solve	Explain the use of computers in the design and drafting process.

				1.6 Use layer control to change the layers in a drawing 1.7 Use Cartesian and Polar coordinates to draw lines 1.8 Customize the size of the drawing field	problems using the HELP menu Guide students to use layer control to change the layers in a drawing Guide students to use Cartesian and Polar coordinates to draw lines Guide students to customize the size of the drawing field	
General Objective 2.0: Understand how to construct simple Geometric Shapes using CAD						
Week	Specific Learning Outcome:	Teachers Activities	Learning Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
2-3			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	2.1 Draw circles, ellipses and arcs to given dimensions 2.2 Construct polygons and squares to given dimensions 2.3 Hatch the shapes drawn using different patterns and scales 2.4 Produce a simple drawing	Guide students to draw circles, ellipses and arcs to given dimensions Guide students to construct polygons and squares to given dimensions Guide students to hatch the shapes drawn using different patterns and scales	Explain simple geometric shapes constructed in CAD.

					Guide students to produce simple drawing	
General Objective 3.0: Understand how to edit CAD drawings						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
4-5			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	3.1 Use edit commands 3.2 Use different edit boxes and their attributes 3.3 Select the shapes using edit boxes. 3.4 Use array command to draw both polar and rectangular arrays 3.5 Use the offset Command 3.6 Demonstrate how to move objects accurately using both snap commands and coordinates 3.7 Demonstrate how to copy objects from one position to another accurately using snap and coordinate entry. 3.8 Demonstrate how to erase objects 3.9 Demonstrate how to trim objects 3.10 Demonstrate how to fillet and chamfer angles	Guide students to: -Use edit commands -Use different edit boxes and their attributes -Select the shapes using edit boxes. -Use array command to draw both polar and rectangular arrays -Use the offset Command - move objects accurately using both snap commands and coordinates -copy objects from one position to another accurately using snap and coordinate entry. -erase objects -trim objects	Explain how CAD drawings are edited.

					-fillet and chamfer angles	
General Objective 4.0: Understand how to use layers in CAD						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
6-7			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	4.1 Demonstrate how to create layers. 4.2 Demonstrate how to change colour of layers 4.3 Demonstrate how to change the line types of a layer. 4.4 Demonstrate how to move objects from one layer to another 4.5 Demonstrate how to switch layers on and off	Assist students to: Demonstrate how to create layers. Demonstrate how to change colour of layers Demonstrate how to change the line types of a layer. Demonstrate how to move objects from one layer to another Demonstrate how to switch layers on and off	Explain how layers are used in CAD.
General Objective 5.0: Understand Dimensioning and Annotation						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
8-9			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/	5.1 Create linear, angular and aligned dimensions 5.2 Demonstrate how to add to tolerances to dimensions 5.4 Demonstrate how to create leader lines.	Guide students to: -Create linear, angular and aligned dimensions	Explain how dimensioning and annotation is used in CAD.

			Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	5.5 Demonstrate how to add single line and multiple line texts to drawings 5.6 Demonstrate how to edit dimensions and text	-Demonstrate how to add to tolerances to dimensions -Demonstrate how to create leader lines. -Add single line and multiple line texts to drawings -Edit dimensions and text	
General Objective 6.0: Understand Engineering Drawings in CAD						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
10-11			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	6.1 Create the title block for a drawing 6.2 Write letters and numbers on drawings 6.3 Produce a simple drawing with correct details in terms of title block etc 6.4 Produce a full drawing with title blocks from a real engineered object. 6.5 Show all the views. 6.6 Produce a fully dimensioned drawing of a component	Guide students to: -Create the title block for a drawing -Write letters and numbers on drawings -Produce a simple drawing with correct details in terms of title block etc -Produce a full drawing with title blocks from a real engineered object. -Show all the views.	Explain how engineering drawings are created in CAD.

					-Produce a fully dimensioned drawing of a component	
General Objective 7.0: Understand the Basics of 3D CAD Modeling						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
12-13			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	7.1 Identify the main sections of the GUI of a 3D CAD software 7.2 Use sketcher 7.3 Create referencing planes 7.4 Create extrude, revolve, swept and loft features 7.5 Create a reference (points, axis, coordinates) 7.6 Create fillets and chamfers 7.7 Create holes 7.8 Create dimensioned parts 7.9 Assemble multiple parts 7.10 Use top-down and bottom-up approaches to assembly 7.11 Apply standard mates (e.g. coincident, parallel, perpendicular, tangent, concentric, etc)	Guide students to: -Identify the main sections of the GUI of a 3D CAD software - Use sketcher - Create referencing planes -Create extrude, revolve, swept and loft features -Create a reference (points, axis, coordinates) -Create fillets and chamfers -Create holes -Create dimensioned parts -Assemble multiple parts -Use top-down and bottom-up approaches to assembly	Explain how 3D parts are created in CAD.

					-Apply standard mates (e.g. coincident, parallel, perpendicular, tangent, concentric, etc)	
General Objective 8.0: Understand the Basics of Computer Aided Manufacturing (CAM)						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
14-15			Recommended Textbooks, Whiteboard, marker, Complete computer sets Printer/ Plotters in a Network, Digitizer CAD licensed software such as AutoCAD, SolidWorks, CATIA, etc.	8.1 Identify the main sections CAM part of a CAD software 8.2 Set up a job 8.3 Create a geometry 8.4 Identify the tools, machining parameters and type of machining 8.6 Verify the operation by running a simulation	Guide students to Identify the main sections CAM part of a CAD software Guide students to set up a job Guide students to create geometry Guide students to identify the tools, machining parameters and type of machining Guide students to simulate to verify an operation	Explain how CAM jobs are set up.

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Technical Report Writing

COURSE CODE: MEC 217

DURATION: 15 Hours (1 Hour Lecture and 0 Hour Practical)

CREDIT UNIT: 2.0

Course: Technical Report Writing	Code: MEC 217	Total Hours: 2 Hours/Week
	Pre-requisite:	Theory: 1 Hour/Week
		Practical: 0 Hour/Week
Semester: Third		
Goal: This course is designed to provide effective means of communicating a properly researched topic or performed experiment and project		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Recognize the contents of a technical report
2	Know the process of carrying out research
3	Know the different sections of a technical report
4	Comprehend the information that is required in technical report writing
5	Understand the style and format of technical report writing

Technical Report Writing

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: TECHNICAL REPORT WRITING			COURSE CODE: MEC 217	CONTACT HOURS: (2-0-0) HOURS/WEEK		
GOAL: This course is designed to provide effective means of communicating a properly researched topic or performed experiment and project						
General Objective 1.0: Recognize the content of a technical report						
COURSE SPECIFICATION: THEORETICAL CONTENT				COURSE SPECIFICATION: PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1–3	1.1 Explain the meanings of technical reports 1.2 Identify the purpose of technical reports 1.3 Explain technical report in Engineering 1.4 recognize the three Rules to consider in Writing a Report	• Explain the details of writing technical report • Describe the three rules to adhere to in technical report writing • Illustrate with an example	Whiteboard, markers, Duster, textbooks, lecture notes			Explain the contents of a technical report
General Objective 2.0: Know the process of carrying out research						
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation

4-7	1.1 Determine the project topic or title 1.2 Justify the topic or title chosen 1.3 State the background information 1.4 Refine the topic 1.5 Shape the search strategy 1.6 Evaluate the information	• Illustrate activities 2.1 to 2.6	Recommended textbooks, whiteboard, marker lecture notes, library catalogue for books and articles, etc			Carryout a research and apply the methods to arrive at a topic or title
General Objective 3.0: Know the different sections of a technical report						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8– 9	3.1 Explain the following sections of a technical Report: • Title Page • Abstract or Synopsis • Aim and Objective • Background/literature review • Experiment • Classification of data • Scope and Limitation • Data Analysis (graphical method, tabular method descriptive method) • Results and Discussion	Explain the contents of each section listed in 3.1	Recommended textbooks, whiteboard, marker, lecture notes, library catalogue for books and articles, Internet for authoritative websites. etc.			Write a technical report on the research carried out in section 2

	• Conclusion • Recommendation/Further Work • References • Appendices					
General Objective 4.0: Comprehend the information that is required in technical report writing						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10 – 12	4.1 Explain the various types of information that would be required in Reports 4.2 Determine the factors that influence solutions 4.3 Advance Mechanical Engineering conclusions arising from factors 4.4 Select criteria required in case studies	• Explain 4.1 to 4.14 with good examples and ask the students to pick a topic as assignment to demonstrate the illustrated techniques.	Recommended textbooks, lecture notes, library catalogue for books and articles,			Assess the students
	4.5 Determine critical analysis of case studies 4.6 Produce summary 5.7 Make propositions (Author's propositions) 4.8 Develop conclusion to a technical report 4.9 Write a bibliography in standard format		Recommend d textbooks, lecture notes, whiteboard, marker, duster, etc.			

	4.10 Explain terms of reference in report 4.11 Explain the difference between facts and opinions 4.12 Explain how facts and opinions may be distinguished in writing report 4.13 Write reports on selected technical matters 4.14 Rewrite the abstract.					
	General Objective 5.0: Understand the style and format of technical report writing					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13-15	5.1 Appreciate the following style and required formats: • Appearance – the word process details • Tense and voice – verbs usage, present and past tense usage for different sections enumerated in 3.1 • Spelling, punctuation and word selection • Labeling, referencing and placement of tables and figures • Figures and graphs formatting	Explain the activities in 5.1	Recommended textbooks, whiteboard, marker, lecture notes, library catalogue for books and articles, Internet for authoritative websites. etc.			Explain Writing Styles and Required Formats

FOURTH SEMESTER COURSES

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Supervisory Management

COURSE CODE: MEC 221

DURATION: 30 Hours (2 Hour Lecture and 0 Hour Practical)

CREDIT UNIT: 2.0

Course: Supervisory Management	Code: MEC 221	Total Hours: 2 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 0 Hour/Week
Semester: Fourth		
Goal: This course is designed to develop students' knowledge and skills on job analysis, recruitment, training, motivation, planning and control activities.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand job analysis
2	Know recruiting activities
3	Comprehend how to prepare and implement training plan
4	Understand human motivation
5	Know planning and control activities

Supervisory Management

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Supervisory Management			COURSE CODE: MEC 221		CONTACT HOURS: (2-0-0) HOURS/WEEK	
Goal: This course is designed to develop students' knowledge and skills on job analysis, recruitment, training, motivation, planning and control activities.						
General Objective 1.0: Understand job analysis						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

1-2	1.1 Analyse job under the following: - tasks carried out, - responsibilities, - reporting relationships, - decisions made, - risks involved to plant, - product, self and others, - measures of output and quality	Explain activity 1.1 with detailed notes	White board and markers, Recommended textbooks, etc.			Explain Job Analysis
GENERAL OBJECTIVE 2.0: Know recruiting activities						
3-5	2.1 Prepare personal application for job. 2.2 Decide on source for recruitment. 2.3 Carry out an interview and select candidate	Explain the activities in 2.1 to 2.2 with detailed notes.	Whiteboard and markers, duster, recommended textbooks			Explain the process of recruitment
GENERAL OBJECTIVE 3.0 Comprehend how to prepare and implement training plan						
6-8	3.1 Prepare breakdown of skills, knowledge, methods/procedures and exceptions procedure 3.2 Prepare training plan for each aspect 3.3 Carry out training	Explain activities in 3.1 to 3.3 with detailed notes	White board, markers duster, recommended textbooks			Explain how to prepare and implement training plan

GENERAL OBJECTIVE 4.0: Understand human motivation						
9 –11	4.1 Explain the concept of human needs. 4.2 Describe rewards systems	Describe the activities in 4.1 to 4.2 with detailed notes				Explain the concept of human motivation
GENERAL OBJECTIVE 5.0: Know planning and control activities						
12-15	5.1 Explain how to determine time and skill requirements to match task requirement. 5.2 Explain how to allocate staff to tasks. 5.3 Discuss the scheduling of staff to maximize utilization	Explain the activities in 5.1 to 5.3 with detailed notes	Recommend textbooks, charts,			Explain planning and control activities

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Strength of Materials

COURSE CODE: MEC 222

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Strength of Materials	Code: MEC 222 Pre-requisite:	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Fourth			
Goal: This course is designed to acquaint students with knowledge and skills on stress, strain and forces acting on structures for problem solving in engineering			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Comprehend various types of stresses and strain
2	Comprehend shear force and bending moment
3	Analyze shear stress and torque in circular shafts.
4	Comprehend principal stress and use of Mohr's Circle to solve problems
5	Analyse stresses on column, struts and riveted joints

Strength of Materials

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY		
COURSE: STRENGTH OF MATERIALS	COURSE CODE: MEC 222	CONTACT HOURS: (2-0-2) HOURS/WEEK
Goal: This course is designed to acquaint students with knowledge and skills on stress, strain and forces acting on structures for problem solving in engineering		
General Objective 1.0: Understand various types of stress and strain		
COURSE SPECIFICATION: THEORETICAL CONTENT		PRACTICAL CONTENT -

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
1-5	1.1 Define the terms, 'stress' and 'strain'. 1.2 State Hooke's Law. 1.3 Differentiate between the following: (tensile and compressive stresses) and (tensile and compressive in rotary isolation). 1.4 Explain stress-strain curves for: -Brittle and Ductile materials. 1.5 Describe with illustration the elastic and plastic behaviour of common structural materials. 1.6 Explain proof stresses, direct stresses, load factors, and lateral strain, strain due to direct stresses. 1.7 Describe strength properties of some engineering materials e.g cast iron, concrete, glass fibre, carbon fibre etc.	Explain 1.1 to 1.7 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc. Universal Testing Machine (UTM), Izod/charpy testing apparatus, Universal Hardness Tester (UHT), Spring and Dead Weight	1.1 Perform experiment to verify Hooke's Law using a spring and dead weight. 1.2 Conduct tensile and compressive tests on ductile and brittle materials. 1.3 Conduct Izod and Charpy tests on different materials. 1.4 Conduct Brinell, Vickers and Rockwell hardness test.	Demonstrate the activities in 1.1 to 1.4 for the students to learn and guide then to perform the activities.	Explain types of stress and strain
GENERAL OBJECTIVE: 2.0 Understand shear force and bending moment						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

6-10	2.1 Define shearing force and bending moments. 2.2 Establish the relationship between the shearing force and bending moment. 2.3 Write expressions for shearing force and bending moment at a section of a loaded beam. 2.4 Draw bending moment and shearing force diagrams for any loaded beam. 2.5 Calculate the points of contraflexure. 2.6 Calculate the neutral axis, the second moment of area of cross section, the moment of resistance. 2.7 Compute flexural and shear stresses each separately at a given point on a section. 2.8 Draw stress distribution diagrams at the section. 2.9 Solve problems relating to 2.1 to 2.8	Explain 2.1 to 2.9 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc. Bifilar Suspension Apparatus	2.1 Conduct tests to determine the moment of inertia of discs and rotors.	Demonstrate the activity 2.1 for the students to learn and guide them to perform the activities.	Explain the concept of shear force and bending moment
GENERAL OBJECTIVE: 3.0 Know shear stress and torque in circular shafts						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
11-12	3.1 Describe the torsion of the following circular sections:	Explain 3.1 to 3.3 with diagrams	Whiteboard, marker, text	3.1 Perform experiment to determine the stress	Demonstrate the activities in 3.1 to 3.3 for the students	Explain shear stress and torque

	a. thin tube b. solid shaft c hollow shaft. 3.2 Compute the following for a circular rigid and hollow sections. a. angle of twist b. torsional stress c torsional stiffness 3.3 Solve problems relating to 3.1 and 3.2	and detailed notes where necessary	books, duster, etc. Beam apparatus. Torsion test apparatus. Struts. Bolted and riveted connections samples.	distribution on section of structural elements. 3.2 Conduct torsion tests 3.3 Perform experiment to verify Maxwell's theorem for simply supported beams.	to learn and guide then to perform the activities.	in circular shafts

GENERAL OBJECTIVE 4.0: Comprehend principal stress and use of Mohr's Circle to solve problems.

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13-15	4.1 Describe Mohr's circle of (a) stress (b) strain. 4.2 Compute stresses and strain by Mohr's circle	Explain 4.1 to 4.2 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc. PCs and licensed ANSYS or Solid Work software.	4.1 Apply ANSYS or Solid Works software to compute stresses and strain on a steel bar	Demonstrate for the students to learn and guide then to perform the activities.	Explain the use of Mohr's circle

GENERAL OBJECTIVE 5.0: Analyse stresses on column, struts and riveted joints

	5.1 Define the terms, 'column' and 'strut'. 5.2 Describe the failure mode of a column and a strut.	Explain 5.1 to 5.6 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc. PCs, Licensed ANSYS or	5.1 Use ANSYS or Solid Works to design a model of column, strut, riveted and bolted connections 5.2 Perform test to determine the effects of	Demonstrate the activities in 5.1 to 5.2 for the students to learn and guide then to perform the activities.	Explain how to Analyse stresses on column, struts and

	5.3 State Euler's and Rankine formula for finding critical load. 5.4 Solve problems on various (4) end conditions of column. 5.5 Describe riveted joint. 5.6 Explain the strength, efficiency and failure of riveted joints.		Solid Work software.	eccentrically applied load on: (i) bolted and riveted connections (ii) struts and (iii) columns using the software.		riveted joints

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Drawing II

COURSE CODE: MEC 223

DURATION: 60 Hours (1 Hour Lecture and 3 Hours Practical)

CREDIT UNIT: 2.0

Course: Engineering Drawing II	Code: MEC 223	Total Hours: 4 Hours/Week
	Pre-requisite: MEC 111	Theoretical hours: 1 Hour/Week
		Practical hours: 3 Hours/Week
Semester: Third		
Goal: This course is designed to develop students' knowledge and skills on the importance, application and representation of machine elements and their applications in preparing assembly, working and sectioning drawings for manufacture		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand assembly drawings
2	Understand production/working drawings
3	Understand the sectioning of drawings
4	Know how to prepare curves of intersection and interpenetrations of common solids and develop views of Interpretations of surfaces.

Engineering Drawing II

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Engineering Drawing II			COURSE CODE: MEC 223	CONTACT HOURS: (1-0-3) HOURS/WEEK		
GOAL: This course is designed to develop students’ knowledge and skills on the importance, application and representation of machine elements and their applications in preparing assembly, working and sectioning drawings for manufacture						
General Objective 1.0: Understand Assembly Drawings						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1-3	1.1 Identify standard title-blocks for Assembly drawings. 1.2 Identify detailed drawings of machine parts using cross-referencing to show details.	Explain activities 1.1 and 1.2	White board and markers, Recommended textbooks, etc. Complete drawing instruments and accessories. PCs with licensed AUTOCAD and SOLID WORKS software	1.1 Draw detailed and assembly drawings from physically observed headstock, simple clutch, and gear pump. 1.2 Draw up schedule of parts and materials from various given assembly drawings of machine. 1.3 Identify detailed drawings of machine parts using cross- referencing to show details. 1.5 Draw layout of plant and machinery in a typical Production factory e.g. single product factory and Component factory. 1.6 Use AUTOCAD or Solid Works software to	Demonstrate the activities for the students to learn and guide students to carry out the activities	Produce Assembly Drawings

				perform activities 1.1 to 1.5 above.		
General Objective 2.0 : Understand Production/Working Drawings						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-7	2.1 Define production/working drawings of machine parts using conventional symbols for working instructions	Explain the activity in 2.1	Whiteboard and markers, duster, recommended textbooks. Drawing instruments with accessories. PCs with licensed AUTOCAD and SOLID WORKS software	2.1 Produce curves of interpenetration of various intersecting surfaces. 2.2 Develop the surfaces of intersecting parts e.g. cone/cone, cone/cylinder, cone/pyramid, cylinder/pyramid, prism/sphere etc. 2.3 Draw pipe works, ducts, etc using parallel, radial and triangulation methods. 2.4 Use AUTOCAD or Solid Works software to perform activities 2.1 to 2.3 above.	Demonstrate the activities for the students to learn and guide students to carry out the activities	Produce Working Drawings
General Objective 3.0: Understand the sectioning of drawings						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8-11	3.1 List conventions in orthographic sectional views.	Carry out the activity in 3.1	White board, markers duster, recommended textbooks.	3.1 Produce sectional view of different cutting planes on Isometric and orthographic projections of fairly complex assembly drawing.	Demonstrate the activities for the students to learn and guide students to carry out the activities	Produce sectioning of drawings of an component

			Drawing instruments with accessories PCs with licensed AUTOCAD and SOLID WORKS software	3.2 Use AUTOCAD or Solid Works software to perform activity 3.1 above.		like engine block
General Objective 4.0: Know how to prepare curves of intersection and interpenetrations of common solids and develop views of Interpretations of surfaces.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
12–15	4.1 Define curves of interpenetrations of surfaces. 4.2 Define parallel, radial and triangulation methods in pattern developments	Describe the activities in 4.1 to 4.3	White board, markers duster, recommended textbooks. Drawing instruments with accessories PCs with licensed AUTOCAD and SOLID WORKS software	4.1 Produce curves of intersection and interpenetrations of common solids. 4.2 Use AUTOCAD or Solid Works software to perform the activities in 4.1 above.	Demonstrate the activities for the students to learn and guide students to carry out the activities	Prepare curves of intersection and interpenetrations of common solids and develop views of Interpretations of surfaces

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Properties of Materials

COURSE CODE: MEC 224

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Properties of Materials	Code: MEC 224	Total Hours: 4 Hours/Week
	Pre-requisite:	Theoretical hours: 2 Hour/Week
		Practical hours: 2 Hours/Week
Semester: Fourth		
Goal: This course is designed to acquaint students with the knowledge and skills on structures, mechanical properties, testing, treatment and applications of metals and their alloys as well as the role of non-metallic materials in engineering		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand mechanical properties of materials
2	Understand the structure of solids
3	Know Ferrous metals and their alloys
4	Understand non-ferrous metals and their alloys
5	Understand simple phase transformations
6	Understand the non-metallic materials in engineering applications
7	Understand materials testing techniques

8	Comprehend hot working and cold working processes
9	Understand the basic principles of heat treatment as applied to steels

Properties of Materials

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: PROPERTIES OF MATERIALS			COURSE CODE: MEC 224		CONTACT HOURS: 2-0-2 HOURS/WK	
GOAL: To acquaint students with the knowledge and skills on structures, mechanical properties, testing, treatment and applications of metals and their alloys as well as the role of non-metallic materials in engineering						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
	General objective 1.0: Understand mechanical properties of materials					
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
	1.1 Define the following mechanical properties of materials: strength, elasticity, plasticity, ductility, malleability, stiffness, toughness, brittleness, hardness, wear resistance, machinability, cast ability and weld ability. 1.2 Give examples of materials with each of the properties defined in 1.1 above. 1.3 Define the term, ‘Fatigue’ 1.4 Explain the following: fatigue strength, creep-temperature creep-cyclic loading and repeated loading-endurance limit.	Explain 1.1 to 1.4 with diagrams and detailed notes where necessary.	Whiteboard, marker, text books, duster, etc.	Demonstrate the mechanical properties of materials: strength- elasticity, plasticity, ductility, malleability, stiffness, toughness, brittleness, hardness, wear resistance, machinability, cast ability and weld ability.	Guide students in demonstrating the mechanical properties of materials: strength-elasticity, plasticity, ductility, malleability, stiffness, toughness, brittleness, hardness, wear resistance, machinability, cast ability and weld ability	
	General Objective 2.0: Understand the structure of solids					
	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation

2-3	2.1 Define the term, 'Atomic - Crystal Structure of solids. 2.2 Distinguish between the various types of atomic bonding in materials such as covalent, ionic, metallic, etc. 2.3 Explain the structural arrangement of materials in 2.2 above. 2.4 Describe the elementary crystal structures of materials. 2.5 Explain Unit Cell and Space Lattice-Crystal System: The seven basic crystal systems-Crystal Structure for metallic Elements: BCC, FCC and HCP 2.6 Explain the Coordination Number for simple Cubic, BCC and FCC and the Atomic Packing Factor for simple cubic, BCC, FCC and HCP 2.7 Solve simple problems on finding number of atoms for a unit cell.	Explain 2.1 to 2.7 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc.	Identify the seven basic crystal systems-Crystal Structure for metallic Elements: BCC, FCC and HCP	Guide student to identify the seven basic crystal systems-Crystal Structure for metallic Elements: BCC, FCC and HCP	Explain the structure of solids
General Objective 3.0: Know ferrous metals and their alloys						
	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-5	3.1 Explain the production of iron and steel iron Ores 3.2 List types of iron, its composition, properties, applications and effects of	Explain 3.1 to 3.8 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc.	3.1 Identify all Ferrous Metals and its Alloys. 3.2 Demonstrate the applications of all the Ferrous Metals and its Alloys	Guide student to identify all the Ferrous Metals and its Alloys Guide student to identify application of all Ferrous Metals and its Alloys	Explain Ferrous Metals and its Alloys

	impurities on them: pig iron, cast Iron and wrought iron. 3.3 List classification of carbon steels with their composities and applications: Low Carbon Steel, Mild Steel and High Carbon steel. 3.4 State the commercial sizes of Steel as per BIS. 3.5 Define an alloy. 3.6 State the purpose and effect of alloying. 3.7 List types of ferrous Alloys: Silicon Steels, High Speed Steel(HSS), Heat Resisting Steel, Spring Steel, Stainless Steel (SS). 3.8 State the applications of the alloys listed in 3.7 above					
	General Objective 4.0: Understand non-ferrous metals and their alloys					
	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
6-7	4.1 Explain the properties and uses non-ferrous metals: Aluminium, Copper, Tin, Lead, Zinc, Magnesium and Nickel.	Explain 4.1 to 4.4 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc.	Identify all the non-Ferrous Metals and their Alloys.	Guide student to identify all the non Ferrous Metals and its Alloys	Explain non-Ferrous Metals and its Alloys

	4.2 Describe the properties, composition and uses of the following: - Copper Alloys : Brass, Bronze - Aluminium Alloys: Duralumin, Hindalium, Magnesium - Nickel Alloys: Inconel, Monel, Nichrome, - Anti-friction /Bearing Alloys: Various types of bearing Bronze. 4.3 List types and features of Cutting Tool Materials: Carbon Steels, Medium alloy Steel – HSS – Satellites – Cemented Carbide, CBN – Diamond and Abrasives. 4.4 Give examples of Metal Matrix Composites (MMC) and Nanomaterials.			Demonstrate the applications of the non-Ferrous Metals and its Alloys	Guide student to identify application of all non Ferrous Metals and its Alloys	
GENERAL OBJECTIVE: 5.0 Understand simple phase transformations						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8-9	5.1 Explain thermal equilibrium diagrams.	Explain 5.1 to 5.4 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc.	5.1 Construct simple iron-carbon (Fe-C) thermal equilibrium diagrams for the following: (i) complete solid	Guide student to construct simple iron-carbon (Fe-C) thermal equilibrium	Explain simple phase

	5.2 Describe on phase diagrams in the following transformations: Eutectic, Eutectoid, Peritectic reaction. 5.3 Describe the application of the lever rule, given an equilibrium diagram, to calculate the relative amounts of phases present in an alloy at a given temperature 5.4 Describe simple process of nucleation and grain growth in metals		Emery clothes, Etchants, Metallurgical microscope, alloy specimens, furnaces. Phase diagrams Metallurgical microscope, alloy specimens, furnaces, phase diagrams etc.	solubility (ii) complete solid insolubility (iii) limited solid solubility (iv) formation of chemical compound (v) limited solid solubility accompanied by peritectic. 5.2 Identify solidus and liquidus lines. 5.3 Apply the lever rule, given an equilibrium diagram, to calculate the relative amounts of phases present in an alloy at a given temperature. 5.4 Examine the micro-structure of alloy specimens and make sketches of the structure	diagrams for the following: (i) complete solid solubility (ii) complete solid insolubility (iii) limited solid solubility (iv) formation of chemical compound (v) limited solid solubility accompanied by peritectic Guide students to identify solidus and liquidus lines Guide students in application of the lever rule, given an equilibrium diagram, to calculate the relative amounts of phases present in an alloy at a given temperature.	transformations
	GENERAL OBJECTIVE: 6.0 Understand the non-metallic materials in engineering applications.					
	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
10-11	6.1 Describe non-crystalline atomic structure of nonmetals (plastics, glass, wood, etc) 6.2 Classify common plastics.	Explain 6.1 to 6.5 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc.	6.1 Identify non-metallic materials such as plastics, ceramics, wood, rubber and concrete, their compositions and properties.	Guide student to identify non-metallic materials such as plastics, ceramics, wood, rubber and concrete, their compositions and properties.	Explain non-metallic materials in engineering applications

	6.3 State the properties, uses and limitations of plastics in 6.2. 6.4 Describe the composition and application of glass and rolled Specific glass. 6.5 Explain the properties and uses of other non-metallic materials such as ceramics, wood, rubber and concrete.					
General Objective 7.0: Understand materials testing techniques						
	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
12-13	7.1 Define destructive testing 7.2 List types of destructive testing: Tensile Testing, Compression Testing, Hardness Testing (Brinell Rockwell, Scleroscope and Mohr's Test), Bend Test, Torsion Test, Fatigue Test and Creep Test. 7.3 List Nondestructive Testing (NDT): Radiography, Magnetic Particle Inspection, Liquid penetrant test and Ultrasonic inspection, (Descriptive treatment only).	Explain 7.1 to 7.3 with diagrams and detailed notes where necessary	Recommended textbooks, whiteboard, marker, Lecture notes. UTM, UHT, Torsion tester, Creep tester with accessories	Perform Tensile Testing, Compression Testing, Hardness Testing (Brinell Rockwell, Scleroscope and Mohr's Test), Bend Test, Torsion Test, Fatigue Test and Creep Test	Guide student to Perform Tensile Testing, Compression Testing, Hardness Testing (Brinell Rockwell, Scleroscope and Mohr's Test), Bend Test, Torsion Test, Fatigue Test and Creep Test	Explain materials testing techniques
GENERAL OBJECTIVE 8.0: Comprehend hot working and cold working processes						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
14	8.1 Describe hot working and cold working processes. 8.2 Differentiate hot working from cold working processes.	Explain 8.1 to 8.4 with diagrams and detailed notes where necessary	Recommended textbooks, Lecture notes, whiteboard, marker	8.1 Carry out hot and cold working processes on a given metal specimen.	Guide students to carry out hot and cold working processes on a given metal specimen	Explain hot working and cold working processes

	8.3 List hot working and cold working processes. 8.4 State the effect of hot working and cold working on mechanical properties, dimensional accuracy and surface finish					
GENERAL OBJECTIVE 9.0: Understand the basic principles of heat treatment as applied to steels.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
15	9.1 Explain the Iron-carbon equilibrium diagram. 9.2 Describe the procedures for hardening, annealing, normalising and tempering of steel. 9.3 Describe different types of heat furnaces 9.4 List the procedures for carburising.	Explain 9.1 to 9.4 with diagrams and detailed notes where necessary	Recommended textbooks, Lecture notes, whiteboard, marker furnaces, steel specimen etc.	9.1 Construct iron-carbon equilibrium diagram 9.2 Carry out some heat treatment exercise e.g hardening, annealing, normalising and tempering.	Guide student to Construct iron-carbon equilibrium diagram Guide student to carry out some heat treatment exercise e.g hardening, annealing, normalising and tempering	Explain the basic principles of heat treatment as applied to steels

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Refrigeration and Air-conditioning (RAC)

COURSE CODE: MEC 225

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Refrigeration and Air-conditioning (RAC)	Code: MEC 225	Total Hours: 4 Hours/Week
	Pre-requisite: MEC 122	Theoretical hours: 2 Hour/Week
		Practical hours: 2 Hours/Week
Semester: Fourth		
Goal: The course is designed to acquaint students with knowledge and skills on the installation, operation and maintenance of Refrigeration and Air-conditioning systems.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the basic principles of refrigeration and air-conditioning.
2	Know the basic tools and equipment used in refrigeration and air-conditioning practice.
3	Understand the various types of practical refrigeration and air-conditioning cycles.
4	Understand the functions and properties of refrigerants
5	Understand lubrication of refrigeration and air-conditioning systems.
6	Know the procedure of recharging refrigeration and air-conditioning circuits.
7	Know the various domestic and industrial applications of refrigeration.
8	Understand the various domestic and industrial applications of air-conditioning system.
9	Know latest developments in refrigeration and air-conditioning in inverter technology, auto-defrosting, blast cooling and star rating.

Refrigeration and Air-Conditioning

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: REFRIGERATION AND AIR-CONDITIONING				COURSE CODE: MEC 225	CONTACT HOURS: (2-0-2) Hours/week	
GOAL: The course is designed to acquaint students with knowledge and skills on the installation, operation and maintenance of Refrigeration and Air-conditioning systems.						
General Objective 1.0: Understand the basic principles of refrigeration and air-conditioning						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT -		
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
1	1.1 Describe reversed carnot cycle and heat pumps. 1.2 Explain the basic concepts of refrigeration/air-conditioning. 1.3 Define the terms: Refrigerating effect, Coefficient of performance (COP), dew point, dry bulb, and wet bulb temperatures, humidity and relative humidity. 1.4 Describe the functions of each component of RAC systems.	Explain activities 1.1 to 1.4.	Recommend- ed textbooks, Lecture notes, Chalkboard, Chalk. Models of of refrigeration and air-conditioning systems	1.1 Identify component parts of refrigeration and air-conditioning systems. 1.2 Demonstrate the functioning of the component parts. 1.3 Demonstrate the differences and similarities of refrigeration and air-conditioning systems.	Demonstrate the activities in 1.1 and 1.3 and ask the students to perform the activities.	Explain refrigeration and air-conditioning
GENERAL OBJECTIVE: 2.0 Know the basic tools and equipment used in refrigeration and air-conditioning practice						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

2	2.1 List the basic hand tools used in refrigeration and air-conditioning workshop 2.2 Explain the use of each tool named in 2.1 2.3 List basic equipment used in refrigeration and air-conditioning workshop e.g. manifold gauge, leak detecting instruments, etc 2.4 Explain the use of each of the items named in 2.3	Explain activities 2.1 to 2.4.	Hand cutting tools flaring tools, gas welding equipment	2.1 Identify the equipment used in refrigeration and air-conditioning workshop e.g manifold gauge, leak detecting instruments, etc. 2.2 Perform cutting, flaring bending and joining of tubes using appropriate tools and equipment. 2.3 Identify vapour absorption system and its requirements	Demonstrate activities 2.1 to 2.3 for the students to learn and ask them to practice Assess the students.	Explain tools used in refrigeration and air-conditioning practice

GENERAL OBJECTIVE: 3.0 Understand the various types of practical refrigeration and air-conditioning cycles

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
3-4	3.1 List the various types of vapour compression refrigeration (ideal and actual) cycles 3.2 Describe cycles in 3.1. 3.3 Describe the principles of absorption refrigeration system 3.4 Explain the functions of the basic components of absorption system.	Explain activities 3.1 to 3.4.	Recommended textbooks, Lecture notes, Chalkboard, Chalk.	3.1 Identify various parts of a refrigerator and window air conditioner 3.2 Determine COP of Refrigeration system. 3.3 Measure air flow using anemometer.	Demonstrate activities 3.1 to 3.3 for the students to learn and ask them to practice Assess the students.	Explain refrigeration cycles and absorption

GENERAL OBJECTIVE: 4.0 Understand the functions and properties of refrigerants

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
5	4.1 Define refrigerant 4.2 List common refrigerants 4.3 State the properties of a refrigerant 4.4 Explain the differences	Explain activities 4.1 to 4.10.	Recommended textbooks, Lecture notes, Chalkboard, Chalk.	4.1 Identify various refrigerant and its applications. 4.2 Use refrigeration and air-conditioning	Demonstrate the activities in 4.1 to 4.3 for the students to learn and ask the	Explain refrigerants and its applications in

	between primary and secondary refrigerants 4.5 Describe visibility and phase separation. 4.6 Describe the pressure temperature relationships of common refrigerants 4.7 Describe the effects of refrigerants on piping materials 4.8 State the safety precautions in the storage of refrigerants 4.9 Explain the suitability of each refrigerant for application in (i) domestic refrigerator (ii) cold room for food preservation (iii) air conditioning unit. (iv) the refrigerant /absorbent combinations in the vapour absorption		Refrigerants, Refrigeration/ Air conditioning demonstration units	demonstration units to illustrate the effect of: (i) pressure on temperature (ii) cooling water rate on condenser and evaporator temperatures. 4.3 Observe safety precaution in the workshop and in the storage of refrigerants.	students to practice. Assess the students	refrigeration and air-conditioning.
GENERAL OBJECTIVE: 5.0 Understand lubrication of refrigeration and air-conditioning systems						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
6	5.1 List the required properties of compressor oil 5.5 Explain the term, pour point, flash point and dielectric strength for lubricants 5.3 Describe methods of lubrication and the mechanism of oil pumps.	Explain activities 5.1 to 5.3.	Recommended textbooks, Lecture notes, Chalkboard, Chalk Lubricants, Oil pumps Refrigerator, etc.	5.1 Identify the lubrication points in a refrigerator 5.2 Carry out lubrication operation in a refrigerator and air-conditioner using appropriate equipment e.g oil pumps.	Demonstrate the activities in 5.1 and 5.2 for the students learn and allow the students to practice. Assess the students	Explain lubrication of refrigerators and air-conditioners.
GENERAL OBJECTIVE: 6.0 Know the procedure of recharging refrigeration and air-conditioning circuits						

Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
7	6.1 Describe safe methods of transferring refrigerants to service cylinders. 6.2 Describe correct storage conditions for refrigerants. 6.3 Describe correct storage methods 6.4 Explain the conditions for liquid charging and vapour charging. 6.5 State the circumstances when (i) toxic products may be produced (ii) there is the risk of an explosion in handling refrigeration.	Explain activities 6.1 to 6.3.	Halide torch, Manifold gauge, Hoses, connector, vacuum pump, Hand tools, etc	6.1 Conduct leakage detection tests. 6.2 Purge charge and re-charge domestic refrigeration and window air-conditioning units. 6.3 Dismantle, service and assemble a refrigerator. 6.4 Detect faults in a refrigerator/ air conditioner.	Demonstrate the activities in 6.1 to 6.4 for the students to learn and allow them to practice.	Explain how to charge refrigerators and air-conditioners
GENERAL OBJECTIVE: 7.0 Know the various domestic and industrial applications of refrigeration.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
8	7.1 List examples of other common refrigeration systems for domestic applications. 7.2 List examples of other common refrigeration systems for industrial applications 7.3 Describe a typical layout and control systems for domestic refrigerator and industrial refrigerators for cold rooms. 7.4 List the safety requirements for industrial ammonia plants.	Explain activities 7.1 to 7.4.	Recommended textbooks, Lecture notes, Chalkboard, Chalk Complete tool box, Text equipment etc..	7.1 Dismantle, service and reassemble a refrigerator. 7.2 Dismantle, service, reassemble and test a compressor of a refrigerator.	Demonstrate activities 7.1 and 7.2 for the students to learn and allow them to practice. Assess the students	Explain domestic and industrial applications of refrigeration.

GENERAL OBJECTIVE 8.0: Understand the various domestic and industrial applications of air-conditioning system.						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
9 - 12	8.1 Define the term air-conditioning. 8.2 State the importance of air-conditioning in a building. 8.3 Differentiate between comfort and industrial air-conditioning system. 8.4 Distinguish between package unit and central air-conditioning systems. 8.5 Sketch the cycle and the main components of a package unit air-condition 8.6 Sketch the equipment used in an air-conditioning system e.g. cooler, batteries, humidifier, fan, etc. 8.7 State the functions of each item of equipment named in 8.6. 8.8 Describe typical layouts and control systems of central air-conditioning system. 8.9 Explain the source of various load imposed on the air-conditioning plant like solar heat gain, filtration, occupancy, activities, etc. 8.10 List the techniques by which some of the loads imposed on air-conditioning plant may be reduced.	Explain activities 8.1 to 8.10.	Recommended textbooks, Lecture notes, Chalkboard, Chalk.	8.1 Dismantle, service and reassemble a window and split system type air-conditioners. 8.2 Dismantle, service, reassemble and test a compressor of an air-conditioner.	Demonstrate activities 8.1 and 8.2 for the students to learn and allow them to practice. Assess the students	Explain domestic and industrial applications of air-conditioning.

	General 9.0 Know latest developments in refrigeration and air-conditioning (RAC) systems					
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13-15	9.1 Explain inverter technology in relation to RAC systems. 9.2 Describe auto-defrosting, 9.3 Explain blast cooling and star rating. 9.4 List environmental friendly refrigerants. 9.5 State different industry standards used in the design and maintenance of refrigeration and air-conditioning systems.	Explain activities 9.1 to 9.10.	Recommended textbooks, Lecture notes, Chalkboard, Chalk.			Explain recent developments in refrigeration and air-conditioning

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Plant Services and Maintenance

COURSE CODE: MEC 226

DURATION: 60 Hours (2 Hours Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Plant Services and Maintenance	Code: MEC 226	Total Hours: 4 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Semester: Fourth		
Goal: The course is designed to acquaint students with knowledge and skills on installation, operation and maintenance of water supply systems, boilers, pumps, compressors and other systems.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the general safety rules for maintenance
2	Understand the principles of maintenance planning.
3	Know installation and commissioning of machinery
4	Know how to install and maintain different types of bearings
5	Understand the application and maintenance of different power transmission
6	Know the use and maintenance of different types of flow equipment
7	Understand the operations and maintenance of pumps
8	Understand boiler operation, steam generation, steam distribution, use and maintenance of boiler system
9	Understand the operation, construction and maintenance of compressors

Plant Services and Maintenance

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: PLANT SERVICES AND MAINTENANCE			COURSE CODE: MEC 226		CONTACT HOURS: (2-0-2) HOURS/WEEK	
GOAL: The course is designed to acquaint students with knowledge and skills on installation, operation and maintenance of water supply systems, boilers, pumps, compressors and other systems.						
General Objective 1.0: Know the general safety rules for maintenance						
COURSE SPECIFICATION: THEORETICAL CONTENT				COURSE SPECIFICATION: PRACTICAL CONTENT -		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1 - 2	1.1. List safety rules and regulations for installation and maintenance. 1.2. Explain the procedures use in risk assessment and how to mitigate risks in the factory. 1.3. State the materials and medicines required in a first-aid box. 1.4. Explain safety procedures used in first-aid, fire-fighting and cardiopulmonary resuscitation (CPR).	Explain activities 1.1 to 1.4.	Chalk, Blackboard Manuals, Recommended textbooks, Lecture notes, Ropes and Chairs pulley bodice.	1.1 Observe safety rules and regulations in the factory. 1.2 Demonstrate risks assessment procedures and how to mitigate the identified risks. 1.3 Carryout simple administration of first –aid treatment. 1.4 Demonstrate the procedures for fire-fighting and CPR. 1.5 Demonstrate the procedures used in obtaining permit-to-work in the factory.	Demonstrate activities 1.1 to 1.5 for the students to learn and ask them to carry out the activities. Assess the students	Explain safety rules and regulations in plant services and maintenance

	1.5. Explain the procedures in obtaining permit-to-work in the factory.					
	General Objective 2.0: Understand the principles of maintenance planning.					
	2.1 Explain the functions of a maintenance group. 2.2 Distinguish between corrective, preventive and breakdown maintenance on boilers. 2.3 Explain the planned and unplanned maintenance strategies. 2.4 Describe the following stores procedures: - Ordering of spare parts - Raising of Local Purchase Order (LPO) - Storing of spare parts - Requisitioning of stores	Explain activities 2.1 to 2.4.	Chalk, Blackboard Manuals, Recommended textbooks, Lecture notes			Explain the principles of maintenance planning.

	6.5 Explain the significance of materials handling in maintenance.					
GENERAL OBJECTIVE 3.0: Know installation and commissioning of machinery						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
3 - 4	3.1 State factors affecting plant installation such as weight; size Stability, rigidity, and running speed. 3.2 State properties of concrete wood and bricks for plant installation 3.3 Describe typical machine foundations. 3.4 Describe procedures in the installation, use and maintenance of the following: Ropes and Chains, Collars and Kate's Tripod and shear legs, Forklift and pulley block, Mobile and overhead cranes, Derrick and gantry.	Explain activities 3.1 to 3.4.	Block level, clinometer, straight edge, machine part, Autocollimator, etc. Cement and concrete making materials and tools.	3.1 Install, use and maintain the following ropes and chains, collars and shear legs, forklift and pulley block, mobile and overhead cranes, Retick and gantry. 3.2 Observe safety rules. 3.3 Identify the different foundation bolts isolations. 3.4 Check leveling of machines with block level and clinometer. 3.5 Perform alignment tests for machine parts using straight edge auto collimator, etc. 3.6 Prepare plans for installing some machines like lathe, drilling machine, compressor, etc.	Demonstrate activities 3.1 to 3.6 for the students to learn and ask them to carry out the activities. Assess the students	Explain the installation and commissioning of machinery in a workshop or factory
GENERAL OBJECTIVE: 4.0 Know how to install and maintain different types of bearings						
5-6	4.1 Explain the functions of a bearing inclinometer 4.2 State different types of bearing 4.3 State the applications of the bearings listed in 4.2	Explain activities 4.1 to 4.6.	Chalkboard Recommended textbooks, Manuals, lecture notes, etc.	4.1 Identify different types of bearing. 4.2 Install bearing 4.3 Identify causes of bearing failure	Demonstrate activities 4.1 to 4.4 for the students to learn and allow them to practice.	Explain the installation and maintenance of bearings

	4.4 Explain common bearing faults 4.5. State causes of bearing failure 4.6 Explain the effects of lubrication systems 3.7 Describe typical lubrication system 3.8 Describe common fault in lubrication system		Dusters Bearings, Lubricants, etc	4.4 Carry out lubrication of bearing	Assess the students	
GENERAL OBJECTIVE: 5.0 Understand the application and maintenance of different power transmission systems						
7 - 8	5.1 Describe belt, chain, gear and shaft transmission 5.2 Explain the working principles of each of the transmission system in 4.1 5.3 Describe the working principles of rigid, flexible, disc and universal coupling. 5.4 Describe different coupling e.g key, spline etc. 5.5 Describe the maintenance procedure for various transmission systems.	Explain activities 5.1 to 5.5.	Chalkboard Recommend textbooks, Lecture notes, Manuals, etc. Bearing extractor Puller Bearings Complete Tools box Diagnose and inspection equipment	5.1 Identify belt, chain, gear and shaft transmission. 5.2 Assemble and maintain belt, chain, gear and shaft transmission. 5.3 Dismantle and assemble rigid, flexible, disc and universal coupling. 5.4 Identify different couplings e. key, spline etc 5.5 Use appropriate lubricants for various transmission systems. 5.6 Diagnose transmission fault.	Demonstrate activities 5.1 to 5.5 for the students to learn and allow them to practice. Assess the students	Explain the application and maintenance of different power transmission systems
GENERAL OBJECTIVE: 6.0 Know the use and maintenance of different types of flow equipment						
9	6.1 Explain the functions of different components in a typical hydraulic system. 6.2 Describe causes and methods of preventing contamination of fluids.	Explain activities 6.1 to 6.6.	Chalkboard Recommend textbooks, Lecture notes, Manuals, Chalkboard,	6.1 Identify and maintain fluid flow control valves. 6.2 Identify different packing seals, valves, pumps and flow meters. 5.3 Dismantle and	Demonstrate activities in 6.1 to 6.4 for the students to learn and ask them to carry out the	Explain the use and maintenance of different types of flow equipment.

	6.3 Explain the principles of operation of valves 6.4 Explain fluid flow control valves. 6.5 Describe different packing seals. 6.6 Explain constructional details and requirements of different hydraulic pumps		Chalk, Duster, etc. Compute tool box Valves Hydraulic pumps.	assemble various valves. 5.4 Dismantle hydraulic pumps and examine in them for faults.	activities. Assess the students	
GENERAL OBJECTIVE: 7.0 Understand the operations and maintenance of pumps						
11-12	7.1 Discuss the different types of pumps. 7.2 Explain the main features of centrifugal and submersible pump 7.3 Describe the common pump problems and their remedies 7.4 Describe a typical water distribution system.	Explain activities 7.1 to 7.4.	Recommended textbooks, Lecture notes, Manuals, Chalkboard, Chalk, Duster, Pipes, etc. Pumps Complete tool box Centrifugal pump Submersible Pumps.	7.1 Identify different types of pumps. 7.2 Install and maintain pumps 7.3 Identify common pump problems and solutions 7.4 Design a typical water distribution system. 7.5 Select pipes and pipe joints for water supply. 7.6 Dismantle and rebuild centrifugal and submersible pumps	Demonstrate 7.1 to 7.6 for the students to learn and allow them to practice Assess the students.	Explain the operation and maintenance of pumps.
GENERAL OBJECTIVE: 8.0 Understand boiler operation, steam generation, steam distribution, use and maintenance of boiler system						
13	8.1 Explain the operation boiler. 8.2 Explain the use of steam separators and reducing valves. 8.3 Explain the color codes in piping practice 8.4 Explain the arrangement	Illustrate and explain activities 8.1 to 8.5 with diagrams and make notes where necessary.	Recommended textbooks, Lecture notes, Manuals, Chalkboard, Chalk, Duster Boiler and	8.1 Operate boilers 8.2 Repair and maintain boiler and its accessories. 8.3 Store solid, liquid and gaseous fuel as per specification. 8.4 Select correct pipe size and lay out for	Demonstrate activities in 8.1 to 8.6 for the students to learn and allow them to practice the activities.	Explain boiler operations.

	of steam supply for process heating. 8.5 Explain the use of (i) providing drainage expansion joint and (ii) Enlarge main and branch supply lines.		accessories Complete tool box Pipe fittings and lagging, etc.	distribution. 8.5 Install pipe fittings and laggings. 8.6 Identify the colour codes in piping practice.	Assess the students	
GENERAL OBJECTIVE: 9.0 Understand the operation, construction and maintenance of compressors						
14-15	9.1 List types of compressors. 9.2 Explain constructional details of compressor. 9.3 List maintenance requirements of compressors. 9.4 Describe problems of air storage and distribution. 9.5 Explain types of air receiver and mixture separator. 9.5 State and explain the common types of pneumatic safety and control systems.	Illustrate and explain activities 9.1 to 9.5 with diagrams and make notes where necessary.	Recommend textbooks, Lecture notes, Manuals, Chalkboard, Chalk, Duster, etc. Compressors, Pipe tools Pneumatic tools, etc.	9.1 Identify types and constructional details of compressor 9.2 Observe common types of pneumatic safety and control system 9.3 Select correct sizes of pipes for compressed air distribution with provision for inspection and drainage. 9.4 Lay out pipes in 9.3 9.5 Install ring-main type distribution of compressed air 9.6 Operate air supply and distribution systems 9.7 Dismantle and assemble reciprocating, rotary, and axial flow compressor. 9.8 Repair pneumatic tools	Demonstrate the activities in 9.1 to 9.8 for the students to learn and ask the students to perform the activities. Assess the students	Explain operation, construction and maintenance of compressors

PROGRAMME: National Diploma (ND) in Mechanical Engineering Technology

COURSE TITLE: Automotive Technology and Practice II

COURSE CODE: MEC 227

DURATION: 60 Hours (2 Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Automotive Technology and Practice II	Code: MEC 227	Total Hours:	4 Hours/Week
	Pre-requisite: MEC 125	Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: Fourth			
Goal: This course is designed to acquaint students with knowledge and skills on automotive technology to be able to maintain automotive components and systems			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand automotive suspension system, front axle and steering system
2	Know automotive power transmission system
3	Understand automotive brake system
4	Understand automotive wheels and tyres

Automotive Technology and Practice II

PROGRAMME: NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: AUTOMOTIVE TECHNOLOGY AND PRACTICE II				COURSE CODE: MEC 227	CONTACT HOURS: 3 HRS/WK	
GOAL: This course is designed to acquaint students with knowledge and skills on automotive technology to be able to maintain automotive components and systems						
General Objective 1.0: Understand suspension system, front axle and steering system						
COURSE SPECIFICATION: THEORETICAL CONTENT				COURSE SPECIFICATION: PRACTICAL CONTENT		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1- 3	1.1 Define the term, ‘suspension system’. 1.2 List types of suspension, springs used in suspension system and shock absorbers 1.3 Explain the working principle and construction of a telescopic shock absorber. 1.4 Explain the functions of shackle/shackle pin, torsion bar and stabilizer. 1.5 Explain the functions of suspension system, rigid axle front wheel and independent front wheel suspension system.	Explain activities 1.1 to 1.14 with diagrams where necessary and detailed notes.	Whiteboard, Marker, textbook, charts, etc.	1.1 Identify common defects and remedies in steering system. 1.2 Perform the following auto workshop activities: - Wheel alignment and balancing. - Adjust front wheel tapered roller bearings - Refill and replace shock absorbers	Guide students to: Identify common defects and remedies in steering system. Perform the following auto workshop activities: - Wheel alignment and balancing. - Adjust front wheel tapered roller bearings - Refill and replace shock absorbers	Explain the principles of operation and construction details of suspension system, front axle and steering system

	1.6 Explain the necessity for front axle, types, stub axles and types. 1.7 Describe front wheel drive assembly, live axle, dead axle, 1.8 Explain the functions of Steering System, 1.9 List different components of Steering System. 1.10 Describe different type of steering gear mechanism and steering gear ratio 1.11 State the fundamental equation for correct steering. 1.12 List the factors effecting wheel alignment, steering geometry-camber angle, caster angle, king pin inclination, included angle, toe-in, toe-out cornering force, slip angle, turning radius, under-steering and over steering, 1.13 Explain the concepts of power steering.					

	1.14 List common defects and remedies in steering system.					
GENERAL OBJECTIVE: 2.0 Know automotive power transmission system						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
4-7	2.1 Define the term, 'Clutch' 2.2 Explain the principles of operation, types (friction clutch, centrifugal clutch, diaphragm clutch, dog and spline clutch, vacuum clutch and hydraulic clutch), main parts and function of a clutch 2.3 List the common defects and remedies in the clutch. 2.4 Explain the principle of operation, functions and types (sliding mesh, synchromesh, constant mesh, and epi-cyclic) gear box. 2.5 Explain the construction, operation and advantages of overdrive. 2.6 List the common defects and remedies in the Gear Box	Explain activities 2.1 to 2.10 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent models) Vehicles. Complete toolbox and service/maintenance kits. Engine test rig for petrol and diesel engines with provision for 2-stroke and 4-stroke tests .	2.1 Identify clutch and gear box. 2.2 Identify common defects and remedies in the clutch, gearbox, propeller shaft and joints, final drive and differential & rear axle. 2.3 Perform the following activities: - Adjust clutch pedal clearance for mechanically controlled clutches. - Check transmission oil level and top up for a gear box. - Check transmission oil level and top-up for a differential gear box unit. 2.4 Dismantle (i) rear axle (ii) differential and find out the gear ratio of crown wheel & driven sun gear and planet pinion.	Guide students to: Identify clutch and gear box. Identify common defects and remedies in the clutch, gearbox, propeller shaft and joints, final drive and differential & rear axle. Perform the following activities: - Adjust clutch pedal clearance for mechanically controlled clutches. - Check transmission oil level and top up for a gear box. - Check transmission oil level and top-up for a differential gear box unit.	Explain automotive power transmission system

	2.7 Explain the functions and construction details of Propeller Shaft and Joints, Final Drive and Differential & Rear Axle: 2.8 Explain the principle of operation, functions and types of final drive and differential lock. 2.9 Explain the principles and functions of Rear axle drives- Hotchkiss drive, Torque tube drive Rear axle types- full floating, three quarter floating, semi floating axle and rear axle housings. 2.10 Describe the power transmission system of two wheelers like scooter, motor cycle etc.				2.4 Dismantle (i) rear axle (ii) differential and find out the gear ratio of crown	
GENERAL OBJECTIVE: 3.0. Understand automotive brake system						

8-10	3.1 Explain the necessity for brakes in automotive. 3.2 Explain the functions and classification of brakes. 3.3 List types of brakes: drum brake and disc brake, Parking and Emergency brake. brake shoe, brake lining, brake drum. 3.4 Explain hydraulic brake system, master cylinder, Tandem master cylinder, wheel cylinder, piping and bleeding 3.5 List the common brake defects and remedies	Explain activities 3.1 to 3.11 with diagrams where necessary and detailed notes	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent models) Vehicles. Complete toolbox and service/maintenance kits. Engine test rig for petrol and diesel engines with provision for 2-stroke and 4-stroke test.	3.1 Identify common brake defects and remedies. 3.2 Perform the following auto workshop activities: - Identify the brake system components. - Bleed the brake system. - Check for leakages in the brake system. - Carry out repairs on brake system. - Replace brake lining and pads	Demonstrate common brake defects and remedies. Guide students to Perform the following auto workshop activities: - Identify the brake system components. - Bleed the brake system. - Check for leakages in the brake system. - Carry out repairs on brake system. - Replace brake lining and pads	Explain automotive brake system
GENERAL OBJECTIVE: 4.0. Understand automotive wheels and tyres						
12-15	4.1 Explain function of wheels 4.2 List type of wheels, hubs, rims, assembly. 4.3 Explain the functions of tyres ,	Explain activities 4.1 to 4.7 with diagrams where necessary and detailed notes.	Whiteboard, Marker, textbook, charts, etc. Live and Dead (old and recent	Perform the following auto workshop activities: - Check linkages for wear and tear and carry out necessary repairs. - Check for correct tyre pressure - Check for tyre wear	Guide students to Perform the following auto workshop activities: - Check linkages for wear and tear and carry out necessary repairs.	Explain automotive wheels and Tyres

	4.4 List types of tyres: tyre-tube tyre and tubeless tyre 4.5 Explain tyre construction, tyre tread pattern, tyre pressure and wear-under inflation, over inflation and proper inflation. 4.6 List causes of tyre wear 4.7 Describe tyre size and tyre maintenance		models) Vehicles. Complete toolbox and service/maintenance kits. Engine test rig for petrol and diesel engines with provision for 2-stroke and 4-stroke test.	- Vulcanizer a punctured tube	- Check for correct tyre pressure - Check for tyre wear - Vulcanizer a punctured tube	

LIST OF WORKSHOPS, LABORATORIES AND STUDIOS

S/N	Workshops	Laboratories
i	Machine Shop	i. Fluid Mechanics/Hydraulics
ii.	Fitting Shop	ii. Thermodynamics/Heat Engines Laboratory
iii.	Welding and Fabrication Workshop	iii. Mechanics of Machine/Metrology Laboratory
iv.	Foundry, Heat Treatment and Forge Workshop	iv. Materials Science/Strength of Materials Laboratory
v	Automotive Workshop	v. Automotive Laboratory
vi	Building Services, Refrigeration and Air-conditioning Workshop	
	Studios	
i	Drawing Room/Studio	
ii.	CAD Room	

REQUIRED MINIMUM LIST OF EQUIPMENT IN THE WORKSHOPS AND LABORATORIES

A. Workshops

i. Machine Shop

S/N	Description of Equipment	Quantity Required
1.	Standard centre lathe with accessories	2
2.	Column/pillar drilling machine	1
3.	Universal milling machine complete with accessories	1
4.	Surface grinding machine complete with accessories	1
5.	Pedestal grinding machine	
6.	Power hacksaw	1
7.	Arbor/hydraulic press	1
8.	Shaping machine with accessories	1
9.	Universal tool and cutter grinder	1
10.	Box spanners	5
11.	Allen Keys (set)	5 sets
12.	Flat screw driver (set) 3 sets	3 sets
13.	Philips screw driver	3 sets
14.	Drift/pin punches (various sizes)	3 sets each
15.	Knurling tools	2 sets
16.	Parallel strips	3
17.	Vernier protractor	3
18.	Micrometers outside 0.25 mm 25-50 mm 50-75 mm and sets of Inside micrometers	3
19.	Depth gauge	5
20.	Steel rule 300 mm	5
21.	Calipers (inside and outside)	5
22.	Vee block with clamps	4
23.	Scribing block	4
24.	Surface plate	3
25.	Hand/machine reamers (sets)	3 each
26.	Oil Can	2
27.	Centre drills (set)	4 sets

28.	Twists drills (set)	4 sets
29.	Thread chaser (Assorted) 3 each	3 each
30.	Marking out table	2
31.	Combination set	4
32.	Screw gauges (assorted)	4
33.	Plug gauges (assorted)	4
34.	Dial indicator and stand	4
35.	Slip gauges (set)	2
36.	Grease gun	2
37.	Angle plates	3
38.	Engineer's square	5
39.	Measuring balls/rollers	2
40.	Limit gauges	5
41.	Fire Extinguisher & sand buckets	2 each

ii. Fitting Shop

S/N	Description of Equipment	Quantity Required
1.	Bench vice	15
2.	Sensitive bench drilling machine	2
3.	Marking out table	1
4.	Surface plate	1
5.	Multi-purpose furnace	1
6.	Flat rough file (300 mm) Round rough file (300 mm) Round smooth file (300 mm) Source rough file (300 mm) Flat smooth file 250 mm) Half round rough file (150 mm) Triangular rough file (150 mm) Half round smooth file (250 mm) Triangular smooth file (150 mm)	10 each
7.	Guillotine	1

8.	Tri-square Dividers Steel rule Wallets of warding file 10 sets Scribers Vee block and clamp Scribing block Centre punches Cold chisels (set) Scrapers (set)	10 each
9.	Vernier Calliper Hacksaw frame Stock and dies (set) metric Taps and wrenches (set) metric Hand drill Centre drills Lot Tap extractor (set) Screw extractor (set)	3 sets each
10.	Screw driver (set) and Hammers (assorted weight)	2 each
11.	Measuring tapes Feeler gauges Rivet gun Goggles Drill set Electric Hand drill	2 each

	Electric hand grinder/sander Vernier height gauge Dial indicators and stand Mallets (rubber, wood/rawhide)/Number stamps	
12.	Letter stamps Punches (cold) Plier (assorted) Hand shear	3 each
13.	Fire Extinguisher/sand buckets	2 each

iii. Automotive Shop

S/N	Description of Equipment	Quantity Required
1.	Digital engine diagnostic equipment	1
2.	Hydraulic jack	3
3.	Hydraulic press (100 tonne)	1
4.	Manual table press	2
5.	Standard service pit	1
6.	Brake testing equipment with control panel	1
7.	Sensitive drilling machine	1
8.	Electric vulcaniser	1
9.	Valve grinder	1
10.	Workshop service compressor	1
11.	Wheel balancing equipment (dynamic type)	1

12.	Wheel alignment equipment (digital type)	1
13.	Work benches	2
14.	Bench vices	4 (2 per work bench)
15.	Pneumatic tyre removal equipment	1
16.	Injector pump test bench	1
17.	Master cylinder test equipment	1
18.	Universal battery charger	1
19.	Engine mounting stand	3
20.	Hydro-meters	5
21.	Trolley Jacks	2
22.	Foot operated grease dispenser	2
23.	Complete mechanics tool kit	10
24.	Electric hand drill	2
25.	Breast drill (manual)	2
26.	Airline pressure gauge	4
27.	Portable tyre inflator (manual)	2
28.	Tyre repair kit	3
29.	Heavy duty tyre changer	1
30.	Exhaust gas analyser	1
31.	Portable crane	1
32.	Valve refacer	2
33.	Dynamometer	2
34.	Steam cleaner	1

35.	Diesel fuel pump test stand	1
36.	Carburettor service kit	1
37.	Chain wrench (for removing oil filter)	2
38.	Portable vehicle hoist	1
39.	Piston ring extractor	2
40.	Spark plug tester	2
41.	Pullers (various sizes)	6
42.	Grease gun	2
43.	Cylinder ridge remover	6
44.	Engine sump drainer	6
45.	Honing machine	1
46.	Head light tester	2
47.	Oil can	6
48.	2 stroke diesel engine	3
49.	4 Cylinder diesel engine	2
50.	6 Cylinder petrol engine	2
51.	Clutch testing machine	1
52.	Live and dead vehicles	2 each
53.	Spanners of assorted types and sizes	assorted
54.	Fire extinguishers, water, foam, dry powder, and sand buckets	2 each

iv. Welding and Fabrication Shop

S/N	Description of Equipment	Quantity Required
1.	Universal welding machine (ProMIG-315DCMMA/TIG/MIG/MAG) with accessories	3
2.	Oxygen cylinder	5
3.	Acetylene cylinder	5
4.	Argon cylinders	2
5.	CO ₂ cylinders	2
6.	Oxy acetylene welding manifold (regulator)	2
7.	Weld joint teaching aids (diagrams)	2
8.	Apron (leather)	15
9.	Hand gloves	15
10.	Welding head shield	15
11.	Welding booth/cubicle	3
12.	Working benches, for each welding machine	3
13.	Safety charts	Assorted
14.	Safety boots	6
15.	Fire Extinguisher/sand buckets	2 each

v. Foundry/Heat Treatment/Forge Shop

S/N	Description of Equipment	Quantity Required
1.	Oil-fired lift-out crucible furnace, 100 kg capacity, for melting soft pig iron and non-ferrous metals plus accessories (optional)	1
2.	Electrically heated lift-out crucible furnace with electrical rating 50kw, 3x450V supply, maximum furnace temperature 1300degree for melting steel grades, plus accessories and control	1
3.	Crucible pots (100kg capacity)	4

4.	Thermocouple/pyrometer for melt temperature measurement	1
5.	Moulding boxes, 310x310x100, 410x410x100 (metal)-	4 pairs each
6.	Core sand mixing machine	1
7.	Bentonite(foundry trade), 50 kg	10
8.	Parting Powder (20 kg bags)	10
9.	Soft pig iron ingots (2x2x5 inches)	50 pieces
10.	Pure aluminium ingots(2x2x5 inches)	50 pieces
11.	Sodium silicate liquid for core making, (foundry trade), 4 litre tins	10
12.	Charge make-up scale, 50kg capacity, with horizontal platform	1
13.	Core baking oven, temperature 300 C, 50HZ, single phase, 240V	1
14.	Fine silica sand for core making. (50kg bags)	10
15.	Foundry protective dress	15
16.	Foundry face shields	15
17.	Foundry heat resistant hand gloves	15 pairs
18.	Foundry safety shoes	15 pairs
19.	Core boxes	10
20.	Heat treatment furnace	1
21.	Crucible rest or stool	2
22.	Crucible lifting tongs	2
23.	Combined slag lifter and skimming ladle	2
24.	Hammers (assorted)	6 each
25.	Wire brush	2
26.	Hacksaw frame and blades	10
27.	Tapered shank drill bits	2 sets
28.	Straight shank drill bits	2 sets
29.	Drill drift	2 sets
30.	Moulding bench	10

31.	Bottom flask	20
32.	Moulding sand shovel	10
33.	Watering can	5
34.	Wheel-barrow	4
35.	Rammers (various types)	5
36.	Moulding trowels (various sizes)	5
37.	Strike-off-bars	5
38.	Gate cutter or spoon	5
39.	Sprue pins	5
40.	Vent rods	5
41.	Lifters	5
42.	Bubb sponges	5
43.	Draw pins	5
44.	Wet brush	5
45.	Bench vice	1
46.	Sand mixing machine	1
47.	G. Clamps	5
48.	Woodworking lathe	1
49.	Circular saw	2
50.	Band saw	2
51.	Jig saw	2
52.	Wood plane-machine	1
53.	Jointer	1
54.	Scraper	1
55.	Measuring and Marking out tools	10
56.	Sawing, planning, boring, turning etc tools	10 each
57.	Fire Extinguisher/Sand Buckets	2 each

vi. Building Services, Refrigeration and Air-conditioning Workshop

S/N	Description of Equipment	Quantity Required
1.	Vacuum pump	1
2.	Charging unit	1
3.	Internal cleaning apparatus	1
4.	Mechanical pressure gauge	4
5.	Electronic pressure gauge	4
6.	Recording pressure motor	4
7.	Differential pressure gauge	4
8.	Service man's thermometer	4
9.	Sensor dial thermometer (various degrees)	4
10.	Digital thermometer	4
11.	Heavy duty machine vice	1
12.	Portable electric drill	2
13.	Air compressor	1
14.	Recording hygrometer	1
15.	Avometer	1
16.	Gas flame leak detector	1
17.	Pipe vice	
18.	Bench vice	6
19.	Work bench	3
20.	Anvil	1
21.	Pliers (various sizes)	4 each
22.	Emergency lamp	1

23.	Respirator	10
24.	Safety face screen (face shield)	10
25.	Ear protector	10
26.	Working gloves	10 pairs
27.	Spanners (various sizes and shapes)	4 each
28.	Wrenches (various sizes)	2 each
29.	Hammers (various types and sizes)	2
30.	Screw drivers (various sizes)	6
31.	Files (assorted)	3 each
32.	Brushes	6
33.	Suction valve	2
34.	Shut - diff valve	10
35.	liquid level control	1
36.	Vibration absorber	2
37.	Fire extinguisher and sand buckets	2 each

B. Laboratories

i. Mechanics of Machines/Metrology Laboratory

A	Mechanics of Machines Section	
S/N	Description of Equipment	Quantity Required
1.	Screw jack apparatus	1
2.	Comprehensive fly wheel apparatus	1
3.	Bourdon tube pressure gauge	1
4.	Crank and connecting rod apparatus	1

5.	Slider crank mechanism apparatus	1
6.	Rope, belt and coil friction apparatus	1
7.	Cam and cam follower mechanism apparatus	1
8.	Extensometer and compression of springs apparatus	1
9.	Oldham coupling apparatus	1
10.	Torsion of bar apparatus	1
11.	Geneva stop mechanism apparatus	1
12.	Forces on beam apparatus	1
13.	Conservation of angular momentum apparatus	1
14.	Centrifugal/centripetal apparatus	1
B	Metrology Section	
1.	Comparator (Mechanical or Optical)	1
2.	Universal measuring microscope	1
3.	Angle gauge	1
4.	Set of slip gauge	1
5.	Sine bars with centers	1
6.	Engineer's level/ Engineer's Square	1 each
7.	Micrometers (assorted denomination)	2 each
8.	Vee blocks (assorted sizes)	2 each
9.	Magnetic vee block	1
10.	Vernier callipers	1 each
11.	Vernier height gauge	2
12.	Angle plate	1
13.	Limit gauges for holes, shafts, and threads 3 each	1
14.	Surface plate	1
15.	Marking out table	1
16.	Bevel protractor	2
17.	Dial gauges and magnetic stand	2

18.	Thread gauge	2
19.	Feeler gauge	2
20.	Steel rule	4
21.	Combination set	2
22.	Fire extinguisher and sand buckets	2each

ii. Materials Science/Strength of Materials Laboratory

S/N	Description of Equipment	Quantity Required
1.	Universal hardness testing machine for Brinell, Vickers, Rockwell testing with accessories	1
2.	Universal testing machine (UTM) with accessories	1
3.	Polygon of forces apparatus	1
4.	Impact testing machine (Izod/Charpy)	1
5.	Strain gauge apparatus	1
6.	Young's Modulus apparatus	1
7.	Polishing Machine	2
8.	Metallurgical microscope with USB for PC picture processing	3
9.	Etching machine	2
10.	Specimen mounting screen	2
11.	Desiccators	2
12.	Parting machine	1
13.	Abrasive cutters	2
14.	Shearing force apparatus	1
15.	Bending moment apparatus	1
16.	Fire extinguisher and sand buckets	2 each

iii. Thermodynamics/Heat Engine Laboratory

S/N	Description of Equipment	Quantity Required
1.	Auto bomb calorimeter	1
2.	Boyle gas calorimeter	1
3.	Air compressor test rig	1
4.	Thermal conductivity apparatus	1
5.	Pressure cooker	1
6.	Rotary viscometer	1
7.	Pyrometer infrared, non-contact digital infrared	1
8.	Resistance thermometer	1
9.	Smoke tunnel	1
10.	Tachometer	1
11.	Stroboscope	1
12.	Thermal conductivity apparatus	1
13.	Marcet boiler	1
14.	Fire extinguisher and sand buckets	1 each

iv. Fluid Mechanics/Hydraulics Laboratory

S/N	Description of Equipment	Quantity Required
1.	Hydraulic bench with accessories for various experiments in fluid flow measurements: Weir tank, impact on jet, orifice, floating body, manometer, etc)	1
2.	Turbine set (Pelton, Francis or Kaplan)	1
3.	Rotameter	1
4.	Laminar/turbulent pipe flow apparatus	1
5.	Pitot static tube	1
6.	Water current meter	1

7.	Centrifugal and axial fan test rings	1
8.	Fire extinguisher and sand buckets	1 each

v. Automotive Laboratory

S/N	Description of Equipment	Quantity Required
1.	Automotive engine test bed	1
2.	Lubricating oil test rig	1
3.	Wear and friction bearing test apparatus	1
4.	Hydraulic dynamometer	1
5.	Vibration meter	1
6.	Steering geometry measuring device	1
7.	Compression meter	1
8.	Electrolytic tester	1
9.	PH meter	1
10.	Battery tester	4
11.	Exhaust emission unit	1
12.	Flash point apparatus	1
13.	Automobile final drive	1
14.	Digital Tachometer	1
15.	Coolant flow meter	1
16.	Fire extinguisher and sand buckets	1 each

IDEA GENERATION WORKSHOP TEAM LIST

S/N	Name	Contact Address	Phone Number	Email Address
1.	Tpl. Ekpenyong E. Ekpenyong, fnitp	Ag. Executive Secretary NBTE, Kaduna		ekpenyongee@gmail.com
2.	Mal. Musa Isgogo	Director, Polytechnic Programmes NBTE, Kaduna	08067185383	dugujiisgogo@gmail.com
3.	Engr. Dr. Ibraheem A. Abdul	Department of Mechanical Engineering Technology, Yaba College of Technology, Lagos	08023212275	dotun.abdul@gmail.com
4.	Engr. Sani Malami Suleiman	Department of Mechanical Engineering Technology, Kaduna Polytechnic, Kaduna	08023792886	Sanimalami1968@gmail.com
5.	Engr. Dr. Bona Ekwueze	Department of Mechanical Engineering Technology, Institute of Management and Technology (IMT) Enugu	08034068980	
6.	Engr. Shaibu U. Okene	Department of Mechanical Engineering Technology, Federal Polytechnic, Bida	08036545230	shamanokene@yaahoo.com
7.	Engr. Abba Mohammed Danmowa	NBTE, Kaduna	08034304850	abbadanmowa@yahoo.com
8.	Dr. Fatima Umar Kabir	NBTE, Kaduna	08034521639	fatikmama@yahoo.com
9.	Engr. Yusuf S. Ringim	NBTE, Kaduna	08034697876	alkujaja89@gmail.com
10.	Engr. Dr. Jonathan Item Ukpai	NBTE, Kaduna	08035552002	jonukpai@gmail.com
11.	Engr. Suleiman Muhammad	NBTE, Kaduna	08036423172	khalifas2006@yahoo.com
SECRETARIAL STAFF				
15.	Mrs. Abdullahi Hassana	NBTE, Kaduna	08037671945	hassabdalla.70@gmail.com

16.	Mustafa Aminu	NBTE, Kaduna	07032281995	mustafarimi@gmail.com
17.	Mrs. Sani Rabi	NBTE, Kaduna	08036913246	rabiyoynbo.70@gmail.com

PRE-CRITIQUE WORKSHOP TEAM LIST

S/N	Name	Contact Address	Phone Number	Email Address
1.	Tpl. Ekpenyong E. Ekpenyong, fnitp	Ag. Executive Secretary NBTE, Kaduna		ekpenyongee@gmail.com
2.	Engr. Muhyideen Alimi Yusuf	COREN Representative, COREN Headquarters, Abuja.	08033045327	almasconsult12@gmail.com
3.	Dr. Zamani Ishaya Waidung	Automotive Engineers Institute (AutoEI), National Engineering Centre, Abuja	07033503420	zdishaya@gmail.com
4.	Engr. Binfa Bongfa, PhD	Department of Mechanical Engineering Technology, Federal Polytechnic, Idah.	07086512294 09053972320	engrbinfabongfa@gmail.com
5.	Engr. Dr. Nazmat Toyin Surajudeen-Bakinde	Faculty of Engineering and Technology, University of Ilorin.	08137288435	deenmat1211@gmail.com
6.	Dr. Mohammed Tahir Abba	Department of Mechanical Engineering Technology, Air Force Institute of Technology (AFIT), Kaduna	09080165045	m.tahir.abba@gmail.com
7.	Engr. Dr. Ibraheem A. Abdul	Department of Mechanical Engineering Technology, Yaba College of Technology, Lagos	08023212275	dotun.abdul@gmail.com
8.	Engr. Mamaki Usman Peni	Waziri Umaru Federal Polytechnic, B/Kebbi	08033053194	mamakipeni94@gmail.com
9.	Mal. Musa Isgogo	Director, Polytechnic Programmes NBTE, Kaduna	08067185383	dugujiisgogo@gmail.com
10.	Engr. Abba Mohammed Danmowa	NBTE, Kaduna	08034304850	abbadanmowa@yahoo.com
11.	Dr. Fatima Umar Kabir	NBTE, Kaduna	08034521639	fatikmama@yahoo.com
12.	Engr. Yusuf S. Ringim	NBTE, Kaduna	08034697876	alkujaja89@gmail.com

13.	Engr. Dr. Jonathan Item Ukpai	NBTE, Kaduna	08035552002	jonukpai@gmail.com
14.	Engr. Suleiman Muhammad	NBTE, Kaduna	08036423172	khalifas2006@yahoo.com
SECRETARIAL STAFF				
15.	Mrs. Abdullahi Hassana	NBTE, Kaduna	08037671945	hassabdalla.70@gmail.com
16.	Mustafa Aminu	NBTE, Kaduna	07032281995	mustafarimi@gmail.com
17.	Mrs. Sani Rabi	NBTE, Kaduna	08036913246	rabioyinbo.70@gmail.com

NATIONAL CRITIQUE WORKSHOP TEAM LIST

S/N	NAME	ADDRESS	PHONE NO.	E-MAIL
1.	Tpl. Ekpenyong E. Ekpenyong, fnitp	Ag. Executive Secretary NBTE, Kaduna		ekpenyongee@gmail.com
2.	Engr. Dr. Anthony Anyakora	General Services/Engineering NIPRD, Idu, Abuja. COREN Representative	08033174308	tonyanyakora@yahoo.com
3.	Engr. Abdussalam El-Suleiman, PhD	Mechanical Engineering Technology Department, Federal Polytechnic, Nasarawa	08034589003	a.elsuleiman@gmail.com
4.	Dr. Mohammed Tahir Abba	Mechanical Engineering Technology Department, AFIT, Kaduna	09080165045	m.tahir.abba@gmail.com
5.	Engr. Ahmed Muhammad Gusau	Mechanical Engineering Technology Department, Federal Polytechnic, Kaura-Namoda	08080356985	magusaux@gmail.com
6.	Engr. Ibrahim Salisu Iro	NSSTSB Minna, Niger State	08067361707	ibrahimsalisusaidu@yahoo.com
7.	Engr. Daniel Tobechei Ezemuo	Mechanical Engineering Technology Department, Federal Polytechnic, Oko	08028892167	dantobechei@hotmail.com

		Anambra State		
8.	Engr. John Boniface Otuu	Mechanical Engineering Technology Department, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State	08165221672	johnotuu@gmail.com
9.	Engr. Mary Samuel	Mechanical Engineering Technology Department, Nigerian Defence Academy, Kaduna	08023758440	marydibal267@gmail.com
10.	Engr. Yusuf Yakubu	FAAN, Ikeja, Lagos	08062853644	yyakubu13@gmail.com
11.	Engr. Dr. Dayo Hephzibah OLADEBEYE	Mechanical Engineering Technology Department, Federal Polytechnic, Ado-Ekiti, Ekiti State	08033881945	dayobeye@yahoo.com
12.	Engr. Yusuf M. Mamuda	Mechanical Engineering Technology Department, Kano State Polytechnic, Kano	08036967660	yusmaimam@yahoo.com
NBTE STAFF				
13.	Mal. Musa Isgogo	Director (Polytechnic Programmes) NBTE, Kaduna	08067185383	dugujiisgogo@gmail.com
14.	Engr. Abba M. Danmowa	NBTE, Kaduna	08034304850	abbadanmowa@yahoo.com
15.	Dr. Fatima Umar Kabir	NBTE, Kaduna	08034521639	fatikmama@yahoo.com
16.	Engr. Yusuf S. Ringim	NBTE, Kaduna	08034697876	alkujaja89@gmail.com
17.	Engr. Dr. Jonathan Item Ukpai	NBTE, Kaduna	08035552002	jonukpai@gmail.com
18.	Engr. Suleiman Muhammad	NBTE, Kaduna	08036423172	khalifas2006@yahoo.com
SECRETARIAL STAFF				
19.	Mrs. Abdullahi Hassana	NBTE, Kaduna	08037671945	hassabdalla.70@gmail.com
20.	Mustafa Aminu	NBTE, Kaduna	07032281995	mustafarimi@yahoo.com
21.	Mrs. Sani Rabi	NBTE, Kaduna	08036913246	rabiyoynbo.70@gmail.com



NATIONAL BOARD FOR TECHNICAL EDUCATION

CURRICULUM AND COURSE SPECIFICATIONS

FOR

HIGHER NATIONAL DIPLOMA (HND)

IN

MECHANICAL ENGINEERING TECHNOLOGY

**OPTIONS IN: i. AUTOMOTIVE ENGINEERING TECHNOLOGY
ii. MANUFACTURING ENGINEERING TECHNOLOGY
iii. PLANT ENGINEERING TECHNOLOGY**

November, 2020

FOREWORD

The Higher National Diploma (HND) in Mechanical Engineering Technology with Options in Automotive, Manufacturing and Plant curriculum is designed to be used by training institutions which produce manpower for the Automotive, Manufacturing and Energy industries nationwide.

The acute shortage of professionally-trained manpower in these industries in Nigeria as well as the need to produce professional practitioners with good ethics and career progression, through the acquisition of desirable knowledge and skills necessitated the production of this national curriculum.

It is my belief that this curriculum and course specifications which is the minimum required to produce professionals with sound knowledge and skills in these specialist areas, if properly implemented with the required resources (qualified teaching staff in adequate number and mix, adequate consumables, training materials, teaching aids), and qualified candidates are admitted into the programme, will lead to the production of competent and skilled manpower required in the sector.

I wish to express my deep appreciation to those that made the development of this curriculum possible. The invaluable contributions of all the members of the committee and resource persons during the idea generation, pre-critique and national critique workshops are appreciated.

I hope that the curriculum would be properly implemented, so as to produce the required Automotive, Manufacturing and Energy Work Force of our dream.

TPL Ekpenyong E. Ekpenyong, fnitp
Ag. Executive
Secretary, NBTE,
Kaduna

TABLE OF CONTENT

FOREWORD	2
TABLE OF CONTENT	3
GENERAL INFORMATION	6
CURRICULUM TABLE	13
FIRST SEMESTER COURSES.....	16
COMPUTER PROGRAMMING	18
ENGINEER IN SOCIETY	27
ENGINEERING DESIGN	31
STRESS ANALYSIS.....	35
INSTRUMENTATION AND CONTROL	40
MECHANICS OF MACHINES.....	50
MACHINE ELEMENT DESIGN I	57
SECOND SEMESTER COURSES	60
PROJECT MANAGEMENT	62
MECHANICAL STRUCTURAL ANALYSIS	68
ADVANCED FLUID MECHANICS	75
SAFETY AND ENVIRONMENTAL ENGINEERING	81
APPLIED THERMODYNAMICS	90
AUTOMOTIVE ENGINES, PERFORMANCE AND TEST.....	95
TRANSMISSION TECHNOLOGY AND PRACTICE	102
AUTOTRONICS.....	108
MECHANICS OF MOTOR VEHICLE	113
METAL FORMING AND HEAT TREATMENT	120
JOINING AND FABRICATION PROCESSES	129
FOUNDRY TECHNOLOGY AND PRACTICE	136
INTERNAL COMBUSTION ENGINES	143

ENERGY CONVERSION AND HEAT TRANSFER	148
RENEWABLE ENERGY SYSTEMS.....	153
THIRD SEMESTER COURSES	158
NUMERICAL METHODS	160
CAD/CAM	164
FLUID POWER MACHINES	169
OPERATIONS MANAGEMENT	176
ENGINEERING MATERIALS AND ...ONS.....	180
VEHICLE CHASSIS AND BODY TECHNOLOGY	185
AUTOMOTIVE AIR-CONDITIONING SYSTEM	194
WORKSHOP MANAGEMENT	199
METROLOGY.....	207
TESTING AND FAILURE OF MATERIALS	217
MACHINE ELEMENTS DESIGN II	223
CNC PROGRAMMING AND ROBOTICS	228
ELECTRICAL POWER AND MACHINES	231
REFRIGERATION AND AIR-CONDITIONING	237
MECHANICAL EQUIPMENT IN BUILDINGS	246
FOURTH SEMESTER COURSES	252
STATISTICAL METHODS IN ENGINEERING.....	254
QUALITY ASSURANCE.....	262
INDUSTRIAL ENGINEERING	265
MATERIALS HANDLING	269
PIPING DESIGN	275
ENGINE AND TRANSMISSION DESIGN	280
AUTOMOTIVE TRIBOLOGY	290
VEHICLE DIAGNOSIS AND MAINTENANCE	300

TRANSPORT MANAGEMENT	303
MACHINE TOOLS SYSTEMS	306
MACHINE TOOLS PROCESSES.....	310
PRESS AND CUTTING TOOLS DESIGN.....	318
MACHINE ASSEMBLY, INSTALLATION AND COMMISSIONING.....	325
JIGS AND FIXTURES DESIGN	331
PROCESS, CONSTRUCTION AND MINING EQUIPMENT.....	334
MAINTENANCE MANAGEMENT	337
POWER PLANT ENGINEERING	340
LECTRO-MECHANICAL CONTROLS	344
FINAL YEAR PROJECT.....	349
LIST OF WORKSHOPS AND LABORATORIES.....	351
REQUIRED MINIMUM LIST OF EQUIPMENT IN THE WORKSHOPS AND LABORATORIES.....	352
IDEA GENERATION WORKSHOP TEAM LIST	367
PRE-CRITIQUE WORKSHOP TEAM LIST	368
NATIONAL CRITIQUE WORKSHOP TEAM LIST	369

GENERAL INFORMATION

1.0 CERTIFICATION AND TITLE OF THE PROGRAMME:

The certificate to be awarded and the programme title shall read: “**HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY**”

2.0 GOAL AND OBJECTIVES

Goal

The Higher National Diploma (HND) programme in Mechanical Engineering Technology with options in Automotive, Manufacturing and Plant is aimed at producing technologists with knowledge, skills and competencies to carry out design implementation, operation, troubleshooting and maintenance of mechanical and related systems, components and equipment for both the public and private sectors of the economy.

Objectives

A. On completion of HND Automotive Engineering Technology programme, the diplomates should:

- ▢ Apply basic principles of Engineering, Science and Mathematics to solve Engineering problems.
- ▢ Function as technologists in automotive, energy, construction as well as other related industries.
- ▢ Participate in the development of machines and equipment for automotive industries.
- ▢ Carry out necessary test procedures and standard trouble-shooting techniques in fault detection and rectification of automotive and related products;
- ▢ Use intelligent diagnostic equipment and tools in maintenance and repairs of automotive products;
- ▢ Observe relevant safety precautions, environmental awareness and sustainability principles in automotive and other related engineering practice;

- ▢ Use relevant techniques to implement optimal designs and install automated machines and robots to meet the needs of the automotive and related industries;
- ▢ Supervise mechanical engineering technicians, craftsmen and artisans in automotive and other process and industrial plants;
- ▢ Set up and manage an enterprise effectively and efficiently.

B. On completion of HND Manufacturing Engineering Technology programme, the diplomates should:

- ▢ Apply basic principles of Engineering, Science and Mathematics to solve Engineering problems.
- ▢ Function as technologists in manufacturing, energy, construction as well as other related industries;
- ▢ Participate in the development of machines and equipment for domestic and industrial applications
- ▢ Operate various machine tools and equipment in the manufacturing of engineering components.
- ▢ Apply the various manufacturing management techniques;
- ▢ Design tools and jigs and produce proto-type of such items;
- ▢ Prepare CNC part program and use CNC machines to make simple jobs as well as interface CAD/CAM machines.
- ▢ Perform material testing for its properties using traditional and nondestructive techniques (NDT)
- ▢ Fabricate metal products using various techniques and processes;
- ▢ Observe relevant safety precautions, environmental awareness and sustainability principles in manufacturing and other related Engineering practice;
- ▢ Carry out installation, maintenance and repair of machines and equipment;
- ▢ Manage materials resources optimally in the manufacturing industries at this level.
- ▢ Supervise mechanical engineering technicians, craftsmen and artisans in a manufacturing and other process and industrial plants;
- ▢ Manage an enterprise effectively and efficiently.

C. On completion of HND Plant Engineering Technology programme, the diplomates should:

- ▢ Apply basic principles of Engineering, Science and Mathematics to solve Engineering problems
- ▢ Function as technologists in energy, manufacturing, transportation as well as other related industries;
- ▢ Interpret information in mechanical and technical literature and specify requirements for mechanical systems;
- ▢ Use relevant techniques to Install, maintain, and repair industrial plants;
- ▢ Use relevant techniques to Install, maintain, diagnose and repair power generating units such as internal combustion engines, gas and steam turbines, hydraulic and pneumatic equipment, e.g. forklift, compressors and steam boilers;
- ▢ Supervise mechanical engineering technicians, craftsmen and artisans in manufacturing and other process and industrial plants;
- ▢ Execute maintenance operations in the industry
- ▢ Observe relevant safety precautions, environmental awareness and sustainability principles in plant and other related Engineering practice;
- ▢ Manage an enterprise effectively and efficiently.

3.0 ENTRY REQUIREMENTS

The general entry requirements for the HND programmes include:

- a) All the requirements for admission into ND programme in Mechanical Engineering Technology.
- b) A minimum of lower credit (CGPA) of 2.50 and above in ND in Mechanical Engineering Technology with one year post ND industrial experience.
- c) In exceptional cases, diplomates with a pass grade (CGPA) 2.0 - 2.49 in the ND with minimum of two years post ND industrial experience may be admitted into the HND programme. However, the number of these candidates should not be more than 10% of the total student intake in each class.

- d) A minimum of lower credit (CGPA) of 2.50 and above in ND Mechatronics Engineering Technology. In exceptional cases, diplomates with a pass grade (CGPA) 2.0 - 2.49 in ND Mechatronics Engineering Technology with minimum of one year post ND industrial experience may be admitted into the relevant HND programmes.

4.0 DURATION

The programme is designed to run for at least a minimum of four semesters, which is two academic sessions.

5.0 CURRICULUM

5.1 The curriculum of the HND programme consists of three main components. These are:

- General Studies/Education
- Foundation courses
- Professional Courses

5.2 The General Education component shall include courses in:

English Language, Communication, Industrial Management and Engineer in Society, The General Education component shall account for not more than 10 - 15% of the total contact hours for the programme.

5.3 Foundation courses include courses in Mathematics. The number of hours for the programme may account for about 10-15% of the total contact hours.

5.4 Professional courses are core courses of the programme which give the student the theory and professional skills he needs to practise his field of calling at the technologist level. These may account for between 60-70% of the contact hours.

6.0 CURRICULUM STRUCTURE

The structure of the HND programme consists of four semesters of classroom, laboratory and workshop activities in the institution.

Each semester shall be of 17 weeks duration made up as follows:

15 contact weeks of teaching, i.e. lecture recitation and practical exercises, etc. and 2 weeks for tests, quizzes, examinations and registration.

7.0 ACCREDITATION

The Higher National Diploma programme shall be accredited by the National Board for Technical Education before the diplomates can be awarded the Higher National Diploma certificates. Details about the process of accrediting a programme for the award of the National Diploma are available from the Executive Secretary, National Board for Technical Education, Plot “B”, Bida Road, P.M.B. 2239, Kaduna, Nigeria.

8.0 MANDATORY SKILL QUALIFICATION

MSQ is a four (4) credit unit course spanning across two semesters of a programme totaling (8) which requires the student to learn a hands-on skill qualification either relevant or related to his area of study.

It is mandatory for HND graduates to acquire certification from appropriate awarding body of Nigerian Skills Qualification or any equivalent proprietary bodies. This policy of the Board requires that student should not be allowed to graduate without obtaining certification in the skill area they chose as a compulsory graduating requirement.

The MSQ is aimed to add value to all TVET graduates towards dual certification by way of obtaining a HND certificate and additional skills qualification to meet local and global demand for skilled labour

9.0 CONDITIONS FOR AWARD OF HIGHER NATIONAL DIPLOMA

The award of Higher National Diploma includes the following:

- a. Satisfactory performance in all prescribed course work which may include class work, tests, quizzes.
- b. Workshop practice, laboratory work.
- c. Satisfactory performance at all semester examinations.
- d. Satisfactory completion of final year project work normally, continuous assessment contributes 30%, project work 10% while semester examinations are weighted 60% to make a total of 100%.

Higher National Diploma shall be awarded based on the Standardized Unified Grading System as follows:

Mark Range (%)	Letter Grade	Weighting
75 and Above	A	4.00
70 – 74	AB	3.50
65 - 69	B	3.25
60 – 64	BC	3.00
55 – 59	C	2.75
50 – 54	CD	2.50
45 - 49	D	2.25
40 - 44	E	2.00
Below 40	F	0.00

Unified Class of Diploma

Distinction -	CGPA of 3.5 and Above
Upper Credit -	CGPA of 3.00 - 3.49
Lower Credit -	CGPA of 2.50 - 2.99
Pass -	CGPA of 2.00 - 2.49.

10.0 GUIDANCE NOTES FOR TEACHERS OF THE PROGRAMME

10.1 The new curriculum is drawn in unit courses. This is in keeping with the provisions of the National Policy on Education which stress the need to introduce the semester credit units which will enable a student who so wish to transfer the units already completed in an institution similar standard from which he/she is transferring.

10.2 In designing the units, the principle of the modular system by product has been adopted, thus making each of the professional modules, when completed provides the student with technician operative skills, which can be used for employment purposes self - and otherwise.

10.3 As the success of the credit unit system depends on the articulation of programmes between the institutions and industry, the curriculum content has been written in behavioural objectives, so that it is clear to all the expected performance of the student who successfully completed some of the courses or the diplomates of the programme. This is slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching he programme to write their own curriculum stating the conditions existing in their institution under which performance can take place and to follow that with the criteria for determining an acceptance level of performance. Departmental submission on the final curriculum may be vetted by the Academic Board of the institution. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the Polytechnic system.

10.4 The teaching of the theory and practical work should, as much as possible, be integrated. Practical exercises, especially those in professional courses and laboratory work should not be taught in isolation from the theory. For each course, there should be a balance of theory to practical in the ratio of 50:50 or 60:40 or the reverse.

11.0 FINAL YEAR PROJECT

Final year students in this programme are expected to carry out a project work. This could be on individual basis or group work. The project should, as much as possible incorporate basic element of design, drawing and complete fabrication of a marketable item or something that can be put to use. Project reports should be well presented and should be properly supervised. The departments should make their own arrangement of schedules for project work.

CURRICULUM TABLE

Higher National Diploma (HND) in Mechanical Engineering Technology
Options in: (a) Automotive (b) Manufacturing and (c) Plant

HND I SEMESTER I

Course Code	Course	L	T	P	CU	CH
GNS 301	Use of English III - Comprehension & Essay	2	0	0	2	2
MTH 311	Advanced Algebra	1	0	1	2	2
COM 311	Computer Programming	1	0	1	2	2
MEC 311	Engineer in Society	2	0	0	2	2
MEC 312	Engineering Design	2	0	2	3	4
MEC 313	Stress Analysis	2	0	1	3	3
MEC 314	Instrumentation and Control	2	0	1	3	3
MEC 315	Mechanics of Machines	2	0	2	3	4
MEC 316	Machine Element Design I	2	0	2	3	4
TOTAL		16	0	10	23	26

HND I SEMESTER II

Course Code	Course	L	T	P	CU	CH
GNS 302	Technical Report Writing II	1	0	0	1	1
MTH 312	Advanced Calculus	2	0	0	2	2
ENT 326	Practice of Entrepreneurship I	2	0	2	2	2
MEC 321	Project Management	2	0	0	2	2
MEC 322	Mechanical Structural Analysis	2	0	1	3	3
MEC 323	Advanced Fluid Mechanics	2	0	2	3	4
MEC 324	Safety and Environmental Engineering	2	0	0	2	2
MEC 325	Mandatory Skills Qualifications I	0	0	4	4	4
Automotive Engineering Technology Option						
MEA 321	Applied Thermodynamics	2	0	2	3	4
MEA 322	Automotive Engines, Performance and	1	0	2	2	3
MEA 323	Transmission Technology and Practice	1	0	2	2	3
MEA 324	Autotronics	1	0	2	2	3
MEA 325	Mechanics of Motor Vehicles	2	0	1	2	3
	Total	20	0	18	30	36

Manufacturing Engineering Technology Option						
MEM 321	Metal Forming and Heat Treatment	2	0	2	3	4
MEM 322	Joining and Fabrication Processes	2	0	2	3	4
MEM 323	Foundry Technology and Practice	2	0	2	3	4
	Total	19	0	15	28	32
Plant Engineering Technology Option						
MEA 321	Applied Thermodynamics	2	0	2	3	4
MEP 322	Internal Combustion Engines	2	0	2	3	4
MEP 323	Energy Conversion and Heat Transfer	2	0	1	2	3
MEP 324	Renewable Energy Systems	2	0	2	3	4
	Total	21	0	16	30	35

HND II SEMESTER I

Course Code	Course	L	T	P	CU	CH
MTH 412	Numerical Methods	2	0	0	2	2
ENT 416	Practice of Entrepreneurship II	2	0	2	4	4
MEC 411	CAD/CAM	1	0	2	2	3
MEC 412	Fluid Power Machines	2	0	2	3	4
MEC 413	Operations Management	2	0	0	2	2
MEC 414	Engineering Materials and Applications	1	0	2	3	3
MEC 415	Mandatory Skills Qualifications II	0	0	4	4	4
MEC 400	Final Year Project	0	0	3	3	3
Automotive Engineering Technology Option						
MEA 411	Vehicle Chassis and Body Technology	2	0	2	3	4
MEA 413	Automotive Air Conditioning Systems	1	0	2	2	3
MEA 414	Workshop Management	2	0	0	2	2
	Total	15	0	19	30	34
Manufacturing Engineering Technology Option						
MEM 411	Metrology	2	0	1	2	3
MEM 412	Testing and Failure of Materials	2	0	1	2	3
MEM 413	Machine Elements Design II	2	0	1	2	3
	Total	16	0	18	29	34
Plant Engineering Technology Option						
EEE 442	Electrical Power and Machines	2	0	2	3	4
MEP 411	Refrigeration and Air-conditioning	2	0	2	3	4
MEP 412	Mechanical Equipment in Building	2	0	2	3	4
Total		16	0	21	32	37

HND II SEMESTER II

Course Code	Course	L	T	P	CU	CH
MTH 422	Statistical Methods in Engineering	1	0	1	2	2
MEC 421	Quality Assurance	2	0	0	2	2
MEC 422	Industrial Engineering	2	0	0	2	2
MEC 423	Materials Handling	2	0	0	2	2
MEC 424	Piping Design	2	0	1	2	3
MEC 400	Final Year Project	0	0	3	3	3
Automotive Engineering Technology Option						
MEA 421	Engine and Transmission Design	2	0	2	3	4
MEA 422	Automotive Tribology	2	0	2	3	4
MEA 423	Vehicle Diagnosis and Maintenance	1	0	2	2	3
MEA 424	Transport Management	2	0	0	2	2
	Total	16	0	11	23	27
Manufacturing Engineering Technology Option						
MEM 421	CNC Programming and Robotics	1	0	2	2	3
MEM 422	Machine Tools Processes	2	0	2	3	4
MEM 423	Press and Cutting Tools Design	1	0	2	2	3
MEM 424	Machine Assembly, Installation and	2	0	1	2	3
MEM 425	Jigs and Fixtures Design	1	0	2	2	3
	Total	16	0	14	24	30
Plant Engineering Technology Option						
MEP 421	Process, Construction and Mining Equipment	2	0	2	3	3
MEP 422	Maintenance Management	1	0	0	1	1
MEP 423	Power Plant Engineering	2	0	2	3	4
MEP 424	Electro-Mechanical Controls	2	0	1	2	3
	Total	16	0	10	22	25

FIRST SEMESTER COURSES

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: COMPUTER PROGRAMMING

COURSE CODE: COM 301

DURATION: 30 Hours (1 Hour Lecture, 1 Hour Practical)

CREDIT UNIT: 2.0

Subject: COMPUTER PROGRAMMING	Code: COM 301	Total Hours:	2 Hours/Week
		Theoretical hours:	1 Hour/Week
		Practical hours:	1Hour/Week
Semester: FIRST	Pre-requisite: NIL		
Goal: This course is intended to acquaint students with the knowledge and skills of C++ and MATLAB and their application.			

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the Features of C++
2	Comprehend Operator and Function Overloading
3	Understand the Concepts of Inheritance and friendship.
4	Know the Interpolations in C++
5	Know the Applications of C++
6	Understand MATLAB as a tool in Engineering
7	Know the function of MATLAB
8	Understand Programming in MATLAB
9	Comprehend Programming Modeling, Simulation and Implementation using MATLAB and Simulink

COMPUTER PROGRAMMING

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (ALL OPTIONS)						
COURSE: COMPUTER PROGRAMMING				COURSE CODE: COM 301		CONTACT Hours: 1-0-1 Hrs/Wk
Goal: This course is intended to equip the student with the knowledge of C++ and MATLAB and their application.						
COURSE SPECIFICATION:THEORETICAL CONTENTS				PRACTICAL CONTENTS		
	General Objective: 1.0: Understand the Features of C++					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1	1.1 Explain the basic concept of Object Oriented Programming. 1.2 Explain the basic concept of C and C++ Programming Language. 1.3 Explain the character set of C and C++ 1.4 Define C and C++ reserved words. 1.5 Explain features of C++.	Explain 1.1 – 1.5	Marker, whiteboard recommended textbooks,	-	-	Explain features of C++
	General Objective 2.0: Comprehend Operator and Functions of Overloading					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
	2.1 Explain classes in C++.	Explain 2.1 – 2.2	Marker, whiteboard recommended textbooks, C++	-	-	-

	2.2 Explain overloading		software.			

2	functions and operators.					
	General Objective 3.0: Understand the Concepts of Inheritance and friendship					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
3	3.1 Explain Heirs Apparent and friends: Inheritance Vs friendship, specifications. 3.2 Solve some programming problem in C++	Explain 3.1 – 3.2	Marker, whiteboard recommended textbooks, PCs, C++ software.	Perform basic programming in C++.	Guide students to carry out activities.	Explain the Concepts of Inheritance and friendship.
	General Objective: 4.0: Know the Interpolations in C++					
	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
4-5	4.1 Explain interpolations in C++ (Polynomial fitting). 4.2 Explain input and output statement. 4.3 Explain: Pseudo-Random Number Generation and test such as: Random Number Generator, Normal variate, Randomness test and elementary simulation. 4.4 Explain statistical	Explain 4.1 – 4.5.	Marker, whiteboard recommended textbooks, PCs C++ software.	Write program to verify input and output statement. Write program to verify correlation, averages of a time series, and chi-square test of independence.	Guide students to carry out practical activities.	Explain the Interpolations in C++

	programs in C++ 4.5 Explain the terms correlation, moving averages of a time series, chi-square test of independence.					
	General Objective: 5.0 Know the Applications of C++					
6-7	5.1 Explain applications of C++ such as: Turbo C++ Graphics, Addressing the graphics screen, points, colours, lines, shapes, simple Animation. 5.2 Explain Rag tracing in C++. 5.3Explain: • Rag tracing Application • program strategy • Application with graphics	Explain 5.1 – 5.3	Marker, whiteboard recommended textbooks, PCs C++ software	Write program on simple animation.	Guide students to carry out practical exercise.	Explain basic Applications of C++
	General Objective: 6.0: Understand MATLAB as a tool in Engineering					

8-9	6.1 Explain the basic concept of MATLAB. 6.2 Explain the basic features of MATLAB. 6.3 Explain Variables, Assignment Statements and Expression. 6.4 Explain Characters, Encoding, Vectors and Matrices. 6.5 Explain Algorithms, MATLAB Scripts- Documentation, Input and Output, Scripts to Produce and Customize Simple Plots. 6.6 Explain the Plot Function: Simple Related Plot Functions 6.7 Describe File Input/Output (Load and Save): • Writing Data to a File	Explain 6.1 – 6.10	Marker, whiteboard recommended textbooks, PCs with licensed MATLAB	Write program to implement tools in MATLAB.	Guide students to carry out practical activities.	Explain MATLAB as a tool in Engineering

	• Appending Data to a Data File • Reading from a File. 6.8 Describe Selection Statement relational Expressions: • The if Statement Representing • Logical True and False • The if-Else Statement • Nested if-Else Statements • The Switch Statement. 6.9 Explain the Menu and is Functions in MATLAB.					
	General Objective: 7.0: Know the function in MATLAB					
10	7.1 Explain Looping: • The for Loop. • While loop. 7.2 Explain Nested for Loops: • Nested Loops and	Explain 7.1 – 7.3	Marker, whiteboard recommended textbooks, PCs MATLAB	Write programs to implement various types of looping.	Guide student to carry out the practical activities.	Explain the basic functions in MATLAB

	Matrices, - Combining - Nested for Loops and if Statements. 7.3 Describe Vectorizing: - Logical Vectors - Vectors and Matrices as function arguments.					
General Objective: 8.0: Understand Programming in MATLAB						
11-13	8.1 Explain: - MATLAB Program Organization - Modular Programs - Sub functions. 8.2 Explain application Menu-Driven Modular Program. 8.3 Explain Variable Scope, Persistent Variables 8.4 Explain Debugging Techniques: - Types of error - Tracing,	Explain 8.1 – 8.17	Marker, whiteboard recommended textbooks, PCs MATLAB	Write simple MATLAB programs.	- Guide students to carry out practical activities.	Explain Programming in MATLAB

	• editor/Debugger • function Stubs 8.5 Explain String Manipulation. 8.6 Explain Operations on Strings, concatenation, creating customized Strings, removing Whitespace characters, changing case, comparing Strings, finding, replacing, and Separating Strings, evaluating a String 8.7 Describe the is function for Strings 8.8 Describe converting between String and Number Types 8.9 Describe Data Structures: cell arrays and Structures 8.10 Describe cell arrays, creating cell arrays. 8.11 Explain Structures and their attribute. 8.12 Explain advanced file transfer. 8.13 Describe Writing and reading					

	Spreadsheet files. 8.14 Describe Using MaT-files for Variables, Writing Variables to a file, appending Variables to a MaT-file, reading from a MaT-file. 8.15 Explain advanced functions. 8.16 Explain the concept of argument. 8.17 Explain Nested and recursive functions.					
General Objective: 9.0: Comprehend Programming Modeling, Simulation and Implementation using MATLAB and Simulink						
14-15	9.1 List different MATLAB and Simulink tool box. 9.2 Explain 9.1 9.3 Describe MATLAB/Simulink environment. 9.4 Explain Engineering concepts Using MATLAB and Simulink. 9.5 Explain the concept of Mechatronics and Control System using MATLAB and Simulink.	Explain 9.1 – 9.5	Marker, whiteboard recommended textbooks, PCs MATLAB Simulink Arduino, RaspberryPi	Demonstrate modeling, Simulation and Implementation using MATLAB/Simulink. Demonstrate Project-Based Learning (Arduino, RaspberryPi) using MATLAB/Simulink.	Guide students to carry out practical activities.	Explain Modeling, Simulation and Implementation using MATLAB and Simulink

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Engineer in Society

COURSE CODE: MEC 311

DURATION: 30 Hours (2 Hours - Lecture, 0 Hour - Practical)

CREDIT UNIT: 2.0

Subject: ENGINEER IN SOCIETY	Code: MEC 311	Total Hours: 2 Hours/Week
		Theory: 2 Hours/Week
		Practical: 0 Hour/Week
Semester: FIRST	Pre-requisite: NIL	
Goal: This course is designed to enable students understand various developments and impact of engineering activities in the society in order to prepare them for the future challenges and prospects		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the early development of Technology
2	Understand Technological Advancements
3	Understand Technological Developments in Nigeria
4	Understand the Technical Education system in Nigeria
5	Understand the Engineers' Roles and Responsibilities in the Community
6	Know all the Professional Bodies in Engineering
7	Appreciate the Concept of Transfer of Technology

ENGINEER IN SOCIETY

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE TITLE: ENGINEER IN SOCIETY		COURSE CODE: MEC 311	UNIT: 2	CONTACT HOURS: 2 -0-0		
Goal: This course is designed to enable students understand various developments and impact of engineering activities in the society in order to prepare them for the future challenges and prospects						
GENERAL OBJECTIVE 1.0: Know the early development of technology.						
	THEORETICAL CONTENT		PRACTICAL CONTENT			
WEEK	Specific learning outcome	Teacher's Activity	Resources	Specific learning outcome	Teacher's Activity	Evaluation
1 – 2	1.1 Define science 1.2 Define engineering 1.3 Define Technology, integrating the views of ducker, Gengron, Schon, etc 1.4 Trace the history of Engineering from early Egyptian, Greek and Rome civilizations 1.5 Explain the contributions and problems of early technology	Explain 1.1-1.5	Projector, Slides, PCs, marker board and markers.	-	-	Give account of early development of technology
GENERAL OBJECTIVE 2.0: Understand technological advancements						

3-5	2.1. State the pervasive nature of Technological advances 2.2. Explain the importance of Technology in the Manufacturing industry 2.3. State Lady Woodward's "Technology Theory" 2.4. State the role of Technology in the Development of power and fuel 2.5. Explain improvements in transportation through technology 2.6. Evaluate technological	Explain 2.1-2.7	Projector, Slides, PCs, marker board and markers.	-	-	Explain technological advancements

	Advances in electronics					
GENERAL OBJECTIVE 3.0: Understand technological developments in Nigeria						
6-7	3.1. Explain early Indigenous technology in Nigeria 3.2. Explain the influence of foreign technology on Nigeria Indigenous Technology 3.3. State the main features of Nigerian"s National policy on Technology 3.4. Explain the present state of Technology in Nigeria 3.5. Analyze the advantages and disadvantages of importation of foreign expertise on Nigeria Technology. 3.6. Examine the Implications of the „Lima Target“ 3.7 Suggest possible solutions to the problem in 3.6 above	Explain 3.1-3.7	Projector, Slides, PCs, marker board and markers.	-	-	Explain technological developments in Nigeria
GENERAL OBJECTIVE 4.0: Understand the technical education system in Nigeria						
8-9	4.1 Explain the structure of Technical Education in Nigeria 4.2 State the main features of Nigeria"s National policy on Technical Education 4.3 List the roles of the Different categories of Technical Personnel produced in 4.1 above. 4.4 Compare and contrast university programmes in engineering with those of polytechnics in Nigeria 4.5 Explain the functions of the National Board for Technical	Explain 4.1-4.5	Projector, Slides, PCs, marker board and markers.	-	-	Discuss the technical education system in Nigeria

	Education. (N.B.T.E)					
GENERAL OBJECTIVE 5.0: Understand the engineers' roles and responsibilities in the community.						
10 -11	5.1 Outline the social, moral and professional responsibilities of the engineer in the society 5.2 Analyze proposals, target time and strategies as the development plans in Nigeria 5.3 List the roles of engineering development in national defence.	Explain 5.1-5.3	Projector, Slides, PCs, marker board and markers.	-	-	Explain the engineers' roles and responsibilities in the community
GENERAL OBJECTIVE 6.0: Know all the professional bodies in engineering						
12 -13	6.1 List all the professional bodies in engineering in Nigeria. 6.2 Explain the aims and objectives of each body listed in 6.1 above 6.3 State the requirements for registration of membership of each society/association body listed in 6.1	Explain 6.1-6.3	Projector, Slides, PCs, marker board and markers.	-	-	Explain the professional bodies in engineering -
GENERAL OBJECTIVE 7.0: Appreciate the concept of transfer of technology						
14-15	7.1 Explain technology transfer concept from the prospective of the less advanced countries. 7.2 Evaluate the advantages and disadvantages of transfer technology. 7.3 State the problems and prospects of technology transfer in Nigeria. 7.4 Suggest possible alternatives to technology transfer in Nigeria 7.5 Formulate a feasible plan for providing Nigeria with indigenous "know how".	Explain 7.1-7.5	Projector, Slides, PCs, marker board and markers.	-	-	Explain the concept of transfer of technology

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: ENGINEERING DESIGN

COURSE CODE: MEC 312

DURATION: 60 Hours (2 Hour Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Subject: ENGINEERING DESIGN	Code: MEC 312	Total Contact Hours: 4 Hours/Week
		Theoretical Hours: 2 Hours/Week
	Pre-requisite: NIL	Practical Hours: 2 Hours/Week
Semester: FIRST		
Goal: This course is designed to acquaint the students with the knowledge and skills in engineering design processes		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the sequence that lead to a workable design
2	Know the factors that influence the selection of materials and manufacturing processes in a particular design
3.	Understand the process in estimating cost of design
4.	Know how to analyse the alternative solution concepts

ENGINEERING DESIGN

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: ENGINEERING DESIGN				COURSE CODE: MEC 312	CONTACT Hours: 2-0-2Hrs/Wk	
Goal: This course is designed to acquaint the students with the knowledge and skills in engineering design processes						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT:		
	General Objective 1.0: Know the sequence that lead to a workable design					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-5	1.1 Establish the need for a design 1.2 Describe the steps that make up the sequence leading to a workable design i.e. definition of a problem, gathering of information, concept of solutions evaluations of solutions, modifications decision on the best solution, communication of the design 1.3 Describe phases involved in a typical design project 1.4 Describe possibility solutions to the design problem	Explain the activities in 1.1 – 1.4.	Recommended textbook, duster, Marker, Related videos, projector etc.	.		Explain the sequence that lead to a workable design.
	General Objective 2.0: Know the factors that influence the selection of materials and manufacturing processes in a particular design					

6-7	2.1 Specify the physical and mechanical properties of materials relevant to the design 2.2 Outline the steps in the selection of an appropriate material	Explain the activities in 2.1 - 2.3	Recommended textbook, White Marker Board, duster, Temporary Marker, Related videos, Lecture	2.1 Select the most appropriate manufacturing process considering cost factors as materials utilization factor, effect of	Demonstrate activities 2.1 to 2.2 for the students to learn and ask them to perform all the activities.	Explain the factors that influence the selection of materials and manufacturing processes in a particular design

8 - 10	2.3 Classify manufacturing processes into eight categories i.e. casting, deformation, machining, joining, heat treatment and surface treatment assembly		notes, etc.	method of materials properties and subsequent performance of the part in service 2.2 Carry out simple project on selection of material and manufacturing process for a real life problem	• Assess the students.	
General Objective 3.0: Understand the process in estimating cost of design						
10-12	3.1 Identify the three basic product costs as it relates to Design for economic manufacture 3.2 Breakdown a product cost into the various cost stages that exist in an organization 3.3 Compare projected production costs with the expected income from a realistic selling price using a breakdown chart. 3.4 Describe some methods by which thought design may reduce the overall product cost i.e. economic choice of production technique, material and design form, avoiding material wastage,	Explain the activities in 3.1 - 3.3	Recommended textbook, White Marker Board, duster, Temporary Marker, Related videos, Lecture notes, etc.			Explain the process in estimating cost of design

	consideration for size and product, efficient use of standard components and bought-out items designing to aid packaging 3.5 Carry out exercises in cost estimation					
	General Objective 4.0: Know how to analyse the alternative solution concepts					
13-15	4.1 List four factors that are used to analyse alternative solutions i.e. technical, economic human, legal and environmental factors 4.2 State criteria for evaluating a given design 4.3 Explain the need for and purpose of considering each one of the factors in 4.1 above 4.4 Explain the role of models in engineering design 4.5 Classify test models into quantitative and qualitative (i.e. mathematical equations).	Explain the activities in 4.1 - 4.7	Recommended textbook, White Marker Board, duster, Temporary Marker, Related videos, Lecture notes, etc.	4.1 Perform group design of an engineering component. 4.2 Test design against specification for a design 4.3 Test designs against factor of safety	Demonstrate activities 4.1 to 4.3 for the students to learn and guide them to perform all the activities. • Assess the students.	Explain how to analyse the alternative solution concepts

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Stress Analysis

COURSE CODE: MEC 313

DURATION: 45 Hours (2 Hours - Lecture, 1 Hour - Practical)

CREDIT UNIT: 3.0

Subject: STRENGTH OF MATERIAL	Code: MEC 313	Total Hours: 3 Hours/Week
Semester: FIRST	Pre-requisite:	Theory: 2 Hours/Week
		Practical: 1 Hour/Week
Goal: This course is designed to enable students acquire knowledge of the effects of stress, strain and deformation on engineering elements and systems.		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the concept of stress and strain.
2	Know stress analysis in simple bars
3	Understand stress, shear force and bending moment on beams
4	Understand the concept of torsion and strain energy
5	Understand deflection of beams, thin cylindrical and spherical shells

STRESS ANALYSIS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY(ALL OPTIONS)						
COURSE: STRESS ANALYSIS				COURSE CODE: MCE 313		CONTACT Hours: 2-0-1 Hrs/Wk
Goal: This course is designed to enable students acquire knowledge of the effects of stress, strain and deformation on engineering elements and systems						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand the concept of stress and strain.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-3	1.1 Explain the basic concepts of stress and strain. 1.2 Define tensile and compressive stresses. 1.3 Explain stress and strain in 2-dimension with emphasis on uni-axial, bi-axial and tri-axial stresses. 1.4 Define elastic limit. 1.5 Define Hooke’s law 1.6 Define Young Modulus 1.7 Explain the following terms: □ Poisson ratio □ Modulus of elasticity □ Bulk modulus □ Yield stress □ Ultimate stress, etc 1.8 Establish the relationship between all the elastic constants E, G and K .	Explain 1.1-1.8	Projector, Slides, PCs, Textbooks, marker board and markers Universal Testing Machine. .	Perform tension/tensile test on mild steel bar Perform tension/tensile test on cast steel bar Determine modulus and elastic constants for mild steel and cast steel bars	Guide students to carry out practical exercise.	Explain the concept of stress and strain
	General Objective 2.0: Know stress analysis on simple bars					

4 - 6	2.1 Establish the case for 2-dimensional stress with directions of principal stresses. 2.3 Explain the following: - Principal plane, - Shearing Stress, - Maximum shearing and normal stress on planes of maximum shearing stress, - Mohr's Circle. 2.3 Explain the use of Mohr's Circle to determine principal stresses and stresses on arbitrary plane. 2.4 Solve problems involving 2.1 to 2.3 above	Explain 2.1-2.4	Projector, Slides, PCs, marker and whiteboard PCs, ANSYS-Metaphysics software. Mohr's Circle Charts..	Construct Mohr's Circle and use it to determine principal stresses. Perform simple stress analysis on a bar using Finite Element Analysis software such as ANSYS-Metaphysics.	Guide students to carry out practical exercise.	Explain the concept of stress analysis on simple bars.
General Objective 3.0: Understand stresses, shear force and bending moment in beams						
7-9	3.1 Define axial and shear force. 3.2 Describe bending moment diagrams as applied to statically determinate beams including beams with internal hinges for different types of loading. 3.3 Establish the relationship between rates of loading, shear force and bending moment. 3.4 Describe the principles of pure bending and its assumptions.	Explain 3.1-3.8	Projector, Slides, PCs, marker board and markers. Flexural tester. Beam with central point load and beam with two point load.	Perform flexural test on a beam for central point load. Perform flexural test on a beam for two point load. Perform simple stress analysis on a beam using Finite Element Analysis software such as ANSYS-Metaphysics	Guide students to carry out practical exercise.	Explain stresses, shear force and bending moment in beams.

	3.5 Derive flexural formula for straight beams and moment of resistance 3.5 Explain bending stress distribution with section moduli for different sections. 3.6 Explain beams for uniform strength and flitched beams. 3.7 Describe distribution of shear stress across plane sections used commonly for shear connectors and structural purposes. 3.8 Solve problems related to 3.1 to 3.7.					
General Objective 4.0: Understand the concept of torsion and strain energy						
10-12	4.1 Define torsion. 4.2 Explain torsion of circular shafts for both solid and hollow shafts. 4.3 Explain stresses in shafts when transmitting power, shafts in series and parallel. 4.4 Define strain energy. 4.5 Define resilience, and proof resilience as applied to strain energy. 4.6 Explain strain energy stored in the member due to gradually applied load, suddenly applied load and impact load. 4.7 Explain strain energy stored due to shear, bending and torsion.	Explain 4.1-4.8	Projector, Slides, PCs, marker board and markers. Torsion tester, Universal hardness tester, Izod impact tester, Charpy tester	Perform torsion test on mild steel bar/cast iron bar specimens. Carry out Brinell hardness test on mild steel bar/cast iron barspecimens. Carry out Rockwell hardness test on mild steel bar/cast iron bar specimens. Perform Izod impact test/Charpy test on mild steel bar/cast iron bar specimens.	Guide students to carry out practical exercise.	Explain the concept of torsion and strain energy

	4.8 Solve problems related to 4.1 to 4.7.					
	General Objective 5.0: Understand deflection of beams, thin cylindrical and spherical shells					
13-15	5.1 Define cantilever and different types of beam supports 5.2 Explain deflection of cantilevers, 5.3 Solve problems on cantilevers, simply supported and over hanging beams using double integration and Macaulay's Method for different type of loadings. 5.4 Define thin cylindrical and spherical shells. 5.5 Explain the difference between cylinders and spheres due to internal pressure. 5.6 Explain cylindrical shell with hemispherical end.	Explain 5.1-5.7	Projector, Slides, PCs, marker board and markers. Beam apparatus	Identify cylindrical and spherical shells. Carry out experiment on deflection of beam. Perform simple stress analysis on thin/thick cylindrical and spherical shells using Finite Element Analysis software such as ANSYS-Metaphysics	Guide students to carry out practical exercise..	.Explain deflection of beams, thin cylindrical and spherical shells

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: INSTRUMENTATION AND CONTROL

COURSE CODE: MEC 314

DURATION: 60 Hours (2Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Subject: INSTRUMENTATION AND CONTROL	Code: MEC 314	Total Hours: 4 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Semester: FIRST	Pre-requisite: NIL	
Goal: This course is designed to acquaint students with the knowledge and skills in measurements, instrumentation and control as applicable to mechanical systems.		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Comprehend the characteristics of instrument and measurement.
2	Understand the measurement of various parameters e.g. displacement stress, speed, time, temperature etc.
3	Understand the principles of form measurement.
4	Understand advances in measurement and instrumentation.
5	Understand the principles of industrial calibration
6	Comprehend the concept of digital control system
7	Know the various control systems

INSTRUMENTATION AND CONTROL

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
Goal: This course is designed to acquaint students with the knowledge and skills in measurements, instrumentation and control as applicable to mechanical systems.						
COURSE: MEASUREMENT AND INSTRUMENTATION				COURSE CODE: MEC 314	CONTACT Hours: 2 – 0-2 Hrs/Wk	
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Comprehend the characteristics of instrument and measurement.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 Explain the concept of measurement and instrumentation.	Explain 1.1 – 1.9 using equations, formulae and teaching aids where applicable.	White Marker Board, duster, Marker, Related videos, Lecture notes, Projector etc. • Practical guide • Granty apparatus • Fluid - pressure apparatus • Deflection apparatus • Piezo-electric train transducer	1.1 Measure force using the following methods:- (i) Gravity (ii) Fluid-pressure (iii) Deflection (iv) Piezo electric train transducer.	• Demonstrate activities for the students to learn and ask them to perform the activities. • Assess the students Demonstrate activities for the students to learn and ask them to perform the activities. • Assess the students	Explain measurement and instrumentation
	1.2 Classify instruments into types.			1.2 Measure Pressure using Piezometer and manometers.		
	1.3 Explain the factors affecting instrument selection.			1.3 Measure strain using the following:- a) Mechanical gauges b) Optical strain-gauges, and c) Bridge amplifiers		
	1.4 Classify the sources of errors in measurement systems.					
	1.5 State the application of sensing element, amplifying element and signal converters.					
	1.6 Describe methods of determining the following parameters of measuring systems:					

	sensitivity, accuracy, precision, hysteresis, dead band, zero stability, etc. 1.7 Describe how parameters associated with dynamic performance of measuring systems can be determined e.g. step response and frequency response. 1.8 Describe the step responses to a first order and second order systems. 1.9 Describe the frequency response of a second order system.		• Piezometer • Manometer • Mechanical gauges • Optical strain gauges •			
	General Objective 2.0: Understand the measurement of various parameters e.g. displacement stress, speed, time, temperature etc					
3-4	2.1 Classify displacement - measuring devices into electrical and mechanical types, giving examples. 2.2 Explain the construction and principle of operation of a dial indicator. 2.3 Explain with aid of diagram the principle of	Explain activities of 2.1 to 2.15	Recommend -ed textbook, White Marker Board, duster, Temporary Marker, Related videos,	2.1 Measure strain using the following:- a) Mechanical gauges b) Optical strain-gauges, and c) Bridge amplifier 2.2 Measure time using the following: a) electronic timers b) stroboscopes. d) Function generators and	• Demonstrate the activities for the students to learn and guide them to practice all the activities. • Assess the students.	Explain the measurement of displacement stress, speed, time and temperature

	operation of a 'float' as a simple displacement-measuring device. 2.4 Explain the principle of operation of the linear variable displacement transducer (L.V.D.T). 2.5 Explain the operation of potentiometer as a displacement-measuring device. 2.6 Describe the measurement of force by (i) gravity balance method. (ii) Fluid-pressure method (iii) deflection of elastic element method (iv) piezoelectric element.		Lecture notes, Projector etc. • Stroboscopes • Function generators • Mechanical gauges • Optical strain gauges	e) Stop watches 2.3 Measure frequency signals using cathode ray, and oscilloscopes.		
	2.7 Describe various methods of measuring torque. 2.8 Describe method of measuring strain of elastic elements. 2.9 Explain strain measurement using (i). Mechanical gauge. (ii) optical strain gauge and (iii) electrical strain gauge.		• Mechanical gauges • Optical strain gauges • Bridge amplifiers • Electronic timers • Stroboscopes			

	2.10 Explain stress measurements using (i) photo elastic models (ii) photo elastic coatings. 2.11 Describe the method of time measurement using (i) measuring oscillators (ii) industrial timing method using stop-washer or stop-clocks. 2.12 Describe the operation of counting devices such as (i) mechanical counters (ii) Electronic counters. 2.13 Explain the principle of signal of frequencies by measurement using the (i) cathode ray oscilloscope (ii) Digital methods. 2.14 Describe method of angular-velocity measurements using (i) mechanical tachometers (ii) The drag-cut tachometers (iii) the electro-magnetic pulse technique (iv) the photo-electronic technique (v) the stroboscope. 2.15 Describe temperature		• Function generators • Stop watches.			

	measurement using non-electrical methods involving (i) expansion of liquids (ii) expansion of vapors and gases (iii) expansion of solids.					
General Objective 3.0: Understand the principles of form measurement.						
5-6	3.1 State the principle and methods of straightness. 3.2 Explain flat measurement. 3.3 Describe thread measurement. 3.4 Determine gear measurement in terms of thickness. 3.5 Describe surface finish measurement. 3.6 Determine roundness measurement 3.7 Describe the practical applications of 3.1-3.6.	Explain activities of 3.1 to 3.7	Recommended textbook, White Marker Board, duster, Temporary Marker, Related videos, Lecture notes, Projector etc.	3.1 Identify all the instruments used in form measurement. 3.2 Demonstrate the working of all the instruments.	• Demonstrate the activities for the students to learn and guide them to practise all the activities. • Assess the students.	Explain the principles of form measurement
General Objective 4.0: Understand advances in measurement and instrumentation.						
7-8	4.1 Explain the basic concepts of lasers. 4.2 List types of lasers (DC and AC-laser Interferometer).	Explain activities of 4.1 to 4.8	Recommended textbook, White Marker Board,			Explain the recent advances in measurement and instrumentation

	4.3 Describe the practical applications of 4.1 and 4.2. 4.4 Explain straightness and alignment. 4.5 Enumerate the various probes and accessories. 4.6 List the various software packages used and their areas of applications. 4.7 Describe the concept of machine vision system. 4.8 Enumerate the various element and areas of applications.		duster, Temporary Marker, Related videos, Lecture notes, Projector etc.			
	General Objective 5.0: Understand the principles of industrial calibration					
9-10	5.1 Define calibration 5.2 Explain how calibration affects quality, productivity, and safety. 5.3 Explain the necessary conditions. 5.4 Define accuracy and precision.	Explain activities of 5.1 to 5.8	Recommended textbook, White Marker Board, duster, Temporary Marker, Related videos,	5.1 Identify common test equipment used as measurement standards for calibration of instruments. 5.2 Observe if an instrument is properly calibrated by examining the instrument input and output. 5.3 Identify zero shift, span	• Demonstrate the activities for the students to learn and guide them to practise all the activities. • Assess the students.	Explain the principles of industrial calibration

	5.5 Explain zero shift, span error, combined zero shift and span error, and non-linearity with a pattern of instrument readings on an input/output graph or calibration data sheet 5.6 Explain the following; • Calibrating Pressure and Differential Pressure Instruments • Calibrating Temperature Instruments • Calibrating Flow Instruments. 5.7 Explain Electrical Measurement & Calibration under: • Electrical units, traceability, and standards • Calibration of hand-held digital multimeters • Calibration of current and voltage sources • Calibration of decade resistance boxes • Error avoidance tactics for electrical		Lecture notes, Projector etc.	error, combined zero shift and span error, and non-linearity with a pattern of instrument readings on an input/output graph or calibration data sheet. 5.4 Identify the basic elements of a calibration set-up 5.5 Identify the input values for a five point. 5.6 Perform a five-point calibration check on an analog electronic pressure transmitter, a differential pressure transmitter, etc. 5.7 Calibrate a differential pressure transmitter used in an open tank or dip pipe, a closed tank with dry leg, and closed tank with wet leg. 5.8 Calibrate a magnetic flowmeter. 5.9 Calibrate Differential Pressure Switch & Safety Valve.		

	measurements.					
	General Objective 6.0: Comprehend the concept of digital control system					
11-12	6.1 Explain importance of and areas of application of control system. 6.2 Explain types of control systems (open-loop and closed-loop). 6.3 Describe continuous and sequential systems (with examples) as sub-divisions of open-loop control system. 6.4 Discribe continuous and on-off systems (with examples as sub-divisions of closed loop control system. 6.5 Explain the terms associated with a basic closed-loop control system. 6.6 State the advantages and disadvantages of a closed-loop system.	Explain activities of 6.1 to 6.6	Recommend ed textbook, White Marker Board, duster, Temporary Marker, Related videos, Lecture notes, Projector etc.	Identify the areas of application of digital control system in the laboratory. Demonstrate open and closed loops control systems in the laboratory	• Demonstrate the activities for the students to learn and guide them to practice all the activities. • Assess the students.	Explain the concept of automatic control system
	General Objective 7.0: Know the various control systems and its applications					
	7.1 Classify control system into branches of applications (i.e. speed control, position control, process control,	Explain activities of 7.1 to 7.8	Recommend ed textbook, White	Use MATLAB/Simulink (Toolboxes & Functions) to solve control system problems.	• Demonstrate the activities for the students to learn and guide them to	Explain various control systems and its applications

13-15	path control etc.). 7.2 Describe the concept of frequency response of a system. 7.3 Explain Nyquist diagram and Bode plots. 7.4 Illustrate with transfer functions and block diagram the types of control systems listed in 7.1. 7.5 Explain the general principle of determination of system time and frequency response (i.e. using step and ramp input signals.). 7.6 Find response for first and second order systems 7.7 Describe parameters of the response of a second order system (e.g. overshoot, rise time etc.). 7.8 Explain the use of MATLAB/Simulink (Toolboxes & Functions) to solve control system problems.		Marker Board, duster, Temporary Marker, Related videos, Lecture notes, Projector etc.		practice all the activities. • Assess the students.	

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Mechanics of Machines

COURSE CODE: MEC 315

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Subject: MECHANICS OF MACHINES	Code: MEC 315	Total Hours: 4 Hours/Week
		Theory: 2 Hours/Week
		Practical: 2 Hours/Week
Semester: FIRST	Pre-requisite: NIL	
Goal: This course is designed to acquaint student with knowledge and skills in the mechanics of machine elements.		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the basic concepts of links and plane mechanism
2	Understand friction, its effects, application and reduction
3	Know the concept of balancing of machines
4	Understand the functions and application of flywheels
5	Understand the basic principles of free and forced vibration and vibration isolation
6	Understand the transmission of power by belts, chains and gears
7	Know cam and cam follower dynamics

MECHANICS OF MACHINES

PROGRAMME: HIGHER NATIONAL DIPLOMA (HND) IN MECHANICAL ENGINEERING TECHNOLOGY (ALL OPTIONS)						
COURSE: MECHANICS OF MACHINES				COURSE CODE: MEC 315	CONTACT HOURS: 1-0-2 Hrs/Wk	
Goal: This course is designed to acquaint the student with knowledge and skills in the mechanics of machine elements.						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand the basic concepts of links and plane mechanism					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1	1.1 Define the following term: machine, link mechanism, kinematics pairs, inversion, etc. 1.2 Describe the fundamentals of simple plane mechanism e.g. slider crank, Oldham coupling 1.3 Differentiate between the types of kinematics constants 1.4 Solve problems involving 1.1 to 1.3	Explain 1.1 - 1.4 Illustrate with diagrams.	Recommended, Textbooks Marker, Whiteboard, Duster, • Stress jack apparatus • Sliding block, force board, etc.	1.1 Identify various links and plane mechanisms in machines (slider crank, oldham coupling, etc). 1.2 Demonstrate the operation of these mechanisms in the laboratory.	Demonstrate for the students to learn and ask them to perform the activities.	Explain basic concepts of links and plane mechanism
	General Objective 2.0: Understand friction, its effects, application and reduction					
2	2.1 Define friction 2.2 Define and state the factors which influence 2.1 2.3 Explain the difference between static, kinetic, sliding, rolling and fluid friction. 2.4 Analyse the kinetics of a body on a rough inclined plane. 2.5 Calculate the friction on	Explain 2.1 - 2.16		2.1 Conduct experiment to determine the co-efficient of friction between thread and nut using the screw jack apparatus. 2.2 Perform experiment on sliding block with (i) No lubrication (ii) Thin film lubrication (iii) Rolling support	Demonstrate for the students to learn and ask them to perform the activities.	Explain the application of friction, its effects, application and reduction

3-4	square and vee thread. 2.6 State the advantages and disadvantages of friction 2.7 Enumerate different types of clutches 2.8 Define the formula for the frictional torque in flat clutches conical clutches, and collars assuming uniform pressure and rate of wear. 2.9 Explain fluid friction. 2.10 Differentiate the different types of anti-friction bearing. 2.11 Describe the application of journal bearings. 2.12 Sketch the pressure distribution in a journal bearing 2.13 List the common lubricants and their properties 2.14 List the common solid lubricants and their properties. 2.15 Explain the effect of temperature on the viscosity of lubricants. 2.16 Explain the quantitative aspect of thin and thick film and their applications.					
	General Objective 3.0: Know the concept of balancing of machines					
5-6	3.1 Explain the importance of balancing of machines 3.2 Differentiate between	Explain 3.1 - 3.4	Marker, white board, projector,	3.1 Carry out primary and secondary balancing 3.2 Conduct experiment on	Demonstrate for the students to learn and ask them to perform	Explain the concept of balancing

	static and dynamic balancing 3.3 Find the magnitude and position of balancing mass for rotating bodies on the same plane or different planes. 3.4 Explain the principle, and use of typical dynamic balancing machine.		computer to play the video clips, recommended textbooks, Balancing wheels	static balancing of four mass system relating to flywheels such as mass, moment of inertia torque, turning moment diagrams, co-efficient of fluctuation of speed and energy, maximum, mean speed.	the activities.	of machines
General Objective 4.0: Understand the functions and application of flywheels						
7-8	4.1 Define the different terms relating to flywheels, such as, mass, moment of inertia, torque, turning moment diagrams, co-efficient of fluctuation of speed and energy, maximum, minimum, and mean speeds. 4.2 Distinguish between rim and disc types of flywheels. 4.4 Determine the size of the flywheel from the turning moment diagram and fluctuation of speed. 4.4 Explain the importance of turning moments in reciprocating engines 4.5 Explain D'Alembert's Principle 4.6 Calculate inertia forces of turning moment in reciprocating engines 4.7 Solve problems related to 4.5 and 4.6	Explain 4.1 - 4.7	Marker, whiteboard, projector, computer to play the video clips, recommended, Textbooks, Lecture notes • Flywheel and its accessories.	4.1 Conduct experiment to determine moment of inertia of a flywheel by falling wheel method. 4.2 Carry out experiment on fluctuation of speed with load on a working engine and how the flywheel operates	Demonstrate for the students to learn and ask them to perform the activities.	Explain the functions and application of flywheels

General Objective 5.0: Understand the basic principles of free and forced vibration and vibration isolation.						
9-10	5.1 Explain vibration, its effects and applications. 5.2 Define the terms amplitude, cycle, periods, frequency, phase angle, degrees of freedom, damping ratio, log development, and resonance. 5.3 Distinguish between longitudinal, transverse and torsional vibrations 5.4 Derive equations of motion for an undamped and damped spring-mass system in free translation vibration-single degree of freedom 5.5 Analyse the delay characteristics of under-damped, over-damped, and critically damped freely vibrating simple system. 5.6 Explain the basic concepts of vibration transmissibility and isolation in a spring system. 5.7 Solve problems related to above topics. 5.8 Coefficient using universal vibration apparatus. 5.9 Explain vibration in machines and required damping.	Explain 5.1 - 5.9	Marker, white board, Duster, projector, computer to play the video clips, recommended textbooks,	5.1 Perform experiment to demonstrate free and forced vibration spring-mass system. 5.2 Demonstrate delay characteristics of under-damped, over-damped, and critically damped freely vibrating simple system	Demonstrate for the students to learn and ask them to perform the activities.	Explain basic principles of free and forced vibration

	General Objective 6.0: Understand the transmission of power by belts, chain and gears					
11 -12	6.1 Differentiate between open and crossed belt drives and calculate the length of the belt used in each case 6.2 Explain the use of idler pulling connector, shaft pulley and stepped pulleys 6.3 Derive an expression relating initial tension to tension in the slack and tight sides of a belt. 6.4 Derive the maximum tension ratio in a flat belt and vee-belts. 6.5 Derive expressions for power transmitted belt drives. 6.6 State the condition of uniform motion in toothed gearing system 6.7 State the classification of V-belts by sizes and length 6.8 Define gear involute, addendum and reddendum, circular pitch, diametrical Pitch, module, pressure angle. 6.9 State the advantages of gear drives over belts, rope, and chain drives 6.10 Distinguish between simple and compound gear train. 6.11 Define epicyclic gear train.	Explain 6.1 - 6.15	Marker, white board, Duster, projector, computer to play the video clips, recommended textbooks, • Belt drives, Belt, • Gear trains	6.1 Conduct experiment to determine the coefficient of friction for flat and vee-belts. 6.2 Conduct experiment to determine the velocity ratio of epicycles gear trains	Demonstrate for the students to learn and guide them to perform the activities.	Explain the principles of transmission of power by belts, chain and gears

	6.12 State the advantages and disadvantages of epicyclic gear train. 6.13 Calculate the velocity ratio of epicyclic gear trains. 6.14 Sketch typical examples of coupling 6.15 Describe power transmission by hydraulic means.					
	General Objective 7.0: Know cam and cam follower dynamics					
13-15	7.1 List types of cam and cam follower 7.2 Describe cam follower motion and applications. 7.3 Explain cam functional considerations 7.4 Explain cam design and manufacturing considerations. 7.5 Solve problems related to cam and cam follower	Explain 7.1 – 7.5		7.1 Demonstrate the operation of cam and cam follower in the laboratory. 7.2 Perform simple cam and cam follower design.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the principles of cam and cam follower dynamics

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Machine Element Design I

COURSE CODE: MEC 316

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Subject:	Code: MEC 316	Total Hours: 4 Hours/Week
Semester: FIRST	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: The course is designed to acquaint students with knowledge and skills on design of machine elements		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the criteria for machine elements' design
2	Understand principle of joint design
3	Know power transmission and couplings design
4	Understand V-belts and chain drives design
5	Understand the types and design of clutches
6	Know the types and design of brakes

MACHINE ELEMENT DESIGN I

PROGRAMME: HIGHER NATIONAL DIPLOMA MECHANICAL ENGINEERING TECHNOLOGY - ALL OPTIONS						
COURSE: MACHINE ELEMENT DESIGN			Course Code: MEC 316		Contact Hours: 2-0-2 HRS/WK	
Goal: The course is designed to acquaint students with knowledge and skills on design of machine elements						
Course Specification: THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	General Objective 1.0: Know the criteria for machine elements' design					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-3	1.1 Define machine elements 1.2 List source machine elements 1.3 Explain the build-up of machine elements to form sub-assemblies 1.4 Explain the build-up of sub-assemblies to form a machine 1.5 Explain the criteria for machine Elements design. 1.6 Explain the interplay of function, strength, materials, manufacturing facility and lost in Machine element design.	Explain 1.1 to 1.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Machine sub-assembly Different Machine Element Mechanism models Practical guide	1.1 Identify various elements of a machine. 1.2 Identify the basic criteria used in design of machine elements	Demonstrate for the students to learn and allow them to perform the activities	Explain the criteria for machine elements" design
	General Objective: 2.0 Understand principle of joint design					
4-6	2.1 Classify types of joint into permanent and non-permanent 2.2 Describe different types of rivets 2.3 Calculate the dimensions of riveted joints	Explain 2.1 to 2.2	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Riveted joints • Welded joints	2.1 Identify permanent and non-permanent joints. 2.2 Carryout the design of bolted joints that are subjected to tensile load and or torque.	Demonstrate for the students to learn and allow them to perform the activities	Explain the principles of joint design

	2.4 Design bolted joints that are subjected to tensile load and or torque.		• Bolted joints • Practical guide, etc			
	General Objective: 3.0: Know power transmission and couplings design					
7-8	3.1 Explain the principles of operation of different types of transmission-friction, drive, cylindrical and conical, belt drive, keys and coupling, etc. 3.2 List with examples the use of these devices 3.3 Describe the stress on the different types of couplings.	Explain 3.1 to 1.3	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc • Couplings • Practical guide.	3.1 Identify different couplings 3.2 Identify criteria used in coupling design 3.3 Carry out design of couplings. 3.4 Analyse the stress on the different types of coupling.	Demonstrate for the students to learn and allow them to perform the activities	Explain power transmission and couplings design
	General Objective 4.0: Understand V-belts and Chain drives design					
9-10	4.1 Describe V-belt and chain drives 4.2 Describe the V-belt drive in terms of normal design parameters 4.3 State the standard dimensions of V-belts rated A,B,C,Z,Y. 4.4 Classify chains and sprockets. 4.5 State the criteria for the design of chain drives 4.6 Describe the following: (a) Chain drives lubrication (b) Drip feed lubrication (c) Shallow belt lubrication	Explain 4.1 to 4.8	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Belts • Chains • Sprockets • Design materials • Practical guide	4.1 Identify V-belt and chain drives 4.2 Identify chains and sprockets 4.3 Identify the criteria for the design of belt and chain drives 4.4 Carry out the selection and design of belt and chain drives 4.5 Point out area of lubrication of belt and chain drives	Demonstrate for the students to learn and allow them to perform the activities	Explain the steps in V-belts and Chain drives design

	(d) Disc or swinger lubrication. 4.7 Describe oil stream lubrication. 4.8 Solve problems related to belt and chain drives.					
General Objective: 5.0 Understand the types and design of clutches						
11-12	5.1 List types of clutches plate-type, cone-type, slip-clutch, air-actuated type etc 5.2 State the performance parameters involved in the rating of clutches 5.3 Describe two basic methods used to determine torque capacity required of a clutch 5.4 Describe the application of clutches in 5.1 above	Explain 5.1 to 5.4	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Clutches • Design materials • Practical guide	5.1 Identify different types of clutches - Plate type - Cone type - Slip clutch - Air - a - chated 5.2 Identify and select the parameters in the rating and design of clutches. 5.3 Carryout the design of a clutch.	Demonstrate for the students to learn and allow them to perform the activities	Explain types and design of clutches
General Objective 6.0: Know the types and design of brakes						
13-15	6.1 List types of brake systems in use e.g., friction type, plate type, cone type etc. 6.2 State the performance parameters involved in the design and rating of brake systems 6.3 Describe the applications of each type of brake system in 6.1 above	• Explain 6.1 to 6.3	Recommended textbooks, Projectors, Lecture notes, • Brake system dismantled from a vehicle • Models • Practical guide	6.1 Identify the types and application of brake items - friction, plate, cone types. 6.2 Identify and select the parameters in the design and rating of brake systems. 6.3 Carryout the design of a complete brake system	Demonstrate for the students to learn and allow them to perform the activities	Explain types and design of brakes

**SECOND SEMESTER
COURSES**

PROGRAMME: Higher National Diploma (HND) In Mechanical Engineering Technology

COURSE: Project Management

COURSE CODE: MEC 321

CONTACT HOURS: 30 (2 Hours/Week Lecture Only)

CREDIT UNIT 2.0

Subject:	Code: MEC 321	Total Hours:	2 Hours/Week
		Theoretical hours:	2 Hour/Week
		Practical hours:	0 Hour/Week
Semester: SECOND	Pre-requisite: NIL		
Goal: This course is designed to acquaint students with analytical tools/techniques in project management as well as develop hands-on skills on the use of computer software for project management, risk management, and resources optimization.			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the meaning of project, its attributes, concepts and context
2	Know project scope management.
3	Understand project time management: Planning, Scheduling and Controlling
4	Know project cost management
5	Understand project quality and risk management
6	Utilize Microsoft Project software to implement and manage a project
7	Know how to terminate and review a project.

PROJECT MANAGEMENT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: PROJECT MANAGEMENT			COURSE CODE: MEC 321		CONTACT HOURS: 2HOURS/WEEK	
GOAL: This course is designed to acquaint the students with analytical tools/techniques in project management as well as develop hands-on skills on the use of computer software for project management, risk management, and resources optimization.						
General Objective 1.0: Understand the meaning of project, its attributes, concepts and context.						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT -		
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
1 - 2	1.1 Define a project.	Explain the following: - project. - project management - the relationship between project management and other management disciplines. - the attributes of a good project. - project stakeholders. - roles of a project manager - phases of project management - stages of a major project (project life cycle).	Recommended textbooks, Lecture notes, Whiteboards, markers, projectors and case studies.			Explain the meaning of project, its attributes, concepts and context.
	1.2 Define project management.					
	1.3 Explain the relationship between project management and other management disciplines.					
	1.4 State the attributes of a good project.					
	1.5 Explain project stakeholders.					
	1.6 State the roles of a project manager.					
	1.7 Explain the phases of project management.					
	1.8 State the stages of a major project (project life cycle – initiation, planning, implementation and closing).					

GENERAL OBJECTIVE 2.0: Know project scope management						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
2- 4	1.9 Define project scope. 1.10 State project objectives. 2.3 Enumerate project requirements. 2.4 Explain how to generate project ideas. 2.5 Define feasibility study 2.6 Explain the procedures for determining feasibility of a project. 2.7 Use case studies and group discussions to illustrate activities 2.1 to 2.6 above.	Explain: - project scope. - project objectives. - project requirements. - project ideas. - procedures for determining feasibility of a project. Guide the students through the case studies and group discussions.				Explain project scoping.
GENERAL OBJECTIVE 3.0: Understand project time management: planning, scheduling and controlling						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
5-6	3.1 Define Work breakdown Structure (WBS). 3.2 Explain the components of WBS 3.3 Describe precedence relationships using WBS 3.4 Apply WBS in sequencing project tasks	Explain: - work breakdown Structure (WBS). - precedence relationships. - sequencing project tasks. - network diagrams (PERT/CPM analyses) and critical path. Guide the students through the case studies				Explain the concept of project planning, scheduling and controlling.

	3.5 Use WBS in precedence diagrams. 3.6 Explain the meaning of milestones, activity sequencing, network diagrams (PERT/CPM analyses) and critical path. 3.7 Estimate cost and time in network diagrams of specific project examples. 3.8 Solve problems involving critical path 3.8 Create Gantt charts for specific projects	and group discussions.				
GENERAL OBJECTIVE 4.0: Know project cost management						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
7- 8	4.1 Define the following terms: - Resource planning - Estimating - Budgeting - Control 4.2 Estimate cost in network diagrams of specific project examples. 4.3 Use case studies and group discussions to illustrate activities 4.1 and 4.2 above.	Explain: - resource planning. - estimating. - budgeting. - control. Guide the students through the case studies and group discussions.				Explain project resource planning, estimating, budgeting and Control.
GENERAL OBJECTIVE 5.0: Understand project quality and risk management						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation

9-11	5.1 Define the terms, „project quality planning” and „project risk management”. 5.2 List the tools and techniques used in project quality planning and risk management. 5.3 Explain the following as applied to project quality: - Control limits - Normal distribution - Standard deviation - Sigma levels and six sigma. 5.4 Explain the procedures in project risk identification, evaluation and mitigation. 5.5 Use case studies and group discussions to illustrate activities 5.1 to 5.4 above.	Explain activities 5.1 to 5.5. Guide the students through the case studies and group discussions.				Explain project quality and risk management
GENERAL OBJECTIVE 6.0: Utilize Microsoft Project Software to implement and manage a project						
Week	Specific Learning Objectives	Teacher’s Activities	Learning Resources	Specific Learning Objective	Teacher’s Activities	Evaluation
11-12	6.1 Explain the impact of Microsoft Project and the Microsoft Application Suite on project management as it applies to planning and managing real world projects. 6.2 Describe how to assign tasks and resources using MS Project.	Explain activities 6.1 to 6.8. Guide the students through the case studies and group discussions.	PCs with MS Project 2016 licensed software			Explain the procedures in utilizing MS Project to implement and manage a project,

	6.3 Fine-tune tasks and resources using MS Project. 6.4 Format project schedule and information. 6.5 Apply project schedule tracking feature in MS Project. 6.6 Integrate Microsoft Project with other programs. 6.7 Optimize the use of project schedule using Gantt Charts. 6.8 Manage multiple projects while working with a resource pool.					
GENERAL OBJECTIVE 7.0: Know how to terminate and review a project						
Week	Specific Learning Objectives	Teacher's Activities	Learning Resources	Specific Learning Objective	Teacher's Activities	Evaluation
13-15	7.1 State the key activities in project completion. 7.2 Explain the procedures involved in the following: - contract closure - releasing the project team. - final payments. - post project evaluations. - trust and alignment effectiveness. - customer satisfaction, etc. 7.3 Use case studies and group discussions to illustrate activities 7.1 to 7.2	Explain activities 7.1 to 7.3. Guide the students through the case studies and group discussions.				Explain the processes of termination and review of a project.

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Mechanical Structural Analysis

COURSE CODE: MEC 322

DURATION: 45 Hours (2 Hours - Lecture, 1 Hour - Practical)

CREDIT UNIT: 3.0

Subject: Mechanical Structural Analysis	Code: MEC 322	Total Hours: 3 Hours/Week
		Theory: 2 Hours/Week
		Practical: 1 Hour/Week
Semester: SECOND	Pre-requisite: NIL	
Goal: This course is designed to enable students use the knowledge of stress, strain and deformation to analyse real-life mechanical structures.		

GENERAL OBJECTIVES	
On completion of this module students should be able to:	
1	Comprehend forces in members of statically determinate and simple intermediate Structure.
2	Analyze and solve problems in statically determinate structures.
3	Understand the bending theory and its application.
4	Apply the concept of shearing force and bending moment diagrams.
5	Predict Structural Stability of a beam from deflection point of view.
6	Derive and apply the 3-moment equations governing continuous beam behaviors.
7	Know Castigliano's theorem and apply it to solve problems of deflection of curved bars.
8	Understand factors which affect eccentrically loaded columns.
9	Know spring elements for different engineering applications.
10	Understand theorems applicable to failure and mode of failure of materials subjected to complex stresses.

MECHANICAL STRUCTURAL ANALYSIS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (ALL OPTIONS)						
COURSE: MECHANICAL STRUCTURAL ANALYSIS				COURSE CODE: MEC 322		CONTACT Hours: 2-0-1 Hrs/Wk
Goal: This course is designed to enable students use the knowledge of stress, strain and deformation to analyse real-life mechanical structures.						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand forces in members of statically determinate and simple intermediate structure					
Week	Specific Learning Outcome	Teacher's Activity	Resources	Specific Learning Outcome	Teacher's Activity	Evaluation
1	1.1 State the conditions for equilibrium of concurrent and co-planer forces 1.2 State the assumptions made in the analysis of pin-jointed structures. 1.3 Define statically determinate structure. 1.4 Define an indeterminate structure. 1.5 Define a stable indeterminate structure.	Explain 1.1-1.5.	Projector, Slides, PCs, Textbooks, marker board and markers. Force board apparatus. Models of trusses • Beam rake apparatus. • Tensile test equipment with digital read-out of load and deformation measurement.	1.1 Determine UTS, its modulus of Elasticity, stress at yield point, Elongation and contraction in X-sectional area of a specimen by UTM. through necking phenomenon. 1.2 Determine the angle of twist for a given torque by torsion apparatus and to plot a graph between torque and angle of twist	Demonstrate for the students to learn and guide them to perform the activities.	Explain forces in members of statically determinate and simple intermediate Structure
	General Objective 2.0: Analyze and solve problems in statically determinate structures					
2	2.1 Determine forces in statically determinate frame members by: a. Analytical method b. Graphical method c. Method of section 2.2 Solve problem related to above using the 3 methods	Explain 2.1-2.8.	Projector, Slides, PCs, marker and whiteboard. SolidWorks, ANSYS-Metaphysics software. .	2.1 Determine Rockwell Hardness Number and Brinell Hardness Number of a sample. 2.2 Determine the Shock Resistance of different qualities of materials by Izod's test and	Demonstrate for the students to learn and guide them to perform the activities.	State the procedure to determine forces in statically determinate frame members by: Analytical method b. Graphical method c. Method of

	2.3 Compute shearing force and bending moment in loaded beams 2.4 Relate the intensity of loading and the bending moment 2.5 Calculate the second moment of area for simple cases. 2.6 Use the parallel and perpendicular axis theorems to compute the second moment of area I 2.7 Establish the bending equation			Charpy test. 2.3 Use software to analyze and simulate frame structures and beams.		section. Establish the relationship between intensity of loading and bending moment in a loaded member.
General Objective 3.0: Understand the bending theory and its application						
3 -4	3.1 State various types of beams as differentiated in their: a. Supports: Simple and Rigid b. Loading: Point or concentrated load, uniformly distributed load (UDL) and mixed loading. 3.2 Apply static equilibrium laws of forces and moments to the determination of beam supports 3.3 Apply simple bending theory to the analysis of beams in flexure. 3.4 Determine longitudinal stress on a beam due to bending.	Explain 3.1-3.4 and solve exercises.	Projector, Slides, PCs, marker board and markers. UTM. Beam with central point load and beam with two point load. SolidWorks, ANSYS-Metaphysics software.	Determine the ultimate crushing strength of materials like steel and copper and compare their strength	Demonstrate for the students to learn and guide them to perform the activities.	State static equilibrium laws of forces and moments.

	General Objective 4.0: Comprehend the concept of shearing force and bending moment diagrams					
5	4.1 Derive the expression for shearing stress at any point in a beam section in flexure. 4.2 Calculate the shearing stress distribution in a symmetric homogenous beam section in flexure. 4.3 Solve problems related to above. 4.4 Draw shear force and bending moment diagrams.	Explain 4.1-4.4 and solve application problems as examples.	Projector, Slides, PCs, marker board and markers. Universal testing machine (UTM). SolidWorks, ANSYS-Metaphysics software.	4.1 Perform double shear test on mild steel specimen. 4.2 Use software to solve and simulate application problems.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the concept of shearing force and bending moment diagrams
	General Objective 5.0: Know structural stability of a beam from deflection point of view					
6	5.1 Explain the double-integration method of analyzing deflection in beams 5.2 Use double integration method to analyze deflection of various types of loaded beams. Solve problems. 5.3 Sketch slope and deflection curves 5.4 Derive Macaulay's equation for deflection caused by concentrated and uniformly distributed loads. 5.5 Determine the value and position of maximum deflection	Explain 5.1-5.5	Projector, Slides, PCs, marker board and markers. Beam apparatus. SolidWorks, ANSYS, MATLAB and Simulink software.	5.1 Determine experimentally the value of „E“ for a steel beam by method of deflection for different loads. 5.2 Determine the Max-Fiber stress in X-section of simply supported beam with concentrated loads and to find the neutral axis of the section. 5.3 Use SolidWorks or ANSYS software to model exercises on beam deflection.	Demonstrate for the students to learn and guide them to perform the activities.	Explain structural stability of a beam from deflection point of view
	General Objective 6.0: Understand 3-moment equations governing continuous beam behaviours.					
	6.1 Distinguish amongst	Explain 6.1 to 6.4.	UTM or any	3.2 Perform experiment	Demonstrate for the	Derive the 3-

7	continuous beams. 6.2 Derive the 3-moment equation. 6.3 Use the 3-moment equation to determine reaction at simple supports of continuous beams 6.4 Use the 3-moment equation to determine reaction at supports of continuous beams built in at one end.		continues beam apparatus. SolidWorks, ABAQUS, ANSYS, MATLAB and Simulink software.	on the continuous beam apparatus to determine reactions at supports. Determine the bending moment at a given section of a simply supported beam for different loading.	students to learn and guide them to perform the activities.	moment equation and apply it to determine reaction at (i) supports of a simply supported continuous beam (ii) supports of continuous beams built in at one end.
General Objective 7.0: Understand Castigliano's theorem and apply it in solving problems of deflection of curved bars.						
8	7.1 Calculate strain energy due to bending. 7.2 Prove Castigliano's theorem. 7.3 Apply Castigliano's theorem. 7.4 Calculate strain energy due to twisting 7.5 Solve problems related to 7.1 to 7.4.	Explain 7.1 to 7.5.	UTM or any applicable apparatus. SolidWorks, ABAQUS, ANSYS, MATLAB and Simulink or any applicable software.	7.1 Determine the ultimate crushing strength of materials like steel and copper bars and compare their strength	Demonstrate for the students to learn and guide them to perform the activities.	Explain Castigliano's theorem and apply it to solve problems of deflection of curved bars.
General Objective 8.0: Understand factors which affect eccentrically loaded columns						
9	8.1 Define columns 8.2 Analyze the effect of shape, length and restraints on load carrying capacity of columns with mathematical relationships. 8.3 Calculate safe load on columns loaded axially.	Explain 8.1 to 8.9.	UTM or any applicable apparatus. SolidWorks, ANSYS or any relevant software.	8.1 Perform experiment using the strut testing rig to determine creeping loads for metallic structures when (a) Both ends are fixed (b) Both ends are free (c) One end free and one end fixed.	Demonstrate for the students to learn and guide them to perform the activities.	Explain factors which affect eccentrically loaded columns

	8.4 Differentiate between crushing load and buckling load on columns. 8.5 Solve problems relating to above topics.			8.2 Use SolidWorks and/or ANSYS software to model		
10-11	8.6 Explain slenderness ratio of columns/struts 8.7 Calculate site load on columns loaded eccentrically. 8.8 Derive the cosine equation for eccentrically loaded columns. 8.9 Solve problems related to above.					
General Objective 9.0: Comprehend spring elements for different engineering applications.						
12-13	9.1 Describe a close-coiled helical spring. 9.2 Derive an expression for maximum shear stress in a close-coiled helical spring under axial load 9.3 Calculate the axial deflection of a close-coiled helical spring. 9.4 Derive the expression for an angular spring under axial load 9.5 Derive an expression for the stress in a laminated spring. 9.6 Determine the proof load in a laminated spring. 9.7 Determine the maximum deflection of a	Explain 9.1 to 9.9	Slides, PCs, marker board and markers. UTM or Helical Spring Tester, Leaf spring testing machine, Universal hardness tester, Izod impact tester, Charpy tester. Fatigue tester and Creep tester. Analysis tools (SolidWorks and ANSYS)	9.1 Determine the various parameters of helical coil spring 9.5 Use analysis software to simulate computer models of 9.1 to 9.3.	Demonstrate for the students to learn and guide them to perform the activities.	Explain spring elements for different engineering applications

	laminated spring. 9.8 Calculate the strain energy stored in a laminated spring. 9.9 Solve problems related to laminated spring.					
	General Objective 10.0: Understand the theorems applicable to failure and the mode of failure of materials subjected to complex stress situations					
14-15	10.1 Describe maximum strain theory of St. Venant. 10.2 Explain Rankine's maximum principal stress theorem. 10.3 Explain Guest's maximum shear stress theorem. 10.4 Explain Von Mises total distortion energy theorem. 10.5 Apply Von Mises total distortion energy theorem to predict stability or otherwise in a combined stress system. 10.6 Solve problems related to 10.1 to 10.5.	Explain 10.1 to 10.6	Projector, Slides, PCs, marker board and markers. Universal testing machine (UTM). SolidWorks, ANSYS-Metaphysics software.	Solve industrial and real life mechanical structural analysis problems using Solid Works or ANSYS Metaphysis software	Demonstrate for the students to learn and guide them to perform the activities. Plan assignments so as to promote problem solving abilities and develop continued learning skills.	Explain the theorems applicable to failure and the mode of failure of materials subjected to complex stress situations

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: ADVANCED FLUID MECHANICS

COURSE CODE: MEC 323

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Subject: ADVANCED FLUID MECHANICS	Code: MEC 323	Total Hours: 4 Hours/Week
		Theoretical hours: 2 Hours/Week
Semester: SECOND	Pre-requisite: NIL	Practical hours: 2 Hours/Week
Goal: The course is designed to provide student with knowledge and skills in fluid flow measuring devices, internal, external and compressible fluid flows and their application in rotor dynamics and positive displacement machines.		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the working principles and the use of different types of fluid flow measuring devices.
2	Understand the basic principles and governing equations of internal fluid flow.
3	Know the basic principles and governing equations of external fluid flow.
4	Understand the basic principles and governing equations of compressible flows
5	Understand the basic principles and governing equation of computational fluid dynamics (CFD)
6	Understand the application of all the fluid flows principles in rotor dynamic machines.
7	Understand the application of all the fluid flows in positive displacement machines.

ADVANCED FLUID MECHANICS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (ALL OPTIONS)						
COURSE: ADVANCED FLUID MECHANICS				COURSE CODE: MEC 323		CONTACT Hours: 2-0-2Hrs/Wk
Goal: The course is designed to provide student with knowledge and skills in fluid flow measuring devices, internal, external and compressible fluid flows and their application in rotor dynamics and positive displacement machines						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand the working principles and the use of different types of fluid flow measuring devices.					
Week	Specific Learning Outcome	Teacher’s Activity	Resources	Specific Learning Outcome	Teacher’s Activity	Evaluation
1-2	1.1 List various fluid flow measuring devices. 1.2 Explain the working principles of the devices for measuring the following parameters: □ Pressure □ Velocity □ Density □ Viscosity □ Surface Tension □ Head (Displacement), etc.	Explain 1.1 - 1.2	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc. Orifice meter -Venturi meter - Flow nozzles - Notches (rectangular & - V- notch - Viscometer - Manometer - Tensiometer - Capillary Tube - Hydraulic Bench with accessories	1.1 Identify each of the fluid measuring devices. 1.2 Measure parameters: pressure, velocity, density, viscosity, surface tension, head displacement using fluid measuring devices	Demonstrate for the students to learn and guide them to perform the activities.	Explain working principles and the use of different types of fluid flow measuring devices
	General Objective 2.0: Understand the basic principles and governing equations of internal fluid flow.					
	2.1 Define the following: □ Fluid Dynamics □ Static Pressure □ Dynamic Pressure □ Stagnation and Total Pressure	Explain 2.1 - 2.11	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc. • Orifice meter	2.1 Perform experiments to verify the following: □ conservation of mass, □ conservation of energy and □ conservation of	Demonstrate for the students to learn and guide them to perform the activities.	Explain basic principles and governing equations of internal fluid flow

3-5	▢ Streamline ▢ Stream Tube ▢ Control Volume. 2.2 Classify different fluid behaviours: ▢ Steady and Unsteady ▢ Uniform and non-uniform ▢ One dimension and multi dimension ▢ Viscid and Inviscid ▢ Compressible and Incompressible ▢ Ideal and Real 2.3 State the conservation of mass equation 2.4 State the conservation of energy equation 2.5 Explain conservation of energy equation (Bernoulli Equation). 2.6 Explain flow measurement using Bernoulli Equation. 2.7 Solve problems involving the following: ▢ Venturi meter, ▢ Orifice meter ▢ Pitot-static tube 2.8 Explain flow regimes: laminar,		• Venturi meter • Pitot Static Tube ▢ Hydraulic Bench with accessories	momentum equations. 2.2 Perform experiments to demonstrate the following: ▢ Laminar Flow ▢ Transition Flow ▢ Turbulent		

	transition and turbulent flows. 2.9 State Darcy formula and momentum equation. 2.10 Explain the concept of fluid power. 2.11 Solve problems involving 2.3 to 2.10.					
	General Objective 3.0: Understand the basic principles and governing equations of external fluid flow.					
6-7	3.1 State the regimes of external flows. 3.2 Describe different regimes of external flows. 3.3 Define the term, „Drag Coefficient“. 3.4 Explain the concept of boundary layer. 3.5 Solve problems involving 3.1 to 3.4 above.	Explain 3.1 - 3.5	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc. Open Channel Flow Apparatus with accessories. Orifice meter. Venturi meter	3.1 Perform experiments to demonstrate different regimes in external flow.	Demonstrate for the students to learn and guide them to perform the activities.	.Explain basic principles and governing equations of external fluid flow
	General Objective 4.0: Understand the basic principles and governing equations of compressible flows					
8-9	4.1 Define the term, „compressible flow“ 4.2 State the governing equations and the assumptions in compressible flows. 4.3 Derive the expression for speed of	Explain activities 4.1 - 4.8	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc. Hydraulic Bench with	4.1 Perform experiments to demonstrate the following: - Compressible flows - Compressible flow regimes. - Compressible	Demonstrate for the students to learn and guide them to perform the activities.	.Explain basic principles and governing equations of compressible flows

	sound in fluids. 4.4 Define Mach Number and its associated flow regimes for compressible fluid flow. 4.5 Explain the term „compressibility factor“ 4.6 State the energy equation for frictionless adiabatic gas processes. 4.7 Describe the stagnation properties of compressible flow. 4.8 Solve problems involving 4.2 to 4.7 above.		accessories	factor. - Stagnation properties of compressible flows. - Mach Number and associated flow regimes.		
General Objective 5.0: Understand the basic principles and governing equation of computational fluid dynamics (CFD)						
10-11	5.1 Define CFD. 5.2 State the governing equations e.g Continuity, Navier Stokes (Momentum)/ Energy Equations and Equation of State. 5.3 Explain time averaging procedure and turbulence modelling in CFD. 5.4 Suggest solution procedures of the difference equations. 5.5 Enumerate the boundary conditions 5.6 Describe velocity-pressure coupling and its solution using SIMPLE algorithm.	Explain 5.1 - 5.7	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc. PCs, CFD Software: - CFX/ANSYS, FLUENT, PHOENICS and STAR-CD - PATRAN, IDEAS.	5.1 Use a CFD code (FLUENT) to model and simulate simple fluid dynamic problem	Demonstrate for the students to learn and guide them to perform the activities.	Explain basic principles and governing equation of computational fluid dynamics (CFD).

	5.7 Enumerate commercial CFD codes with emphasis on principles and structures: - CFX/ANSYS, FLUENT, PHOENICS and STAR-CD - PATRAN, IDEAS.					
General Objective 6.0: Understand the application of all the fluid flows principles in rotor dynamic machines.						
12-13	6.1 Classify hydraulic machines as positive displacement and rotor-dynamic machines. 6.2 Give at least 3 examples for each type of machines above. 6.3 Describe the main rotor dynamic machines. 6.4 Explain the working principles of rotor-dynamic machines. 6.5 Solve problems on rotor dynamics machines.	Explain 6.1 - 6.5	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc. Gear pumps, rotary compressors, and centrifugal pumps and their accessories	6.1 Identify different rotor-dynamic machines and functions of their component parts. 6.2 Perform experiments to demonstrate the working principles of each machines.	Demonstrate for the students to learn and guide them to perform the activities.	Explain application of all the fluid flows principles in rotor dynamic machines.
General Objective 7.0: Understand the application of all the fluid flows in positive displacement machines.						
14-15	7.1 List types of positive displacement machines. 7.2 Describe the features of these machines. 7.3 Explain their working principles. 7.4 Solve problems on positive displacement machines.	Explain 7.1 - 7.4	Textbook, White Board, Marker, Related videos, Projectors, Lecture notes, etc Reciprocating pumps, reciprocating compressors and their accessories	7.1 Identify different displacement machines and functions of their component parts. 7.2 Perform experiments to demonstrate the working principles of each the machines.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the application of all the fluid flows in positive displacement machines.

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Safety and Environmental Engineering

COURSE CODE: MEC 324

DURATION: 30 Hours (2 Hours - Lecture, 0 Hour - Practical)

CREDIT UNIT: 2.0

Subject: Safety and Environmental Engineering	Code: MEC 324	Total Hours: 2 Hours/Week
		Theory: 2 Hours/Week
		Practical: 0 Hour/Week
Semester: SECOND	Pre-requisite: NIL	
Goal: This course is designed to enable students acquire knowledge and skills of safety practice and the importance of environmental control		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Appreciate the importance of safety and safety inspection in the industry
2	Recognize the causes and ways of preventing industrial accidents not caused by fire
3	Know the various causes, prevention of fire and ways to fight it in the industry
4	Appreciate the factories act and the principles involved in the factory law
5	Comprehend the various types of Environmental pollution and their effects on the environment
6	Recognize the methods of onsite handling storage and processing of liquid and solid wastes
7	Appreciate the generation and collection of liquid and solid wastes
8	Comprehend the equipment and methods for processing, transfer and transport of liquid and solid wastes
9	Understand the source and utilization of various forms of energy from waste materials
10	Know the steps in implementing Environmental Standards

SAFETY AND ENVIRONMENTAL ENGINEERING

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (ALL OPTIONS)						
COURSE: SAFETY COURSE CODE: MEC 324				CONTACT HOURS: (2,0,0)Hrs/WK		
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Appreciate the importance of safety and safety inspection in the industry					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 – 2	1.1 Explain industrial safety and its impact on profit maximization 1.2 Outline the importance of accident prevention and role of workers in achieving it in the industry 1.3 Explain safety and the following terms: (a) Safety audits (b) Formal inspection (c) hazard spotting (d) Specific inspection and identify the relationship between them and the appropriate places where they apply. 1.4 State the workers responsible for inspections listed in 1.3 1.5 Explain the areas to concentrate during safety inspections	Explain 1.1 to 1.5	•Recommended textbooks • white board, markers, videos, projector • Helmet, Goggle, Gloves, Safety boots, coverall, etc.	1.1 Identify the different personal protective equipment (PPE) and practise the use of each of them. 1.2 Identify the roles of shareholders, managers, supervisors and other workers in contributing towards accidents prevention in industry. 1.3 Carry out the following safety inspection (i) safety audits (ii) formal inspection (iii) hazard spotting (iv) specific inspections	Guide students to identify the different personal protective equipment(PPE) and practise the use of each of them Guide students to identify the rolesof shareholders, managers, supervisors and other workers in contributing towards accidents prevention in industry Guide students to carry out the following safety inspection: -safety audits -formal inspection -hazard spotting specificinspections	Explain the importance of safety and safety inspection in the industry.
	General Objective 2.0: Recognize the causes and ways of preventing industrial accidents not caused by fire					

	2.1 Outline the various factors that undermine industrial safety	Explain activities 2.1 to 2.10 with diagrams where necessary and	Same as above	2.1 Identify the types of accidents in various workshop	Guide students to: Identify the types	Outline the various factors

5	3.1 Describe the following causes of fire and how to prevent them: i. electricity ii. Welding and cutting operation, sparks from power units, ignition from chemical actions, smoking 3.2 Enumerate the factors which constitute „Bad house keeping“ in industrial and business premises and how they can lead to incidences of fire 3.3 Explain how heating appliances constitute very common fire hazard and how to prevent fire from them. 3.4 Define the three factors that are essential for combustion to take place and show that the principles of fire extinguishing lies in the elimination of one or more of the factors. 3.5 Describe the general course of action to be adopted by an industrial or business premises in case of fire including such things as evacuation signal, allocation of duties. 3.6 Classify fire and	Explain activities 3.1 to 3.12 with diagrams where necessary and make detailed notes.		3.1 Identify various causes and prevention of fire in industry 3.2. Carryout various structural fire precautions installed in industrial and business premises. 3.3 Use manual and automatic fire extinguishers and demonstrate how to use them	Guide students to identify various causes and prevention of fire in industry Guide students to carryout various structural fire precautions installed in industrial and business premises Guide student to use manual and automatic fire extinguishers and demonstrate how to use them	• Explain the causes of fire and how to prevent them as listed in 3.1. • Enumerate the factors, which constitute „Bad house keeping“ in industrial and business premises and how they can lead to incidences of fire. • Explain how heat appliance constitute very common fire hazard and how to prevent fire from them • Define the three factors that are essential for combustion to take place and show that the principle of fire extinguishing lies in the elimination of one or more of the factors. • Describe the general course of action to be adopted by an industrial or business premises in

	associate the various classes with their methods of extinguishing. 3.7 List the different types of a manual fire extinguisher. 3.8 Explain the operation of manual fire extinguisher such as buckets water types foam, vapourizing liquid, dry powder and carbondioxide. 3.9 Select a manual fire extinguisher and demonstrate its use. 3.10 List the different types of automatic fire extinguishers and explain their operation e.g. automatic sprinklers, drencher systems, water spray systems etc. 3.11 List the different types of automatic fire detection systems and explain their operation. 3.12 Explain salvage considerations and fire insurance.					case of fire including such things as evacuation signals, allocation of due ties • Explain salvage considerations and fire insurance
	General Objective 4.0 Appreciate the factory act and the principles involved in factory law					
6	4.1 Give a general definition of a factory as given by the factories act. 4.2 State the factory Act. 4.3 Outline the general health safety and welfare	Explain activities 4.1 to 4.4 with diagrams where necessary and make detailed notes.				Explain the factory act and the principles of factory law

	provisions of the factories Act. 4.4 Explain factory law as it relates to the use and maintenance of machinery, factory buildings, health and safety at work					
GENERAL OBJECTIVE 5.0: Comprehend the various types of pollution, environmental pollution and their effects on the environment						
7– 8	5.1 Explain pollution and environmental pollution and what constitutes environmental pollution 5.2 State the relationship between pollution and pollutants 5.3 State pollution expected in various work environments and show how they can be measured with reference to 5.1 above 5.4 Describe the effects of pollutants on plants, human beings, animals and materials 5.5 Explain the physiological implication of pollution in work environment 5.6 Describe chemical, thermal, radioactive and noise pollution 5.7 Explain the social implications of 5.6	Explain 5.1 to 5.9	• Environmental control apparatus • Solid waste compactor Recommended textbooks • Lecture notes • Chalk, chalkboard, • Duster • Visual aids.			Explain various types of pollution, environmental pollution and their effects on the environment

	5.8 Explain the meaning of “hazardous waste”. 5.9 State sources of hazardous wastes 5.10 List hazardous wastes (radioactive, chemical, biological, Flammable etc)					
GENERAL OBJECTIVE 6.0: Recognize the methods of onsite handling storage and processing of liquid and solid wastes						
9	6.1 Explain public health and aesthetics 6.2 Describe the method of onsite handling for (i) Residential Premises (ii) commercial premises 6.3 Describe the methods of onsite processing, e.g. grinding, serving Compaction, shredding and composting, chemical and biological.	Explain 6.1 to 6.3				Explain the methods of onsite handling storage and processing of liquid and solid wastes
GENERAL OBJECTIVE 7.0: Appreciate the generation and collection of liquid and solid wastes						
10	7.1 Describe sources and types of liquid waste 7.2 Explain the composition of liquid and solid wastes 7.3 Describe the generation rate of liquid and solid wastes 7.4 Classify modes of measurement of 7.3 e.g. (i) measure of Volume/flow rate (ii) Statistical analysis of generation rate. 7.5 Describe collection services	Explain 7.1 to 7.9 Solve mathematical problems involving: - Haul container system - Stationary collection systems - Labour requirements of collection systems.	• Standard collection BIN (WASCO)			• List sources and types of liquid Wastes. • Explain generation rate, different ways of measuring as well as factors affecting liquid waste • Explain a collection service. • List collection systems • Analyse collection systems and

	7.6 Describe collection systems, equipment and labour requirement 7.7 List collection systems, e.g., hauled container system and stationary collection systems 7.8 Analyse collection systems 7.9 Determine collection routes.					collection routes
GENERAL OBJECTIVE 8.0: Comprehend equipment and methods for processing, transfer and transport of liquid and solid wastes						
11	8.1 State purpose of processing 8.2 Describe the methods of processing a. mechanical volume reduction(ii) chemical volume reduction b. mechanical size reduction(iv) component separation 8.3 Explain the need for transfer stations 8.4 Describe transfer stations 8.5 Describe transport means and methods 8.6 Determine the location of transfer stations	Explain 8.1 to 8.6				Explain the equipment and methods for processing, transfer and transport of liquid and solid wastes
GENERAL OBJECTIVE 9.0: Understand the sources and utilization of various forms of energy from the waste materials						
	9.1 Review the principles of conservation of energy 9.2 List the forms of energy available in various forms of	Explain 9.1 to 9.5				Explain the sources and utilization of various forms of energy from the waste materials

12 -13	pollutants such as in solid waste, air, etc. 9.3 Explain the process of energy conversion in 8.2 9.4 Identify materials that can be re-cycled, e.g., waste paper, waste cloth, gully water, etc. 9.5 Describe land reclamation process					
General Objective 10.0: Know the steps in implementing Environmental Standards						
14-15	10.1 Comprehend the benefits of environmental management: Cost, Marketing, Customer, Employees, Local Community. 10.2 Carry out Environmental Review: Flow process diagrams, mass balance, quantifying complaints, summing disposal cost, assessing significance. 10.3 Appreciate Environmental matrix scoring: Normal and other operations, contingency planning. 10.4 Enumerate the Environmental policy: Management responsibility, objectives and targets, External Communication, Audit period. 10.5 ISO 14,000 Certification.	Explain activities 10.1 to 10.4 with diagrams where necessary and make detailed notes.				Design an overview of requirements under ISO headings for a small local company.

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive and Plant Options)

COURSE TITLE: Applied Thermodynamics

COURSE CODE: MEA 321

DURATION: 60 Hours (2 Hours - Lecture, 2 Hours - Practical)

CREDIT UNIT: 3.0

Course: Applied Thermodynamics	Course Code: MEA 321	Total Hours: 4 Hours/Week
Semester: SECOND	Pre-requisite: NIL	Theory: 2 Hours/Week
		Practical: 2 Hours/Week
Goal: This course is designed to acquaint students with the knowledge and skills in practical application of thermodynamic processes		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the equations governing the flow and non-flow processes in common engineering devices
2	Understand the common-thermodynamic vapour power cycles
3	Understand the Common thermodynamic gas power cycles
4	Understand various types of compressors
5	Understand gas turbine engines
6	Know the volumetric efficiency in relation to 4-stroke engine and solve related problems of air capacity, power etc

APPLIED THERMODYNAMICS

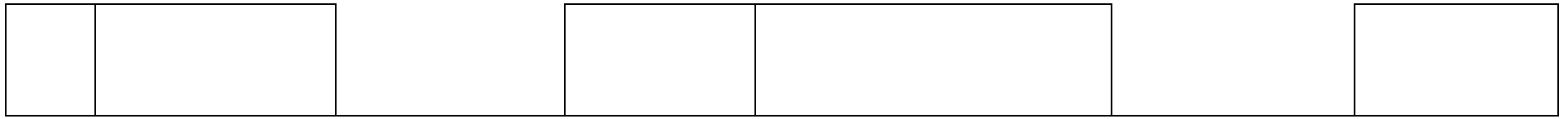
PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (Automotive and Plant)						
COURSE: APPLIED THERMODYNAMICS			COURSE CODE: MEA 321		CONTACT HOURS: 2-0-2 Hrs/wk	
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Goal: This course is designed to acquaint students with the knowledge and skills in practical application of thermodynamic processes						
Week	General Objective 1.0: Know the equations governing the flow and non-flow processes in common engineering devices					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 State the steady flow energy equation as it applies to (a) turbine (b) compressors (c) nozzles and diffusers (d) throttling process (e) boilers, condensers, evaporators and other heat transfer equipment 1.2 Explain the assumption made in the derivation of the equation in 1.1 above	Explain activities 1.1 to 1.3 with diagrams where necessary and make detailed notes.	Lecture notes Recommended textbooks Marker, Whiteboard Dusters. Turbine Compressors, Nozzles and diffusers, Throttling devices Boilers, condensers, evaporators	1.1 Identify the following (a) Turbine (b) Compressors, (c) Nozzles and diffusers, (d) Throttling devices (e) Boilers, condensers, evaporators. 1.2 Demonstrate the working of each of the devices in 1.1	Guide students to identify the following -Turbine -Compressors, -Nozzles and diffusers, -Throttling devices -Boilers, condensers, evaporators	Explain the equations governing the flow and non-flow processes in common engineering devices
	1.3 State the non-flow energy equation for (a) Constant volume (b) constant pressure (c) isothermal process (PV = constant) of a perfect gas (d) polytropic process (PV ⁿ = constant)					
	General Objective: 2.0 Understand the common-thermodynamic vapour power cycles					

	2.1 Describe the essential processes in a carnot cycle	Explain activities 2.1 to 2.6 with diagrams where	• Lecture notes • Recommended textbooks			Explain the common-thermodynamic

3-4	2.2 Define specific steam consumption, work ratio and the cycle efficiency 2.3 Explain the practical difficulties in employing the carnot cycle for a steam power plant 2.4 Explain the Rankine cycle 2.5 Explain the advantages of Rankine cycle over carnot cycle	necessary and make detailed notes.	• Marker, • Whiteboard • Dusters. • Boilers steam plant. • Compressors • Diffusers, • Boilers, • Turbine, etc.			vapour power cycles
	2.6 Analyse Rankine cycle with super heat re-heat regeneration, economizer and air pre-heater					
General Objective: 3.0 Understand common thermodynamic gas power cycles						
6	3.1 Describe the Brayton/Joule cycle 3.2 Analyse the cycle in 3.1. 3.3 Analyse the cycle in 3.1 with inter-cooling and pre-heating	Explain activities 3.1 to 3.6 with diagrams where necessary and make detailed notes.	• Lecture notes • Recommended textbooks • Marker, • Whiteboard • Dusters.	3.1 Determine, experimentally, steam consumption, work ratio and cycle efficiency of steam plant. 3.2 Determine experimentally the cycle efficiencies of Otto, Diesel and Dual cycles. 3.3 Carryout experiments on steam plant.	Guide student to - Determine, experimentally, steam consumption, work ratio and cycle efficiency of steam plant, - Determine experimentally the cycle efficiencies of Otto, Diesel and Dual cycles - Carryout experiments on steam plant	Explain Common thermodynamic gas power cycles

7	3.4 Describe Otto, Diesel, Dual, Stirling and Atkinson cycles 3.5 Analyse cycles in 3.4. 3.6 Explain mean effective pressure,					

	compression ratio and cut-off ratio.					
General Objective 4.0: Understand various types of compressors						
8-10	4.1 Explain advantages and disadvantages of reciprocating and rotary compressors 4.2 Explain delivery pressures 4.3 Explain the need for and effect of clearance volume in construction of compressor 4.4 Explain staging of compressors 4.5 Explain inter-cooling, after-cooling and optimum inter-stage pressures	Explain activities 4.1 to 4.6 with diagrams where necessary and make detailed notes.	• Lecture notes • Recommended textbooks • Marker, • Whiteboard • Dusters. • Rotary compressor • Axial compressor • Reciprocating Compressor	4.1 Identify different types of compressors. 4.2 Demonstrate the working of compressors	Guide students to identify different types of compressors. Demonstrate the working of compressors	Explain various types of compressors
	4.6 Explain efficiencies (e.g. isothermal, isentropic)					
General Objective 5.0: Understand the working principles of gas turbine engines						
11-12	5.1 Analyse gas turbine cycle with or without reheat 5.2 Calculate parameters such as thermal efficiency, SFC, etc. 5.3 Explain the differences in the design of gas turbines for air craft and industrial applications	Explain activities 5.1 to 5.7 with diagrams where necessary and make detailed notes.	• Lecture notes • Recommended textbooks • Marker, • Whiteboard • Dusters. • Compressors • Gas turbine	Demonstrate the working of gas turbine. Demonstrate the differences between gas turbines for air craft propulsion and industrial applications (power generation, etc)	Guide student to demonstrate the working of gas Turbine Demonstrate the differences between gas turbines for air craft propulsion and industrial applications (power generation, etc	Explain the working principles of gas turbine engines



	5.4 Describe application of gas, turbine cycles for aircraft propulsion ramjet, turbojet, turbofan and turboprop engines 5.5 Enumerate the limitations of ideal gas turbine cycle 5.6 Explain with the aid sketches the gas turbine 5.7 Compare and contrast gas turbine engine with the reciprocating internal combustion engines					
	General Objective 6.0: Know the volumetric efficiency in relation to 4-stroke engine and solve related problems on air capacity, power, etc					
13-15	6.1 Define volumetric efficiency and express it mathematically. 6.2 Explain the importance of (a) inlet density (b) the mach index in relation to volumetric efficiency 6.3 Explain factors influencing the volumetric efficiency 6.4 Describe the methods for determining volumetric efficiency	Explain activities 6.1 to 6.4 with diagrams where necessary and make detailed notes.	• Lecture notes • Recommended textbooks • Marker, • Whiteboard • Dusters. • Engine test bed with petrol and diesel engines, etc.	6.1 Carryout experiments on compressors to determine power output of a compressor 6.2 Carryout experiment to determine power output of gas turbine 6.3 Determine experimentally fuel consumption, power output on engine test bed	Guide students to: -carryout experiments on compressors to determine power output of a compressor -Carryout experiment to determine power output of gas turbine -Determine experimentally fuel consumption, power output on engine test bed	Explain the volumetric efficiency in relation to 4-stroke engine and solve related problems of air capacity, power etc

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive option)

COURSE TITLE: Automotive Engines Performance Test

COURSE CODE: MEA 322

DURATION: 45 Hours (1Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Automotive Engines Performance Test	Code: MEA 322	Total Hours: 3Hrs
		Theoretical hours: 1Hr
		Practical hours: 2Hrs
Semester: SECOND	Pre-requisite: NIL	
Goal: This course is designed to acquaint students with the knowledge and skills in the maintenance, analysis and testing of automotive engines		
GENERAL OBJECTIVES		
On completion of this module students should be able to :		
1	Understand the working principle of petrol and diesel engines.	
2	Know the constructional details of engine parts and their functions.	
3	Understand the fuel systems for spark ignition (S.I.) and compression ignition (C.I.) engines	
4	Understand the cooling systems for S.I. and C.I. engines	
5	Understand lubricating systems for S.I. and C.I. engines.	
6	Understand engine performance and testing.	
7	Understand electric and hybrid vehicles	

AUTOMOTIVE ENGINES PERFORMANCE TEST

PROGRAMME: HND IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: Automotive Engines Performance Test			COURSE CODE: MEA 322		CONTACT HOURS: 1-0-2	
Goal: This course is designed to acquaint students with the knowledge and skills in the maintenance, analysis and testing of automotive engines						
Week	General Objective 1.0: Understand the working principle of petrol and diesel engines.					
	Theoretical Content			Practical Content		
	Specific Learning Outcomes	Teacher’s Activities	Resources	Specific Learning Outcomes	Teacher’s Activities	Evaluation
	1.1 Explain with the aid of sketches the two and four stroke cycles of operation for S.I.E and C.I.E 1.2 Compare and contrast the two cycles in 1.1 1.3 Describe single and multi-cylinder engines. 1.4 Explain the firing order of 1.3. 1.5 Describe poppet valve and its operation. 1.6 Explain the significance of valve and ignition timing on engine performance. 1.7 Explain a valve timing diagram. 1.8 Explain valve operating mechanism. 1.9 Explain with the aid of diagrams the layout of ignition systems: -Contact point ignition -electronic ignition	Explain activities 1.1-1.11	Recommended Textbook, White Marker Board, duster, Marker. Complete two stroke & Four stroke S.I & C.I. engines.Tool box	Identify the following: -two stroke S.I. and C.I. engines. - four stroke S.I. and C.I. engines. -valve mechanism -Mechanical & electronic ignition system components.Draw a valve timing diagram	Guide students to : -distinguish the differences in construction of S.I and C.I. two & four stroke engines. Guide the students to - remove contact point & electronic ignition systems. inspect and refit.	Explain the working principle of petrol & diesel engines

	system with emphasis on: - transistorized coil ignition system, - distributor less ignition system. capacitor discharge ignition system. 1.10 State the functions of all the parts and the operational principle of the systems in 1.9. 1.11 Explain detonation, knock, pre- ignition, octane number and back-firing.					
	General Objective 2.0: Know the constructional details of engine parts and its functions.					
	2.1 List engine component parts and their functions. 2.2 Explain the construction and materials used for parts such as cylinder block, cylinder head, piston, crankshaft, connecting rod, camshaft, etc. 2.3 Describe the various layouts or arrangements of the cylinder block.	Explain activities 2.1-2.3	Recommended Textbook, White Marker Board, duster, Marker. Complete engine. Tool box. Service pit.	Identify all engine parts	Guide students to dismantle, identify all parts and re-assemble	Explain the constructional details of engine parts and its functions
	General Objective 3.0: Understand the fuel systems for S.I. and C.I. engines					

	system with emphasis on: - transistorized coil ignition system, -distributor less ignition system. - capacitor discharge ignition system. 1.11 State the functions of all the parts and the operational principle of the systems in 1.9. 1.12 Explain detonation, knock, pre-ignition, octane number and back-firing.					
General Objective 3.0: Understand the fuel systems for S.I. and C.I. engines						
6 - 8	3.1 Explain, using sketches, the layout of fuel supply systems for petrol and diesel engines.	Explain activities 3.1-3.11	Recommended Textbook, White Marker Board,duster, Marker. -carburetor	Identify the following; -carburetor -fuel lift pump -injector pump -nozzles	Guide students to: -dismantle and refit-carburetor, fuel lift pump, injector pump, nozzle.	Explain the fuel systems for S.I. and C.I. engines

	3.2 Explain the functions of each part of the systems in 3.1. 3.3 Describe the various types of carburetors and the component parts of each. 3.4 Analyse the carburetor as venture tube and drive expression for air and fuel flow rate. 3.5 Analyse the effect of air compressibility and altitude on fuel air ratio. 3.6 Describe electronically controlled gasoline injection system for S.I. engines. 3.7 Describe mixture formation methods in compression ignition engines. 3.8 Explain, with the aid of sketches, in-line fuel injection pump and lift pump. 3.9 Explain calibration and phasing of in-line injection pump. 3.10 Explain the direct and indirect injection chambers. 3.11 Describe piston head design and valves that permit swirl.		-fuel lift pump -injector pump -nozzles -Electronic injection components. Nozzle testing equipment. Phasing and calibrating equipment. Complete tool box.	-Electronic injection components.	-calibrate and phase an in-line injection pump. Carry out timing of petrol injection	

	General Objective 4.0: Understand the cooling systems for S.I. and C.I. engines					
9 - 10	4.1 State the reasons for cooling engines 4.2 Differentiate between water and air cooled engines. 4.3 Explain with sketches the functions of the major parts such as the water pump, radiator and its pressure cap, fan, fan belt and thermostat. 4.4 state the composition and advantages of anti-freeze and corrosion inhibiting solutions in the cooling system. 4.5 Discuss the effects of over cooling, under cooling and their causes and remedies.	Explain activities 4,1-4.5	Recommended Textbooks, White Marker Board, duster, Marker. Live modern vehicles. Complete tool box. Service pit	Identify all the parts of cooling system	Guide students to: -remove the radiator from the vehicle, inspect, clean and reverse flush the radiator and fit. -remove the water pump, clean, inspect and refit. -remove and test thermostat for effective operation. - test cooling system for leakage.	Explain the cooling systems for S.I. and C.I. engines
	General Objective 5.0: Understand lubricating systems for S.I. & C.I. engines.					
11-12	5.1 Explain the need for lubrication. 5.2 Explain the functions and properties of lubricating oil. 5.3 Explain with sketches the layout of a forced feed lubricating system. 5.4 Explain with sketches the layout of	Explain activities 5.1-5.5	Recommended Textbook, White Marker Board, duster, Marker. Live modern vehicles. Complete tool box. Service pit.	5.1 Identify all parts of lubricating system. 5.2 Demonstrate the working of the lubricating system. 5.3 Perform change of lubricating oil for SI and CI engines.	Guide students to : -remove oil sump -remove oil pump & filter, inspect and refit.	Explain the lubricating systems for S.I. & C.I. engines.

	dry and wet sump lubricating system. 5.5 Explain the function and construction of: gear type pump, pressure relief valve, full flow and by pass flow filter.					
General Objective 6.0: Understand engine performance.						
13	6.1 Calculate: power (indicated, brake and friction). 6.2 Calculate thermal efficiency: indicated and brake. 6.3 Calculate efficiency: mechanical and volumetric. 6.4 Calculate mean effective pressure: indicated & brake. 6.5 Calculate specific fuel consumption and air-fuel ratio. 6.6 Calculate energy balance and draw sankey diagram.	Calculate 6.1-6.6	Recommended Textbook, White Marker Board, duster, Marker. S.I. and C.I engine test beds	Determine efficiency, fuel consumption and power output of engines. Carry out trouble shooting of engines	Carry out experiment to determine the characteristics performance of S.I and C.I. engines. Guide student to carry out trouble shooting of engines	Explain the procedure to determine engine performance.
General Objective 7.0: Understand Electric and Hybrid vehicles						
14 -15	7.1 Give historical background of electric and hybrid vehicles. 7.2 Explain the basic principles of electric vehicles. 7.3 Describe motors, controllers, batteries and chargers. 7.3 Explain the	Explain activities 7.1-7.7	White Marker Board, duster, Marker. Live modern Videos of electric vehicles. Tool box and service pit	Identify: -motors. -controllers. -batteries. -chargers	Guide students to remove, observe and refit components of electrical vehicles.	.Explain the principles of operation of Electric and Hybrid vehicles

	principles of Hybrid electrical vehicles. 7.4 List the types by drive train structure: series hybrid, parallel hybrid and combined hybrid. 7.7 List the types by nature of power source: electric-internal combustion engine hybrid, fuel cell hybrid and human power and environmental power hybrids.					

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering (Automotive option)

COURSE TITLE: Transmission Technology and Practice

COURSE CODE: MEA 323

DURATION: 45 Hours (1 Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 2.0

Course: TRANSMISSION TECHNOLOGY AND PRACTICE.	Code: MEA 323	Total Hours: 3 Hours
		Theoretical hours: 1 Hour
	Pre-requisite: NIL	Practical hours: 2 Hours
Semester: SECOND		
Goal: This course is designed to acquaint students with the knowledge and skills in the maintenance and analysis of automotive transmission system		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the vehicle layouts, chassis frame and locations of various systems
2	Understand clutch system
3	Understand gearbox system
4	Understand propeller shaft universal joint and final drive
5	Understand brakes, wheels and tyres

TRANSMISSION TECHNOLOGY AND PRACTICE

PROGRAMME: HND IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: Transmission Technology & Practice.			COURSE CODE: 323		CONTACT HOURS: 1-0-2 HRS/WK	
Goal: To acquaint students with the knowledge and skills in the maintenance and analysis of automotive transmission system						
WEEK	General Objective 1.0: Understand the general arrangement and layout of the vehicles and types of transmission systems					
	Theoretical Content			Practical Content		
	Specific Learning Outcomes	Teacher’s Activities	Resources	Specific Learning Outcomes	Teacher’s Activities	Evaluation
1-3	1.1 State purpose and the needs for a transmission system for road vehicles. 1.2 Explain Classification and specifications of chassis; two wheeler, passenger car and commercial vehicle 1.3 Describe vehicle layout & types: -2 wheel drive – front engine front wheel drive, rear engine rear wheel drive, front engine rear wheel drive & 4 wheel drive.	Explain 1.1-1.5	Recommended Textbooks, Marker Board, Marker.	Identify : -front wheel drive vehicles -rear wheel drive vehicles. -four wheel drive vehicles.	Guide the students to identify -front wheel drive vehicles -rear wheel drive vehicles. -four wheel drive vehicles.	Live modern vehicles. Complete tool box. Service pit.

	1.4 Assembles their locations and functions 1.5 Types of frames, construction and materials- 2 wheeler and 4 wheeler.					

	General Objective 2.0: Understand clutch system					
4-6	2.1 Explain Necessity of clutch 2.2 Describe clutch with emphasis on its types –single plate, multi-plates, dry & wet clutches, centrifugal clutch, etc. 2.3 List materials used for clutch lining. 2.4 Explain Hydraulic & mechanical clutch linkage, cable operated clutch linkage. 2.5 Fluid coupling-principle, construction and operation	Explain 2.1 -2.5	Recommended Textbooks, Marker Board, Marker. Different types of clutches. Complete toolbox. Service pit	Identify the following: - Friction clutch, centrifugal clutch, diaphragm clutch, dog and spline clutch, vacuum clutch, hydraulic clutch -clutch linkages	Guide students to identify clutch types and linkages. Guide student to dismantle and re-assemble different types of clutch system.	Explain Different types of clutches. Complete tool box. Service pit.
	General Objective 3.0: Understand gearbox system					
7 - 10	3.1 Explain gear boxes with emphasis on: manual and automatic and gear shift mechanisms. 3.2 Explain Construction and working of gear boxes & their layouts such as sliding mesh, constant mesh, synchromesh type.	Explain 3.1-3.4	Recommended Textbooks, Marker Board, Marker. Live modern vehicles. Complete tool box. Service pit. Cutaway demonstrative models of: - manual gear - automatic gear, - shift mechanisms, - over drive - transfer box.	Identify the following: - gear boxes with emphasis on: manual and automatic and gear shift mechanisms, - over drive - transfer box. - fluid flywheel. - torque converter. -gear shift mechanism.	Guide the students to identify Guide students to dismantle and assemble of manual & automatic transmission systems	Explain gearbox system

	3.3 Explain Gear ratios with the help of power flow diagrams 3.4 Describe the following: - over drive, - transfer box - fluid flywheel - torque converter		- fluid flywheel. - torque converter.			
General Objective 4.0: Understand propeller shaft and final drive						
11-13	4.1 Explain the necessity and function of propeller shaft 4.2 Describe universal joints and its types 4.4 Describe Hotchkiss & torque tube drive 4.4 Explain the necessity and function of final drive and differential	Explain 4.1-4.5	Recommended Textbooks, Marker Board & Marker. Live modern vehicles. Complete tool box. Service pit. Vehicle framework (chassis) for front engine front wheel drive and front engine rear wheel drive.	Identify the following: - propeller shaft, slip joints and universal joints - crown wheel and pinion gears. - differential and rear axle. - axle shafts. - Hotchkiss drive and torque tube drive.	Guide students to identify: - propeller shaft, slip joints and universal joints - crown wheel and pinion gears. - differential and rear axle. - axle shafts. - Hotchkiss drive and torque tube drive Assist student to dismantle and assemble - propeller shaft, slip joints and universal joints - crown wheel and pinion gears. - differential and rear axle. - axle shafts. - Hotchkiss drive and torque tube drive	Live modern vehicles. Complete tool box. Service pit.

	4.5 Explain working of differential and differential lock. Backlash in differential 4.5 State types of rear axle such as semi-floating, three quarter and full floating types.					
14-15	General Objective 5.0: Understand brakes, wheels and tyres					

	5.1 Explain the necessity for brakes in automotive. 2 Explain the functions and classification of brakes. 5.3 List types of brakes: drum brake and disc brake, parking and emergency brake. brake shoe, brake lining and brake drum. 5.4 Explain hydraulic brake system, master cylinder (tandem/ single), wheel cylinder, piping and bleeding. 5.5 List the common brake defects and remedies 5.6 State types of wheels, rims and tyres. 5.7 Explain tyre materials,	Explain 5.1-5.9	Recommended Textbooks, Marker Board & Marker. drum brake and disc brake, parking and emergency brake. brake shoe, brake lining and brake drum. Tyres and wheels.	5.1 Identify common brake defects and remedies. 5.2 Perform the following auto workshop activities: - Identify the brake system components. - Bleed the brake system. - Check for leakages in the brake system. - Carry out repairs on brake system. - Replace brake lining and pads Identify the following: -tyre types & construction -tyre valves -wheels	Guide students to: - check defective tyres, repair and replacement. -fit tyre to vehicles. -check tyre pressure. - balance wheel. -perform wheel alignment Guide student to: - Identify the brake system components. - Bleed the brake system. - Check for leakages inthe brake system. - Carry out repairs onbrake system. - Replace brake liningand pads	Different Types of tyres. Complete tool box. Wheel balance and wheel alignment equipment. Service pit.

	specifications and construction. 5.8 Explain the necessity and types of treads. 5.9 Describe tyre inflation, its effect, rotation and nomenclature.					

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering (Automotive option)

COURSE TITLE: Autotronics

COURSE CODE: MEA 324

DURATION: 45 Hours (1 Hour Lecture and 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Autotronics	Code: MEA 324	Total Hours: 3 Hours
		Theoretical hours: 1 Hour
		Practical hours: 2 Hours
Semester: SECOND	Pre-requisite: NIL	
Goal: This course is designed to acquaint students with the knowledge and skills in vehicle control systems to enable them maintain electronic control devices and circuits in automotive.		

GENERAL OBJECTIVES

On completion of this module students should be able to :	
1	Understand the fundamentals of automotive electronics
2	Know various sensors and actuators used in automotive systems
3	Comprehend electronic fuel injection and ignition system
4	Understand digital engine control system
5	Know automotive electrical systems
6	Understand comfort and safety systems in automotive.
7	Know electromagnetic interference suppression in automotive systems
8	Comprehend holistic system approach to control/instrumentation and new developments in automotive

AUTOTRONICS

PROGRAMME: HIGHER NATIONAL DIPLOMA (HND) IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: AUTOTRONICS			COURSE CODE: MEA 324		CONTACT HOURS: 1-0-2 HRS/WK	
Goal: This course designed to acquaint students with knowledge and skills in vehicle control systems to enable them maintain electronic control devices and circuits in automotive						
WEEK	General Objective 1.0: Understand the fundamentals of automotive electronics					
	Theoretical Content			Practical Content		
	Specific Learning Outcomes	Teacher’s Activities	Resources	Specific Learning Outcomes	Teacher’s Activities	Evaluation
1-2	1.1 Define the terms: „microprocessor” and micro-computer”. 1.2 Explain the applications of microprocessor”, microcontroller and micro-computer” in automobiles. 1.3 List the components for engine management System 1.4 Explain electronic management of chassis system; vehicle motion control and electronic panel meters.	Explain activities 1.1 to 1.4	Recommend ed textbook, lecture notes, whiteboard and marker. Microprocess or Microcontroll er used in automotive	1.1 Identify electronic components in automotive. 1.2 Identify different parts and configuration of microprocessor and microcontroller. 1.3 Demonstrate the working principles of microprocessor and microcontroller. 1.4 Select appropriate microcontroller and microprocessor for applications in automotive.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the fundamentals of automotive electronics
	General Objective 2.0: Know various sensors and actuators used in automotive systems					

3-4	2.1 Define the terms „sensor“ and „actuator“ 2.2 List types of sensors used in automotive (oxygen, crank angle position, fuel metering/vehicle speed and	Explain activities 2.1 to 2.3	Recommended textbook, lecture notes, whiteboard and marker. Sensors used in automotives	2.1 Select right type of transducer, sensor and actuator for automotive applications. 2.2 Demonstrate working of various	Demonstrate for the students to learn and guide them to perform the activities.	Explain sensors and actuators used in automotive systems

	Detonation sensors), stepper motors and relays. 2.3 Explain with the aid of diagrams basic sensor and actuator arrangements.			sensors and actuators for multi cylinder diesel engines. 2.3 Demonstrate working of various sensors and actuators for multi cylinder modern petrol engines		
General Objective 3.0: Comprehend electronic fuel injection and ignition system						
5-6	3.1 Explain the principle of operation of feedback carburettor system 3.2 Describe throttle body injection and multi point fuel injection System. 3.3 Explain with the aid of diagram injection system controls 3.4 State the advantages of electronic ignition systems; 3.5 Explain the principle of operation of electronic spark timing and solid state systems.	Explain activities 3.1 to 3.5	Recommended textbook, lecture notes, whiteboard and marker. PLCs used in automotive.	3.1 Identify electronic fuel injection and ignition system in an automotive. 3.2 Measure shaft speed by using stroboscope and tachometer. 3.3 Perform experiment to verify truth tables for logic gates: - NOT, AND, OR, NAND, NOR. 3.4 Create a logic circuit by logic gates. 3.4 Identify the parts of PLC 3.5 Demonstrate the working of PLC.	Demonstrate for the students to learn and guide them to perform the activities.	Explain electronic fuel injection and ignition system
General Objective 4.0: Understand digital engine control system						
	4.1 Describe open loop and closed loop control systems. 4.2 Explain the control mechanisms of the following: - Engine cooling and warm-up control; - Acceleration/deceleration and idle speed control;	Explain activities 4.1 to 4.3	Recommended textbook, lecture notes, whiteboard and marker.	4.1 Identify all the control systems in automotive. 4.2 Implement PLC in: - Engine cooling and warm-up control; - Acceleration	Demonstrate for the students to learn and guide them to perform the activities.	Explain digital engine control system

7-8	- Integrated engine control system; and - Exhaust emission control engineering. 4.3 Describe on-board diagnostic system of automotive.			/deceleration and idle speed control		
General Objective 5.0: Know automotive electrical systems						
9-10	5.1 Describe the principles of operation of batteries; starter motor and drive mechanism; D.C. generator and Alternator. 5.2 Explain the processes of regulation of charging. 5.3 List factors involved in lighting design. 5.4 Explain dashboard instruments; horn, warning system and safety devices in automotive.	Explain activities 5.1 to 5.4	Recommended textbook, lecture notes, whiteboard and marker.	5.1 Identify batteries; starter motor and drive mechanism; D.C. generator and Alternator. 5.2 Demonstrate the working of batteries; starter motor and drive mechanism; D.C. generator and Alternator. 5.3 Carryout a simple lighting design of an automotive	Demonstrate for the students to learn and guide them to perform the activities.	Explain automotive electrical systems
General Objective 6.0: Understand comfort and safety systems in automotive						
11-12	6.1 Explain all the safety and comfort systems in automotive such as: seats, mirrors and sun roofs; central locking and electronic windows; cruise control; in-car multimedia; security; airbag and belt tensioners. 6.2 Describe recent developments in safety and comfort systems .	Explain activities 6.1 to 6.2	Recommended textbook, lecture notes, whiteboard and marker.	6. 1 Identify seats, mirrors and sun roofs; central locking and electronic Windows; cruise control; in-car multimedia; security; airbag and belt tensioners. 6.2 Demonstrate the working of 6.2	Demonstrate for the students to learn and guide them to perform the activities.	Explain comfort and safety systems in automotive

	General Objective 7.0: Know electromagnetic interference suppression in automotive systems					
13	7.1 Explain the term electromagnetic compatibility in automotive. 7.2 Explain the application of 7.1 in electronic dash board instruments, on-board diagnosis system, security and warning system.	Explain activities 7.1 to 7.2	Recommended textbook, lecture notes, whiteboard and marker.	Demonstrate the working of electromagnetic interference suppression in automotive systems.	Demonstrate for the students to learn and guide them to perform the activities.	Explain electromagnetic interference suppression in automotive systems.
	General Objective 8.0: Comprehend holistic system approach to control/instrumentation and new developments in automotive					
14-15	8.1 Present a holistic schematic diagram of automotive electronic components and circuits 8.2 Describe recent developments in automotive digital electronics, microcomputer instrumentation and control, sensors and actuators, digital engine control systems, vehicle motion control, telematics, etc.	Explain activities 8.1 to 8.2	Recommended textbook, lecture notes, whiteboard and marker.	Identify recent developments in automotive control and electronics systems	Demonstrate for the students to learn and guide them to perform the activities.	Explain recent developments in autotronics

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive)

COURSE: Mechanics of Motor Vehicle

COURSE CODE: MEA 325

CONTACT HOURS: 45 Hours (2 Hours - Lecture, 1 Hour - Practical)

CREDIT UNIT: 2.0

Course: Mechanics of Motor Vehicle	Code: MEA 325	Total Hours: 3 Hours
		Theoretical hours: 2 Hours
		Practical hours: 1 Hour
Semester: SECOND	Pre-requisite: NIL	
Goal: This course is designed to acquaint students with the knowledge and skills in the principles of engineering mechanics and relate them to the practicalities of automotive engineering design and operations		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the action of vehicle suspension springs and torsion bars
2	Understand the kinematics of reciprocating parts of the engine
3	Know the principle of moment and center of gravity as applied to simple supported beams in the motor vehicle e.g. axles, chassis, tracts, etc
4	Know the application of principles and laws of mechanics of machines to motion of motor vehicle components.
5	Solve problems involving work, torque and kinetic energy of a rotating body in motor vehicles.
6	Understand the concept of tractive resistance relating to motion of vehicle.
7	Know how to design mechanical joints
8	Understand the design concepts and constraints of vehicle dynamics as related to vehicle design
9	Know the principles and applications of polar moment of inertia and yaw moment of inertia as they apply to vehicle design

MECHANICS OF MOTOR VEHICLE

PROGRAMME: HIGHER NATIONAL DIPLOMA (HND) IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: MECHANICS OF MOTOR VEHICLE			COURSE CODE: MEA 325		CONTACT HOURS: 2-0-1 HRS/WK	
Goal: This course is designed to acquaint students with the knowledge and skills in the principles of engineering mechanics and relate them to the practicalities of automotive engineering design and operations.						
WEEK	General Objective 1.0: Understand the action of vehicle suspension springs and torsion bars					
	Theoretical Content			Practical Content		
	Specific Learning Outcomes	Teacher’s Activities	Resources	Specific Learning Outcomes	Teacher’s Activities	Evaluation
1	1.1 Compare the action of leaf, coil springs, and torsion bars. 1.2 Explain the benefit derived from the use of variable rate and constant rate suspension springs in motor vehicles. 1.3 Solve related problems in 1.1 and 1.2 above.	Explain activities 1.1 to 1.3	Recommended textbook, lecture notes, whiteboard and marker.	1.1 Carry out the load/deflection on constant rate and variable rate springs. 1.2 Carry out a compressive load test on open coiled helical valve and suspension springs. 1.3 Carry out the torque/angle of twist test on torsion bar.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the action of vehicle suspension springs and torsion bars
	General Objective 2.0: Understand the kinematics of reciprocating parts of the engine					
2-3		Explain activities 2.1 to 2.3	Recommended textbook, lecture notes, whiteboard and marker.	2.1 Use a dial gauge to determine piston displacements from top dead center (T.D.C) to bottom dead center (B.D.C) for given crank angles. 2.2 Determine the experimentally the effects of short and long connecting rod on piston	Demonstrate for the students to learn and guide them to perform the activities.	Explain the kinematics of reciprocation parts of the engine.

				speed. 2.3 Determine experimentally the effects of shortening the crank radius on piston speed and displacement. 2.4 Carry out the static and dynamic balancing of the crankshaft balancing rig.		
	General Objective 3.0: Know the principle of moment & center of gravity as applied to simple supported beams in the motor vehicle (axles, chassis, tracts, etc)					
4-5	3.1 Analyse statics of supported beams subjected to points and distributed loads. 3.2 Solve simple beam problems involving reactions with particular reference to laden and unladen vehicles – and other applications.	Explain activities 3.1 to 3.5	Recommended textbook, lecture notes, whiteboard and marker. PLCs used in automotive.	3.1 Determine the position of the vehicles center of gravity under-laden and un-laden conditions. 3.2 Determine the effort required to balance the force operating on a bell-crank lever such as (i) helical valve spring (ii) clutch pedal (iii) gear box lever (iv) clutch fingers and (v) diaphragm springs. 3.3 Determine experimentally the position and height of vehicles centre of gravity on (i) wheel base (ii) track.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the principle of moment & center of gravity as applied to simple supported beams in the motor vehicle (axles, chassis, tracts, etc)
	General Objective 4.0: Know the application of principles and laws of mechanics of machines to motion of motor vehicle components					
	4.1 Apply the principles of	Explain activities	Recommended	Apply the appropriate	Demonstrate for the	Explain the

6-7	linear and angular motion and analyse (a) the motion of motor vehicle engine components (i) engine (ii) piston and conrod (iii) connecting rod (iv) crankshaft (b) road wheel movement, i.e. trans-rotational and rotational motion. 4.2 Apply Newton's law of motion to solve problems related to motor vehicles. 4.3 Use the concept of relative velocity to solve problems on engine connecting rod and crank mechanism. 4.4 Use velocity and acceleration diagram to determine when the motion of valves, pistons and plunger type, pumps, etc are simple harmonic or not.	4.1 to 4.4	textbook, lecture notes, whiteboard and marker.	concept of mechanics of machines to determine: (a) force ratio (mechanical advantage) (b) movement ratio (c) efficiency of vehicles transmission and steering components.	students to learn and guide them to perform the activities.	application of principles and laws of mechanics of machines to motion of motor vehicle components
General Objective 5.0: Solve problems involving work, torque and kinetic energy of a rotating body in motor vehicles.						
8-9	5.1 Calculate the mean variable force from a force distance graph. 5.2 Show graphically a turning moment diagram for (a) single cylinder engine (b) 4-cylinder engine. 5.3 Explain the use of single cylinder engine and 4-cylinder engine in the design and	Explain activities 5.1 to 5.3	Recommended textbook, lecture notes, whiteboard and marker. Flywheel, single cylinder engine and 4-cylinder engine models	5.1 Use single cylinder engine and 4-cylinder engine to explain the design and purpose of a flywheel.	Demonstrate for the students to learn and guide them to perform the activities.	Solve problems involving work, torque and kinetic energy of a rotating body in motor vehicles

	purpose of a flywheel.					
	General Objective 6.0: Understand the concept of tractive resistance relating to motion of vehicle					
10-11	6.1 Define tractive effort. 6.2 Define the components of tractive resistance as (a) rolling resistance (b) gradient resistance (c) air (or wind) resistance. 6.3 Solve problems involving forces applied when accelerating and braking vehicles on a level and on inclined planes. 6.4 State the meaning of brake efficiency. 6.5 Solve problems involving stopping distance, retardation and brake efficiency. 6.6 Determine vehicle gradeability, speedability and gear split in relation to a given speed under laden and un-laden condition	Explain activities 6.1 to 6.2	Recommended textbook, lecture notes, whiteboard and marker.		Demonstrate for the students to learn and guide them to perform the activities.	Explain the concept of tractive resistance relating to motion of vehicle
	General Objective 7.0: Know how to design mechanical joints					
12	7.1 State the roles and applications of belted, riveted and welded joints. 7.2 Apply conventional representation and the use of I.S.O standards. 7.3 Calculate the load and stress in the joint 7.4 Sketch various mechanical joints.	Explain activities 7.1 to 7.4	Recommended textbook, lecture notes, whiteboard and marker.	Design a simple framework structure	Demonstrate for the students to learn and guide them to perform the activities.	Explain how to design mechanical joints

	General Objective 8.0: Understand the design concepts and constraints of vehicle dynamics as related to vehicle design					
13-14	8.1 Define vehicle dynamic in relation to vehicle design. 8.2 Classify vehicle dynamic problems as (a) vehicle handling/road holding problem (b) vehicle ride quality problem. 8.3 Explain all known interacting design parameters of vehicle dynamics. 8.4 Illustrate 8.3 above with a vehicle dynamic model. 8.5 Explain the principles of gyroscopic moment of couples as it applies to vehicle dynamics studies e.g. the case of (a) wheeled vehicles turning corner (b) influence of aerodynamics “overturning moment” of complete vehicle.	Explain activities 8.1 to 8.5	Recommended textbook, lecture notes, whiteboard and marker.		Demonstrate for the students to learn and guide them to perform the activities.	Explain the design concepts and constraints of vehicle dynamics as related to vehicle design
	General Objective 9.0: Know the principles and applications of polar moment of inertia and yaw moment of inertia as they apply to vehicle design					
15	9.1 Define polar moment of inertia 9.2 Explain the principles and effects of (a) Low Polar Moment of Inertia (B) High Polar Moment of Inertia (e.g. the analysis of the Page Sticks or dumbbell illustrating simplified coupled suspensions) in vehicle layout. 9.3 Explain the method for					Explain the principles and applications of (a) polar moment of inertia (b) yaw

	determination of radius of gyration in each case as applies to vehicle centroid. 9.4 Explain 9.2 in the study of vehicle handling problem e.g bouncing and pitching. 9.5 Define “Yaw Moment of Inertia” 9.6 Explain the effect of 9.5 on the vehicle layout. 9.7 Explain 9.5 on the motion of vehicle e.g. 9a) spin on slide (b) Yaw response (c) roll steer					moment of inertia as they apply to vehicle design

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing Option)

COURSE TITLE: Metal Forming and Heat Treatment

COURSE CODE: MEM 321

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Metal Forming and Heat Treatment	Code: MEM 321	Total Hours: 4 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Semester: SECOND	Pre-requisite: NIL	
Goal: This course is designed to acquaint students with the knowledge and skills in metal forming and heat treatment operations		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the meaning and classification of heat treatment
2	Comprehend heat treatment processes involving bulk solid-state changes
3	Understand heat treatment involving surface changes
4	Comprehend selection of heat treatment furnaces
5	Know heat treatment of non-ferrous metals
6	Understand deformation of Metals
7	Know hot working processes
8	Understand cold working processes
9	Comprehend the reasons for the control of variables in heat treatment
10	Know the origin and mitigation of heat treatment defects.
11	Understand powder metallurgy

METAL FORMING AND HEAT TREATMENT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - MANUFACTURING (OPTION)						
COURSE: METAL FORMING AND HEAT TREATMENT			Course code: MEM 321		CONTACT HOURS: 2-0-2 Hrs/Wk	
Goal: This course is designed to acquaint students with the knowledge and skills in metal forming and heat treatment operations						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
General Objective 1.0: Know the meaning and classification of heat treatment						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
1	1.1 Define heat treatment 1.2 Explain heat treatment and its application. 1.3 Classify heat treatment into (i) those involving bulk solid-state changes in materials (ii) those involving surface changes in material. 1.4 Explain the engineering situations where 1.3 above is used	• Explain 1.1 to 1.4	Whiteboard, marker, duster, textbooks, lecture notes • IT and TTT wall charts for some metals.			Explain the meaning and classification of heat treatment

	General Objective 2.0: Comprehend heat treatment processes involving bulk solid-state changes.					
2	2.1 Explain solid - state changes in material using phase diagram 2.2 Describe the following using isothermal transformation curves (IT) and time temperature transformation (TTT) diagrams: (i) annealing and its applications (ii) full annealing and its applications (iii) sub-critical annealing (iv) isothermal annealing (v) stress-relief annealing (vi) homogenizing annealing 2.3 Explain the effect of the various heat treatments in 2.2 on the structure and properties of steels 2.4 Explain the term hardenability 2.5 Describe quenching and tempering treatments. 2.6 Describe the Joining-End- Quench Test 2.7 Explain the term limiting ruling section 2.8 Describe different types of quenching media	Explain 2.1 to 2.8	Whiteboard, marker, duster, textbooks, lecture notes • Iron-carbon diagram • IT and TTT diagrams • Heat treatment • Furnace • low or medium carbon steel, pieces of bars or rods. • Joining End-Quenching test apparatus. • Water Oil	2.1 Select appropriate heat treatments for a range of steels in application. 2.2 Use IT and TTT diagrams to select suitable quenching media. 2.3 Prepare specimens. 2.4 Carry out etching, grinding, and polishing of samples. 2.5 Carry out heat treatments e.g. relief anneal or case hardening, quenching and tempering on some carbon steel. 2.6 Carry out observation of prepared specimens using metallurgical microscope and print out images of observed microstructures.	Guide student to -Select appropriate heat treatments for a range of steels in application. -Use IT and TTT diagrams to select suitable quenching media. -Prepare specimens. -Carry out etching, grinding, and polishing of samples. -Carry out heat treatments e.g. relief anneal or case hardening, quenching and tempering on some carbon steel - Carry out observation of prepared specimens using metallurgical microscope and print out images of observed microstructures	Explain heat treatment processes involving bulk solid changes.

	General Objective 3.0: Understand heat treatment involving surface changes					
3	3.1 Describe the following localized thermal treatments: (i) flame hardening (ii) induction hardening (iii) laser hardening (iv) electron beam hardening. 3.2 Describe the following thermochemical treatments: (i) carburizing (ii) carbonitriding (iii) austenitic nitrocarburising (iv) nitriding (v) ferritic nitrocarburising. 3.3 Explain how the treatments in 3.2 can be carried out in the following media: solid, liquid, gas, vacuum and plasma arc glow discharge pointing out their advantages and disadvantages.	Explain 3.1 to 3.3	Whiteboard, marker, duster, textbooks, lecture notes	Conduct flame hardening, induction hardening, laser hardening and electron beam hardening	Guide students to Conduct flame hardening, induction hardening, laser hardening and electron beam hardening	Explain heat treatment involving surface changes

	General Objective 4.0: Comprehend selection of heat treatment furnaces					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
4-5	4.1 Describe fuels for heating furnaces 4.2 State the advantages and disadvantages of various fuels listed in 4.1 4.3 Describe types of heat treatment furnaces (i) batch and continuous, (ii) direct and indirect (iii) forced air circulation (iv) liquid bath (v) fluidised beds (vi) vacuum 4.4 State the advantages and disadvantages of each furnace listed in 4.3	Explain 4.1 to 4.4	Whiteboard, marker, duster, textbooks, lecture notes • Electric muffle furnace.	Identify different furnaces used on heat treatment and demonstrate its use.	Guide students to identify different Furnaces used on heat treatment and demonstrate how to use them	Explain types of heat treatment furnaces Explain various fuels use for heating furnaces

	General Objective 5.0: Know heat treatment of non-ferrous metals					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
6-7	5.1 Explain the structural and property changes of aluminum alloys to heat treatment. 5.2 List the engineering applications of heat-treated aluminum alloys. 5.3 Explain the structural and property changes of copper alloys due to heat treatment 5.4 List the engineering properties of heat-treated copper alloys.	Explain 5.1 to 5.4	Whiteboard, marker, duster, textbooks, lecture notes • Aluminum copper alloys bar • High purity aluminum bars • Copper tin alloys • Copper zinc alloys. - Heat treatment furnace	Carryout treatment processes in selected non-ferrous metal materials.	Guide students to carryout treatment processes in selected non-ferrous metal materials	Explain structural and property changes that heat treatment confer on copper alloys. Explain engineering properties of heat-treated copper alloys.
	General Objective: 6.0 Understand deformation of Metals					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
8	6.1 Describe the mechanism of plastic deformation using the slip theory. 6.2 Explain the effect of 6.1 on the structure and mechanical properties of materials.	Explain 6.1 to 6.2	Whiteboard, marker, duster, textbooks, lecture notes			• Explain mechanism of plastic deformation.
	General Objective 7.0: Know hot working processes					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
	7.1 List various hot working processes 7.2 Describe the	Explain 7.1 to 7.3	Whiteboard, marker, duster, textbooks,	Demonstrate the procedures in hot working processes	Guide students to demonstrate the procedures in hot working processes	List various hot working

9	following hot working processes (a) rolling of plate or sheet (b) forging and drop forging (c) extrusion of solid and hollow sections 7.3 Explain the applications of processes in 7.2		lecture notes • ferrous bar	7.2 Identify the defects of heat treatment and its origin.	Guide students to identify the defects of heat treatment	processes Explain the difference between rolling, forging and extrusion
General Objective 8.0: Understand cold working processes						
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
10	8.1 Describe the following cold working processes (a) drawing of wire and tubes (b) rolling of plate, sheet or strip (c) spinning and flow turning (d) heading (e) coining and embossing 8.2 Explain the stages in drawing a typical component (Cup) 8.3 State the products for which each of the processes in 8.1 are suitable. 8.4 Describe the annealing of cold worked materials 8.5 State the structural changes which occur during annealing of a cold worked material 8.6 Explain the phenomenon of grain growth during re-	Explain 8.1 to 8.7	Whiteboard, marker, duster, textbooks, lecture notes	Draw wire, tubes and roll plate sheet or strip Spin and flow turn metal sheet Make heading using a hammer	Guide students to: -Draw wire, tubes and roll plate sheet or strip -Spin and flow turn metal sheet -Make heading using a hammer	Explain what is meant by cold working

	crystallization 8.7 Explain the advantages and disadvantages of hot working and cold working					
	General Objective 9.0: Comprehend the reasons for the control of variables in heat treatment					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
11- 12	9.1 Explain the following process variables in heat treatment: (a) heating rate (b) mode of heat transfer (c) soaking temperature and time (d) cooling rate (e) furnace atmosphere 9.2 Classify controlled atmosphere applications into protective and chemically active. 9.3 Describe the physical and chemical principles of controlled atmospheres with respect to (a) oxidation control (b) carburisation or decarburisation control (c) nitrogen potential control. 9.4 Describe atmosphere generation from (a) exothermic source (b) stripped exothermic source (c) endothermic from propane and from natural gas.	Explain 9.1 to 9.4	Whiteboard, marker, duster, textbooks, lecture notes	Heat the material and observe the mode of heat transfer Soak material and observe its temperature and time	Guide students to heat the material and observe the mode of heat transfer Guide students to soak material and observe its temperature and time	Explain the following process variables in heat treatment: (a) heating rate (b) mode of heat transfer (c) soaking temperature and time (d) cooling rate (e) furnace atmosphere

	General Objective 10.0: Know the origin and control of heat treatment defects.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
13	10.1 Explain the origin of the following defects (a) distortion and warpage (b) cracking (c) surface scale and/or contamination (d) grain growth, (e) Blistering (f) insufficient hardness or soft spots. 10.2 Explain how to mitigate the defects in 10.1	Explain 10.1 to 10.2	Whiteboard, marker, duster, textbooks, lecture notes	Identify the origin of the following defects (a) distortion and warpage (b) cracking (c) surface scale and/or contamination (d) grain growth, (e) Blistering (f) insufficient hardness or soft spots	Demonstrate the origin of the following defects (a) distortion and warpage (b) cracking (c) surface scale and/or contamination (d) grain growth, (e) Blistering (f) insufficient hardness or soft spots	Explain the origin and mitigation of heat treatment defects
	General Objective 11.0: Understand powder metallurgy					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14 - 15	11.1 Describe the different methods of metal powder preparation 11.2 Describe the different methods of achieving powder specifications e.g. chemistry particle size and shape. 11.3 Describe the process of powder compaction 11.4 Explain the effect of binders on the ease of handling of green compacts. 11.5 Describe isostatic	Explain 11.1 to 11.9	Whiteboard, marker, duster, textbooks, lecture notes. Powder compaction machine	Demonstrate the methods of metal powder preparation. 11.1 Demonstrate the process of powder compaction. 11.2 Demonstrate the sintering process.	Guide students to: demonstrate the methods of metal powder preparation -Demonstrate the process of powder compaction. -Demonstrate the sintering process	Various metal powder samples. e.g. reduced iron, Atomized magnesium, etc.

	pressing. 11.6 Describe the sintering process. 11.7 Explain the phenomenon of surface energy reductions during sintering. 11.8 Describe the processes that lead to the reduction of surface energy 11.9 List the advantages and limitations of powder metallurgy					

PROGRAMME: **Higher National Diploma (HND) in Mechanical Engineering Technology**

COURSE TITLE: **Joining and Fabrication Processes**

COURSE CODE: **MEM 322**

DURATION: **60 Hours (2 Hours Lecture, 2 Hours Practical)**

CREDIT UNIT: **3.0**

Subject: Joining And Fabrication Processes	Code: MEM 322	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Semester: SECOND	Pre-requisite: NIL		
Goal: This course is designed to acquaint students with knowledge and skills in joining and fabrication processes			

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know metal joining processes
2	Understand electric Arc Welding
3	Understand equipment for Gas welding and cutting
4	Know special welding Processes
5	Comprehend welding processes of non - ferrous metals, cast iron and stainless Steel
6	Understand weld Defects
7	Know weld symbols and specifications
8	Know machine tools used in fabrication
9	Know bending, folding and cutting processes
10	Understand stiffening of metal sheets and plates
11	Know marking out procedures
12	Understand Intersections

JOINING AND FABRICATION PROCESSES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING - MANUFACTURING (OPTION)						
COURSE TITLE: Joining and Fabrication Processes			COURSE CODE: MEM 322		CONTACT HOURS: 2-0-2 HRS/WK	
Goal: To acquaint students with knowledge and skills in joining and fabrication processes						
COURSE SPECIFICATION: THEORETICAL CONTENT			PRACTICAL CONTENT			
General Objective 1.0: Know metal joining processes						
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 Define weldability of metals. 1.2 Explain soldering, brazing and welding 1.3 State the applications of the processes in 1.2. 1.4 State the factors that affect the strengths of joints produced by the processes in 1.2. 1.5 Describe adhesive bonding 1.6 List bonding materials 1.7 State the application of adhesive bonding materials in 1.6 1.8 List different rivet types 1.9 Describe riveting 1.10 Determine the number of rivets required for a given joint	Explain 1.1 to 1.10	• Text books • Lecture notes • Whiteboard • Marker. • Drilling machine, drill bits, rivet guns, rivet pins.	1.1 Identify situation whereriveting is preferred to welding 1.2 Select different rivet sizes, the size of matching drill bit. 1.3 Carryout riveting operation.	Guide students to: -Identify situation where riveting is preferred to welding -Select different rivet sizes and matching drill bit. -Carryout riveting operation	Explain the following: soldering, brazing and welding of metals

	General Objective 2.0: Understand electric Arc Welding					
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	2.1 Describe correctly the characteristics of AC welding transformer, rectifiers and the D.C welding generators 2.2 Explain the functions of a rectifiers straight and reverse polarity 2.3 Differentiate between A.C and D.C. welding machines. 2.4 Explain the advantages and disadvantages of machine types in 2-3 2.5 Explain the materials used for electrode coating and their functions. 2.6 Solve problems associated with welding in various positions and how to counter them. 2.7 Explain the various weld joints and how to prepare them. 2.8 Describe the procedure for multi-run welds.	Explain 2.1 to 2.8	• Welding machine, electrodes Universal welding machine set.	2.1 Identify joints to be welded 2.2 Carry out joint preparation 2.3 Select welding nozzles and electrode sizes for various material thickness 2.4 Demonstrate the procedures for welding various ferrous and non-ferrous metals.	Guide students to: -Identify joints to be welded -Carry out joint preparation -Select welding nozzles sizes for various material thickness -Demonstrate the procedures for welding various ferrous and non-ferrous metals.	Explain safety precautions for connecting welding machines • Explain the procedures for operating a welding machine • Explain the various weld joints and how to prepare them. • Explain the procedure for multi-run welds.

	General Objective 3.0: Understand equipment for Gas welding and cutting					
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
5	3.1 Describe the operations of (a) welding regulator (b) welding blowpipe (c) cutting blowpipe. 3.2 Describe the procedure for lighting the welding torch and closing. 3.3 State the applications of different types of flames 3.4 State different cutting nozzles 3.5 State welding nozzles (sizes) for various material thicknesses.	Explain 3.1 to 3.5	• Oxy-acetylene sets - 5 • Flash gas lighter • Steel rule • Tri-square.	3.1 Identify different types of gas welding machine components 3.2 Identify different types of flames 3.3 Demonstrate the operations of the machines used in shearing, bending and gas welding operations. 3.4 Demonstrate a step-by-step procedure of stiffening by wise edge, folded edge and swaging.	Guide students to -Identify different types of gas welding machine components -Identify different types of flames - Demonstrate the operations of the machines used inshearing, bending and gas welding operations. -Demonstrate a step-by-step procedures of stiffening by wise edge, folded edge and swaging	Explain the procedures for lighting the welding torch and closing
	General Objective 4.0: Know MIG, MAG and TIG welding processes					

week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6	4.1 Explain the types of gases used for shielded gas arc welding their areas of application and their effect on welds. 4.2 Describe the principles of operation of a submerged arc welding 4.3 State the equipment and filler materials used in 4.4.	Explain 4.1 to 4.3	Universal welding machine set. Welding electrodes for specific jobs.			Explain MIG and MAG welding processes
General Objective 5.0: Comprehend welding processes of non - ferrous metals, cast iron and stainless Steel						
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7	5.1 Explain the problems involves in welding copper and its alloys 5.2 Describe the problems involved in welding aluminum and its alloys 5.3 State the procedures for fusion welding of cast iron and stainless steel. 5.4 Describe other methods of welding cast iron other than fusion welding	Explain 5.1 to 5.4	Text books • Lecture notes • Whiteboard • Marker.	Demonstrate fusion and other welding procedures for stainless steel and cast iron	Guide students to demonstrate fusion and other welding procedures for stainless steel and cast iron	Explain welding processes of non - ferrous metals, cast iron and stainless Steel
General Objective 6.0: Understand weld Defects						
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8	6.1 Explain the various types of weld defects and their causes. 6.2 Describe the following types of weld defects (i) distortion (ii) lack of penetration (iii) slag inclusion (iv) undercutting cracks (v) lack of fusion blow holes	Explain 6.1 to 6.7	Text books • Lecture notes • Whiteboard • Marker.	Identify weld defects and ways of remedying them.	Guide students to identify weld defects and ways of remedying them	Explain the various types of weld defects and their causes.

	6.3 Explain the nature and causes of distortion 6.4 Explain methods of eliminating distortion and cracking by means of the skip and step back methods, pre and post heating peening welding from free to fixed zone etc 6.5 Describe correct weld profiles and dimensions 6.6 Explain the reasons for dressing welds. 6.7 Explain the concept of stress relief in weld merits.					
General Objective 7.0: Know weld symbols and specifications						
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
9	7.1 Explain various weld symbols and interpret them. 7.2 Interpret welds in drawings 7.3 Describe suitable weld joints.	Explain 7.1 to 7.3	Textbooks • Lecture notes • Whiteboard • Marker.	Identify various weld symbols and interpret them. Identify welds in drawings	Guide students to: - Identify various weld symbols and interpret them - Identify welds in drawings	Explain weld symbols and specifications
General Objective 8.0: Know machine tools used in fabrication						
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10	8.1 Explain the working principles and uses of the following cutting machines (a) guillotine (b) nibbling machine (c) cropping machine (d) shearing machine (e) sawing machine 8.3 State the advantages and limitations of the machines in 8.2	Explain 8.1 to 8.3	• Profile cutting machine • Bending other • Spinning machine • Foot operated. guillotine	Identify the following cutting machines: - guillotine - nibbling machine - cropping machine - shearing machine - sawing machine	Guide students to identify the following cutting machines: - guillotine - nibbling machine - cropping machine - shearing machine - sawing machine	Explain machine tools used in fabrication

	General Objective 9.0; Know bending, folding and cutting processes					
	9.1 Explain bending action 9.2 Explain the working principle of form machines (a) fly - press (b) hydraulic press (c) press brake (d) folding machines (e) rolling machine (f) bending rolls 9.3 Describe the various operations carries out on the above machine (a) bending (b) edge curving (c) straightening (d) bottoming folding (f) rolling of sheet and plate materials 9.4 State the advantage and limitations of the machines in 9.2.	Explain 9.1 to 9.4	Textbooks, Whiteboard etc Profile cutting machine, Bending Other, Spinning Machine, Foot operated. guillotine	Identify the following form machines: -fly – press - hydraulic press - press brake - folding machines - rollingmachine - bending rolls	Guide students to identify the following form machines: -fly – press - hydraulic press - press brake - folding machines - rollingmachine - bending rolls	Explain bending, folding and cutting processes
	General Objective 10.0: Understand stiffening of metal sheets and plates					
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11-12	10.1 Explain stiffening in fabrication. 10.2 State reasons for stiffening 10.3 Describe the following methods of stiffen sheet metal (a) wired edge (b) folded edge (c) swaging 10.4 Describe the following methods of stiffening plates and structural members (a) web stiffening (b) troughing (c) channeling (d) ribbing.	Explain 10.1 to 10.3	Profile cutting machine • Bending machine • Spinning machine • Foot operated guilotine roller.	Demonstrate the methods of stiffening	Guide students to demonstrate the methods of stiffening	Explain stiffening in fabrication. State reasons for stiffening

	General Objective 11.0: Know marking out procedures					
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13-14	11.1 Explain the importance of marking out profiles in fabrication. 11.2 Describe the concept of material economy in marking out profiles from sheet metal or plates. 11.3 Correctly set out the procedure for marking - out profiles of (i) cone (ii) frustrum of a curve (iii) rectangular vessel (iv) rectangular vessel with folded edge.	Explain 11.1 to 11.3	• Basic marking out tools. Profile cutting machine • Bending machine • Spinning machine • Foot operated guillotine roller.	Demonstrate the procedure for mark out profiles: -Cone -Frustum -Rectangular vessel -Rectangular vessel with folded edge.	Guide students to demonstrate the procedure for mark out profiles -Cone -Frustum -Rectangular vessel -Rectangular vessel with folded edge.	Explain the importance of marking out profiles in fabrication.
	General Objective 12.0: Understand Intersections					
week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
15	12.1 Explain the concept of intersections of hollow vessels or solids. 12.2 Mark out the intersection profiles of (i) two cylinders at right angles (ii) one cylinder at angle of 60° to the other.	Explain 12.1 to 12.2	Text books • Lecture notes • Whiteboard • Marker.	Demonstrate the mark out of intersection profiles of -two cylinders at right angles -one cylinder at angle of 60° to the other.	Guide students to demonstrate the mark out of intersection profiles of -two cylinders at right angles -one cylinder at angle of 60° to the other.	Explain the concept of intersections of hollow vessels or solids

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Foundry Technology and Practice

COURSE CODE: MEM 323

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course; Foundry Technology and Practice	Code: MEM 323	Total Hours: 4 Hours/Week
Semester: SECOND	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in foundry operations		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand pattern making
2	Know the properties of silica sand and other refractory materials
3	Understand the effects of clay and other additives to moulding sand
4	Know mould and core making operations
5	Understand how to determine clay content of a clay-banded moulding sand.
6	Know the criteria in the use of cupola and electric arc furnaces
7	Understand the structure, properties and factors affecting metals used in foundry operations
8	Understand modern methods of production
9	Understand machine core making
10	Understand special production processes and their economic considerations

FOUNDRY TECHNOLOGY AND PRACTICE

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY- Manufacturing Option						
COURSE: FOUNDRY TECHNOLOGY AND PRACTICE				CODE: MEM 323		CONTACT HRS: 2-0-2
Goal: This course is designed to acquaint students with knowledge and skills in foundry operations						
Course Specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand pattern making					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 List materials for pattern making 1.2 List the properties required of pattern materials 1.3 State pattern materials on the basis of overall economic advantage and optimum performance. 1.4 Describes the preparation of pattern from solid materials 1.5 Describe by means of diagrams the following pattern construction: thin frames segmental and lagged patterns 1.6 Describe the various methods of determining the position of lighting and supporting joints 1.7 Describe the methods of joining pattern materials by adhesives, soldering, brazing metal fastening and welding. 1.8 State the application of the types of pattern equipment. 1.9 Describe the different types of patterns: rose patterns, split patterns,	Explain 1.1 to 1.10	• Text books, lecture notes • whiteboard, marker Various pattern materials pattern making tools and machines.	1.1 Select pattern materials on the basis of overall economic advantage and optimum performance. 1.2 Identify materials used in pattern making 1.3 Carryout the production of pattern from solid materials.	Demonstrate for the students to learn and ask them to perform all the activities.	Explain materials for pattern making their relative cost and properties

	skeleton patterns, cope and drag patterns, match plates in hard wood and metal. 1.10 State the application of various patterns in 1.9					
General Objective 2.0: Know the properties of silica sand and other refractory materials						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3	2.1 Explain the effects of heat upon refractoriness and expansion characteristics of silica sand 2.2 State the advantages of using: Zirconite, chromite and other refractory materials in preference to silica sand for mould and core production	Explain 2.1-2.2	• Text books, lecture notes • whiteboard, marker			Explain the properties of silica sand and other refractory materials
General Objective 3.0: Understand the effects of clay and other additives to moulding sand						
Week	Specific Learning Outcome	Teachers Activities	Resources			Evaluation
4-5	3.1 Explain the influence of the following types of clay on the moulding properties of clay banded sand: Montmorillonite, bentonite, kaodinite, hydromica, polymineral clays, in naturally banded sands 3.2 State the effects of heat on clay bonded sands as in 5.1 3.3 Describe the effects of dead burnt clay bond on mould materials. 3.4 Explain the reasons for adding coal, pitch, oil, flour, dextrin and starch to clay banded moulding sands.	Explain 3.1-3.4	• Text books, lecture notes • whiteboard, marker. jolting machine, sand slinger, squeezes, jolt-squeeze machines, roll-over machines, pattern draws machine, etc.	3.1 Demonstrate the effects of dead burnt clay on mould materials. 3.2 Identify and operate the following moulding machines - jolting machine, sand slinger, squeezes, jolt-squeeze machines, roll-over machines, pattern draws machines, silicate and chemical hardening dispensing machine	Demonstrate for the students to learn and ask them to perform all the activities.	Explain the effects of clay and other additives to moulding sand

	General Objective 4.0: Know mould and core making operations					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6-7	4.1 Explain the following: (a) bedding in (b) parting down (c) mould reinforcement. 4.2 Describe the following: (a) ramming boards (b) odd sides (c) floor boards (d) sloping pieces 4.3 Describe snap flasks, slip flasks and special moulding boxes 4.4 Describe the following (i) position of joint (ii) construction of pattern (iii) loose pieces (iv) core prints (v) core covers (vi) cone prints (vii) stopping off pieces (viii) template (ix) part-patterns. 4.5 Describe methods of pattern and moulding box alignment 4.6 Explain the use of single and double sided pattern plate (in metal and other materials) and stripping plates. 4.7 Describe the following moulding machines: jolting machines, sand slinger, squeezes, jolt-squeeze machines, roll-over machines, pattern draw machines silicate and chemical hardening dispensing machine.	Explain 4.1-4.7	• Moulding machine flask • Text books, lecture notes • whiteboard, marker			Explain mould and core making operations
	General Objective 5.0: Understand how to determine the clay content of a clay-banded moulding sand					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

8	5.1 Explain castings using sand moulds containing varying amounts of additives. 5.2 Explain moulds using different moulding technique 5.3 Explain cores using core boxes. 5.4 Calculate necessary alloy additions to adjust the composition of non-ferrous metals and then melt and carry out alloying. 5.5 Design patterns for sand moulding.	Explain 5.1-5.5	• Clay bonded moulding sand, • Standard jar • Additives. • Core sand • Core boxes. • Pattern material shrink rate. • Pattern making tools.	5.1 Produce castings using sand moulds containing varying amounts of additives. 5.2 Produce moulds using different moulding techniques. 5.3 Produce cores using core boxes. 5.4 Calculate necessary alloy additions to adjust the composition of non-ferrous metals and then melt and carry out alloying. 5.5 Design patters for sand moulding.	Demonstrate for the students to learn and ask them to perform all the activities. Assess the students.	Explain the procedures for determining the clay content of a clay-bonded moulding sand
General Objective 6.0: Know the criteria in the use of cupola and electric arc furnaces						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
9	6.1 Review principle types of melting furnaces 6.2 Explain factors including causes that influence the choice of melting furnaces 6.3 Describe with diagrams the methods of heating and controlling the blast in a hot blast cupola 6.4 State the functions of the electrodes in an arc furnace. 6.5 Explain the necessity for water cooling in arc furnaces	Explain 6.1-6.5	• Text books, lecture notes • whiteboard, marker Electric furnace Diesel/Oil fired furnace	6.1 Demonstrate the general layout of an arc furnace including equipment and plant.	Demonstrate for the students to learn and guide them to perform all the activities. Assess the students.	Explain the criteria in the use of cupola and electric arc furnaces
General Objective 7.0: Understand the structure, properties and factors affecting metals used in foundry operations						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	7.1 Describe the iron carbon equilibrium diagram 7.2 Classify cast iron. 7.3 Describe the structure of	Explain 7.1-7.12	• Text books, lecture notes • whiteboard, marker			Explain the structure and properties of cast iron

10-11	white cast iron illustrating the main features 7.4 Describe the structure of Grey cast iron illustrating the main features 7.5 Explain the reasons for the structural difference between white and grey cast irons by reference to phase diagram. 7.6 Explain the properties and give examples of uses of each category of cast iron.					
	7.7 State the effects of composition on casting temperature of plain carbon and low alloy steels 7.8 Describe how casting temperatures of steels affect the properties of mould and their materials 7.9 Describe the running and feeding system necessary for plain carbon and low alloy steels.					
	7.10 State the common effects of gas content in aluminum alloys					
	7.11 Describe the methods for removing surplus metal from casting. 7.12 Explain how to isolate waste from re-cycle materials.					
General Objective 8.0: Understand modern methods of mould production						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	8.1 Explain universal or rotary table moulding	Explain 8.1-8.5	• Text books, lecture notes			Explain modern methods of

12-13	machines. 8.2 Describe conveyor type automatic moulding lines to produce small or medium size castings. 8.3 Explain metal pattern plates and master pattern plates 8.4 Explain slip flask moulding and the use of automatic flask-less moulding machines of a high productive capacity. 8.5 Describe automatic lines which make flask less moulds with a vertically extending parting		• whiteboard, marker			mould production
General Objective 9.0: Understand machine core making						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14	9.1 Explain the goal of using core making machines 9.2 Describe core jarring machines 9.3 Describe core blowers.	Explain 9.1-9.3	• Text books, lecture notes • whiteboard, marker			Explain machine core making
General Objective 10.0: Understand special production processes and their economic considerations						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
15	10.1 Describe centrifugal casting 10.2 Describe investment casting (lost-wax process) 10.3 Describe die casting 10.4 Describe shell moulding 10.5 Describe CONCAST 10.6 Explain economic considerations of the various processes.	Explain 10.1-10.6	• Text books, lecture notes • whiteboard, marker			Explain special production processes and their economic considerations

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology – Plant Option

COURSE TITLE: Internal Combustion Engines

COURSE CODE: MEP 322

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Internal Combustion Engines	Code: MEP 322	Total Hours: 4 Hours/Week
Semester: SECOND	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in the maintenance and analysis of internal combustion engines		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand working principles of petrol and diesel engines
2	Know the constructional details of engine parts and it's functions
3	Understand the fuel systems for S.I. and C.I engines
4	Understand the cooling systems for S.I and C.I engines
5	Understand the lubricating systems for S.I and C.I Engines
6	Understand engine performance and testing
7	Understand gas turbine engines

INTERNAL COMBUSTION ENGINES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - PLANT OPTION						
COURSE: INTERNAL COMBUSTION ENGINES			COURSE CODE: MEP 322		CONTACT HOURS: (2-0-2) Hours/week	
Goal: This course is designed to acquaint students with knowledge and skills in the maintenance and analysis of internal combustion engines						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand working principles of petrol and diesel engines					
	Specific Learning Outcome	Teacher's Activities	Resources	Specific Learning Outcome	Teacher's Activities	Evaluation
1-3	1.1 Explain with the aid of sketches the two and four stroke cycles of operation for S.I.E and C.I.E 1.2 Compare and contrast the two cycles mentioned in 1.1 1.3 Describe single and multi-cylinder engines 1.4 Explain the firing order of 1.3 1.5 Explain the significance of valve and ignition timing on engine performance 1.6 Draw and explain a valve timing diagram 1.7 Explain the valve operating mechanism. 1.8 Explain with the aid of diagrams the layout of ignition system and state the functions of all the parts. 1.9 Explain detonation, knock, pre-ignition, octane number and back - firing.	Explain 1.1 to 1.9	• Recommended textbooks • Lectures notes • Marker • Whiteboard • Duster • 2 stroke engine • 4 stroke engine • practical guide	1.1 Dismantle engine and identify all parts and reassemble 1.2 Calibrate and phase an in-line injection pump 1.3 Flush the cooling system of an engine.	Demonstrate activities 1.1 to 1.3 for the students for learn and ask them to practice the activities	Explain working principles of petrol and diesel engines
	General Objective 2.0: Know the constructional details of engine parts and it's functions					
4-5	2.1 List engine component parts and their functions 2.2 Explain the construction and materials used for parts such as	Explain 2.1 to 2.2	• Recommended textbooks • Lectures notes • Marker			Explain the constructional details of

	cylinder block, cylinder head cylinder liners piston crankshaft, connecting rod etc.		• Whiteboard • Duster			engine parts and its functions
General Objective 3.0: Understand the fuel systems for S.I. and C.I engines						
6 - 8	3.1 Explain using sketches the layout of fuel supply systems for petrol and diesel engines 3.2 Explain the functions of each part of the systems in 3.1 3.3 Describe the various types of carburetors and the component parts of each. 3.4 Analyse the carburetor as venturitube and derive expression for air and fuel flow rate 3.5 Analyse the effect of air compressibility and altitude on fuel air ratio 3.6 Describe mixture formation methods in compression ignition engines 3.7 Explain the effect of fuel injection pressure fuel penetration on nozzle hole size. 3.8 Explain with aid of sketches in line fuel injection pump, injector and lift pump. 3.9 Explain calibration and phasing of inline injection pump. 3.10 Explain the direct and indirect injection chambers 3.11 Describe piston head Design and valves that permit swirl 3.12 Explain the function and operation of governors and turbo chargers used in diesel engines	Explain 3.1 to 3.12	• Carburetor • Injector nozzles and pump • Governors apparatus and turbo chargers	3.1 Perform experiment to determine the characteristics curves of speed rotation against the sleeve position of a governor.	Demonstrate activity 3.1 for the students for learn and guide them to practice the activities	Explain the fuel systems for S.I. and C.I engines

	General Objective 4.0: Understand the cooling systems for S.I and C.I engines					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
9 - 10	4.1 Explain with sketches the layout of a water pump assisted cooling system. 4.2 Explain with sketches the functions of the major parts such as the water pump, radiator and its pressure cap and thermostat 4.3 Explain the effects of over cooling, under cooling and their causes and remedies	Explain 4.1 to 4.3	• Recommended textbooks • Lectures notes • Marker • Whiteboard • Duster			Explain the cooling systems for S.I and C.I engines
	General Objective 5.0: Understand the lubrication systems for S.I and C.I Engines					
11-12	5.1 Explain the functions and properties of lubricating oil. 5.2 Explain with sketches the layout of a forced feed lubricating system 5.3 Explain with sketches the layout of dry and wet sump lubricating system. 5.4 Explain the function and construction of: gear type pump, pressure relief valve, full flow and by pass flow filter	Explain 5.1 to 5.4	- Recommended textbooks • Lectures notes • Marker • Whiteboard • Duster • Gear type pump • Pressure relief valve • Filters.			Explain the lubrication systems for S.I and C.I Engines
	General Objective 6.0: Understand engine performance and testing					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	6.1 Calculate: power (indicated, brake, and friction) thermal efficiency (indicated and brake) mechanical efficiency, volumetric efficiency, mean effective pressure (indicated and brake,) specific fuel consumption and air-fuel ratio. 6.2 Calculate energy balance and draw sankey diagram	Explain 6.1 to 6.2	- Recommended textbooks • Lectures notes • Marker • Whiteboard • Duster Engine Test Bed – with	6.1 Carryout experiment to determine the characteristic performance of S.I, C.I engines. 6.2 Carryout trouble shooting of engines.	Demonstrate for the students to learn and guide them to perform the activities.	Explain engine performance and testing

			accessories			
	General Objective 7.0: Understand gas turbine engines					
14-15	7.1 Analyse gas turbine cycle with or without re-heat 7.2 Calculate parameters such as thermal efficiency, net turbine work, work ratio overall temperature ratio, component efficiencies 7.3 Explain the differences in the design of gas turbines for aircraft and industrial applications. 7.4 Describe the application of turbine cycles for aircraft propulsion, ram jet, turbo jet, and turbo fan and turbo prop engines. 7.5 Enumerate the limitations of ideal gas turbine cycle 7.6 Explain with the aid of sketches gas turbine engine 7.7 Compare and contrast gas turbine engine with the reciprocation internal combustion engine.	Explain 7.1 to 7.7	Recommended textbooks • Lectures notes • Marker • Whiteboard • Duster Lab type Gas turbine	7.1 Carryout experiment to determine the characteristic of gas turbine	Demonstrate for the students to learn and guide them to perform the activities.	Explain gas turbine engines performance

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology – Plant Option

COURSE TITLE: Energy Conversion and Heat Transfer

COURSE CODE: MEP 323

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 2.0

Course: Energy Conversion and Heat Transfer	Code: MEP 323	Total Hours: 3 Hours/Week
Semester: SECOND	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 1 Hour/Week
Goal: This course is designed to acquaint the students with knowledge and skills in energy conversion and heat transfer		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the sources, Conversion and Utilization of Energy
2	Understand further sources, Conversion and Utilization of Energy
3	Understand the Modes of Heat Transfer
4	Understand the Application of Heat Transfer

ENERGY CONVERSION AND HEAT TRANSFER

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING - PLANT ENGINEERING (OPTION)						
COURSE: ENERGY CONVERSION & HEAT TRANSFER				Course Code: MEP 323		Contact Hours: 2-0-1 Hrs/wk
Goal: This course is designed to acquaint the students with knowledge and skills in energy conversion and heat transfer						
Course Specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Know the sources, Conversion and Utilization of Energy					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 - 3	1.1 Explain the renewable and non- renewable sources of energy 1.2 Explain the world reserves of non-renewable energy resources and their rates of consumption. 1.3 Describe fossil fuels and their application 1.4 Explain the thermodynamics of combustion of fossil fuels. 1.5 Solve problems related to the thermodynamics of fuels. 1.6 Explain the physics and optics of solar radiation. 1.7 Describe the elements of solid-state physics with particular reference to photovoltaic devices. 1.8 Explain the design and construction of devices for conversion of solar energy to thermal energy	Explain activities 1.1 to 1.8	Recommend ed Textbook, Lecture Notes, Whiteboard duster and marker. Auto bomb calorimeters, Thermal conductivity apparatus, Orsat apparatus • Free and forced convection Heat and mass transfer apparatus	1.1 Identify the various devices for conversion of different forms of energy. 1.2 Carry out experiment to analyse the products of combustion of fossil fuels.	Demonstrate for the students to learn and ask them to perform all the activities.	Explain the sources, Conversion and Utilization of Energy
	General Objective 2.0: Understand further sources, conversion and utilization of energy					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	2.1 Calculate solar energy conversion efficiency 2.2 Describe the devices for	Explain activities 2.1 to 2.8	• Photovoltaic cells, DC/AC	2.1 Identify different sources of energy and how they are converted to electricity and	Demonstrate for the students to learn and ask them to perform all the	Explain further sources, Conversion

4-6	conversion of solar energy to electrical energy- photovoltaic devices, thermoelectric converters and thermionic devices. 2.3 Describe briefly the elements of atomic and nuclear physics 2.4 Explain the chain reaction and nuclear power generation. 2.5 Describe the nuclear reactor 2.6 Describe wind Energy 2.7 Explain the engineering application of wind energy 2.8 Determine the Betz Limit		inverters, solarimeters, apparatus for the determination of radioactive projection of materials. • Wind Tunnel	utilized in the laboratory. 2.2 Conduct experiment to demonstrate the conversion of solar and wind energy sources to electricity.	activities.	and Utilization of Energy
General Objective 3.0 Understand the modes of heat transfer						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-11	3.1 Explain Fourier's Law of heat conduction in two dimensions 3.2 Describe the methods of solving conduction equation e.g. analytical, numerical, graphical and experimental. 3.3 Describe an expansion for steady state one - dimensional conduction through slabs, composite walls, concentric cylinders. 3.4 Solve problems related to 3.2. 3.5 Explain heat transfer by convection 3.6 Determine surface film and overall heat transfer coefficient.	Explain activities 3.1 to 3.12	• Free and forced convection Heat & Mass Transfer Apparatus. Thermal conductivity apparatus, orsat apparatus • Free and forced convection Heat and mass transfer apparatus	3.1 Identify modes of heat transfer in the laboratory. 3.2 Carry out experiment to demonstrate heat transfer by - conduction, convention and radiation	Demonstrate for the students to learn and guide them to perform all the activities.	Explain Modes of Heat Transfer

	3.7 Explain the concept of heat transfer by natural convection. 3.8 Explain the concept of heat transfer by forced convection. 3.9 Explain thermal radiation. 3.10 Explain the absorption, reflection and transmission of radiation. 3.11 Explain specular and diffuse radiation. 3.12 Explain the emission of radiant energy from black body source.					
General Objective 4.0: Understand the application of heat transfer						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12 -15	4.1 Explain (a) Kirchoff's Law (b) Planck's Law (c) Stefan-Boltzmann's Law (d) Wien's Law 4.2 Explain the emission of radiant energy from grey and other bodies 4.3 Explain radiation interchange between 2 black bodies and between 2 grey bodies. 4.4 Explain radiation shielding 4.5 Explain total radiation interchange in a grey enclosure. 4.6 Explain gas and flame radiation 4.7 Solve simple problems on the above.	Explain activities 4.1 to 4.11	• Pyrometers	Perform experiment to verify the following laws (a) Kirchoff's law (b) Planck's law (c) Stefan Boltzman's law (d) Wien's Law (e) Fourier's Law of Thermodynamics	Demonstrate for the students to learn and guide them to perform all the activities.	Explain different applications of Heat Transfer

	4.8 Explain the types of heat exchangers (a) recuperators (b) fins (c) cooling towers. 4.9 Explain how heat transfer coefficient is used in the design of heat exchangers. 4.10 Explain the various solar collectors 4.11 Explain how the various modes of heat transfer affect the performance of solar collectors.					

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology – Plant Option

COURSE TITLE: Renewable Energy Systems

COURSE CODE: MEP 324

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Renewable Energy Systems Semester: SECOND	Code: MEP 324 Pre-requisite: NIL	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2 Hours/Week
Goal: This course is designed to acquaint students with the knowledge of renewable energy sources and basic skills on the implementation of their technologies and utilisation			

GENERAL OBJECTIVES	
On completion of this course, students should be able to :	
1	Understand the fundamentals of renewable sources of energy and technologies for their utilisation
2	Comprehend solar energy sources, its implementation and utilisation
3	Know wind energy sources, its implementation and utilisation
4	Understand hydropower sources, its implementation and utilisation
5	Know biomass energy sources, its implementation and utilisation
6	Comprehend geothermal energy sources, its implementation and utilisation
7	Understand hydrogen energy sources, its implementation and utilisation
8	Know ocean energy sources, its implementation and utilisation

RENEWABLE ENERGY SYSTEMS

PROGRAMME: HIGHER NATIONAL DIPLOMA (HND) IN MECHANICAL ENGINEERING TECHNOLOGY- PLANT (OPTION)						
COURSE: RENEWABLE ENERGY SYSTEMS			Course Code: MEP 324		Contact Hours: 2-0-2 Hrs/wk	
Goal: This course is designed to acquaint students with the knowledge of renewable energy sources and basic skills on the implementation of their technologies and utilisation.						
Course Specification: THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	General Objective 1.0: Understand the fundamentals of renewable sources of energy and technologies for their utilisation					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 Define the term. „renewable energy“. 1.2 List the basic properties of different renewable sources of energy and technologies for their utilisation. 1.3 Describe main elements of technical systems designed for utilisation of renewable sources of energy. 1.4 State the advantages and disadvantages of different renewable sources of energy. 1.5 Undertake simple analysis of energy potential of renewable sources of energy. 1.6 Explain the correlation between different operational parameters of renewable energy systems. 1.7 State the engineering	Explain activities 1.1 to 1.7	Recommended Textbook, Lecture Notes, Whiteboard duster and marker. Lab prototypes of different renewable energy sources.	Identify sources of renewable energy in the laboratory	Demonstrate for the students to learn and ask them to perform all the activities.	Explain renewable sources of energy and technologies for their utilisation

	approaches to problem solving when implementing the projects on renewable sources.					
	General Objective 2.0: Comprehend solar energy sources, its implementation and utilisation					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3-4	2.1 State the basic properties of solar energy. 2.2 Explain the applications of solar energy. 2.3 Describe the transformation of solar energy. 2.4 Explain solar heat and solar photovoltaic collectors. 2.5 Explain the application of solar collectors with examples and its economics 2.6 Explain the implementation of solar power plant with diagrams and new trends in solar energy utilisation.	Explain activities 2.1 to 2.6	Recommended Textbook, Lecture Notes, Whiteboard duster and marker.	2.1 Design a simple solar plant in the laboratory. 2.2 Implement a simple solar plant designed in 2.1	Demonstrate for the students to learn and ask them to perform all the activities.	Explain solar energy sources, its implementation and utilisation
	General Objective 3.0: Know wind energy sources, its implementation and utilisation					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	3.1 State the basic properties of wind energy. 3.2 Explain the applications of wind energy with examples. 3.3 Describe the transformation of wind energy.	Explain activities 3.1 to 3.5	Recommended Textbook, Lecture Notes, Whiteboard duster and marker.	3.1 Design a simple wind power plant in the laboratory. 3.2 Implement a simple wind power plant designed in 3.1.	Demonstrate for the students to learn and guide them to perform all the activities.	Explain wind energy sources, its implementation and utilisation

5-6	3.4 Explain the operation and features of wind turbines. 3.5 Describe the implementation of wind power plant with its utilisation, economics and new trends.					
General Objective 4.0: Understand hydropower sources, its implementation and utilisation						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-8	4.1 State the basic properties of water energy. 4.2 Describe the procedure to harness available energy of water flow. 4.3 Explain the transformation of water energy. 4.4 Describe the procedures in implementing micro, mini, small and large hydropower plants with its utilisation, economics and new trends.	Explain activities 4.1 to 4.4	Recommended Textbook, Lecture Notes, Whiteboard duster and marker.	4.1 Design a simple micro hydropower plant in the laboratory. 4.2 Implement a micro hydropower plant designed in 4.1.	Demonstrate for the students to learn and guide them to perform all the activities.	Explain hydropower sources, its implementation and utilisation
General Objective 5.0: Know biomass energy sources, its implementation and utilisation						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	5.1 Define the term „biomass energy“. 5.2 List types of biomass and their basic properties.	Explain activities 5.1 to 5.5	Recommended Textbook, Lecture Notes, Whiteboard duster and marker.	5.1 Design a simple biomass power plant in the laboratory. 5.2 Implement a biomass power plant	Demonstrate for the students to learn and guide them to perform all the activities.	Explain biomass energy sources, its implementation and utilisation

9	5.3 Explain the transformation of biomass energy. 5.4 Explain the applications of biomass. 5.5 Describe the implementation technologies of biomass with its utilisation, economics and new trends.			designed in 5.1.		
General Objective 6.0: Comprehend geothermal energy sources, its implementation and utilisation						
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10 -11	6.1 Explain the operation of geothermal power plant. 6.2 Explain the functions of heat pumps in geothermal power plant. 6.3 Explain legislative and financial models on the implementation of geothermal power plant. 6.4 Describe the framework and administrative procedures of geothermal power plant implementation	Explain activities 6.1 to 6.4	Recommended Textbook, Lecture Notes, Whiteboard duster and marker.	6.1 Identify sources of geothermal energy sources in Nigeria. 6.2 Carryout a simple feasibility for the establishment of geothermal power plant identified in 6.1.	Demonstrate for the students to learn and guide them to perform all the activities.	Explain geothermal sources, its implementation and utilisation
General Objective 7.0: Understand hydrogen energy sources, its implementation and utilisation						
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	7.1 State the basic properties of hydrogen. 7.2 Explain the technologies	Explain activities 7.1 to 7.6	Recommended Textbook, Lecture Notes, Whiteboard	7.1 Design a simple fuel cell in the laboratory.	Demonstrate for the students to learn and guide them to perform all the activities.	Explain hydrogen energy sources, its

12-13	of hydrogen production. Describe the transformation of hydrogen energy with emphasis on hydrogen economy. 7.3 Define the term „fuel cell“ 7.4 Explain the operating principle, main parts and properties of fuel cells. 7.5 Explain the applications of hydrogen and fuel cells with examples. 7.6 Describe the economics of hydrogen energy, its implementation, utilisation and new trends in fuel cells technology		duster and marker.	7.2 Implement a fuel cell power plant designed in 7.1.		implementation and utilisation
General Objective 8.0: Know ocean energy sources, its implementation and utilisation						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	8.1 State the advantages and potentials of ocean energy over wind and solar sources. 8.2 Explain wave characteristics and statistics 8.3 List wave energy devices 8.4 Explain tide characteristics and statistics. 8.5 Explain the following: • Tide Energy Technologies • Ocean Thermal Energy • Osmotic Power • Ocean Bio-mass	Explain activities 8.1 to 8.5	Recommended Textbook, Lecture Notes, Whiteboard duster and marker.	8.1 Identify sources of ocean energy sources in Nigeria. 8.2 Carryout a simple feasibility for the establishment of tidal power plant identified in 8.1.	Demonstrate for the students to learn and guide them to perform all the activities.	Explain ocean energy sources, its implementation and utilisation

THIRD SEMESTER COURSES

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: NUMERICAL METHODS

COURSE CODE: MTH 413

DURATION: 30 Hours (2 Hours Lecture, 0 Hour Practical)

CREDIT UNIT: 2.0

Subject: NUMERICAL METHODS	Code: MTH 413	Total Hours: 2 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 0 Hour/Week
Semester: THIRD	Pre-requisite: NIL	
Goal: To acquaint students with numerical and analytical skills and knowledge to solve engineering and scientific problems		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the use of numerical methods to solve linear and non-linear equations.
2	Understand finite Differences.
3	Understand interpolation as applied to difference table.
4	Understand Numerical Differentiation.
5	Understand Numerical Integration.
6	Understand numerical methods of solving first and second order ordinary differential equation.

NUMERICAL METHODS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
Course: NUMERICAL METHODS			Course Code: MTH 413		Contact Hours: 2-0-0 HRS/WK	
Goal: To acquaint students with numerical and analytical skills and knowledge to solve engineering and scientific problems						
	Theoretical Content				Practical Content	
	General Objective: 1.0 Understand the use of numerical methods to solve linear and non-linear equations					
Week	Specific Learning Outcomes	Teachers activities	Resources	Specific Learning Outcomes	Teachers activities	Evaluation
1-3	1.1 Find solution of linear algebraic equation using Guass elimination method 1.2 Solve linear algebraic equations using Guass-seidel iteration methods 1.3 Apply Newton-Raphson iteration formulae to non-linear equations e.g. find the roots of the equation $\cos x = x^2$ as accurately as your tables permit. Find the square root series of $\log x^2-5$	Explain 1.1 to 1.3	• Recommended textbooks, whiteboard, marker, lecturer notes etc			Explain the use of numerical methods to solve linear and non-linear equations
	General Objective 2.0: Understand Finite Differences					
4-5	2.1 Define finite differences 2.2 Explain the forward differencing tabulation 2.3 Explain the building of errors in a	Explain 2.1 to 2.6	• Recommended textbooks, whiteboard, marker, lecturer notes etc			Explain Finite Difference Method

	difference table 2.4 Explain the backward difference table 2.5 Explain the central difference formula 2.6 Apply the forward, backward and central difference formula or tables in solving related practical problems					
General Objective 3.0: Understand interpolation as applied to difference table						
6-7	3.1 Define the Newton-gregory forward difference interpolation formula 3.2 Evaluate the difference table with unequal interval using divided differences 3.3 State Lagrange's interpolation formula 3.4 Evaluate a table using Lagrange's interpolation formula	Explain 3.1 to 3.4	• Recommended textbooks, whiteboard, marker, lecturer notes etc			Explain interpolation as applied to difference table
General Objective 4.0: Understand Numerical Differentiation						
8	4.1 Explain the basic process of numerical differentiation up to the third derivative 4.2 Explain differentiation based on equal interval interpolation formula 4.3 Evaluate higher order derivatives	Explain 4.1 to 4.3	• Recommended textbooks, whiteboard, marker, lecturer notes etc			Explain Numerical Differentiation

	General Objective 5.0: Understand Numerical Integration					
9	5.1 Explain the Trapezoidal and Simpson's rules 5.2 Evaluate an integral using the three sights Rule	Explain 5.1 to 5.2	• Recommended textbooks, whiteboard, marker, lecturer notes etc			Explain Numerical Integration
	General Objective 6.0: Understand numerical methods of solving first and second order ordinary differential equation					
10-15	6.1 Explain Runge-Kutta's and Euler's methods 6.2 Solve the first order ordinary differential equation, using Runge-Kutta's method. e.g if $dy = 2x + y$, $y(0) = 1$, find the approximate value of y , using (a) Euler's and (b) Runger-Kutta's methods 6.3 Solve the second order ordinary differential equation using Rung-Kutta's method	Explain 6.1 to 6.3	• Recommended textbooks, whiteboard, marker, lecturer notes etc			Explain numerical methods of solving first and second order ordinary differential equation

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: CAD/CAM

COURSE CODE: MEC 411

DURATION: 45 Hours (1 Hour Lecture, 2 Hours Practical)

CREDIT UNITS: 3.0

Subject: CAD/CAM	Code: MEC 411	Total Hours:	3 Hours/Week
		Theoretical hours:	1 Hour/Week
		Practical hours:	2 Hours/Week
Semester: THIRD	Pre-requisite: NIL		
Goal: The course is designed to acquaint students with knowledge and skills on the application of computer in the design and manufacture of engineering components.			

GENERAL OBJECTIVES	
On completion of this course, the students should be able to :	
1	Know the fundamentals of Computer Aided Design and Computer Aided Manufacturing (CAD/CAM)
2	Understand Surface/Solid Modelling using CAD/CAM
3	Comprehend Viewing Objects in 3D Space
4	Understand Data Transfer
5	Understand Computer Aided Manufacturing (CAM)
6	Understand fundamentals of 3D Printing

CAD/CAM

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: CAD/CAM				COURSE CODE: MEC 411		CONTACT Hours: 1-0-2Hrs/Wk
Goal: The course is designed to acquaint students with knowledge and skills on the application of computer in the design and manufacture of engineering components.						
General Objective 1.0: Know the fundamental of Computer Aided Design and Computer Aided Manufacturing (CAD/CAM)						
COURSE SPECIFICATION: THEORETICAL CONTENT			Learning Resources	PRACTICAL CONTENT:		Evaluation
Week	Specific Learning Outcomes	Teachers Activities		Specific Learning Outcomes	Teachers Activities	
1 - 2	1.1 Explain the history of CAD/CAM 1.2 List the advantages and limitations of CAD/CAM 1.3 Describe the product cycle of CAD/CAM 1.4 Describe the automation of CAD/CAM	• Explain the history, advantages, and limitations of CAD and CAM. • Explain the product cycle of CAD/CAM • Explain the automation of CAD/CAM	Recommended textbook, duster, Marker, Related videos, projector etc., Computer system installed with 3D CAD Software	.		Explain how CAD and CAM are used and automated.
General Objective 2.0: Understand Surface/Solid Modelling using CAD/CAM						
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation

3 - 7	2.1 Explain parametric and non-parametric surfaces 2.2 Explain the concept of solid models 2.3 Explain geometric dimensioning and tolerance (GDT).	• Explain parametric and non-parametric surfaces. • Explain solid models • Explain GDT	Recommended textbook, White Board, duster, Temporary Marker, Related videos, Lecture notes, etc., Computer system installed with 3D CAD Software	2.1 Create simple surfaces using revolved surface, ruled surface, and 3D surface commands 2.2 Create solid primitives (box, cylinder, cone, wedge, sphere, torus, etc) 2.3 Construct solids using region, extrude, revolved features, etc. 2.4 Create composite solids using Boolean functions (union,	Guide students through activities 2.1 to 2.9	Explain the different processes for creating solids in CAD.

				subtraction, intersection, etc.) 2.5 Modify solids, solid edges and faces using solid editing commands (shell, separate, etc) 2.6 Perform 3D operation like array, mirror, rotate, etc 2.7 Create fillets and chamfers 2.8 Add dimensions to drawings 2.9 Transform 2D and 3D drawings using translation, scaling, rotation, mirror, zooming, panning, clipping, etc		
General Objective 3.0: Comprehend Viewing Objects in 3D Space						
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
8 – 9	3.1 Explain the concept of SW, SE, NE, and Isometric views	Describe the concept of different views	Recommended textbook, White Board, duster, Temporary Marker, Related videos, Lecture notes, etc., Computer system installed with 3D CAD Software	3.1 View 3D objects in different views 3.2 Use view ports 3.3 Change the layout from model to paper space 3.4 Arrange drawings to show different views 3.5 Plot different engineering drawing with title blocks	Guide students through activities 3.1 to 3.5	Explain how objects are viewed in CAD software.
General Objective 4.0: Understand Data Transfer						
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation

10			Recommended textbook, White Board, duster, Temporary Marker, Related videos, Lecture notes, etc., Computer system installed with 3D CAD/CAM Software	4.1 Structure CAD data with reference to datum and direction 4.2 Transfer data using different file extensions 4.3 Transfer data between CAD and CAM software	Guide students through activities 4.1 to 4.3	Explain how data is transferred within and between CAD software.
General Objective 5.0: Understand Computer Aided Manufacturing (CAM)						
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
11 - 13	5.1 Describe the operation procedure for CAM	• Describe the operation procedure for CAM	Recommended textbook, White Board, duster, Temporary Marker, Related videos, Lecture notes, etc., Computer system installed with 3D CAD/CAM Software, CNC Machine	5.1 Set up a CAM job 5.2 Create the geometry 5.3 Specify the tools, machining parameters and type of machining 5.4 Verify the operation 5.5 Convert the generated tool path to NC code 5.6 Transfer drawing data to CNC machine 5.7 Generate G-codes, M-codes, etc	Guide students through activities 5.1 to 5.7	Explain how CAM software works.
General Objective 6.0: Understand fundamental of 3D Printing						
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
14 - 15	6.1 State the history of 3D printing 6.2 Identify the advantages and limitations of 3D	• Explain the history, advantages, and limitations of 3D printing.	Recommended textbook, White Board, duster,	6.1 Create a 3D CAD model for 3D printing 6.2 Prepare the model for transfer to the 3D printer	Guide students through activities 6.1 to 6.4	Explain the procedures for using 3D printing.

	printing 6.3 Describe the operation procedure for 3D printing	• Describe the operation procedure for 3D printing	Temporary Marker, Related videos, Lecture notes, etc., Computer system installed with 3D CAD Software, 3D printer (optional)	6.3 Verify the model 6.4 Print the model		

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Fluid Power Machines

COURSE CODE: MEC 412

DURATION: 60 Hours (2 Hour Lecture, 2 Hours Practical)

UNIT: 3.0

Course: Fluid Power Machines	Code: MEC 412	Total Hours: 4 Hours/Week
Semester: THIRD	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in operation and maintenance of hydraulic and pneumatic systems		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand schematic Diagrams of hydraulic & Pneumatic systems.
2	Know the characteristics and components of fluid power systems
3	Understand the working principles and detailed construction of automatic gearboxes
4	Know the operation, constructional details and performance characteristics of fluid coupling and torque converters
5	Know the arrangement and operation of valve body and the governing systems used in automatic fluid power system
6	Know the analysis and design of a hose coupling for commercial vehicle applications
7	Know the layout and operating principles of fluid power systems for utility vehicle application

FLUID POWER MACHINES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – ALL OPTIONS						
COURSE: FLUID POWER MACHINES				COURSE CODE: MEC 412		Contact Hours: 2-0-2 Hours/Wk
Goal: This course is designed to acquaint students with knowledge and skills in operation and maintenance of hydraulic and pneumatic systems						
Course Specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective: 1.0 Understand schematic diagrams of hydraulic & pneumatic systems.					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 - 2	1.1 Draw different symbols used in hydraulic and pneumatic circuits (including general symbols, pumps, motors, valves, filters, etc) 1.2 Draw typical hydraulic and pneumatic circuit diagrams for various afflictions 1.3 Describe the working principles of a typical hydraulic and pneumatic circuit. 1.4 Describe the various types of fluid power machines e.g. turbines, pumps, compressors, fans. 1.5 Derive Euler equation for rotor dynamic machines and describe the components of these machines. 1.6 Determine force, power and efficiency of hydraulic power machines. 1.7 Describe Pascal principle of compatibility of power for presses and lifters.	Explain activities 1.1 to 1.7 with diagrams and make notes	Recommend ed text books, Whiteboard, chalk, lecture notes, etc. • Valves • Pumps • Compressors • Fan actuators • Pipe couplings and fitting, • Torque converter	1.1 Identify the following components of fluid power system. Its types and functions - (a) Pumps (b) Turbines (c) Compressors (d) Fans (e) Actuators (f) Valves 1.2 Identify and sketch common types of pipe couplings and fittings. 1.3 Identify and sketch a simple two-member torque converter. Demonstrate the working principles of the components in 1.1.	Demonstrate for the students to learn and guide them to perform the activities.	Explain schematic diagrams of hydraulic & pneumatic systems
	General Objective 2.0: Know the characteristics and components of fluid power systems					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3 - 4	2.1 Draw the performance curve	Explain activities 2.1 to	Recommend	Measure pressure head by	Demonstrate for the	Explain the

	for (a) Service operation of fluid power system (b) Parallel operation of fluid power system 2.2 Explain the basic action of the following types of pumps (a) gear (b) sliding-vane (c) piston (d) screw. 2.3 Explain the action of the following types of actuators (a) single-acting actuators (b) double-acting actuators (c) compound activators. 2.4 Sketch the common types of pipe couplings and fittings. 2.5 State the needs for filtration and list types of filters. 2.6 Explain the following hydraulic properties: (a) viscosity (b) lubricity (c) chemical stability (d) anti-foam. 2.7 Explain the advantages and dis-advantages of the following hydraulic fluids (a) water (b) mineral oil (c) glycol (d) phosphor base (e) emulsions	2.6 with diagrams and make notes where necessary. Assess the students.	ed text books, Whiteboard, chalk, lecture notes, etc.	using: i) Piezometer tube ii) Single and double column manometer. Perform experiment to determine the following: - viscosity - surface tension - Lubricity - chemical stability - anti-foam	students to learn and guide them to perform the activities.	characteristics and components of fluid power systems
	2.8 Describe types of valves with the aid of sketch e.g. (a) directional control valves (b)	Explain activities 2.8 to 2.12 with diagrams and make notes.	Recommended text books,			

5-6	pressure control (c) flow control valve. 2.9 Explain the operations of the types of valves in the categories in 2.8 2.10 Explain the principles of operation of directional control valves. 2.11 Sketch a reservoir detailing design features and fitment. 2.12 Sketch the layout of basic hydraulic circuit with two-three actuators and explain		Whiteboard, chalk, lecture notes, etc.			
General Objective 3.0: Understand the working principles and detailed construction of automatic gearboxes.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7	3.1 Sketch the power flow and relative positions of clutches and brake bands for the following drives (a) low gear (b) intermediate gear (c) top gear (d) reverse gear (e) lock up (f) park. 3.2 Explain how gear selection is controlled hydraulically in (a) road speed (b) engine speed (c) the driver 3.3 Explain the need for the installation of an oil cooler	Explain activities 3.1 to 3.3 with examples, diagrams and make notes.	Recommended text books, Whiteboard, chalk, lecture notes, etc.		Demonstrate for the students to learn and guide them to perform the activities.	Explain the working principles and detailed construction of automatic gearboxes
General Objective 4.0: Know the operation, constructional details and performance characteristics of fluid coupling and torque converters.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	4.1 State the purpose, benefits and limitations of the use of fluid coupling. 4.2 Sketch the layout of a fluid coupline. 4.3 Describe the operation of the fluid coupling.	Explain activities 4.1 to 4.12 with diagrams and make notes. • Asses the students.	Recommended text books, Whiteboard, chalk, lecture notes, etc.	4.1 Identify fluid coupling and torque converters in the hydraulic circuit of a modern vehicle. 4.2 Demonstrate the working of fluid coupling and torque	Demonstrate for the students to learn and guide them to perform the activities.	Explain the operation, constructional details and performance characteristics of fluid

8 - 9	4.4 Interpret a performance characteristic graph for fluid coupling. 4.5 State the purpose, benefit and limitations of a torque converter. 4.6 Describe the construction of a simple two-member torque converter with the aid of sketching. 4.7 Describe the operation and the power flow of torque converter in 4.6 above. 4.8 Describe the operation of a multi-stage torque converter and show when the power flow is (a) at stall (b) through the driving range (c) on over-run 4.9 Explain the meaning and significance of (a) torque ratio (b) converter efficiency (c) coupling point 4.10 Derive equations for the terms in 4.9 above. 4.11 Interpret converter efficiency and torque ratio graphs. 4.12 Solve problems related to 4.9.		• Various hoses and fittings/couplings. • Used/serviceable automatic gear box	converters. 4.3 Perform troubleshooting and fault diagnosis in fluid coupling and torque converter system.		coupling and torque converters.
General Objective: 5.0 Know the arrangement and operation of valve body and the governing systems used in automatic fluid power system						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10-11	5.1 Explain the factors affecting the design of the hydraulic valve control systems 5.2 State the function of the basic types of hydraulic control valve body. 5.3 Describe the basic and expanded circuits for 5.1 above. 5.4 Describe a typical automatic	Explain activities 5.1 to 5.7 with diagrams and make notes.	Recommended text books, Whiteboard, chalk, lecture notes, etc.	5.1 Identify hydraulic valve control system in a hydraulic circuit. 5.2 Demonstrate the working the valve control system in vehicle's automatic	Demonstrate for the students to learn and guide them to perform the activities.	Explain the arrangement and operation of valve body and the governing systems used in automatic fluid power

	transmission valve control circuit.			transmission system. Perform troubleshooting and fault diagnosis in hydraulic valve control system		system
	5.5 Select a valve control for a specific operation 5.6 Calculate valve area by simultaneous equation. 5.7 Solve several related problems					
	General Objective 6.0: Know the analysis and design of a hose coupling for commercial vehicle applications					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12 - 13	6.1 Explain the application of hydraulic hose couplings in road Vehicles e.g. (a) passengers cars (b) commercial passenger and goods vehicles. 6.2 Describe the fabrication processes used for constructing the basic hose couplings. 6.3 Explain the limitations of the processes in 6.2 above. 6.4 Describe the basic design calculation for predicting (a) the deformation (b) stress response in hose during(i) fabrication(ii) in service loading conditions. 6.5 Use the methods of 6.4 above to solve hose coupling problems. 6.6 Differentiate 6.6 (a &b) and describe methods for reinforcing the coupling hose. 6.7 Describe the effects of surge pressures in components of 6.6 above and calculate (a) excess pressure produce (b) water hammer effects (c) pressure	Explain activities 6.1 to 6.10 with diagrams and make notes.	Recommend ed text books, Whiteboard, chalk, lecture notes, etc.	6.1 Carryout a design of a hose coupling for: (a) Vehicle brake systems (b) Clutch systems (c) Coupling the truck to the transfer brakes. 6.2 Carryout experiment to determine (a) hose cycles live versus pressure levels (b) Pressure versus failure frequency 6.3 Carry out a design of a hose coupling for (a) vehicle brake systems (b) clutch systems (c) coupling the truck to the transfer brakes.	Demonstrate for the students to learn and guide them to perform the activities.	Design and analyse a hose coupling for commercial vehicle applications

	waves (d) frequency of wave oscillations (e) bulk modulus. 6.8 Explain methods to reduce defects in 6.8 above. 6.10 Describe the failure modes of hydraulic hose in use.					
General Objective 7.0: Know the layout and operating principles of fluid power systems for utility vehicle application						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	7.1 Expand the hydraulic circuit in 1.2 to include (a) two valves in series (b) two valves in parallel 7.2 Use the circuits in 7.1 above for utility vehicle operations e.g. (a) for digger device system (b) for dump vehicle application 7.3 Describe the application of two or more directional valves connected in (a) series (b) parallel for application in utility vehicles	Explain activities 7.1 to 7.3 with diagrams and make notes	Recommended text books, Whiteboard, chalk, lecture notes, etc.	Demonstrate the working principle of hydraulic circuit of an automobile brake and hydraulic ram with emphasis on the location and arrangement of valves.	Demonstrate for the students to learn and guide them to perform the activities.	Explain layout and operating principles of fluid power systems for utility vehicle application.

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Operations Management

COURSE CODE: MEC 413

DURATION: 2 Hours (2 Hours Lecture, 0 Hour Practical)

CREDIT UNIT: 2.0

Course: Operations Management	Code: MEC 413	Total Hours: 2 Hours/Week
Semester: THIRD	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 0 Hours/Week
Goal: The course is designed to acquaint students with knowledge and skills in operations management		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand competitive profile
2	Know capacity planning
3	Comprehend material management
4	Understand scheduling
5	Comprehend layout planning
6	Know Just-in-time (JIT) principles
7	Comprehend lean and agile manufacturing

OPERATIONS MANAGEMENT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – ALL OPTIONS						
COURSE: OPERATIONS MANAGEMENT			COURSE CODE: MEC 413		CONTACT HOURS: 2-0-0	
Goal: The course is designed to acquaint students with knowledge and skills in operations management						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand Competitive Profile					
	Specific Learning Outcome	Teachers Activities	Resource	Specific Learning Outcome	Teachers Activities	Evaluation
1-3	1.1 Define the following market qualifying criteria: Time, quality, Delivery, Price, Flexibility, Design features, Pre/post sales relationship. 1.2 Explain order winning/Losing criteria, Gaining competitive advantage Customer & Supplier dependence.	Explain activities 1.1 and 1.2	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain the concept of Competitive Profile
	General Objective 2.0: Know Capacity Planning					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
4-5	2.1 Define Capacity Planning 2.2 Explain the need for capacity plan along time horizons. 2.3 Explain procedure for calculating capacity - ideal, actual achievable and maximum 2.4 Describe the methods of adjusting capacity to match demand. 2.5 State the factors that control productive capacity	Explain activities 2.1 to 2.5	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain Capacity Planning

	General Objective 3.0: Comprehend Material Management					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6-7	3.1 Explain inventory management systems – economic order quantity (EOQ), Periodic replacement, Part-period balancing 3.2 Describe Materials Requirement Planning (MRP) Systems - Bills of material (common & unique parts), Master production planning, exploding, amalgamating and off-setting to produce time phased order raising.	Explain activities 3.1 and 3.2	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain Material Management
	General Objective 4.0: Understand Machine Scheduling					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8-9	4.1 Explain simple one/two machine scheduling. 4.2 Describe capacity requirement planning - load profiles & utilizing warehousing. 4.3 Explain bottleneck scheduling	Explain activities 4.1 to 4.3	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain Machine Scheduling
	General Objective 5.0: Comprehend Layout Planning					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10-11	5.1 List types of layout planning. 5.2 Explain Systematic Layout Planning (SLP). 5.3 Describe Cellular Layout - Production Flow Analysis (PFA)	Explain activities 5.1 to 5.3	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain Layout Planning
	General Objective 6.0: Know Just-in-time (JIT) principles					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

12-13	6.1 Explain the principles of JIT - Work-in-progress reduction, management-by-sight, Multi- skilling zero defects, preventive maintenance. 6.2 Describe Kanban system 6.3 Describe Set-up Reduction	Explain activities 6.1 to 6.3	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain Just-in-time (JIT) principles
General Objective 7.0: Comprehend Lean and Agile Manufacturing						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	7.1 Explain Lean Manufacturing 7.2 Describe time compression 7.3 Describe Agile Manufacturing	Explain activities 7.1 to 7.3	Marker, Whiteboard, lecture note, recommended textbooks, etc.			Explain Lean and Agile Manufacturing

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Engineering Materials and Applications

COURSE CODE: MEC 414

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 3.0

Course: Engineering Materials and Applications	Code: MEC 414	Total Hours: 3 Hours/Week
		Theoretical hours: 2 Hours/Week
	Pre-requisite: NIL	Practical hours: 1 Hour/Week
Semester: THIRD		
Goal: This course is designed to acquaint students with the knowledge and skills in engineering materials and their applications		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand ferrous materials
2	Know non – ferrous metals
3	Comprehend non-metallic materials
4	Know composite materials
5	Understand nanomaterials
6	Comprehend smart materials and emerging technologies in materials engineering

ENGINEERING MATERIALS AND APPLICATIONS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: ENGINEERING MATERIALS AND APPLICATIONS			COURSE CODE: MEC 414		CONTACT HOURS: 2-0-1 HRS/WK	
Goal: This course is designed to acquaint students with the knowledge and skills in engineering materials and their applications						
Course specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand ferrous materials					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-3	1.1 Explain the allotropic nature of iron 1.2 Explain the iron-carbon phase diagram 1.3 Define steel 1.4 Classify plain carbon steels and describe the mechanical properties as a function of composition and structure 1.5 State the uses and limitations of plain carbon steel in engineering applications	Explain 1.1 to 1.9	Recommended textbooks, Projectors, Lecture notes, Whiteboard , Marker, etc. • Practical guide and specimens	.1 Construct iron-carbon phase diagram 1.2 Identify alloying elements based on the ability to (a) Stabilise carbides (b) Graphite carbides (c) Stabilize austenite (d) Stabilize ferrite	Demonstrate for the students to learn and allow them to perform the activities	Explain the properties and applications of ferrous materials
4-7	1.6 Define alloy steel 1.7 Classify alloy steels 1.8 State typical alloying elements and their effect on the structure/property of steel 1.9 Classify alloying elements based on the ability to: a. Stabilise carbides b. graphite carbides c. stabilise austenite d. stabilise ferrite			1.3 Use TTT-curve to illustrate the effects of alloying elements and their effect on the structure and property of steel. 1.4 Identify the following: (a) low alloy steel (b) high alloy steel (c) cast iron (d) pearlitic iron (e) martensitic iron (f) austenitic iron	Demonstrate for the students to learn and allow them to perform the activities	

	1.10 Use TTT-Curve to illustrate the effects in 1.8 1.11 State various engineering applications of the following alloy steels (a) low alloy steels (b) high alloy steels like stainless steel, manganese steel, heat resisting steel, tool steel 1.12 Define cast iron and draw iron graphite equilibrium diagram Explain the two forms of carbon in carbon in cast iron and factors affecting their states 1.13 Describe the following cast iron varieties and their uses: a. Malleable cast iron b. Spheroidal graphite cast iron c. Flake graphite cast iron 1.14 Define cast iron 1.15 Describe the following cast iron varieties and their uses a. Pearlitic iron b. Nodular c. Martensitic iron d. Austenitic iron		Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			
	General Objective 2.0: Know Non - ferrous metals					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-8	2.1 List various grades of commercial copper(e.g. tough pitch copper, deoxidised copper and oxygen - free high conductivity copper)	Explain 2.1 to 2.5	Recommended textbooks, Projectors, Lecture notes,	2.1 Construct copper-zinc phase diagram 2.2 Identify various grades of commercial copper	Demonstrate for the students to learn and allow them to perform the activities	Explain the properties and applications of Non -

	2.2 State engineering application of the grades in 2.1 above 2.3 Define brass 2.4 Draw and explain the copper/Zinc equilibrium diagram 2.5 State the properties and engineering applications of brass		Whiteboard , Marker, etc. • Practical guide and Specimen	- tough pitch copper - doxided copper and - oxygen free high conductivity copper 2.3 Identify brass and its alloys		ferrous metals
	General Objective 3.0: Comprehend non-metallic materials					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	3.1 State different types of non-metallic materials. 3.2 Explain the properties, processing and applications of rubber. 3.3 Explain the properties, processing and applications of plastics: thermosetting and thermoplastics. 3.4 Explain the properties, processing and applications of ceramics. 3.5 Explain the properties, processing and applications of adhesives. 3.6 Explain the properties, processing and applications of optical fibers.	Explain 3.1 to 3.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard , Marker, etc.			Explain non-metallic materials
	General Objective 4.0: Understand nanomaterials					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	4.1 Define nanomaterials 4.2 Describe types of nano materials. 4.3 Explain physical and mechanical properties and	Explain 4.1 to 4.3	Recommended textbooks, Projectors, Lecture			Explain nanomaterials

	applications of nanomaterials		notes, Whiteboard Marker, etc.			
	General Objective 5.0: Comprehend smart materials and emerging technologies in materials science and engineering					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	5.1 Define smart materials. 5.2 Describe types of smart materials: piezoelectric, shape memory, chromoactive, magnetorheological, photoactive, etc. 5.3 Explain the applications of the smart materials listed in 5.2. 5.4 Mention the emerging technologies in materials science and engineering	Explain 5.1 to 5.4	Recommended textbooks, Projectors, Lecture notes, Whiteboard Marker, etc.			Explain smart materials and emerging technologies in materials science and engineering

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive Option)

COURSE TITLE: Vehicle Chassis and Body Technology

COURSE CODE: MEA 411

DURATION: 60 Hours (2 Hour Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Vehicle Chassis and Body Technology Semester: THIRD	Code: MEA 411	Total Hours: 4 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills on various types of layout and construction used in the manufacture of Vehicle chassis and bodies		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the reasons for the general layout and distinguish between the body constructions.
2	Appreciate the construction of the vehicle chassis with respect to materials, frame and methods of reinforcement.
3	Know the essential features of construction pressed steel and customized body work.
4	Know the various types of car body construction styles.
5	Appreciate the integral construction of a vehicle body and means of mounting its main components.
6	Appreciate the principle of car body construction and finishing.
7	Know body construction in aluminum
8	Know the various types of construction and layout of commercial vehicles used for road haulage and municipal or public utility services

VEHICLE CHASSIS AND BODY TECHNOLOGY

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: Vehicle Chassis and Body Technology			COURSE CODE: MEA 411		CONTACT HOURS: 2-0-2 Hrs/Wk	
Goal: This course is designed to acquaint students with knowledge and skills on various types of layout and construction used in the manufacture of Vehicle chassis and bodies.						
COURSE SPECIFICATION:THEORETICAL CONTENT			PRACTICAL CONTENT			
	General Objective 1.0: Know the reasons for the general layout and distinguish between body construction.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 List the reasons for layout difference such as (a) interior space (b) base of handling (c) ability to maintain (d) balanced breaking (e) other basic consideration. 1.2 Describe each item in 1.1 above 1.3 Illustrate with diagrams items in 1.1 above	Explain 1.1 - 1.4	Marker, white board, Duster, Textbooks .			Explain the reasons for the general layout and distinguish between the body constructions
	General Objective 2.0: Appreciate the construction of the vehicle chassis with respect to materials, frame and methods of reinforcement					

3-4	2.1 Describe the construction of the ladder frame. 2.2. List the material sections used e.g (a) channel section (b) I-Section (c) Top-hat section e.t.c 2.3 Describe the locations of the items in 2.2 above 2.4 Illustrate diagrammatically the items in 2.2 above 2.5 Illustrate with diagrams the methods in 2.5 above. 2.6 Describe the methods in 2.5 above. 2.7 Describe the methods of reinforcing the frame joints, e.g by gusset plates e.t.c. 2.8 Explain the methods of modes frame deflection, e.g., fatigue, torsion e.t.c. 2.9 Draw the mode of chassis deflection.	Explain 2.1 - 2.9	Marker, white board, Duster, Textbooks	Draw to scale a diagram of ladder frame Construct prototype ladder frame using sheet of metals	Guide students to draw to scale a diagram of ladder frame Demonstrate the construction of prototype ladder frame	Explain the construction of the vehicle chassis with respect to materials, frame and methods of reinforcement
	General Objective 3.0: Know the essential features of construction pressed steel and customized body work					
	3.1 List the requirements for vehicle construction contained within each of the following: (a) construction and use regulations	Explain 3.1-3.10	Marker, white board, Duster, Textbooks	Identify the sub-assemblies of a typical custom-built body structure	Guide students to identify the sub-assemblies of a typical custom-built body structure	Explain the essential features of construction pressed steel

	(b) public service vehicle (conditions of fitness regulations) (c) type of approval of legislation. 3.2 Describe the relationship among body building, panel beating/sheet metal working, painting and trimming. 3.3. Relate the main method of body construction to the following types of body: (a) general purpose (b) temperature controlled (c) ambulance (d) passenger service (e) mobile shops (f) heavy goods (g) tipping 3.4 State factors considered in vehicle body construction and describe the maintenance features of the body construction methods. 3.5 Name the main longitudinal and transverse members in a custom built body structure. 3.6 Identify the sub-assemblies of a typical custom-built body structure. Describe a solid body mounting capable of transmitting load to the web of a chassis runner. 3.8 State the condition demand			Demonstrate the effect of mounting a load that transmitted the web on a chassis Demonstrate the body mounting to different types of structure and load	Guide students to demonstrate the effect of mounting a load that transmitted the web on a chassis Guide students to demonstrate the body mounting to different types of structure and load	and customized body work

	the use of a flexible body mounting 3.9 Relate the method of body mounting to types of structure and loads carried. 3.7 State the need for a safe locking device in a body mounting.					
	General Objective 4.0: Know the various types of car body construction body styling.					
7-8	4.1 List the types of body structure, e.g., (a) the non-load carrying separate body and chassis (b) the semi integral type (c) the integral type. 4.2 Describe each type of body in 4.1 above 4.3 Explain with the aid of diagrams, the type of styling forms of car body.	Explain 4.1 - 4.4	Marker, white board, Duster, Textbooks	Carry out group project on damaged vehicle's body: pulling out, filling, smoothening, priming and painting.	Guide students to carry out group project on damaged vehicle's body: pulling out, filling, smoothening, priming and painting	Explain the various types of car body construction body styling
	General Objective 5.0: Appreciate the integral construction of a vehicle body and means of mounting its main components.					
	5.1 Describe with aid of sketches the integral construction of a vehicle body. 5.2 Describe the parts played by the following components in the stiffening of a vehicle body of integral construction (a) scuttle (b) under-body assembly (c) roof bow assembly (d) suspension	Explain 5.1 - 5.4	Marker, white board, Duster, projector, computer to play the video clips, recommended textbook	Demonstrate with aid of sketches the integral construction of a vehicle body Demonstrate the role of the following: - scuttle - under-body assembly - roof bow assembly - suspension supports	Guide students to draw sketches the integral construction of a vehicle body	Explain the integral construction of a vehicle body and means of mounting its main components

	supports (e) bulk head brace (f) contrails 5.3 State the method used to support and locate (a) engine gear box assembly (b) final drive (c) front suspension (d) rear suspension (e) exhaust system. 5.4 Explain methods of reducing the transmission of noise and vibration of mechanical components to the passenger compartment.			- bulk head brace - contrails in the stiffening of a vehicle body of integral construction		

	General Objective 6.0: Appreciate the principle of car body construction and finishing.					
11-12	6.1 List the material requirements and body posts. 6.2 Identify the function of the body pressings. 6.3 Describe the shroud and dash panel assembly. 6.5 Describe the roof and back window aperture panels. 6.6 Describe the centre pillar 6.7 Describe the bulkhead and parcel shelf. 6.8 Describe the front end. 6.9 Describe the front wings 6.10 Describe the front door panel assembly, bonnet panel and boot lid assembly. 6.11 Describe the processes of (a) body building (b) painting (c) sealing 6.12 Describe the activities in 6.11 6.13 Describe the methods of sound deadening. 6.14 Describe the fixture and	Explain 6.1 – 6.15		Identify various body pressings and their function Demonstrate the processes of - body building - painting - sealing Demonstrate fixture and fittings on vehicle body Demonstrate the effects of corrosion in carbodies	Guide students to: -identify various body pressings and their function -Demonstrate the processes of - body building - painting - sealing -Demonstrate fixture and fittings on vehicle body - Demonstrate the effects of corrosion in carbodies	Explain the principle of car body construction and finishing

	fittings.					
	6.15 Review corrosion in car bodies					

General Objective 7.0: Know body construction in aluminum						
13	7.1 State the economic advantages.	Explain 7.1 – 7.11		Demonstrate the behavior of aluminum in contact with materials	Guide students to: -Demonstrate the behavior of aluminum in contact with materials	Explain vehicle body construction in aluminum
	7.2 Describe the behavior of aluminum in contact with materials.			Join two metals using Gas welding	-Join two metals using Gas welding	
	7.3 Describe the methods of joining.			Clean the car body for good finishing	-Clean the car body for good finishing	
	7.4 Describe the method of finishing, cleaning and maintenance.			Identify the principal aluminum used in vehicle bodywork	-Identify the principal aluminum alloy used in vehicle bodywork	
	7.5 Describe the aluminum extension.			Identify other materials used in vehicle body construction	-Identify other materials used in vehicle body construction	
	7.6 List the principal aluminum alloy used in vehicle bodywork.			Use aluminum to flat platform bodies	- Use aluminum to flat platform bodies	
	7.7 Describe the use of aluminum for flat platform bodies.					
	7.8 List other materials used in vehicle body construction.					
	7.9 State the advantages and limitation of the materials in 7.8 above.					
	7.10 Give reasons why timber is obsolete body construction.					
	7.11 Describe the methods of forming materials for body					

	construction					
	General Objective 8.0: Know the various types of construction and layout of commercial vehicles used for road haulage and municipal or public utility services					
14-15	8.1 Define commercial vehicle. 8.2 Distinguish between light commercial vehicle, heavy commercial vehicle and municipal vehicle. e.g waste/refuse disposal vehicles. 8.3 Describe the articulate vehicle as combination of tractive unit and semi-trailers. 8.4 Describe trailers. 8.5 Describe municipal vehicles. 8.6 Describe the types of public service and layout. 8.7 Explain methods of operation in 8.6 above	Explain 8.1 to 8.7				Explain the various types of construction and layout of commercial vehicles used

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive Option)

COURSE TITLE: AUTOMOTIVE AIR-CONDITIONING SYSTEM

COURSE CODE: MEA 413

DURATION: 45 Hours (1 Hour Lecture, 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Automotive Air Conditioning Systems	Code: MEA 413	Total Hours:	3 Hours/Week
	Pre-requisite: MEA 321	Theoretical hours:	1 Hour/Week
		Practical hours:	2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in trouble-shooting using standard procedures for maintaining modern automotive air conditioning.			

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the fundamentals of automotive air-conditioning system.
2	Understand the fundamentals of automotive heating system.
3	Know the operation and functions of the components of automotive air-conditioning systems
4	Understand the principle of automatic control of automotive air-conditioning systems
5	Understand the steps involved in diagnosis and troubleshooting of automotive air-conditioning systems
6	Understand the fundamentals of mobile refrigerators (Cooling Van)
7	Know various types of tools and equipment used in the maintenance of automotive air-conditioning systems

AUTOMOTIVE AIR-CONDITIONING SYSTEM

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: Automotive Air-conditioning System				COURSE CODE: MEA 413		CONTACT HOURS: 1-0-2 Hrs/Wk
Goal: This course is designed to acquaint students with knowledge and skills in trouble-shooting using standard procedures for maintaining modern automotive air conditioning.						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand the fundamentals and basic principles of automotive air-conditioning system.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 Define the following terms: - Heat, Latent Heat, Sensible Heat, Humidity, Relative Humidity, Dew Point Temperature, Wet/Dry Bulb Temperatures. 1.2 Explain the following: - Modes of heat transfer - Refrigerants and their properties. - Air circulation. - Air-cooling. - Air drying and - Air cleaning 1.3 Explain Air-conditioning principle with Schematic layout (Vapour Compression Refrigeration cycle). Modes of heat transfer	Explain 1.1 - 1.4	Marker, white board, Duster, projector, computer to play the video clips, recommended textbooks, Air-conditioning and Refrigeration test rig.	Perform experiment to demonstrate Vapour Compression Refrigeration (VCR) cycle	Guide the students and ask them to perform the activities.	Explain the fundamentals and basic principles of automotive air-conditioning system
	General Objective 2.0: Understand the fundamentals and basic principles of automotive heating system.					
3-4	2.1 Explain the operating modes of automotive heating air-conditioners. 2.2 Describe manually controlled automotive air-conditioning	Explain 2.1 - 2.4	Marker, white board, Duster, projector, computer to play the video	Identify air-conditioner heater systems	Guide the students and ask them to perform the activities.	Air-conditioning and Refrigeration test rig.

	systems. 2.3 Explain different types of automotive heating air-conditioning systems.		clips, recommended textbooks,			
General Objective 3.0: Understand the operation and functions of the components of automotive air-conditioning and heating systems						
5-7	3.1 Describe the operation of air-conditioning system components such as: - Magnetic clutch. - Compressors with types. - Condensers. - Receiver Drier and Filter. - Expansion valves and suction valves. - Evaporator and heat sensing tube. - Thermostats switch, Evaporator - Pressure Regulator.	Explain 3.1	Marker, white board, projector, computer to play the video clips, recommended textbooks, Air-conditioning and Refrigeration test rig.	Identify the following air-conditioner components: - Magnetic clutch. - Compressors with types. - Condensers. - Receiver Drier and Filter. - Expansion valves and suction valves. - Evaporator and heat sensing tube. - Thermostats switch, Evaporator Pressure Regulator.	Guide the students and ask them to perform the activities.	Explain the operation and functions of the components of automotive air-conditioning and heating systems
General Objective 4.0: Understand the principle of automatic control of automotive air-conditioning and heating systems						
8-10	4.1 Describe principle of operation of automatic temperature control of automotive air-conditioning system. 4.2 Explain the different parts of automatic temperature controlled air conditioning system. 4.3 Describe humidity control (Humidifier and Dehumidifier) 4.4 Explain automatic climate control.	Explain 4.1 - 4.4	Marker, white board, projector, recommended textbooks, Air-conditioning and Refrigeration test rig.	Identify the automatic control system of automotive air-conditioning system. Identify the different parts of automatic control system of automotive air-conditioning system.	Guide the students and ask them to perform the activities.	Explain principle of automatic control of automotive air-conditioning and heating systems
General Objective 5.0: Understand the steps involved in diagnosis and general troubleshooting of automotive air-conditioning systems' faults						
	5.1 Explain fire prevention processes. 5.2 Enumerate basic shop safety rules 5.3 State air-conditioner service	Explain 5.1 - 5.6	Marker, white board, Duster, projector, computer to play the video	Use car heater system trouble diagnosis chart to diagnose faults. Perform trouble-shooting car air-conditioning system	Guide the students and ask them to perform the activities.	Explain the steps involved in diagnosis and general troubleshooting

11-12	safety rules. 5.4 Explain the procedures involved in maintenance and service of various components of air- conditioner system. 5.5 Explain the processes involved in charging and discharging of automotive air-conditioning system. 5.6 Explain the causes of automotive air-conditioner failure. 5.7 Explain car air-conditioning system troubleshooting chart		clips, recommended textbooks, Air-conditioning and Refrigeration test rig. - Charging units. - Hoses. - Gauges. - Refrigerant	using air-conditioner trouble - diagnosis chart Use the Leak detector to check for leakages. Check the pressures with pressure gauge set. Perform the following: - periodic maintenance - Vacuum pump service - Discharge the system. - Add oil. - Evacuate the system - Vapour charging and Liquid charging. - Use of Recovery recharging unit. Carryout car air-conditioner service. Remove and replace components: - O – rings - Hose clamps - Compressor drive belts - the compressor - other components. Service different car air-conditioner compressors. (R-4, R-6, V-type etc.)		of automotive air-conditioning and heating systems faults
General Objective 6.0: Understand the fundamentals of mobile refrigerators (Cooling Van)						
13	6.1 Explain with the aid of diagram, the general layout of a cooling van 6.2 Explain the components and functions of a cooling van:	Explain 6.1 – 6.3	Marker, white board, Duster,			Explain the the fundamentals of mobile refrigerators

	compressor, evaporator, condenser, expansion valve, accumulator, dryer, etc. 6.3 Explain the procedures in troubleshooting a cooling van.					(Cooling Van)
	General Objective 7.0: Know various types of tools and equipment used in the maintenance of automotive air-conditioning systems					
14-15	7.1 Describe the various tools used in the maintenance of automotive air-conditioners. 7.2 Describe the various equipment used in the maintenance of automotive air-conditioners: Pressure gauge, leak detector, vacuum pump, etc. 7.3 Explain the uses of each tool and equipment in 7.1 and 7.2. 7.4 Explain the methods used in the maintenance of the tools and equipment in 7.1 and 7.2.	Explain 7.1 – 7.4	Marker, white board, Duster, textbook, RAC test rig. Pressure gauge, leak detector, vacuum pump	7.1 Identify the various tools and equipment used in the maintenance of automotive air-conditioners. 7.2 7.1 Demonstrate the various tools and equipment used in the maintenance of automotive air-conditioners	Guide the students to use the tools and equipment in RAC simple repair	Explain various types of tools and equipment used in the maintenance of automotive air-conditioning systems

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive Option)

COURSE TITLE: Workshop Management

COURSE CODE: MEA 414

DURATION: 30 Hours (2 Hours Lecture, 0 Hour Practical)

CREDIT UNIT: 2.0

Course: Workshop Management	Code: MEA 414	Total Hours:	2 Hours/Week
	Pre-requisite: NIL	Theoretical hours:	2 Hours/Week
		Practical hours:	0 Hour/Week
Goal: This course is designed to acquaint students with knowledge and skills of equipping automotive garage and service stations for the management of automotive sales and services.			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand how the factors involved in workshop administration are applied to the siting, layout and relative location of the workshop and other supporting services
2	Understand the general principles involved in the management and operation of services station forecourt.
3	Understand the duties involved in the reception function and how they are applied in promoting and marketing works services of vehicle sales
4	Understand the principles of production control as applied to automotive repair workshops.
5	Understand costing principles and methods, and the procedures to be followed in vehicle accident repair work.
6	Appreciate the need for efficient inventory control system.
7	Understand the factors involved in the inspection and maintenance of workshop equipment.
8	Understand insurance and the procedures for carrying out valuation and repairs of accident vehicles.
9	Understand the problems associated with the organization and running of diagnostic and flow-line servicing system

WORKSHOP MANAGEMENT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: WORKSHOP MANAGEMENT			COURSE CODE: MEA 414		CONTACT HOURS: 2-0-0 Hrs/Wk	
Goal: This course is designed to acquaint students with knowledge and skills of equipping automotive garage and service stations for the management of automotive sales and services.						
COURSE SPECIFICATION:THEORETICAL CONTENT			PRACTICAL CONTENT			
	General Objective 1.0: Understand how the factors involved in workshop administration are applied to the sitting, layout and relative location of the workshop and other supporting services					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-2	1.1 List the principal factors which influence the siting and the design of a retail service garage and workshop complex. 1.2 Explain the relevant legislations relating to development and to the application in such development proposal 1.3 Explain the choices and constraints on decisions relating to planning the location, layout and equipping the (a) workshop complex including body repair (b) forecourt (c) office (d) reception (e) parts department. 1.4 Explain the selection of the equipment most suitable to the control and processing of correspondent, documents and records for the garage/workshop organization. 1.5 Explain the responsibilities to employees and visitors, which arise, from the ownership and occupancy of land and premises. 1.6 Chart the movement of vehicle and the flow of documents through the workshop.	Explain activities 1.1 to 1.11 with diagrams where necessary and make detailed notes.	Marker, whiteboard, Duster, Textbooks .			Explain the factors involved in workshop administration are applied to the sitting, layout and relative location of the workshop and other supporting services

	1.7 Describe how to design forms suitable for given purposes, such as job cards sets. 1.8 Explain how to perform an assignment of planning a new retail garage/workshop. 1.9 Sketch the layout of a conventional lubrication section for a repair workshop. 1.10 Explain how to produce a layout for a flow-line service section as an integral part of a repair workshop and explain the advantages of the system. 1.11 Describe how to produce a layout for a diagnostic service, e.g. (i) as an integral part of the repair workshop (ii) as a self-contained section within the service station.					
General Objective 2.0: Understand the general principles of management and operation of a service station						
3	2.1 Describe the role of a forecourt manager. 2.2 State the importance of forecourt planning in the functioning of the service station considered as a whole. 2.3 List the techniques by which the forecourt can influence marketing or parts and services. 2.4 Describe the importance of maintaining forecourt 2.5 Describe the procedures for achieving customer satisfaction, e.g. (a) the receipt of petroleum spirit (b) the issuing of petroleum spirit. 2.6 State the legislation relating to the storage and issuing o petroleum spirit.	Explain 2.1 - 2.6	Marker, whiteboard, Duster, Textbooks		Guide the students and ask them to perform the activities.	Explain the principles of management and operation of a service station

	General Objective 3.0: Understand the duties of reception roles and how they are applied in the techniques of promoting the marketing workshop services.					
4-5	3.1 Describe the factors involved in liaison and coordination between reception, workshop and parts departments, and apply them to actual or given situation. 3.2 Explain the principles involved in liaison and coordination between reception, workshop and parts departments, and apply them to actual or given situation. 3.3 Describe a system of registering workshop appointments and controlling workshops loading 3.4 State the techniques for promoting and marketing workshop services. 3.5 Explain how to prepare appropriate customer's repair orders, reports and estimates for actual or simulated vehicle repair work. 3.6 Describe warranty and how to handle warranty problems. 3.7 Enumerate the ways of minimizing or preventing customer's complaint through improved communication between workshop, parts and administrative departments. 3.8 Explain how to prepare an induction-training programme for a new reception engineer employee. 3.9 Use standard time books/repair schedule for costing.	Explain 3.1 to 3.9	Marker, white board, Duster, Textbooks			Explain the duties of reception roles and how they are applied in the techniques of promoting the marketing workshop services.
	General Objective 4.0: Understand the principles of production control as applied in motor vehicle repair workshops.					
	4.1 Describe the accepted methods of the physical handling of the vehicle, on the arrival at reception, in the workshop and at the point of delivery. 4.2 State the principles involved in progress and production control.	Explain activities 4.1 to 4.6 with diagrams where necessary and make detailed notes.	Marker, white board, Duster, Textbooks			Explain the principles of production control as applied in motor vehicle

6	4.3 Describe the role of (i) the job controller (ii) the foreman in a repair workshop 4.6 Describe how to produce a production control chart suitable for use in a motor vehicle repair workshop 4.7 Analyze manufacturers' specifications and bulletins relating to work to be undertaken. 4.8 Evaluate and handle a simple case study which involved problems arising from defective product or a deficient workshop or an unsatisfactory service.					repair workshops.
	General Objective 5.0: Develop an understanding of costing principles and methods and the procedure to be followed in vehicle accident repair work					
7-8	5.1 Describe the basic principles of the methods of costing encountered in a repair workshop. 5.2 Describe the role of manufacturer time schedules in establishing labour costs. 5.3 Describe the basic principle involved in insurance costing. 5.4 Explain how to produce an insurance estimate from given data. 5.5 Describe how a customer's invoice is produced. 5.6 Describe the procedures to be followed prior to undertaking insurance repair work. 5.7 State the cover provided by an insurance company by interpretation of the policy issued. 5.8 State the purpose of excess payments,	Explain activities 5.1 to 5.9 with diagrams where necessary and make detailed notes.				Explain costing principles and methods and the procedure to be followed in vehicle accident repair work

	conditional clauses and completion notes.					
	5.9 State the functions of an insurance assessor.					
	General Objectives 6.0: Appreciate the need for efficient inventory control system					
9-10	6.1 Cost service parts requirements per period for a Public Service Vehicle (P.S.V.) or heavy Goods Vehicle (H.G.V.) giving distance covered and items required for each service. 6.2 Estimate tyre cost per period for a vehicle above. 6.3 Explain how to select a basic fast-moving parts inventory for a homogenous fleet given numbers of vehicles and estimated distance covered per vehicle. 6.4 Justify a part stocking policy using data from 6.1 and 6.3 above. 6.5 Select a suitable location for parts store using workshop plan. 6.6 Select a stock control system suitable for parts store. 6.7 Describe typical services frequency or supply for fast-moving parts. 6.8 Justify the need to locate storage of special tools centrally in or near the parts stores. 6.9 Describe a method of regularly monitoring tools and equipment condition, in order to maintain in usable condition at all	Explain activities 6.1 to 6.11 with diagrams where necessary and make detailed notes.				Explain the need for efficient inventory control system

	times. 6.10 Justify “writing off” and replacing tools and equipment. 6.11 State the advantages of “continuous” and “periodic” stock-taking respectively, in a part’s facility.					
Genera Objectives 7.0: Understand the factors that affect inspection and maintenance of workshop equipment.						
11-12	7.1 Describe the principle involved in budgeting relating to the purchase of equipment. 7.2 Compare the economics of hiring equipment with the out-right purchasing. 7.3 Explain the procedures for evaluating the relative merits of equipment. 7.4 Explain the procedures involved in the inspection and maintenance of buildings. 7.5 Explain the procedures involved in the inspection and maintenance of equipment and tools. 7.6 Evaluate the merits of planned maintenance of special equipment. 7.7 Explain how to produce a system for checking the condition of service tools used in the workshop 7.8 Explain how “whole life cycle” considerations apply when choosing specialist equipment and service tools as in 7.5-7.7 above. 7.9 Describe the equipment involved in	Explain activities 7.1 to 7.11 with diagrams where necessary and make detailed notes.				Explain the factors affecting inspection and maintenance of workshop equipment.

	maintaining an accident repair service. 7.10 Compute whole life cost for (i) a high quality equipment (ii) a low quality equipment. 7.11 Devise a system for recording whole life cycle costs for equipment and tools.					
Genera Objectives 8.0: Understand insurance and the procedure for carrying out the repairs of accident vehicles.						
13-14	8.1 Explain the difference between: (i) insurance indemnity against third party claims (ii) insurance indemnity for cost of vehicle repairs after accident (iii) insurance cover on goods in transit. 8.2 Describe typical accident damage to (i) chassis (ii) suspension, wheels and steering mechanism (iii) body. 8.3 Recognize specialist nature of a manpower skills and capital resources to effect repairs in damaged vehicles. 8.4 Estimate cost of typical accident repairs, given time, parts and materials requirements.	Explain activities 8.1 to 8.4 with diagrams where necessary and make detailed notes.				Explain insurance and the procedure for carrying out the repairs of accident vehicles
Genera Objectives 9.0: Understand the problems associated with the organization and running of diagnostic and flow-line servicing system						
15	9.1 Outline the problems of flow-line servicing. 9.2 Analyze the importance of accurate fault diagnosis in workshop loading and production control. 9.3 State the importance of keeping service records and prepare typical examples. 9.4 State the merits and problems encountered in undertaking used car reconditioning within the existing repair workshop.	Explain activities 9.1 to 9.4 with diagrams where necessary and make detailed notes.				Discuss the problems associated with the organization and running of diagnostic and flow-line servicing system

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing Option)

COURSE TITLE: Metrology

COURSE CODE: MEM 411

DURATION: 45 Hours (2 Hour Lecture, 1 Hours Practical)

CREDIT UNIT: 3.0

Subject:	Code: MEM 411	Total Hours:	3 Hours/Week
		Theoretical hours:	2 Hour/Week
		Practical hours:	1 Hours/Week
Semester: THIRD	Pre-requisite: NIL		
Goal: This course is designed to acquaint students with knowledge and skills in advanced engineering measurement			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the fundamentals of measurement
2	Understand the types and sources of errors
3	Understand the constructional details of simple measuring instruments
4	Understand the concept of quality, the importance and organization of quality control
5	Understand the control of quality through specification of dimensions of machines elements and sub-assembly (at design stage)
6	Understand the control of quality at the production and planning stages
7	Know how to measure and identify the accuracy grade of a thread
8	Know the principles and applications of comparators
9	Understand the principles of angular measurement
10	Understand the measurement of gears and identify their accuracy grade
11	Understand the principles of simple interferometric measurement
12	Know the purpose and types of alignment tests for common types of machine tools

METROLOGY

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - MANUFACTURING (OPTION)						
COURSE: METROLOGY		Course Code: MEM 411			Contact Hours: 2-0-1 Hrs/wk	
Goal: This course is designed to acquaint students with knowledge and skills in advanced engineering measurement						
Course Specification: Theoretical Content				Practical Content		
Week	General Objective: 1.0 Know the fundamentals of measurement					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
1	1.1 Describe workshop standards of length 1.2 List the sub-divisions of standard of length 1.3 Explain the sub-divisions in 1.1	Explain 1.1 – 1.3	Whiteboard, Marker, lecture notes, textbooks, Vernier caliper, • Bench testing centres	1.1 Perform a gauging test on a thread. 1.2 Measure the core and outer diameter on a thread. 1.3 Measure pitch on a thread. 1.4 Compare the measured parameters of a thread with standard values.	Guide students to: - Perform a gauging test on athread. - Measure the core and outerdiameter on a thread. - Measure pitch on a thread. - Compare the measuredparameters of a thread with standard values	• Comparator, Limit gauges, Steel rule, Dynamometer, • Thermometer, Thermocouple • Pyrometer,

	General Objective 2.0: Understand the types and sources of errors					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
2	2.1 Describe the types of errors commonly found in engineering measurement 2.2 Identify sources of errors in measurement such as equipment errors, operational interference, installation. 2.3 Explain means of overcoming errors mentioned in 2.1 above. 2.4 Describe (drunken thread).	Explain 2.1 – 2.4	Whiteboard, Marker, lecture notes, textbooks.	Using ring, snap and plug thread gauges to carry out a gauging process on bolts and nuts Gauge shaft and classify them into limited tolerance groups using an electrical comparator. Gauge holes and classify them into limited tolerance groups using a pneumatic comparator. Use sine bars, slip gauges and precision rollers to carry out angular measurement of an object	Guide students to: -Carry out a gauging process on bolts and nuts using ring, snap and plugthread gauges - Gauge shaft and classify them into limited tolerance groups using an electrical comparator - Gauge holes and classify them into limited tolerance groups using a pneumatic comparator -Carryout angular measurement of an object using sine bars, slip gauges and precision rollers	Pitch measuring machine • Thread micrometer • Standard Ring gauges, Bolts and Nuts

General Objective 3.0: Understand the constructional details of simple measuring instruments						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
3	3.1 Explain the principles, constructional details and operation of the following: (a) dynamometer (b) bourdon tube manometers (c) thermometer, pyrometer, thermocouple etc.	Explain .3.1 a-c	Whiteboard, Marker, lecture notes, textbooks. Dynamometer, bourdon tube, manometers, thermometer, pyrometer, thermocouple etc	Use monochromatic light source, optical flats, optical parallels, slip gauge set and interferometric outfit to perform the following experiments: -measure the error of flatness of slip gauges, micrometer measuring faces and other flat reflecting surfaces. -Measure the error of parallelism of micrometer measuring faces -Measuring small deviation in size and small dimensions -Calibrate the micrometric head.	Guide students to use monochromatic light source, optical flats, optical parallels, slip gauge set and interferometric outfit to perform the following experiments: -Measure the error of flatness of slip gauges, micrometer measuring faces and other flat reflecting surfaces. -Measure the error of parallelism of micrometer measuring faces -Measure small deviation in size and small dimensions -Calibrate the micrometric head	Explain the constructional details of simple measuring instruments

General Objective: 4.0 Understand the concept of quality, the importance and organization of quality control						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
4	4.1 Explain quality control and related terminologies: durability, reliability interchangeability 4.2 Explain the measurement/testing of the parameters in 1.1. 4.3 State the scope and objectives of quality control and explain the work of the quality control department in a firm. 4.4 List the stages of the production process and explain the influence of each on the overall quality of a product. 4.5 List the factors that affect the quality of a product 4.6 Explain the relationship between quality and cost (of a product)	Explain 4.1 - 4.6	Whiteboard, Marker, lecture notes, textbooks. Pitch measuring machine • Thread micrometer • Standard Ring gauges, Bolts and Nuts	4.1 Use the involute testing machine to carry out the measurement of the involute form; tooth line errors and base pitch error of a gear. 4.2 Conduct practical test on the common machine tools, centre lathe, drilling machine, milling machine and shaping machine	Demonstrate for the students to learn and ask them to perform all the activities.	Explain the concept of quality, the importance and organization of quality control

	General Objective 5.0: Understand the control of quality through specification of dimensions of machines elements and sub-assembly (at design stage)					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
5 - 6	5.1 State importance of interchangeability of machine parts and elements with respect to the quality of a product. 5.2 State the necessity of imposition of tolerance on the size of elements. 5.3 Present graphically the position of tolerance in relation to “zero line” for various fundamental deviations. 5.4 State the meaning of “basic hole” and “basic shaft” and present their tolerance zones in graphical form. 5.5 Explain the notion of fit between two mating parts (shaft and hole) 5.6 Calculate the maximum and minimum clearance and interference for various fits. 5.7 Distinguish between three types of fits and give their examples in graphical form 5.8 Explain the difference between “Hole Basic” and “Shaft basis” fits	Explain 5.1 – 5.16	Whiteboard, Marker, lecture notes, textbooks.	Interchange machine parts and elements with respect to the quality of a product Use parts to show the necessity of imposition of tolerance on the size of elements Present graphically the position of tolerance in relation to “zero line” for various fundamental deviations Present graphically the position of tolerance zones of basic hole and basic shaft Calculate the maximum and minimum clearance and interference for various fits Demonstrate dimensional Chains	Guide students to: Interchange machine parts and elements with respect to the quality of a product Use parts to show the necessity of imposition of tolerance on the size of elements Present graphically the position of tolerance in relation to “zero line” for various fundamental deviations Present graphically the position of tolerance zones of basic hole and basic shaft Calculate the maximum and minimum clearance and interference for various fits Demonstrate dimensional chains	Explain the control of quality through specification of dimensions of machines elements and sub-assembly (at design stage)

	5.9 Present graphically 2.8 5.10 Outline the main features of the ISO system for limits and fits. 5.11 Explain why and on what principles that vast number of possible ways to produce fits (combination of all holes with each shaft) has been constrained in practical standards to some limited number of fits. 5.12 Explain when “Hole Basic” fits are preferred to “Shaft Basic” fits and vice-versa. 5.13 Define the meaning of term “Dimensional Chain” 5.14 Explain the linear difference between constructional and technological dimensional chains. 5.15 Perform calculations on tolerated dimensions. 5.16 Calculate dimensional chains			Identify the linear difference between constructional and technological dimensional chains Perform calculation on tolerated dimensions Calculate dimensional chains	-Identify the linear difference between constructional and technological dimensional chains -Perform calculation on tolerated dimensions - Calculate dimensional chains	

	General Objective 6.0: Understand the control of quality at the production and planning stages.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8	6.1 Distinguish between measurable characteristics (variables) and non-measurable (attributes) of a product. 6.2 Explain automatic inspection and statistical method of control using charts	Explain 6.1 – 6.9	Whiteboard, Marker, lecture notes, textbooks. Relevant charts.			Explain the control of quality at the production and planning stages.

	6.3 State the advantages and disadvantages of the inspection methods in 3.1. 6.4 Select means of inspection measuring instruments, gauging devices etc. 6.5 Explain the general theory of control charts used in standards (e.g. BS 2564: 1969) 6.6 Construct control charts (graphs) for sample average and sample range to monitor process variation. 6.7 Construct fraction defective and number defective control charts. 6.8 Interpret information derived from the charts in 6.5 and 6.6 6.9 Explain the effect of the quality of machine tools, cutting tools, jigs and fixtures on the quality of the items produced			Construct control charts, fraction defective and number defective control charts for sample average and sample range to monitor process variation	Guide students to construct control charts, fraction defective and number defective control charts for sample average and sample range to monitor process variation	
General Objective 7.0: Know how to measure and identify the accuracy grade of a thread.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
9	7.1 List the type of thread gauges 7.2 Describe standards for thread gauges tolerances 7.3 Explain setting and adjustments and indicating thread gauges of both external and internal type. 7.4 Perform a gauging test on a thread	Explain 7.1 – 7.8	Whiteboard, Marker, lecture notes, textbooks. Thread gauges	Identify different types of thread gauges Identify accuracy grade of a thread	Guide students to Identify different types of thread gauge Guide students to identify accuracy grade of a thread	Explain how to measure and identify the accuracy grade of a thread

	7.5 Measure the core and outer diameter on a thread. 7.6 Measure pitch on a thread. 7.7 Compare the measured parameters of a thread with standard values. 7.8 Carry out a gauging process on bolts and nuts using ring, snap and plug thread gauges to.			Demonstrate the setting and adjustment indicating thread gauges of both external and internal type Perform a gauging test on a thread Measure the core and outer diameter on a thread. Measure pitch on a thread Carry out a gauging process on bolts and nuts using ring, snap and plug thread gauges to	Guide students to demonstrate the setting and adjustment indicating thread gauges of both external and internal type Guide students to: -Perform a gauging test on a thread -Measure the core and outer diameter on a thread. -Measure pitch on a thread -Carry out a gauging process on bolts and nuts using ring, snap and plug thread gauges to	

General Objective 8.0: Know the principles and applications of comparators						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10	8.1 Differentiate comparative measurement from direct measurement 8.2 List the essential elements of a comparator. 8.3 Explain the functions of each element as stated in 5.2. 8.4 Explain the design and principle of operation of three of the comparators: mechanical, electrical, and pneumatic. 8.5 List the merits and demerits of the comparators listed in 5.4. 8.6 Describe method of obtaining magnifications in the comparators listed in 5.4. 8.7 Describe the method of setting up the comparators for gauging shafts and holes. 8.8 Describe practical application of the comparatives listed in 5.4	Explain 8.1 – 8.8	Whiteboard, Marker, lecture notes, textbooks. comparators	Use comparator to take measurement: mechanical, electrical, and pneumatic Identify essential elements of a comparator Demonstrate the function of each element of a comparator Demonstrate the methods of obtaining magnifications in the comparators Demonstrate the methods of setting up the comparators for gauging shafts and holes	Guide students to: Use comparator to take measurement: mechanical, electrical, and pneumatic Identify essential elements of a comparator Demonstrate the function of each element of a comparator Demonstrate the methods of obtaining magnifications in the comparators Demonstrate the methods of setting up the comparators for gauging shafts and holes	Explain the principles and applications of comparators

	General Objective 9.0: Understand the principles of angular measurement					
11	9.1 List four angular measuring instruments 9.2 Explain the working principles of the angular measuring instrument listed in 6.1 9.3 State the precautions to be observed when using the angular measuring instrument listed in 6.1. 9.4 State the functions of a gear 9.5 Define the elements and standard proportion of gears. 9.6 Name the possible errors and deviations on a gear affecting its accuracy and fit. 9.7 Explain the use of standards for specifying the tolerance and fits of gears. 9.8 Describe a double flank test on a gear and interpret the obtained graph. 9.9 Describe the method of measuring the error of involute form on a gear tooth and interpret the graph		Whiteboard, Marker, lecture notes, textbooks. Clinometer vernier protractors, etc.	Identify angular measuring instruments Identify the elements and standard proportion of gears Demonstrate the use of standards for specifying the tolerance and fits of gears	Guide students to: - Identify angular measuring instruments - Identify the elements and standard proportion of gears - Demonstrate the use of standards for specifying the tolerance and fits of gears - Demonstrate the methods of measuring the error of involute form on a gear tooth and interpret the graph	Explain the principles of angular measurement
	General Objective 10.0: Understand the measurement of gears and identify their accuracy grade					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12	10.1 Describe the method of measuring the error of a pressure line and interpret the graph. 10.2 Describe the method of measuring the base pitch on a gear.	Explain 10.1 – 10.4	Whiteboard, Marker, lecture notes, textbooks. Vernier calipers, micrometer	Demonstrate the methods of measuring the error of involute form on a gear tooth, error of a pressure line, error of base pitch, simple and cumulative errors of circular pitch, draw and interpret the graph	Guide the students to:	Explain the measurement of gears and identify their accuracy grade

	10.3 Describe the method of measuring the simple and cumulative errors of circular pitch and draw the graph and interpret. 10.4 Use the values measured to designate the accuracy grade for the gear.		screw gauge		Demonstrate the methods of measuring the error of involute form on a gear tooth, error of a pressure line, error of base pitch, simple and cumulative errors of circular pitch, draw and interpret the graph	
General Objective 11.0: Understand the principles of simple interferometric measurement						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	11.1 Explain the phenomenon of interferometry. 11.2 Explain the use of optical flat in measurement of small deviations in size, error of flatness and parallelism. 11.3 Describe the principles of design and operation of the NPL gauge interferometer and the diffraction method of slip gauge size evaluation. 11.4 Describe the principles of design and operational of the laser interferometer. 11.5 Describe other applications of laser interferometer like diffraction measurement and holography.	Explain 11.1 – 11.5	Whiteboard, Marker, lecture notes, textbooks.			Explain the principles of simple interferometric measurement
General Objective 12.0: Know the purpose and types of alignment tests for common types of machine tools						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	12.1 State the purpose of no-load running tests. 12.2 State the purpose of	Explain 12.1 – 12.6	Whiteboard, Marker, lecture notes,		Guide the students to:	Explain the purpose and types of

14-15	practical alignment tests. 12.3 List and state the uses of the following equipment used for alignment tests: precision level, dial test indicator, test mandrel, straight edge and square. 12.4 Sketch and describe the following alignment tests for common machine tools (a) coaxial alignment (between axes) (b) parallelism (c) squareness or perpendicularity (d) concentricity and end float of spindles. 12.5 State the effect of alignment error on the workplace 12.6 Compare the results of the test in 9.6 with standard values in alignment charts and machine tool brochure.		textbooks.	Carryout alignment tests for common machine tools -precision level, -dial test indicator, -test mandrel, -straight edge and square	Carryout alignment tests for common machine tools -precision level, -dial test indicator, -test mandrel, -straight edge and square	alignment tests for common types of machine tools

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing Option)

COURSE TITLE: Testing and Failure of Materials

COURSE CODE: MEM 412

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

UNIT: 2.0

Subject:	Code: MEM 412	Total Hours:	3 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	1 Hour/Week
Semester: THIRD	Pre-requisite:		
Goal: This course is designed to acquaint the students with knowledge and skills in engineering materials testing and failures modes			

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the causes and types of corrosion
2	Know the electro-chemical nature of materials corrosion
3	Understand stress and cavitation corrosion and its preventive methods
4	Comprehend different methods of corrosion protection
5	Understand the concept of fatigue failure
6	Understand how to interpret fatigue curves (S-N curves) and the factors affecting endurance limit
7	Understand the Phenomenon of cumulative damage in fatigue
8	Understand the mode of failure of engineering materials by creep
9	Understand the Properties of creep-resisting alloys
10	Understand the concept of Non-destructive Testing
11	Understand the advantages and disadvantages of Non-Destructive Testing (NDT)
12	Understand how to interpret the results of materials tests
13	Understand tensile test and stress-strain relationship
14	Understand how to determine the Proof-stress using stress-strain curve.

TESTING AND FAILURE OF MATERIALS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY- MANUFACTURING (OPTION)						
COURSE: TEST AND FAILURE OF MATERIALS			Course Code MEM 412		Contact Hours 2-0-1 HRS/WK	
Goal: This course is designed to acquaint the students with knowledge and skills in engineering materials testing and failures modes						
COURSE SPECIFICATION THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	General Objective: Understand the causes and types of corrosion					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1	1.1 List the principal types of corrosion 1.2 Explain the causes of corrosion 1.3 Describe chemical corrosion. 1.4 Describe electrochemical corrosion	Explain 1.1 to 1.4	Whiteboard marker, Lecture note, textbooks Universal testing machine	1.1 Carryout tensile tests on selected materials 1.2 Determine from the tensile test result on metals the tensile strength, yield strength, limit of proportionality, proof stress, Young’s modulus, percentage elongation, percentage reduction in area, poisson’s ratio.	Demonstrate for the students to learn and ask them to perform all the activities.	Explain the causes and types of corrosion
	General Objective 2.0: Know the electro-chemical nature of materials corrosion					
2	2.1 Distinguish between direct and electro-chemical corrosion. 2.2 Explain the relationship between microstructure and corrosion resistance. 2.3 Describe the fitting corrosion 2.4 Describe the effect of stress on corrosion.	Explain 2.1 to 2.4	Marker, whiteboard, Lecture note, textbooks Galvanic and electroplating equipment	2.1 Carryout experiment to demonstrate electroplating and galvanic protection	Demonstrate for the students to learn and ask them to perform all the activities.	Explain chemical nature of materials corrosion

	General Objective 3.0: Understand stress and cavitation corrosion and its preventive methods					
	3.1 Explain stress corrosion and cavitation corrosion. 3.2 Explain the effect of design on corrosion 3.3 Describe the different method of corrosion prevention	Explain 3.1 to 3.3	Marker, Whiteboard Lecture note, textbooks Corrosion testing kits	Subject a material to corrosive environment for a specific period and carryout tensile test and comprehension test to determine the effect of corrosion on the mechanical properties of the material.	Demonstrate for the students to learn and ask them to perform all the activities.	Explain stress and cavitation corrosion and its preventive methods
	General Objective 4.0: Comprehend different methods of corrosion protection					
3- 4	4.1 Compare metallic and non-metallic protection. 4.2 Compare the advantages and disadvantages of different methods of corrosion protection.	Explain 4.1 to 4.2	Marker, whiteboard, Lecture note, textbooks			
	General Objective 5.0: Understand the concept of fatigue failure					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
5	5.1 Explain fatigue failure 5.2 List sources of stress fluctuation in engineering systems under service conditions. 5.3 Describe the available types of fatigue tests.	Explain 5.1 to 5.3	Marker, whiteboard, Lecture note, textbooks UTM	5.1 Carryout fatigue tests on different tensile specimens and plot the various S-m curves. 5.2 Analyse the results.	Demonstrate for the students to learn and ask them to perform all the activities.	Explain the concept of fatigue failure
	General Objective 6.0: Understand how to interpret fatigue curves (S-m curves) and the factors affecting endurance limit.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6	6.1 Draw typical S-m curves for readings in fatigue tests for ferrous and non-ferrous materials. 6.2 Explain what is meant by fatigue and endurance limits. 6.3 List the factors affecting endurance or fatigue limit.	Explain 6.1 to 6.3	Marker, whiteboard, Lecture note, textbooks			Interpret fatigue curves (S-m curves) and the factors affecting endurance limit
	7.0 Understand the Phenomenon of cumulative damage in fatigue					

Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7	7.1 Explain the phenomenon of cumulative damage in fatigue. 7.2 Predict the fatigue life of engineering components.	Explain 7.1 to 7.3	Marker, whiteboard, Lecture note, textbooks			Explain the phenomenon of cumulative damage in fatigue
General Objective 8.0: Understand the mode of failure of engineering materials by creep.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8	8.1 Describe the 3 stages in creep. 8.2 Describe a typical creep test. 8.3 Explain a typical creep curve 8.4 Describe the stages leading to rupture of various materials 8.5 Describe creep failure.	Explain 8.1 to 8.4	Marker, whiteboard, Lecture note, textbooks Creep tester	8.1 Carryout experiments to determine creep curves for different materials 8.2 Demonstrate effect of temperature on creep rate and plot creep strain - time graphs for different temperature for a metal. 8.3 Analyse results	Demonstrate for the students to learn and ask them to perform all the activities.	Explain the mode of failure of engineering materials by creep
General Objective 9.0: Understand the properties of creep-resisting alloys.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
9	9.1 List the characteristics of creep-resisting alloys. 9.2 List alloys with good creep resistance.	Explain 9.1 to 9.2	Marker, whiteboard, Lecture note, textbooks			Explain the properties of creep-resisting alloys.
10.0 Understand the concept of Non-destructive Testing.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10	10.1 Explain Non Destructive tests (NDT) 10.2 Discribe the financial and economic aspects of NDT	Explain 10.1 to 14.3	Marker, whiteboard, Lecture note, textbooks Magnetic	10.1 Perform the following NDT on a sample: a. Visual inspection b. Magnetic particle method c. Dye Penetrant	Demonstrate for the students to learn and guide them to perform all the activities.	Explain the concept of Non-destructive Testing

	methods. 10.3 Describe the methods of carrying out the following NDT: a. Visual inspection b. Magnetic particle method c. Dye Penetrant d. Eddy Current e. Ultrasonic f. Radiography		particle/ Dye Penetrant/ Eddy Current/Ultrasonic/ Radiography Test equipment	d. Eddy Current e. Ultrasonic f. Radiography 10.2 Analyse the results on the NDT in 10.1		
General Objective 11.0: Understand the advantages and disadvantages of Non-Destructive Testing (NDT)						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11	11.1 Describe the necessary precessions required to obtain maximum efficiency. 11.2 Explain the principles that govern each of the tests mentioned in 11.3 11.3 Discribe the limitation and advantages of the test in 11.3 above.	Explain 11.1 to 11.3	Marker, whiteboard, Lecture note, textbooks•			Explain the advantages and disadvantages of Non-Destructive Testing (NDT)
General Objective 12.0: Understand how to interpret the results of materials tests						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12	12.1 Describe Destructive tests such as: a. Izod - charpy test b. Hardness test c. Tensile tests etc	Explain 12.1 a-c	Marker, whiteboard, Lecture note, textbooks Universal hardness testing machine, UTM, etc.	12.1 Carry out hardness test to determine the following: a. Brinell hardness numbers. b. Vickers pyramid hardness numbers c. Rockwell hardness number or different test pieces. 12. 2 Demonstrate the effect of heat treatment on Izod values 12.3 Demonstrate the detection of cracks on welds or castings	Demonstrate for the students to learn and ask them to perform all the activities.	Explain how to interpret the results of materials tests

				by radiographic means.		
	General Objective 13.0: Understand tensile test and stress-strain relationship					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	13.1 Explain the effect of strain rate on the tensile test results 13.2 Explain the effect of over straining/reacted loading on metals.	Explain 13.1 to 13.2	Marker, whiteboard, Lecture note, textbooks			Explain tensile test and stress-strain relationship
	General Objective 14.0: Understand how to determine the proof-stress using stress-strain curve.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	14.1 Determine the proof stress using stress strain curve. 14.2 Explain how impact test can reveal the brittleness of materials.	Explain 14.1 to 14.2	Marker, whiteboard, Lecture note, textbooks	Determine impact test can reveal the brittleness and ductility of materials	Demonstrate for the students to learn and guide them to perform the activities.	Explain how to determine the proof-stress using stress-strain curve

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing)

COURSE TITLE: Machine Elements Design II

COURSE CODE: MEM 413

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 3.0

Subject:	Code: MEM 413	Total Hours:	3 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	1 Hour/Week
Semester: THIRD	Pre-requisite: MEC 316		
Goal: The course is designed to acquaint students with knowledge and skills in the design of machine elements			

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the types and design of gears
2	Understand the working principles of gear trains
3	Know the types, selection and design of bearings
4	Understand stress concentration
5	Understand design of shafts
6	Know properties of lubricants

MACHINE ELEMENTS DESIGN II

PROGRAMME: HIGHER NATIONAL DIPLOMA MECHANICAL ENGINEERING TECHNOLOGY – MANUFACTURING OPTION						
COURSE: MACHINE ELEMENTS DESIGN II			Course Code: MEM 413		Contact Hours: 2-0-1 HRS/WK	
Goal: The course is designed to acquaint students with knowledge and skills in the design of machine elements						
Course Specification: THEORETICAL CONTENT			PRACTICAL CONTENT			
Week	General Objective 1.0: Know the types and design of Gears			Demonstrate skills in gears design		
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 List types of gear systems e.g. spur - gear, level gear, worm gear etc 1.2 Describe gear tooth features e.g., pitch, notch diameter etc. 1.3 State the calculations required to completely determine the gear characteristics 1.4 Represent, on a diagram, forces acting along the gear teeth. 1.5 Analyse stresses in gear teeth. 1.6 Perform stress calculations in gear teeth.	Explain 1.1 to 1.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Spur, Bevel, worm gears • Different gear trains models • Practical guide • Design materials.	1.1 Identify different types of gears - spur, bevel, worm, etc. 1.2 Identify the parameters involved in the design of gears and gear trains. 1.3 Select the parameters involved in the design of gears and gear trains. 1.4 Carry out design of gear arrangement. 1.5 Prepare its working drawing	Demonstrate for the students to learn and allow them to perform the activities	Explain types and design of Gears
	General Objective 2.0: Understand the working principles of Gear Trains					
3-4	2.1 Describe the working principle of gear trains. 2.2 Define velocity ratio 2.3 Explain gear train 2.4 Derive	Explain 2.1 to 2.5	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Spur, Bevel, worm gears • Different gear	2.1 Identify gear trains 2.2 Carryout detailed gear train design	Demonstrate for the students to learn and allow them to perform the activities	Explain the working principles of Gear Trains

	the expressions for gear trains. 2.5 Solve problems related to 2.1 and 2.4.		trains models • Practical guide			
General Objective 3.0: Know the types, selection and design of bearings						
6-8	3.1 Define bearings 3.2 List the various types of bearings 3.3 Classify bearing based on the direction of forces acting on the shaft 3.4 Explain the applications of different types of bearings in engineering practice. 3.5 Describe the essential features of the bearings in 3.2 above 3.6 Explain the criteria for bearing selection	Explain 3.1 to 3.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Practical guide Ball bearing, journal bearing, etc	3.1 Identify different types of bearings. 3.2 Identify the criteria for selection and design of bearings in accordance with standard engineering practice. 3.3 Carryout the design of bearings and prepare its working drawings. 3.4 Select appropriate lubricants for bearings.	Demonstrate for the students to learn and allow them to perform the activities	Explain the types, selection and design of bearings
General Objective 4.0: Understand stress concentration						
9 -10	4.1 Describe the phenomenon of stress concentration 4.2 Explain engineering situations where stress concentrations occur e.g. stepped shaft, plate with a hole, notch or coracle on a surface, intersections of solid profiles etc. 4.3 Define the term stress concentration factor SCF. 4.4 Explain the types of	Explain 4.1 to 4.5	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Practical guide	4.1 Identify areas of a stress concentration in a typical design. 4.2 Proffer ways of reducing and eliminating stress concentration.	Demonstrate for the students to learn and allow them to perform the activities	Explain stress concentration

	loading. 4.5 Solve problems related to 4.1 to 4.4					
General Objective 5.0: Understand design of shafts						
11 - 12	5.1 Describe the essential functions performed by a shaft in a machine 5.2 Describe the common mounting of a shaft, 5.3 Describe the reduction of a physical shelf system to a mathematical model for analysis. 5.4 Explain the parameters and criteria for the design of a shaft in accordance with standard engineering practice	Explain 5.1 to 5.4	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Models of shaft • Practical guide • Design materials	5.1 Identify different types of shafts. 5.2 Identify the criteria for selection and design of shafts in accordance with standard engineering practice. 5.3 Carryout the design of shafts and prepare its working drawings.	Demonstrate for the students to learn and allow them to perform the activities	Explain steps in design of shafts
General Objective 6.0: Know properties of lubricants						
13 - 14	6.1 Define lubricants 6.2 State the types of lubricants commonly used in machines e.g. oil, grease and solid lubricants. 6.3 Describe the characteristics of lubricants in 6.2. 6.4 Explain the criteria for selecting lubricants e.g. operating conditions like speed, load, lubricant	Explain 6.1 to 6.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Various types of lubricants.	6.1 Identify different types of lubricants. 6.2 Identify the criteria for selection and application of lubricants in accordance with standard engineering practice 6.3 Select appropriate lubricants for shaft, bearings and other machine elements.	Demonstrate for the students to learn and allow them to perform the activities	Explain types and properties of lubricants

	properties, surface quality. 6.5 Describe, surface quality lubrication, mixed lubrication and fluid film lubrication. 6.6 Explain the application of lubricants in machine tools e.g. spindle oil, hydraulic oil, gear oil and slide-way oil					

PROGRAMME: Higher National Diploma in Mechanical Engineering Technology – Manufacturing

COURSE TITLE: CNC: Programming and Robotics

COURSE CODE: MEM 413

DURATION: 45 Hours (1 Hour Lecture, 2 Hours Practical)

CREDIT UNITS: 2.0

Course: CNC: Programming and Robotics Semester: THIRD	Code: MEM 421 Pre-requisite:	Total Hours: 3 Hours/Week
		Theoretical hours: 1 Hour/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with adequate knowledge and skills on CNC programming, industrial robots and robot programming.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand manual part programming
2	Know computer assisted part programming
3	Comprehend industrial robots
4	Know robot programming

CNC PROGRAMMING AND ROBOTICS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – MANUFACTURING						
COURSE: CNC PROGRAMMING & ROBOTICS		COURSE CODE: MEM 421			CONTACT HOURS: (1-0-2) HRS/WK	
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
General Objective 1.0: Understand manual part programming						
Week	Specific Learning Outcome	Teachers Activities	Resource	Specific Learning Outcome	Teachers Activities	Evaluation
1-5	1.1 Define elements & structure- tooling information, parameter settings, datum"s and axes, positional control & sequencing 1.2 Define CNC standards, machine codes for machine auxiliary functions and movement and sequencing. 1.3 Describe routine techniques: macro routines and sub routines, offsets	• Produce manually written part programs.	Manuals, Recommended Textbooks, Presentation tools, CNC Machine tool	1.1 Input written part programs to CNC machine. 1.2 Run CNC job.	Guide students on how jobs are run on a CNC machine.	Explain how CNC part programs are written and run.
General Objective 2.0: Know computer assisted part programming						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
6 - 9	2.1 Explain profile definition, graphics geometry manipulation, tooling & machine sequences, cutter path simulation 2.2 Develop databases, profiles, attributes, material cutting data, tool data 2.3 Design macro routines, continuous operations, auto-tooling standard components.	• Develop tool paths for a variety of profiles and optimize time.	Manuals, Recommended Textbooks, Presentation tools, PC with 3D CAM and post-processor package, CNC machine	2.1 Produce machine programs using CAM. 2.2 Transfer to CNC machine. 2.3 Verify the program.	• Guide the students through the process of using CAM programs for CNC	Explain computer assisted part programming
General Objective 3.0: Comprehend industrial robots						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation

10 - 12	3.1 Specify industrial robots (physical configurations, basic robot motion, work volume, precession of movement, speed of movement, weight carrying capacity, etc.) 3.2 Explain manipulator elements: drive systems, sensors, brakes and counter balances 3.3 Explain control elements 3.4 Explain integration of intelligence: Proximity, range, position force 3.5 State sources of error 3.6 Study various applications of industrial robots	• Describe industrial robot specifications • Examine various products and determine suitable robot specification to accurately position in an assembly operation.	Manuals, Recommended Textbooks, Presentation tools, Robot			Explain industrial robots
General Objective 4.0: Know robot programming						
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
13 - 15	4.1 Evaluate programming methods such as; task programming, manual data input, teach, explicit and goal directed programming 4.2 Describe facilities such as loops, shifts, external communication, canned cycles, off-sets, macro and sub routines	• Develop robot paths for a variety of operations. • Produce manual programs • Program a robot to carry out a simple task. • Prove the program	Manuals, Recommended Textbooks, Presentation tools, Robot			Explain robot programming

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Electrical Power and Machines

COURSE CODE: EEE 442

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 3.0

Course: Electrical Power and Machines Semester: THIRD	Code: EEE 442 Pre-requisite:	Total Hours: 3 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 1 Hour/Week
Goal: To acquaint students with the knowledge and skills in the application, installation and maintenance of electrical power/machines		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the principles of electrical machines and electro-mechanical energy conversion
2	Understand the performance of various types of AC machines
3	Understand the principles of operation of various types of electric power plants
4	Understand the basic principles involved in electricity supply
5	Understand the principles of system protection and earthing
6	Understand motor selection and speed control

ELECTRICAL POWER AND MACHINES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – PLANT OPTION						
Course: ELECTRICAL POWER AND MACHINES			Course Code: EEE 442		Contact Hours 3 HRS/WK	
Goal: To acquaint students with the knowledge and skills in the application, installation and maintenance of electrical power/machines						
Course Specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand the principles of electrical machines and electro-mechanical energy conversion					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-3	1.1 State the principles of induction and alignment as applied electrical machines 1.2 Explain with the aid of sketches how the principles in 1.1 are applied to electrical machines 1.3 State the motor energy conversion principles 1.4 Derive the general energy balance equation applicable to all situations 1.5 Represent by suitable block diagrams the energy balance equations 1.6 Derive induced voltage and the electrical input in singly excited systems 1.7 Derive and expression for energy in the magnetic field of a singly excited system 1.8 Derive the energy balance equation 1.9 Develop the dynamic equation of a singly excited electro-mechanical system 1.10 Solve problems involving 1.4 to 1.9	Explain 1.1 to 1.10	Recommended textbooks, Projectors, Lecture notes, Whiteboard , Marker, etc. Single excited system	Determine experimentally the conversion of energy in singly excited system	Demonstrate for the students to learn and allow them to perform the activities	Explain the principles of electrical machines and electro-mechanical energy conversion

	General Objective 2.0: Understand the performance of various types of AC machines					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
4-6	2.1 Describe the construction of single-phase and three-phase transformers 2.2 Explain the working principles of the transformer 2.3 Explain the phasor diagram for a transformer on no-load, on-load conditions 2.4 Explain the equivalent circuit of a transformer 2.5 Describe the construction of a synchronous machine 2.6 Sketch the flux and emf waves in synchronous machines 2.7 Explain armature reaction and leakage fluxes and reactances 2.8 Explain synchronous reactance and synchronous impedance 2.9 Sketch the equivalent circuit of synchronous machine 2.10 Sketch phasor diagrams for a synchronous machine operating as a motor or a generator 2.11 Explain open-circuit and short circuit characteristics of a synchronous machine 2.12 Explain steady-state operating characteristics of a synchronous machine 2.13 Describe the construction of an induction machine 2.14 Explain the principle of operation of an induction	Explain 2.1 to 2.18	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Single and three-phase transformers and motors	2.1 Determine experimentally the open-circuit and short circuit characteristics of a synchronous machines 2.2 Determine experimentally the synchronous speed, rotor speed and slip of an induction motor. 2.3 Determine experimentally the torque/slip characteristics of an induction motor. 2.4 Determine experimentally the copper and iron losses in transformer 2.5 Connect three single-phase transformers for three phase operation	Demonstrate for the students to learn and allow them to perform the activities	Explain the performance of various types of AC machines

	machine 2.15 Define synchronous speed, rotor speed and slip 2.16 Explain the equivalent circuit for an induction machine 2.17 Explain the torque/slip characteristics of an induction machine 2.18 Explain the various methods of cooling electric machine					
	General Objective 3.0: Understand the principles of operation of various types of electric power plants					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-8	3.1 State the various sources of energy 3.2 Explain the essential principles of hydro and steam power station design 3.3 Explain the principles of operation of: i. steam power plant ii. hydro power plant iii. gas turbine plant iv. nuclear power plant v. wind power plant vi. solar power plant 3.4 Draw the flow diagram of a thermal power plant 3.5 Explain the factors which influence the choice of site for a steam generating station 3.6 State the advantages and disadvantages of the gas turbine over the steam turbine plant 3.7 List the operational features of a diesel engine generator 3.8 State the various type of water turbines in use	Explain 3.1 to 3.9	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Lab type: steam power plant, hydro power plant, gas turbine plant, nuclear power plant, wind power plant, solar power plant	3.1 Draw the flow diagram of a thermal power plant and explain the factors which influence the choice of site for a steam generating station. 3.2 Draw a good schematic diagram for the electricity supply to auxiliaries of a steam power station. 3.3 Select a water turbine for specific conditions	Demonstrate for the students to learn and allow them to perform the activities.	Explain the principles of operation of various types of electric power plants

	3.9 Draw a schematic diagram for the electricity supply to auxiliaries of a steam power station					
	General Objective 4.0: Understand the basic principles involved in electricity supply					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
9-11	4.1 Sketch a single line diagram of a typical power system 4.2 Differentiate between transmission and distribution 4.3 Compare radial and inter-connected power transmission systems 4.4 State typical conductor sizes and their power limits 4.5 Explain the mechanism of power transfer 4.6 Explain reactive power and power factor 4.7 Explain various types of power system faults	Explain 4.1 to 4.10	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			Explain the basic principles involved in electricity supply
	4.8 Calculate symmetrical 3-phase fault MVA at various points of simple systems 4.9 Explain method of power factor improvement 4.10 Solve problems on power factor improvement					
	General Objective 5.0: Understand the principles of system protection and earthing					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	5.1 State the requirements of a protective schemes 5.2 List components of protective schemes 5.3 Explain the various methods of protection of systems, (overcurrent, distance,	Explain 5.1 to 5.12	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			Explain the principles of system protection and earthing

12-13	differential relaying) 5.4 Explain methods of protecting transmission lines, generators, transformers and busbars 5.5 State the purpose of earthing 5.6 State the various types of practical earth electrodes 5.7 Explain with the aid of sketch, various methods of system earthing 5.8 Explain equipment earth 5.9 Explain bonding of equipment and cables 5.10 Describe a method of measuring earth electrode resistance and earth loop impedance 5.11 Explain protective multiple earthing 5.12 Describe a method of substation earthing.					
	General Objective 6.0: Understand motor selection and speed control					
	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome:	Teachers Activities	Evaluation
14-15	6.1 List various types of electric machine enclosures 6.2 Explain the rating of electric machines 6.3 Explain the procedure for selecting electric motor for an application 6.4 Explain methods of speed control of electric motors 6.5 Select a motor for specific speed control	Explain 6.1 to 6.5	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			Explain the steps in motor selection and speed control

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Plant Option)

COURSE TITLE: Refrigeration and Air-conditioning (RAC)

COURSE CODE: MEP 411

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Refrigeration and Air-Conditioning Semester: THIRD	Code: MEP 411	Total Hours: 4 Hours/Week
	Pre-requisite: MEA 321	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to equip students with knowledge and skills in refrigeration and air-conditioning systems and equipment for fabrication, installation and maintenance of RAC systems.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the general safety rules and regulations and basic principles of refrigeration and air-conditioning (RAC) system
2	Understand the application of refrigeration and air-conditioning
3	Understand the vapour-compression refrigeration system
4	Understand the absorption of refrigeration system
5	Know compressors used in RAC system
6	Know evaporators used in RAC system
7	Know condensers and cooling towers used in RAC system
8	Know refrigerants and lubrication of RAC system
9	Understand RAC pipework, duct designs, insulations and their layout
10	Understand the installation and maintenance of RAC systems

REFRIGERATION AND AIR-CONDITIONING

HIGHER NATIONAL DIPLOMA (HND) IN MECHANICAL ENGINEERING TECHNOLOGY – PLANT OPTION						
COURSE: REFRIGERATION AND AIR-CONDITIONING			COURSE CODE: MEP 411		CONTACT HOURS: 2-0-2	
Goal: This course is designed to equip students with knowledge and skills in refrigeration and air-conditioning systems and equipment for fabrication, installation and maintenance of RAC systems.						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Know the general safety rules and regulations and basic principles of refrigeration and air-conditioning					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 - 2	1.1 Explain the importance of RAC trade in domestic, industrial & commercial fields. 1.2 State industrial safety rules and regulations observed for RAC shop including fire-fighting, occupational health & safety procedures. 1.3 Define the fundamentals and different terminologies and standards of RAC machinery. 1.4 Review the Laws of Thermodynamics, Gas laws, Carnot cycle and reverse Carnot cycle governing RAC.	Explain activities 1.1 to 1.4. Assess the students.	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • An air-conditioner • A refrigerator • A complete tool box	1.1 Familiarize with the equipment, tools & materials used in RAC maintenance. 1.2 Use of personal protection equipment (PPE), fire-fighting equipment. 1.3 Demonstrate different gas cylinder handling procedures, handling of HC refrigerants & safety observations with emphasis on do’s & don’ts in RAC shop. 1.4 Observe various Thermodynamic processes take place while working. 1.5 Perform calculation of Refrigeration capacity (TR).	Demonstrate activities 1.1 to 1.5 for the students to learn and ask the students to perform the activities.	Explain the safety rules and basic principles of RAC.
	General Objective 2.0: Understand the application of refrigeration and air-conditioning (RAC)					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	2.1 Describe the domestic, commercial and industrial applications of refrigeration	Explain activities 2.1 to 2.3.	Recommended textbooks, Projectors,	2.1 Identify wiring of domestic refrigeration appliances (conventional and	Demonstrate for the students to learn and allow them to perform	Explain different applications

3-4	and air-conditioning. 2.2 State the capacity of RAC machinery in each of the applications in domestic, commercial and industrial fields.	Assess the students.	Lecture notes, Whiteboard, Marker, etc.	frost free) 2.2 Measure different parameters like pressure, temperature, heat, Humidity, velocity, etc	the activities.	of refrigeration and air-conditioning (RAC)
General Objective 3.0: Understand the vapour-compression of RAC system						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
5-6	3.1 Review the major components of a RAC systems e.g. Compressor, condenser, evaporator etc. 3.2 Review the functions and constructional details of each component. 3.3 Describe the ideal refrigeration cycles using the P-H and T-S diagrams to define such terms as refrigerating effect, work done, C.O.P, etc 3.4 Define terms related to performance e.g. Refrigeration-effect, work done, C.O.P 3.5 Explain the limitations of the ideal cycle 3.6 Describe the practical cycle using the P-H and T-S diagrams 3.7 Explain the effect of the following performance in the basic practical cycle to suction heat exchanger,	Explain activities 3.1 to 3.6. Assess the students.	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	3.1 Identify the wiring system of bottle cooler, water cooler, widow A/C, Split A/C, deep freezer with their control systems (capacitors, relays, OLP, PTCR, centrifugal switch, starter, thermostat, etc). 3.2 Conduct faults finding and remedial measures of components used in RAC systems. 3.3 Dismantle and assemble of various types of Compressors like Reciprocating, Rotary, Scroll, etc.	Demonstrate for the students to learn and allow them to perform the activities.	Explain vapour-compression of RAC system.

	multistage compression with inter-cooling and flash chamber.					
General Objective 4.0: Understand the absorption RAC system						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-8	4.1 Explain the principle of operation of an absorption system. 4.2 Explain the operation of the simple ammonia-water cycle 4.3 Explain the requirements for refrigerant absorbent combination 4.4 Explain the member - platen refrigeration (vapour absorption) with pump refrigerator 4.5 Describe the water-lithium bromide cycle 4.6 Determine the heat ratio; (efficiency) of an absorption systems	Explain activities 4.1 to 4.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			Explain absorption of RAC system.
	4.7 State ways in which the efficiency of the absorption system may be improved 4.8 Compare the absorption system and the vapour compression system with respect to applications, advantages and disadvantages 4.9 Explain absorption refrigeration principles in the laboratory 4.10 Explain the applications of solar energy		Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Lab • Solar system/room model			

	to refrigeration.					
	General Objective 5.0: Know compressors used in RAC system					
9	5.1 List the various types of compressors in RAC system. 5.2 Explain the operation and constructional details of each type listed in 5.1 5.3 Perform calculations of power requirements for a compressor. 5.4 List the various types of fans used in RAC system. 5.5 Explain the operation and constructional details of each type listed in 5.4 5.6 Perform calculations of power requirements for a fan.	Explain activities 5.1 to 5.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	5.1 Dismantle of open type and sealed type compressors, blower motors, check bearing/ bush, centrifugal switch. 5.2 Check worn out parts, inspect and measure clearance, diameter by micrometer, vernier calipers etc. replace and compensate lubricant in compressor. 5.3 Assemble of open type and sealed type compressors, blower motors, check bearing/bush and centrifugal switch. 5.4 Carryout simple design and selection of compressors and fans for a given application.	Demonstrate activities 5.1 to 5.3 for the students to learn and ask the students to perform the activities.	Explain compressors used in RAC system.
	General 6.0: Know evaporators used in RAC system					
10	6.1 List the various types of evaporators in RAC system. 6.2 Explain the operation and constructional details of each type listed in 6.1 6.3 State the advantages and disadvantages of each of the evaporators listed in 6.1. 6.5 Enumerate the factors	Explain activities 6.1 to 6.5.	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	6.1 Perform Cu-Al brazing technique on damaged evaporators. 6.2 Compare the performance of single, double, multi feeding evaporators. 6.3 Compare different diameter & length of capillary vs Performance.	Demonstrate activities 6.1 to 6.4 for the students to learn and ask the students to perform the activities.	Explain evaporators used in RAC system

	that govern the rating and selection of evaporators for specific duties.			6.4 Use anti freezing thermostat. 6.5 Carryout simple design and selection of evaporators for a given application.		
General Objective 7.0: Know condensers and cooling towers used in RAC system						
11-12	7.1 List the various types of condensers (water-cooled, air-cooled and evaporative) used in RAC system. 7.2 Explain the operation and constructional details of each type listed in 7.1 7.3 State the advantages and disadvantages of each of the condensers listed in 7.1. 7.5 Enumerate the factors that govern the rating and selection of condensers and cooling towers for specific duties. 7.6 Distinguish between different types of cooling towers and identify the governing heat transfer relations. 7.7 List expansion device-types 7.8 Explain the constructional details, operation, adjustments and	Explain activities 7.1 to 7.8.	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	7.1 Determine heat rejection factor, capacity, efficiency and fouling factor of a given condenser. 7.2 Carryout repair work on damaged air cooled, water cooled and evaporative condensers. 7.3 Conduct capillary bore checking and performance test on Test Rig (consisting of capillary tube and TEV) for finding C.O.P. 7.4 Familiarize with capillary selection guide. 7.5 Measure superheat. 7.6 Observe the working of pilot solenoid valve. 7.7 Carryout simple design and selection of condenser, cooling tower and expansion device for a given application.	Demonstrate activities 7.1 to 7.7 for the students to learn and ask the students to perform the activities.	Explain condenser, cooling towers and expansion devices used in RAC system

	applications of each device listed in 7.7.					
	General Objective 8.0: Know refrigerants and lubrication of RAC system					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	8.1 Review different types of refrigerants and lubricants used in RAC systems 8.2 Review functions composition and applications of the refrigerants and lubricants listed in 8.1 8.3 Explain the environmental impact of different refrigerants (e.g. Ozone Depletion Potential - ODP and Global Warming Potential-GWP). 8.4 Explain the alternative refrigerants to the refrigerants in 8.3 as regards ODP and GWP. 8.5 State the thermodynamic properties & characteristics of ideal refrigerants, -Azeotropic and Zeotropic blends. 8.6 Describe retro-fitting procedures for Chrolofluorocarbons (CFCs) and Hydro	Explain activities 8.1 to 8.10.	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	8.1 Identify refrigerant cylinders by colour coding & standing pressure. 8.2 Perform refrigerant recovery technique (active & passive method). 8.3 Carryout HC blend charging with emphasis on the importance of molecular sieve drier (XH-5, XH-7, XH-9) 8.4 Perform the following: - retrofitting of cfc filled refrigerator in to HFC-134a. - retrofitting of CFC-12 into HC blend. 8.5 Identify the limitations of retrofitting, triple evacuation method. 8.6 Determine the eutectic temperature of sodium chloride & calcium chloride brine. 8.7 Calculate heat removal rate of various brines. 8.8 Identify RAC	Demonstrate activities 8.1 to 8.10 for the students to learn and ask the students to perform the activities.	Explain refrigerants and lubrication of RAC system.

	Chlorofluorocarbons (HCFCs). 8.7 Distinguish between primary and secondary refrigerants 8.8 State the properties of brines and glycols. 8.9 Explain the application of various brines, inhibitor and other secondary refrigerants 8.10 Describe the use of eutectic diagrams in the selection of secondary refrigerants			compressors" lubricants with emphasis on grades, unit, types, mineral oil & POE oils. 8.9 Conduct oil charging of domestic & commercial compressors using different methods. 8.10 Perform refrigerant (HFC & HC) charging of a given RAC systems with performance testing.		
General Objective 9.0: Understand RAC pipework, duct designs, insulation and their layout						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14	9.1 Define design considerations for RAC pipework. 9.2 Explain the different types of distributive systems and perform system balancing. 9.3 Describe insulation and anti-vibration mounting of refrigeration pipework. 9.3 Describe the fabrication and mounting of ducts and terminal controls.	Explain activities 9.1 to 9.6.	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	9.1 Design typical refrigeration piping and water piping for air-conditioning systems. 9.2 Perform basic sizing of air ducts and carryout energy balance in a system of duct work. 9.3 Convert ducts from circular to rectangular section and vice-versa. 9.4 Demonstrate technique of glass wool filling method in	Demonstrate activities 9.1 to 9.4 for the students to learn and ask the students to perform the activities.	Explain RAC pipework, duct designs, insulation and their layout

	9.4 Explain the importance and application of insulating materials in ductwork. 9.5 Explain the sources of load RAC system. 9.6 Determine the process of AC selection for a typical application.			conventional refrigerator as well as Puf mixing procedure. 9.4 Carry out load estimation in a typical RAC system.		
General Objective 10.0: Understand the installation and maintenance of RAC systems						
15	10.1 List the factors guiding the selection of installation sites for domestic, commercial and industrial RAC systems.	Explain activity 10.1	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	10.1 Identify the factors guiding the selection of installation sites for domestic, commercial and industrial RAC systems 10.2 Prepare installation sites for domestic, commercial and industrial RAC systems 10.3 Perform installation for domestic, commercial and industrial RAC systems. 10.4 Disassemble a typical RAC system 10.5 Identify the component parts. 10.6 Assemble the component parts. 10.7 Detect leaks 10.8 Evacuate and change the system. 10.9 Carryout troubleshooting and maintenance of RAC systems.	Demonstrate activities 10.1 to 10.9 for the students to learn and ask the students to perform the activities.	

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Mechanical Equipment in Buildings

COURSE CODE: MEP 412

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Mechanical Equipment in Buildings Semester: THIRD	Code: MEP 412 Pre-requisite: NIL	Total Hours:	4 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	2Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills on the installation, operation and maintenance of mechanical equipment in buildings			

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the different types of conveyors used in building
2	Know the equipment in the machine room
3	Understand the control system of conveyors
4	Know system relationship and other design criteria for elevators and escalators.
5	Understand the layout for elevators and escalators installation
6	Know the basic installation precaution and maintenance details of elevators and escalators
7	Understand the selection, installation and maintenance of pumps, boilers and other mechanical equipment in buildings
8	Know the fire-fighting equipment used in buildings

MECHANICAL EQUIPMENT IN BUILDINGS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - PLANT OPTION						
COURSE: MECHANICAL EQUIPMENT IN BUILDINGS			COURSE CODE: MEP 412		CONTACT HOURS: 2-0-2 Hrs/wk	
Goal: This course is designed to acquaint students with knowledge and skills on the installation, operation and maintenance of mechanical equipment in buildings						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand the different types of conveyors used in building					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 Explain conveyors in buildings. 1.2 List different types of conveyors used in buildings. 1.3 Explain details of construction, capacity and application of escalators and elevators. 1.4 Describe the following components: (i) Car, (ii) Cable (different kinds of roping) (iii) Shaft, (iv) Rail, (v) Over-run.	Explain activities 1.1 to 1.7	Recommended textbooks, Projectors, Lecture notes, Whiteboard , Marker, etc.	1.1 Identify the various types of conveyors used in building. 1.2 Demonstrate the use of all the conveyors. 1.3 Identify and demonstrate the criteria for lift selection	Demonstrate for the students to learn and allow them to perform the activities.	Explain the different types of conveyors used in building
	1.5 State the functions of the components in 1.4 1.6 Distinguish between the following types of elevators and escalators: a. elevators and escalators with cable/Traction sheave; b. Hydraulic elevators and escalators. 1.7 Explain the criteria for elevators and escalators Selection.					
	General Objective 2.0: Know the equipment in the machine room					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	2.1 List the equipment to be installed in the machine room:	Explain activities 2.1 to 2.5	Recommended	2.1 Identify the equipment commonly housed in the	Demonstrate for the students to learn and	Explain different

3	boilers, chillers, elevators, etc. 2.2 Describe each of the equipment in the machine room. 2.3 Explain the functions of each of the equipment described in 2.2. 2.4 State reasons for positioning the machine room above or beneath the shaft. 2.5 State the factors that affect the choice of different types of each equipment listed in 2.1.		textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Machine room equipment	machine room 2.2 Demonstrate the use of all the equipment	allow them to perform the activities.	equipment found in machine room
General Objective 3.0: Understand the Control System of elevators and escalators						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
4-5	3.1 Explain how the speed of the car is controlled, and state speed limits for different types of Lifts. 3.2 State the use of Rheostat (resistance) variable voltage and varied speed governor. 3.3 Explain the operations of the following control systems: a. car switch, manually operated system. b. Button control (SAPS) c. Down collective control d. Full - collective control e. Simplex, Duplex, Triplex (group) control. f. Programmed control. 3.4 Explain the following Lift signals: a. all registered light. b. “in use” light with SAPB c. Position indicator (inside car) d. Position indicator (at arrow lights) e. The travel direction arrow lights f. Lanterns/gongs to show when car	Explain activities 3.1 to 3.6	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. Lab type Conveyors with it control systems	3.1 Identify the control system of conveyors 3.5 Demonstrate the operation of the following control systems:- (i) Car Switch, manually operated system (ii) Button control (SAPS) (iii) Down collective control (iv) Full collective control (v) Simplex, Duplex, Triplex (group) control (vi) Programmed Control	Demonstrate for the students to learn and allow them to perform the activities.	Explain Control System of Conveyors

	has landed at a floor. 3.5 Describe the operation of lift doors with specific reference to: - car and hoist way doors - manual opening/closing of doors. - Power operated doors - Transfer time for loading and unloading of car. - Need to keep door open 3.6 Explain how the floor selector operates.					
	General Objective 4.0 Know system relationship and other design criteria for elevators and escalators.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6-7	4.1 Define a counter weight and travel time. 4.2 State the functions of counter weight in design. 4.3 Determine counter weights for specific application. 4.4 Determine the travel time. 4.5 Determine Traction sheave or drum torque 4.6 Explain the following: - Effect of friction on drum torque - Maximum permissible acceleration to prevent slip 4.7 Explain duty cycle diagrams. 4.8 Estimate the power of an electric motor required installation of the duty cycle diagram. 4.9 Determine the motor using the RMS Torque and the empirical equivalent travel time. 4.10 Explain the criteria for Cable/Rope selection e.g. - right choice of material - construction types e.g. regular	Explain activities 4.1 to 4.10	Recommended textbooks, Projectors, Lecture notes, Whiteboard , Marker, etc. Lab type elevators and escalators and Pulleys	4.1 Identify the difficulties associated with installing a lift in an existing building. 4.2 Demonstrate the positioning of guides and diversion pulleys	Demonstrate for the students to learn and allow them to perform the activities.	Explain system relationship and other design criteria for lifts

	lay, long-lay c. rope designation (Diameter, No of strands, No of wires per strand) d. bending stresses on ropes e. rope pressure on Traction sheave f. rope life, effects of types of roping, average speed of car, numbers of bends, statics and dynamic loading, factor of safety.					
General Objective 5.0: Understand the layout for elevators and escalators installation.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8-9	5.1 Explain the factors which influence the following a. grouping elevators and escalators together b. positioning the elevators and escalators (for best utilization) c. size of the elevator and escalator d. capacity of elevator and escalator. e. limiting the noise due to elevator and escalator operation f. aesthetic features e.g. kind of finish.	Explain activities 5.1	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			Explain the layout for elevators and escalators installation
General Objective 6.0: Know the basic Installation precaution and maintenance details of elevators and escalators.						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10-11	6.1 Explain the use of plumb line in the measurement of wall distances to centerlines with the use of working drawings. 6.2 List the difficulties associated with installing elevators and escalators in an existing building. 6.3 Explain the positioning of guides and diversion pulleys. 6.4 Explain maintenance and	Explain activities 6.1 to 6.4	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.			Explain Installation precaution and maintenance details of lift

	repairs on elevators and escalators.					
	General Objective 7.0: Understand the selection, installation and maintenance of pumps, boilers and other mechanical equipment in buildings					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12-13	7.1 State the different types of pumps such as centrifugal, rotary, reciprocating and submersible. 7.2 Describe the procedure for installing water pumps in buildings. 7.3 State the factors guiding the selection of water pumps. 7.4 State the effects of pumps vibration on buildings and the precautions needed to minimize these effects. 7.5 Explain trouble shooting strategies and maintenance of pumps. 7.6 State the types of boilers used for hot water supply. 7.7 State factors guiding the selection of boilers 7.8 Explain the role of boiler auxiliaries such as super heater, economizer, control valves, safety valves and boiler mountings.	Explain activities 7.1 to 7.12	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Samples of the different types of pumps • Boiler unit • Pumps • Boilers • Pressure gauges	7.1 Identify the criteria for pumps and boilers selection 7.2 Identify the different types of pumps such as - centrifugal, rotary, reciprocating and submersible. 7.3 Select suitable water pumps for a particular operation. 7.4 Demonstrate the procedure for installing water pumps in building. 7.5 Carry out fault diagnosis and service/repair of pumps, boilers and economisers. 7.6 Demonstrate the installation and inspection procedures for boilers 7.7 Demonstrate operation and installation procedures of the following: i) Laundry machine ii) Process heaters iii) Kitchen equipment.	Demonstrate for the students to learn and allow them to perform the activities.	Explain the the selection, installation and maintenance of pumps, boilers and other mechanical equipment in buildings
	7.9 Explain the installation procedures for boilers. 7.10 State the inspection procedures for boilers. 7.11 Explain the operation of the following equipment: a. Laundry machine b. Process heaters	Explain inspection procedures carried on boilers. Explain the operation of laundry machines, process heaters, kitchen equipment. State the criteria for	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc. • Pressure	7.8 Carryout trouble shooting and maintenance of the items above	Demonstrate for the students to learn and allow them to perform the activities.	• Pumps • Boilers • Pressure gauges

	c. Kitchen equipment 7.12 State factors guiding the selection of items in 7.11.	boiler selection. Assess.	gauges			
	General Objective 8.0: Know the fire-fighting equipment used in buildings.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluat
14-15	8.1 List important fire-fighting equipment to be installed in a building 8.2 List first Aid equipment such as Hot reel system, Hand appliance, Sprinkler, Total flooding system 8.3 Explain the construction and operation of each of the systems in 8.2 8.4 State fixed equipment e.g. wet riser, Dry rise. 8.5 Describe the construction and operations of fixed equipment in 8.3	Explain activities 8.1 to 8.5	Recommended textbooks, Projectors, Lecture notes, Whiteboard, Marker, etc.	8.1 Identify important fire fighting equipment installed in a building 8.2 Identify first Aid equipment such as Hot reel system, Hand appliance, sprinkler, Total flooding system. 8.3 Demonstrate the operation of each of the systems in 6.2 6.4 Identify fixed equipment e.g. wet riser, Dry riser, etc. 6.5 Demonstrate the operation of fixed equipment in 6.4.	Demonstrate for the students to learn and allow them to perform the activities.	

**FOURTH SEMESTER
COURSES**

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Statistical Methods in Engineering

COURSE CODE: MTH 422

DURATION: 30 Hours (1 Hour Lecture, 1 Hour Practical)

UNIT: 2.0

Course: Statistical Methods in Engineering	Code: MTH 422	Total Hours: 2 Hours/Week
		Theoretical hours: 1 Hour/Week
		Practical hours: 1 Hour/Week
Semester: FOURTH	Pre-requisite: NIL	
Goal: This course is designed to introduce students to the basic knowledge of statistical methods in engineering		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the basic concept of probability
2	Understand the basic concept of probability distributions and application in solving engineering problems
3	Understand the principle of reliability.
4	Understand Basic statistical experimental designs.
5	Understand the main feature of SPSS
6	Understand the use of SPSS Graphical User Interface (GUI) effectively
7	Understand how to perform descriptive analyses with SPSS and Ms Excel ER
8	Understand how to perform common parametric and non-parametric test
9	Understand how to perform regression and multivariate analyses

STATISTICAL METHODS IN ENGINEERING

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – ALL OPTIONS						
Course: STATISTICAL METHODS IN ENGINEERING			Course Code: MTH 422		Contact Hours: 1-0-1 HRS/WK	
Goal: This course is designed to introduce students to the basic knowledge of statistical methods in engineering						
	Theoretical Content				Practical Content	
	General Objective: 1.0 Understand the basic concept of probability					
Week	Specific Learning Outcomes	Teachers activities	Resources	Specific Learning Outcomes	Teachers activities	Evaluation
1-2	1.1 Define an event	Describe an event	Text books PCs Coins and coin tossers Simulation software Calculator Spread sheet	Demonstrate probability of an event using coins, colored balls, dices and the simulation software	Group students to simulate events	Describe an event and its probability.
	1.2 Define probability of an event	Explain probability and properties of an event		Calculate the probability of an event	Guide students to calculate the probability of an event and the concept of probability as a function of sample space	Calculate the probability of an event
	1.3 State the properties of an event	Explain how to calculate the probability of an event		Calculate the probability of an event		Define probability as a function of sample space.
	1.4 Calculate the probability of an event					
	1.5 Define probability as a function of sample space.	Explain the concept of probability as a function of sample space.		Demonstrate the concept of probability as a function of sample space	Guide students to identify the various probability sampling methods	State the different probability sampling methods
	1.6 Explain the various probability-sampling methods	Explain the various probability sampling methods		Identify the various probability sampling methods	Guide students to apply addition law of probability	
	1.7 State addition law of probability	Explain addition law of probability		Apply addition law of probability	Guide students to apply multiplication law of probability.	
	1.8 State multiplication law of	Explain multiplication law of probability		Apply multiplication		

	probability. 1.9 Collect data using the sampling methods	Explain how to collect data using the sampling methods		law of probability Collect data using the various sampling methods	Guide students to collect data using the various sampling methods.	
	General Objective 2.0: Understand the basic concept of probability distributions and application in solving engineering problems					
3-4	2.1 Define a Binomial distribution 2.2 Explain the characteristics of Binomial distribution 2.3 Apply Binomial distribution to samples with replacement 2.4 Apply Binomial distribution to solve engineering problems 2.5 Define the Normal Distribution 2.6 Explain the characteristics of normal distribution 2.7 Describe normal distribution curve and the empirical rule 2.8 Calculate probability given the mean and the standard deviation 2.9 Calculate the deviation Z given the mean, standard deviation, and a particular observation	Define Binomial Distribution, explain its characteristics and apply it to samples with replacement, and to solve engineering problems. Define normal distribution, explain its characteristics and describe normal distribution curve and the empirical rule Calculate probability given the mean and standard deviation Calculate the deviation Z given the mean, standard deviation, and a particular	Recommended textbooks, Whiteboard, , Lecture note, etc. Sample.	Test for equality of means of given population using t-test Test for equality of variances using the F-test. Use the chi-square test in statistical quality control	Guide students to test for equality of means of given population using t-test Guide students to test for equality of variances using the F-test. Guide students to apply the chi-square test in statistical quality control	Calculate the area under the curve at different points from either side of the mean and also apply normal distribution curve to simple engineering problems

	2.10 Calculate the area under the curve at different points from either side of the mean 2.11 Apply normal distribution curve to simple engineering problems 2.12 Define Poisson's distribution 2.13 Explain the characteristics of Poisson distribution 2.14 Explain the quality control techniques in production process 2.15 Explain acceptance sampling as applied to mass production 2.16 Test for equality of means of given population using t-test 2.17 Test for equality of variances using the F-test 2.18 Apply the chi-square test in statistical quality control	observation Calculate the area under the curve at different points from either side of the mean and also apply normal distribution curve to simple engineering problems Define Poisson distribution, explain its characteristics, and explain the quality control techniques in production process Explain acceptance sampling as applied to mass production				
	General Objective: 3.0 Understand the principle of reliability					
5-6	3.1 Distinguish between validity and reliability 3.2 List types of	Distinguish between validity and reliability and list types of	Recommended textbooks, Whiteboard, , Lecture note, etc.	Determine the reliability coefficient	Guide students to determine the reliability coefficient	State the procedures for determining test-retest

	reliability testing 3.3 State the procedures for determining test-retest reliability 3.4 Apply test - retest reliability to samples 3.5 State the procedures for determining split half reliability 3.6 Determine the reliability coefficient 3.7 Determine the acceptance level of reliability 3.8 Determine the standard error of Measurement $\frac{SD}{\sqrt{1-r}}$ where SD = standard deviation r = error = standard Error	reliability testing State the procedures for determining test-retest reliability and apply it to samples State the procedures for determining split half reliability, determine the reliability coefficient and acceptance level of reliability	Sample.	Determine the acceptance level of reliability Determine the standard error of Measurement	Guide students to determine the acceptance level of reliability. Guide students to determine the standard error of Measurement	reliability and apply it to samples
	General Objective: 4.0 Understand Basic statistical experimental designs					
7-8	4.1 Describe various experimental designs e.g complete randomized block design, randomized complete block design, split	Describe various experimental designs as indicated in 4.1 and list examples of when any of the designs can be used	Recommended textbooks, Whiteboard, , Lecture note, etc.	-	-	Explain various experimental designs

	squares, Graeco Latin squares 4.2 List examples of when any of 4.1 above can be used 4.3 Enumerate the advantages and disadvantages of using the various designs in 4.1 above	Enumerate the advantages and disadvantages of using the various designs indicated in				
General Objective: 5.0 Understand the main feature of SPSS						
9-10	5.1 Define SPSS Package 5.2 Identify SPSS general features 5.3 Identify the Importance of SPSS 5.4 Describe File management in SPSS 5.5 Explain data file Storage and Retrieval	Explain the main features of SPSS Explain the general aspect, workflow and critical issues Explain Functions, Menus and commands Explain file management in SPSS Explain data file Storage and Retrieval Explain the importance of SPSS	Books of recorded statistics Internet	-	-	Explain SPSS Identify general Features of SPSS Explain Sorting, Transpose in SPSS Explain how to store and retrieve files
General Objective: 6.0 Understand the Use of SPSS Graphical User Interface (GUI) effectively						
11-12	6.1 Define Variable, 6.2 Describe Manual Data input 6.3 Explain	Define Variable and Explain variable view spreadsheet Explain Manual Data Entry	Textbooks Lecture notes Internet	Demonstrate the concept of Variable Use computer	Guide students to demonstrate the concept of Variable	Describe variable Explain the various methods of data Input

	Automated Data Input and file import 6.4 Explain Data Transformation 6.5 Explain syntax files and scripts 6.6 Explain Output Management	Describe how to generate data and Import file using computer system Explain Data Transformation Explain Syntax files and scripts Explain output Management	PCs	system to generate data	Guide students to generate data online	Explain Data Transformation
	General Objective: 7.0 Understand how to perform descriptive analyses with SPSS					
13	7.1 Explain Frequencies 7.2 Explain Descriptive Analysis 7.3 Explain Explore 7.4 Explain Crosstab 7.4 Explain Charts	Explain Frequencies Explain Descriptive Explain Explore Explain Crosstab Explain Charts	Textbooks Ms. Excel	Categorise various data collected	Guide students to categorise various data	Explain Frequency, Descriptive, Explore
	General Objective: 8.0 Understand how to perform common parametric and non-parametric test					
14	8.1 Explain different statistical test: Mean, T_test, One-way ANOVA, Non	Explain and discuss various types of statistical tests	Textbooks Statistical tables Statistical tables, PCs, Charts, Ms.	Identify the various types of statistical table	Demonstrate how to identify the various types of statistical tables	Enumerate the various types of statistical tables

	Parametric test, Normality test. 8.2 Explain Correlation and Regression: - Linear Correlation and Regression, - Multiple regression (Linear	Explain Linear Correlation and Regression Explain Multiple regression (Linear	Excel	Demonstrate how to construct scattered diagrams, frequency tables and graphs	Guide students to construct scattered diagrams, frequency tables and graphs	Explain how to construct frequency tables and graphs Enumerate the merits and demerits of charts and diagrams
	General Objective: 9.0 Understand how to perform simple regression and multivariate analyses					
15	9.1 Explain Factor Analysis 9.2 Explain Cluster Analysis 9.3 Analyse Data using SPSS	Define and Explain Factor Analysis Define and Explain Cluster Analysis Explain how to analyse data using SPSS	Text books PCs SPSS package	Analyse data using Factor analysis Analyse data using cluster analysis Analyse data using SPSS	Guide students to analyse data using factor analysis Guide students to analyse data using SPSS	Explain factor and cluster analysis

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: QUALITY ASSURANCE

COURSE CODE: MEC 421

DURATION: 30 Hours (2 Hours Lecture, 0 Hour Practical)

CREDIT UNIT: 2.0

Subject: QUALITY ASSURANCE	Code: MCE 421	Total Hours: 2 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 0 Hour/Week
Semester: FOURTH	Pre-requisite:	
Goal: This course is designed to acquaint students with knowledge and skills in quality assurance and reliability of products, processes and services.		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand quality assurance and capacity Index
2	Understand statistical process control.
3	Understand problem solving tools.
4	Understand certification process.
5	Know value engineering
6	Understand reliability improvement

QUALITY ASSURANCE

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY-ALL OPTIONS						
COURSE: QUALITY ASSURANCE				COURSE CODE: MCE 421		CONTACT Hours: 2-0-0Hrs/Wk
Goal: To equip the students with knowledge and skills in quality assurance and reliability of products, processes and services						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0:Understand quality assurance and capacity Index.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1-3	1.1 Define quality assurance. 1.2 Explain components of quality assurance 1.3 Explain customer need – conformity and reliability 1.4 Explain internal need - cost and time compression 1.5 Explain concurrent engineering 1.6 Explain Variability studies of the environments 1.7 Explain capacity index.	Explain1.1 – 1.7	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	-	-	Explain quality assurance and capacity index
	General Objective 2.0: Understand Statistical Process Control.					
4-5	2.1 Explain Sampling techniques. 2.2 Explain Variables; producing mean and range charts 2.3Explain attributes; producing number and percentage defective charts.	Explain 2.1 - 2.3	Textbook, White Marker Board, Marker,Related videos, Lecture notes, Projector etc.	-	-	Explain the features and application of Statistical Process Control
	General Objective 3.0:Understand Problem Solving technique					

6-7	3.1 Explain Pareto analysis. 3.2 Explain Fishbone diagrams and brainstorming. 3.3 Explain Correlation & measles charts.	Explain 3.1 – 3.3	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	-	-	Explain processes of problem solving techniques
General Objective 4.0: Understand certification process.						
8 -9	4.1 Describe the evolution of ISO certifications. 4.2 Explain ISO 9001 4.3 Explain Vendor assessment 4.4 Explain CE Certification 4.5 Explain product and service certification processes. 4.6 Explain the concept of six sigma.	Explain 4.1- 4.4	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	-	-	Explain certification process
General Objective 5.0: Know value Engineering						
10-12	5.1 Explain Functional analysis. 5.2 Explain Cost analysis. 5.3 Explain Comparison matrix & idea development.	Explain 5.1- 5.3	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	-	-	Explain Value Engineering
General Objective 6.0: Understand Reliability improvement.						
13-15	6.1 Explain Simple reliability concepts. 6.2 Explain Fault Tree Analysis. 6.3 Explain Failure mode analysis -FMEA & FMECA.	Explain 6.1 – 6.3	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	-	-	Explain the concept of Reliability improvement.

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Industrial Engineering

COURSE CODE: MEC 422

DURATION: 30 Hours (2 Hours Lecture and 0 Hour Practical)

CREDIT UNIT: 2.0

Course: Industrial Engineering	Code: MEC 422	Total Hours: 2 Hours
		Theoretical hours: 2 Hours
		Practical hours: 0 Hour
Semester: FOURTH	Pre-requisite: NIL	
Goal:. The course is designed to provide the student with basic knowledge and skills in manufacturing systems, production planning and control, methods engineering, ergonomics and engineering economic analysis		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Appreciate the history and perspective of Industrial engineering
2	Understand the nature of manufacturing systems and supply chain
3	Know the basic aspects of production planning and control
4	Comprehend the basic aspects of methods engineering, work design and productivity
5	Know the basic ergonomics and human factors in engineering
6	Understand engineering ethics and engineering economics analysis, engineering value

INDUSTRIAL ENGINEERING

PROGRAMME: HIGHER NATIONAL DIPLOMA (HND) IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: Industrial Engineering			COURSE CODE: MEC 422		CONTACT HOURS: 2-0-0 HRS/WK	
Course Specification: Theoretical & Practical Contents						
Goal: The course is designed to provide the student with basic knowledge and skills in manufacturing systems, production planning and control, methods engineering, ergonomics and engineering economic analysis.						
WEEK	General Objective 1.0: Understand the history and perspective of Industrial engineering					
	Theoretical Content			Practical Content		
	Specific Learning Outcomes	Teacher’s Activities	Resources	Specific Learning Outcomes	Teacher’s Activities	Evaluation
1-2	1.1 Describe chronology and definition of Industrial Engineering 1.2 Explain origins, roles, approach, functions, techniques and contribution of Industrial Engineering in industries 1.3 Explain concept of system and Engineering 1.4 Explain work system and the work system design problem 1.5 Describe models and modeling in Engineering.	Explain activities 1.1 to 1.5	Recommended textbook, lecture notes, whiteboard and marker.			Give the history and perspective of Industrial engineering
	General Objective 2.0: Understand the nature of manufacturing systems and supply chain					
3-4	2.1 Describe the concept and purpose of manufacturing 2.2 Explain processing	Explain activities 2.1 to 2.4	Recommended textbook, lecture notes, whiteboard and marker.			Explain manufacturing systems and supply chain

	operations 2.3 Describe various manufacturing and production systems 2.4 Describe supply chain management					
	General Objective 3.0: Understand basic aspects of production planning and control					
3-4	3.1 Explain need, objectives and function of production planning and control 3.2 Explain production procedure and manufacturing methods and problems of PPC 3.3 Explain facilities layout, problems, types and line balancing	Explain activities 3.1 to 3.3	Recommended textbook, lecture notes, whiteboard and marker.			Explain production planning and control
	General Objective 4.0: Understand basic aspects methods engineering, work design and productivity					
5-7	4.1 Explain the analysis, design and maintenance of work methods 4.2 Describe study of time standards and statistical work sampling 4.3 Explain productivity definitions, models, analysis, measurement, methodologies and reporting systems 4.4 Describe the improvement of productivity as a functional	Explain activities 4.1 to 4.4	Recommended textbook, lecture notes, whiteboard and marker.			Explain methods engineering, work design and productivity

	activity of the enterprise					
	General Objective 5.0: Understand basic ergonomics and human factors engineering					
8-11	5.1 Describe the ways to fit jobs and objects better to the nature and capacity of the human being 5.2 Explain design principles, methods analysis and domains of ergonomics 5.3 Explain Anthropometry, manual material handling, physiological work and work place design	Explain activities 5.1 to 5.3	Recommended textbook, lecture notes, whiteboard and marker.			
	General Objective 6.0: Understand engineering ethics and engineering economics analysis, value engineering					
12-15	6.1 Explain engineering ethics and professional ethics 6.2 Describe basic methods of engineering economic analysis including equivalence, value measurement, interest relationships and decision support theory and techniques as applied to capital projects 6.3 Discribe value engineering	Explain activities 6.1 to 6.3	Recommended textbook, lecture notes, whiteboard and marker.			Explain engineering ethics and engineering economics analysis, value engineering

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: MATERIALS HANDLING

COURSE CODE: MEC 423

DURATION: 30 Hours (2 Hours Lecture, 0 Hour Practical)

CREDIT UNIT: 2.0

COURSE: MATERIALS HANDLING Semester: FOURTH	CODE: MEC 423 Pre-requisite: NIL	Total Hours: 2 Hours/Week
		Theoretical hours: 2 Hour/Week
		Practical hours: 0 Hour/Week
Goal: This course is designed to acquaint students with adequate knowledge and skills in materials handling in work environment		

GENERAL OBJECTIVES	
On completion of this course, students should be able to :	
1	Understand reasons for proper materials handling
2	Understand the various material handling methods and equipment
3	Understand the packing technique and technologies in total material handling
4	Understand the unit load principle and turning circle calculation and their usefulness in material handling
5	Know the causes and ways of preventing common injuries associated with manual handling
6	Understand the basic principle of First Aid
7	Understand the safety and effective maintenance of material handling equipment
8	Understand the various cost involved in Material handling.

MATERIALS HANDLING

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
Course: MATERIALS HANDLING		Course Code: MEC 423			Contact Hours: 2-0-0	
Goal: This course is designed to acquaint students with adequate knowledge and skills in materials handling in work environment						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand reasons for proper materials handling					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 - 2	1.1 Define materials handling 1.2 Explain the concept of materials handling 1.3 List objective of materials handling and relate them to cost, labour, work-in-progress, production control, damages, etc 1.4 Explain the three basic factors which influence the handling of any materials 1.5 Explain the essential differences between production handling (dynamism or mechanical) and warehouse handling (staticism) 1.6 Describe situations where materials handling is needed (workplace or between workplace; departmental, e.t.c through the factory or warehouse and inter-Organisation-receipt of goods from suppliers, delivery to	Explain 1.1 to 1.7	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.			Explain the reasons for proper materials handling

	customers. 1.7 Outline the relationship between the various functions such as information handling function, stock control, order processing, etc involved in material handling					
General Objective 2.0: Understand the various materials handling methods and equipment						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3 - 4	2.1 Explain materials handling methods such as (i) serial picking, parallel picking, FIFO, LIFO, etc. 2.2.List the merits and demerits of the methods of handling in 2.1 2.3 Classify all types of material handling equipment into overhead equipment, conveyor or trucks. 2.4 Determine factors affecting selection of equipment listed in 2.3 2.5 Describe out least five storage systems such bin, shelf, pallet, bar rock, flat support system, adjustable rack, etc. 2.6 Explain the use of demonstrable bodies in materials handling	Explain 2.1 to 2.5	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.			Explain materials handling methods and equipment
General Objective: 3.0 Understand the packing techniques and technologies in total material handling						
Week	Specific Learning	Teachers Activities	Resources	Specific Learning	Teachers Activities	Evaluation

	Outcome			Outcome		
5 - 6	3.1 Explain packaging techniques 3.2 Describe string wrapping cushioning, and secondary packaging. 3.3 Describe the essential features of automated Warehousing. 3.4 Outline the relationship between plant layout and material handling in automation 3.5 Explain a simple material handling system design	Explain 3.1 to 3.5	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.			Explain the packing technique and technologies in total material handling
General Objective: 4.0 Understand the unit load principle and turning circle calculation and their usefulness in material handling						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7 - 8	4.1 Define and explain unit load principle and turning circle calculation 4.2 Relate the unit load principle to Containerization 4.3 Explain the various means such as weight, vehicle capacity, turning moment, types of body, etc, vehicle transport related to the material handling	Explain 4.1 to 4.3	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.			Explain the unit load principle and turning circle calculation and their usefulness in material handling
General Objective: 5.0 Know the causes and ways of preventing common injuries associated with manual handling						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10- 12	5.1 State the types of injuries that are associated	Explain 5.1 to 5.5	Textbook, White			Explain the causes and

	with manual handling 5.2 State the general guidelines that can be given to those who handle materials manually. 5.3 Explain the correct application of the six basic principles essential for safe method of manual handling of load 5.4 Outline the important of Team lifting and carrying 5.5 Explain the methods of handling		Marker Board, Marker, Related videos, Lecture notes, Projector etc.			ways of preventing common injuries associated with manual handling
	General Objective: 6.0 Understand the basic principle of first aid.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	6.1 Describe simple methods of First Aid. 6.2 Explain the techniques of treating minor injuries; e.g. fresh wound, simple Fracture, burns electric shock, etc. 6.3 Apply the technique of application of artificial respiration	Explain 6.1 to 6.3	First Aid Kit			Explain the basic principle of first aid
	General Objective 7.0: Understand the safety and effective maintenance of material handling equipment					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14	7.1 Outline the safety and effective maintenance of materials handling equipment 7.2 Identify simple causes of equipment breakdown and describe their methods	Explain 7.1 to 7.4	Textbook, White Marker Board, Marker, Related videos,			Explain safety and effective maintenance of material handling equipment

	of repair. 7.3 Explain materials handling code of practice		Lecture notes, Projector etc.			
	General Objective 8.0: Understand the various cost involved in materials handling.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
15	8.1 List various cost centers in materials handling 8.2 Establish material handling costs 8.3 Relate costs to stock control policy 8.4 Relate cost to order of processing (information handling, documentation cost, etc)	Explain 8.1 to 8.4	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.			Discuss the various cost involved in materials handling

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: PIPING DESIGN

COURSE CODE: MEC 424

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 2.0

COURSE: Piping Design Semester: FOURTH	CODE: MEC 424 Pre-requisite: NIL	Total Hours: 3 Hours/Week
		Theoretical hours: 2 Hour/Week
		Tutorial hours: 1 Hour/Week
Goal: This course is designed to acquaint students with the knowledge and skills in piping design, installation and maintenance		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the sizing of pipes
2	Know the different types of valves and their applications
3	Understand the types specifications and applications of joints
4	Understand pipe fittings
5	Understand the design and distribution of water supply to single and mutli-storey buildings.
6	Understand pipeline drafting and interpretation
7	Understand preparation of Bill of Engineering Measurement and Evaluation (BEME) for water supply systems.

PIPING DESIGN

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
Course: PIPING DESIGN			Course Code: MEC 424		Contact Hours: 2-0-1 Hours/Wk	
Goal: This course is designed to acquaint students with the knowledge and skills in piping design, installation and maintenance						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand the sizing of pipes					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 - 2	1.1 Define the Hazen-Williams formula 1.2 Use the Hazen-Williams formula to calculate diameter of pipes 1.3 State the standing pipe sizes 1.4 Explain the classifications and ratings of pipes 1.5 Explain the causes and prevention of water hammer 1.6 Explain the use of air vessels, surge tanks and relief valve on water supply systems.	Explain 1.1 to 1.6	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	1.1 Identify pipe codes and standards. 1.2 Use table and charts to size pipes	Demonstrate for the students to learn and guide them to perform the activities.	Explain the sizing of pipes
	General Objective 2.0: Know the different types of valves and their applications					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3 - 4	2.1 List different types of valves used in water supply such as: a) pressure relief valves b) stop valve c) flow regulation valves d) pressure-regulation valves. 2.2 Explain the principles and	Explain 2.1 to 2.5	Textbook, White Marker Board, Marker, Related videos, Lecture	2.1 Identify types of valves used in water supply such as: a) pressure relief valves b) stop valve c) flow regulation valves d) pressure-regulation. 2.2 Demonstrate the	Demonstrate for the students to learn and guide them to perform the activities.	Explain different types of valves and their applications

	constructional details of all the valves listed in 2.1 above. 2.3 Explain the use of each of the 2.1 specification and application of joints.		notes, Projector etc.	principles, constructional details and applications of all the valves listed in 2.1 above.		
General Objective 3.0: Understand the types of specifications and applications of joints						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
5 - 6	3.1 Describe the following joints: - Solder or wiped - Sweet - Slipe - Bell and spigot - Threaded or Screwed joints	Explain 3.1 to 3.5	Textbook, White Marker Board, Marker, videos, Lecture notes, Projector etc.	3.1 Identify the following joints: - Solder or wiped - Sweet - Slipe - Bell and spigot - Threaded or Screwed joints. 3.2 Demonstrate the applications of all the joints identified in 3.1 above	Demonstrate for the students to learn and guide them to perform the activities.	Explain types of specifications and applications of joints
General Objective 4.0: Understand pipe fittings						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7 - 8	4.1 Explain the pipe fittings such as elbows; reducers, tees etc. 4.2 Explain the use of the fitting in 4.1 4.3 Explain the codes and standards used in pipe fittings.	Explain 4.1 to 4.3	Textbook, White Marker Board, Marker, videos, Lecture notes, Projector etc.	4.1 Identify pipe fittings such as elbows; reducers, tees etc. 4.2 Demonstrate the applications of all the pipe fittings identified in 4.1 above	Demonstrate for the students to learn and guide them to perform the activities.	Explain pipe fittings
General Objective 5.0: Understand design and distribution of water supply to single multi-storey building						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	5.1 Describe water up feed, distribution systems water as	Explain 5.1 to 5.5	Textbook, White	5.1 Select materials for installations given	Demonstrate for the students to learn and	Explain the procedure for

10- 12	overhead water distribution down feed. 5.2 Explain procedures for selecting materials for installations given information on the nature of water supply, type of building and pipe work 5.3 Describe how to determine the demand of water supply for the building 5.4 Explain the sizing of the whole water supply pipes for the building 5.5 Specify jointing methods for given installations as well as suitable supports for the pipes 5.6 Outline procedures for inspecting, testing and commissioning installations.		Marker Board, Marker, Related videos, Lecture notes, Projector etc.	information on the nature of water supply, type of building and pipe work 5.2 Determine the demand of water supply for the building 5.3 Size the whole water supply pipes for the building 5.4 Specify jointing methods for given installations as well as suitable supports for the pipes. 5.6 Carry out actual design of water supply to various types of single and storey buildings	guide them to perform the activities.	the design and distribution of water supply to single multi-storey building
General Objective 6.0: Understand pipeline drafting and interpretation						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	6.1 Explain the meaning of each symbols on standard building plans 6.2 Explain how to produce piping drafting for simple	Explain 6.1 to 6.4	Textbook, White Marker Board, Marker, Related videos,	6.1 Interpret the representation of symbols on standard building plans 6.2 Produce piping drafting for simple buildings	Demonstrate for the students to learn and guide them to perform the activities. Organize visits to construction sites	Explain pipeline drafting and interpretation

	buildings 6.3 State the processes in detailing for joints, outlet points, valve connections, faucets household fixtures, connections to closets etc. 6.4 Explain the drafting codes and practices for pipework including simple fabrication and fitting.		Lecture notes, Projector etc.	6.3 Carry out exercise e.g detailing for joints, outlet points, valve connections, faucets household fixtures, connections to closets etc. 6.4 Demonstrate the applications of drafting codes and practices for pipes work including simple fabrication and fitting.		
General Objective 7.0: Understand preparation of Bill of Engineering Measurement and Evaluation (BEME) for water supply systems						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	7.1 List materials and components for water supply system or industrial piping installation from the design drawings. 7.2 Explain the stages in the preparation of Bill of Engineering Measurement and Evaluation (BEME). 7.3 Prepare the Bill of Engineering Measurement and Evaluation (BEME) for the water supply system	Explain 7.1 to 7.4	Textbook, White Marker Board, Marker, Related videos, Lecture notes, Projector etc.	7.1 Identity materials and components for water supply system or industrial piping installation from the design drawings. 7.2 Identify the stages in the preparation of Bill of Engineering Measurement and Evaluation (BEME). 7.3 Prepare the BEME for the water supply system 7.4 Carry out practical exercises on the preparation on Bill of Engineering Measurement and Evaluation (BEME).	Demonstrate for the students to learn and guide them to perform the activities.	Explain the procedures in the preparation Bill of Engineering Measurement and Evaluation (BEME) for water supply systems

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive Option)

COURSE TITLE: Engine and Transmission Design

COURSE CODE: MEA 421

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Engine and Transmission Design	Code: MEA 421	Total Hours: 4 Hour/Week
		Theoretical hours: 2 Hours/Week
Semester: FOURTH	Pre-requisite: NIL	Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in engine and transmission system components design guidelines		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the preliminary analysis of engine design and the factors affecting engine configuration.
2	Understand the procedures for details engine design of the power section
3	Analyse detailed design of valves and valves gears, and auxiliary systems and appreciate the methods of manufacture.
4	Understand the overall criteria of complete engine design
5	Understand the design of cooling and lubrication systems
6	Understand those factors of engine design which affect output and performance.
7	Understand the main concepts of engine balancing and vibration.
8	Appreciate the problem of gear train design for strength and surface durability.
9	Understand the manufacturing methods of gears design and describe the problems associated with each method.
10	Understand the design of gear and planetary gear trains for noise reduction
11	Appreciate the basic design method composition used in designing automatic transmission units.
12	Appreciate the design of manual clutch mechanisms and transmission friction elements.

ENGINE AND TRANSMISSION DESIGN

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: ENGINE AND TRANSMISSION DESIGN			COURSE CODE: MEA 421		CONTACT HOURS: 2-0-2 Hrs/Wk	
Goal: This course is designed to acquaint students with knowledge and skills in engine and transmission system components design guidelines						
COURSE SPECIFICATION:THEORETICAL CONTENT			PRACTICAL CONTENT			
	General Objective 1.0: Know the preliminary analysis of engine design and the factors affecting engine configuration.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1	1.1 List basic engine design consideration. 1.2 Describe basic engine design factors. 1.3 Define cyclinder numbers, dimensions and arrangements 1.4 Describe factors determining the parameters in the above. 1.5 Illustrate with practical design analysis the determination of parameters in 1.3 1.6 Describe the selection of engine configuration and main parameters.	Explain 1.1 - 1.6	Marker, white board, Duster, Textbooks .	Demonstrate steps in engine design and the factors affecting engine configuration	Guide students to demonstrate steps in enginedesign and the factors affecting engine configuration	Explain the steps in engine design and the factors affecting engine configuration
	General Objective 2.0: Understand the procedures for details engine design of the “power section”					
2	2.1 Describe some general problems in detail engine designs and consider (a) material selection (b) structural integrity (c) methods of manufacture (d) methods of assembly (e) thermal performance. 2.2 Describe various engine configuration and explain details. 2.3 Explain design ratios and their	Explain 2.1 - 2.11	Marker, white board, Duster, Textbooks			Explain the procedures for details engine design of the “power section”

3	details. 2.4 Describe power train and gas pressure load and inertia load 2.5 Describe cylinder design and consider (a) cylinder barrel/walls-loading (b) cylinder bores (c) cylinder heads and explain types, e.g. water or air cooled analysis of hold down studs (e) materials for block liners and hold down nuts etc. 2.6 Describe pistons and piston assembly and analysis (a) pistons – materials and geometry (b) piston cooling requirement (c) piston pins – materials, equipment (d) piston properties (e) design dimensions (f) types of rings and their failure modes. 2.7 Describes connecting rods designs and analyse rods, stresses and design for strength/types. 2.8 Discuss proportions, material and configuration. 2.9 Describe crankshaft designs and consider analysis for loads, stresses and strength (b) surface hardening and material treatments (c) results and experimental stress analysis and methods of signs (d) calculation of overlaps (e) boring of pi--- and journals (f) crankshaft check design (g) building crankshaft (h)			Demonstrate the working system of all engine components	Guide students to demonstrate the working system of all engine components	

	recommendation for crankshaft design. 2.10 Describe the design of crankcase and consider types of crankcase and analyse (a) materials requirements (b) structural design (c) accessibility and summary of design. 2.11 Describe engine bearings and consider (a) bearing types and material, length ratio and clearance (b) structural bearing failures (c) lubrication of bearings.					
	General Objective 3.0: Analyse detailed design of valves and vales gears, and auxiliary systems and appreciate the methods of manufacture.					
4	3.1 Describe the methods of valve and valve gear design 3.2 Determine the areas through inlet valves and the conditional inlet veleocities. 3.3 Describe the kinematics of valve gears. 3.4 Analyse valve spring and gear elements. 3.5 Describe the materials for valve and valve gear designs. 3.6. Describe valve cooling and valve failures 3.7. Explain valve gear design. 3.8. Analyse valve gear motion 3.9. Describe Gearing 3.10 Describe the design manifolds, gaskets and seals.	Explain 3.1-3.10	Marker, white board, Duster, Textbooks	Perform the design of valve gears, manifolds, gaskets and seals	Guide the students to perform the design of valve gears, manifolds, gaskets and seals	Explain the processes in design of valves and vales gears, and auxiliary systems and appreciate the methods of manufacture.
	General Objective 4.0: Understand the overall criteria of complete engine design					

5	4.1 State engineering criteria 4.2 State Engine users criteria 4.3 Draw appropriate conclusion	Explain 4.1 - 4.3	Marker, white board, Duster, Textbooks			Explain the overall criteria of complete engine design
General Objective 5.0: Understand the design of cooling and lubrication systems.						
6	5.1 Describe water cooling systems 5.2 Describe thermostat design 5.3 Describe radiator design. 5.4 Calculate the heat dissipation surface of a radiator 5.5 Describe water pumps and explain design requirements. 5.6 Describe air cooling systems 5.7. Describe the design of fans.	Explain 5.1 - 5.10	Marker, white board, Duster, projector, computer to play the video clips, recommended textbooks,	Demonstrate water cooling systems	Guide students to demonstrate water cooling systems	Explain the steps in the design of cooling system and make engineering judgement
7	5.8 Estimate the load and working ability of bearing. 5.9 Describe types of lubrication systems. 5.10 Describe the design of oil pumps, oil filters and oil coolers for air cooled engines.			Demonstrate how the thermostat works Demonstrate lubrication system	Guide students to demonstrate how the thermostat works Guide students to demonstrate lubrication system	Explain the steps in the design of lubrication systems
General Objective 6.0: Understand factors of engine design which affect output and performance.						
8	6.1 Describe how cylinder bore diameter, stroke length and connecting rod/crank ratio influence the physical aspect of an engine layout such as: (a) the number and arrangement of cylinder (b) over-all dimension (c) brake mean effective pressure and power output (d) engine wear. 6.2 Explain the purpose of offsetting the centre line of the crankshaft in relation to cylinder axis (b) gudgeon pin in relation to the major thrust for... 6.3 Explain how combustion	Explain 7.1 – 7.10		Demonstrate how cylinder bore diameter, stroke length and connecting rod/crank ratio influence the physical aspect of an engine layout	Guide students to demonstrate how cylinder bore diameter, stroke length and connecting rod/crank ratio influence the physical aspect of an engine layout	Explain the factors of engine design which affect output and performance

9	efficiency is influenced in combustion camber shape, valve and port geometry. 6.4 Analyse the constraints which limit the maximum compression ratio that can be used in practice. 6.5 Interpret graphs of lift, velocity and acceleration in harmonic c types cam and the operating – of the cam 6.6 Explain the concepts of cam control and spare control and deduce the factors which and volumetric efficiency and false spring behavior and design. 6.7. Describe and compare the following types of gas used in the operation of overhead valve (a) rod operated rockers (b) direct cam operation rocker operated by overhead cam arrangement finger type operated by overhead cam arranged. 6.8. Describe the provisions made for adjusting the clearance in the valve operating systems listed above. 6.9 Describe a method used to reduce or eliminate bounce and valve spring surge. 6.10 Describe with the aid of a sectional skeleton operation of a hydraulic tappet and state the stages of its use.					
	General Objective 7.0: Understand the main concepts of engine balancing and vibration.					
	7.1 Construct from given data a piston velocity diagram for one revolution of the crankshaft large	Explain 7.1 – 7.8				Explain the main concepts of engine

10	and small connecting rod/crank ratios. 7.2 Interpret the diagrams of 7.1 above with respective piston velocity and explain why the piston motion is not simple harmonic. 7.3. Use the piston velocity diagram to explain the meaning and causes of : (a) primary inertial force resulting couple. (b) secondary inertial force resulting couple. 7.4 Describe how primary and secondary forces and couples are balanced (or partially balanced) in the following types of four-stroke engines (a) single cylinder (b) twin cylinder (inline and horizontally opposed) (c) four cylinder inline and vee type (d) six cylinder in-line and vee type. 7.5. Explain the principle of operation of a secondary harmonic balancer. 7.6 Explain the cause of camshaft pulsation and the method used to reduce this vibration. 7.7 Describe the features of crankshaft design which provide maximum strength and resistance to vibration and wear. 7.8 Describe the features which influence the design and positioning of engine mountings			Demonstrate how primary and secondary forces and couples are balanced (or partially balanced) in the following types of four-stroke engines (a) single cylinder (b) twincylinder (inline and horizontally opposed) (c) four cylinder inline and vee type (d) six cylinder in-line and vee type	Guide students to demonstrate how primary and secondary forces and couples are balanced (or partially balanced) in the following types of four-stroke engines (a) single cylinder (b) twin cylinder (inline and horizontally opposed) (c) four cylinder inline and vee type (d) six cylinder in- line and vee type	balancing and vibration

	and stabilizers to constrain the engine against static and vibratory loads.					
	General Objective 8.0: Appreciate the problem of gear train design for strength and surface durability.					
11	8.1 Describe the basic mechanical design principles for gear trains. 8.2 Explain reason for the adoption of compound gears for automotive application. 8.3 Describe gear train selection. 8.4 Analyze gear tooth bending strength 8.5 List modes of gear tooth fatigue, e.g (a) bending fatigue (b) compressive fatigue (c) scoring. 8.6 Describe each mode of failure in 8.5 8.7 Explain material selection for gear design.	Explain 8.1 - 8.7		Select compound gears for automotive application	Guide students to select compound gears for automotive application	Explain the problem of gear train design for strength and surface durability
	General Objective 9.0: Understand the manufacturing methods of gears design and describe the problems associated with each method.					
12	9.1 List types of manufacturing methods, of gear e.g., (a) full topping hop (b) semi-topping hop (c) chopper cutting (d) shalving and broaching (e) chambers (f) fines – pitch 9.2 Describe each of the methods in 9.1.	Explain 9.1 – 9.2		Demonstrate manufacturing methods of gear design -full topping hop -semi-topping hop -chopper cutting -shalving and broaching -chambers -fines – pitch	Guide students to demonstrate manufacturing methods of gear design -full topping hop -semi-topping hop -chopper cutting -shalving and broaching -chambers -fines – pitch	Explain the manufacturing methods of gears design and describe the problems associated with each method
	General Objective 10.0: Understand the design of gear and planetary gear trains for noise reduction.					

13	10.1 Describe the sources of noise in gear boxes. 10.2 Calculate tooth, contact frequency, involute and helical contact ratios. 10.3 Explain the problems of angles of approach, recess and pinion spacing 10.4 Describe shaft and support design for: (a) counter shaft transmission arrangement (b) planetary gear. 10.5 Calculate tolerances and compare with specification. 10.6 Describe the method of calculating gear ratios and illustrate diagrammatically:	Explain 10.1 – 10.6		Demonstrate the sources of noise in gear box	Guide students to demonstrate the sources of noise in gear box	Explain the design of gear for noise reduction
14	(a) simple planetary gear set (b) analysis of planetary gear set. (c) analysis of double-pinion set analysis of long and short pinion meshing with sun gears					Explain the step in the design of planetary gear trains

	General Objective 11.0: Appreciate the basic design method composition used in designing automatic transmission units.					
14	11.1 Describe the design of hydrodynamic units. 11.2 Derive the torque capacity equation governing the application of e.g. hydrodynamic unit in engine and unit combined operation, vehicle and unit combined operation and effects of gearing and size of units. 11.3 Describe basic design requirements for two member fluid coupling. 11.4 Explain basic theory and formulas for 11.4 above. 11.5 Describe the fabrication methods of torque converters (3-member) 11.3 Describe performance analysis of torque converter. 11.4 Describe converter fluids and axial thrust.	Explain 11.1 – 11.8		Demonstrate the fabrication methods of torque converters (3-member)	Guide student to demonstrate the fabrication methods of torque converters (3-member)	Explain the basic design method composition used in designing automatic transmission units

	General Objective 12.0: Appreciate the design of manual clutch mechanisms and transmission friction elements.					
15	12.1 Describe the theoretical analysis of manual and automatic friction clutch design. 12.2 Describe the manufacturing process in: (a) clutch plate and disc (b) transmission bands (c) disc clutch	Explain 12.1 – 12.2		Demonstrate the manufacturing process in: -clutch plate and disc -transmission bands -disc clutch	Guide student to demonstrate the manufacturing process in: -clutch plate and disc -transmission bands -disc clutch	Explain the steps in the design of manual clutch mechanisms and transmission friction elements.

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Automotive option)

COURSE TITLE: AUTOMOTIVE TRIBOLOGY

COURSE CODE: MEA 422

DURATION: 60 HOURS (2 Hours Lecture and 2 Hours Practical)

UNIT: 3.0

Course: AUTOMOTIVE TRIBOLOGY	Code: MEA 422	Total Hours: 4Hrs
		Theoretical hours: 2Hrs
		Practical hours: 2Hrs
Semester: FOURTH	Pre-requisite: NIL	
Goal: This course is designed to acquaint students with knowledge and skills to solve friction, wear and lubrication problems in modern automotive systems.		
GENERAL OBJECTIVES		
On completion of this module students should be able to:		
1	Understand the history and concept of automotive tribology.	
2	Comprehend tribological properties of components of automotive systems.	
3	Know the tribological mechanisms in automotive engines.	
4	Solve tribological problems associated with bearings assembly, piston assembly, valve train & calm follower.	
5	Know the challenges on the tribology of automotive transmission and drive line.	
6	Understand tribological issues in automotive gear systems and auxiliaries.	
7	Know the layout of lubricating systems in S.I. & C.I. engines.	
8	Troubleshoot and fix friction and wear problems in automotive brake systems.	
9	Know the Tribology of Electric vehicles (EVs) and Hybrid vehicles (HVs).	

AUTOMOTIVE TRIBOLOGY

PROGRAMME: HND IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: Automotive Tribology			COURSE CODE: MEA 422		CONTACT HOURS: 2-0-2	
Course Specification: Theoretical & Practical Contents						
Goal: This course is designed to acquaint students with knowledge and skills to solve friction, wear and lubrication problems in modern automotive systems.						
Week	General Objective 1.0: Comprehend tribological properties of components of automotive systems.					
	Theoretical Content			Practical Content		
	Specific Learning Outcomes	Teacher’s Activities	Learning Resources	Specific Learning Outcomes	Teacher’s Activities	Evaluation
1	1.1 Explain the history of Tribology 1.2 State the Significance of Tribology in Industries 1.3 State various disciplines in the field of tribology 1.4 Explain friction and different types of friction. 1.5. Explain difference types of wear mechanisms. 1.6. Explain lubrication 1.7. Explain the difference regimes of lubrication: boundary lubrication, Mixed Lubrication, Elasto-hydrodynamic lubrication and Hydrodynamic Lubrication. Use figures in each case. 1.8. State the significance of lubrication in automotive tribology.	Explain 1.1-1.8.	Recommended Textbook, White Marker Board, duster, Marker. Projector, PC, various worn surfaces of automotive parts and lubricants (virtual and/or real life).	Identify the following: Various worn surfaces of automotive parts .	Display and guide the students to identify different types of wear and their mechanisms on worn parts.	Explain tribology and its components (giving examples with automotive systems), its history, and significance to industries.

	General Objective 2.0: Comprehend tribological properties of components of automotive systems.					
2	2.1 Classify the tribological systems of motor vehicle viz - engine, - transmission, - continuously variable transmission (CVT) - drive train, - traction drive, - joints, - shock absorber - brake - power steering - air conditioner - windshield washer 2.2 List the different tribological components, and their mating parts in each tribological system listed in 2.1. e.g. bearings and journals, piston rings and cylinder liners etc. 2.3 State the percentages of energy losses through each of the tribological system and by their various pairs.	Explain 2.1-2.2 and 2.3 using a tree diagram/flowchart and pie chart respectively.	Recommended Textbook, White Marker Board, duster, Marker. PC, projector, Various tribological components of motor vehicle. Live modern vehicle, tool box.	Identify all the tribological parts of a motor vehicles.	Guide students to identify all the tribological parts of a motor vehicles	Make a chart showing the tribological systems and their pairing parts in motor vehicle. State the percentage energy losses in each system and their respective mating parts.
	General Objective 3.0: Know the tribological mechanisms in automotive engines.					

3 - 4	3.1 Explain using power point, sketch of reciprocating internal combustion engine as a representative power system of ground and sea transportation vehicles. 3.2 State the importance of engine tribology 3.3 Reveal with facts and figures of the energy consumption in the I.C engine as a result of wear. 3.4 Outline the distribution of energy consumption in light-duty and in heavy-duty vehicles. 3.5 Describe using stribeck curve the various lubrication regimes of engine tribo-pairs. Explain from the stribeck curve the following: - Coefficient of friction - oil film thickness ratio or Summerfield number - boundary lubrication, mixed lubrication, and hydrodynamic lubrication regimes. - film thickness ratio (stating the	Explain 3.1-3.6 clearly and systematically.	Recommended Textbook, White Marker Board, duster, Marker. Projector, PC. Four-ball wear tester, Pin-on-disc tribometer, ball on disc tribometer, SKF or Ducom ball bearings, samples standard automotive engine oil, controller, optical microscope (X500 magnification).	3.1 Draw out experiments base on various standard (ASTM D4175 etc.) to mimic closely the tribo-systems in the I.C engine. 3.2 Plot the results to show the stribeck curve, and also the relationship among other relevant parameters. .	Guide students to perform the experiment 3.1 and 3.2. Arrange and lead the students on a visit to a standard automotive assembly and maintenance industry.	Elucidate on the various lubrication regimes in the IC engine tribo-system, giving details of key parametric players in the regimes.

	equation in terms of root mean square (rms) surface roughness and also in terms of the center line average surface roughness values.					
General Objective 4.0: Understand tribological problems associated with bearings assembly, piston assembly, valve train & cam follower.						
5- 6	4.1 Explain, preferably using power point, sketches of tribo-pairs and mechanisms of engine bearing assembly, piston assembly, valve train and cam follower. 4.2. List types of friction and power losses due to friction in each of the tribo-pairs in 4.1. 4.3. Describe the wear phenomenon in each of the pairs in 4.1. 4.4. Disclose the lubrication system of the pairs in 4.1, mentioning the types of automotive lubricant use in their lubrication. 4.5 Explain the following: a. Functions of the lubricant b. Range of service conditions the lubricant may be exposed to c. Properties and composition of the lubricant	Explain 4.1-4.5.	Recommended Textbook, White Marker Board, duster, Marker, projector, pointer. Samples of standard automotive engine lubricating oil. Life I.C engine, C.I engine. Tool-box	4.1 Identify all the engine oil samples and their standard label. 4.2 Dismantle each engine and explain the engine bearing assembly, piston assembly, valve train, cam follower.	Guide students to carry out activities 4.1 and 4.2. Arrange and lead the students on a visit to a standard automotive assembly and maintenance industry.	Explain the procedures in solving tribological problems associated with bearings assembly, piston assembly, valve train & cam follower

	d. Changes in lubricant properties during service e. Test methods and standards (ASTM and ISO) f. current trend in the development of these lubricants, e.g. environmental friendliness, new viscometric properties etc.					
General Objective 5.0: Know the challenges on the tribology of automotive transmission and drive line.						
7-8	5.1. Explain using power point, sketches of tribo-pairs and mechanisms of automotive transmission system, traction drive, universal and constant velocity joints, wheel bearings, and drive chains. 5.2. List type of friction and power losses due to friction in each of the tribo-pairs in 5.1. 5.3. Explain the wear phenomenon in each of the pairs in 5.1 5.4. Analyse the lubrication system of the pairs in 5.1, mentioning the types of automotive lubricant use in their lubrication. 5.5 Explain the following a. Functions of the lubricant b. Range of service conditions the lubricant	Explain 5.1 to 5.5.	Recommended Textbook, White Marker Board, duster, Marker, projector, pointer. Samples of relevant automotive lubricants. Life assembly of automotive transmission system, traction drive, universal and constant velocity joints, wheel bearings, and drive chains. Tool box.			Show the type of friction, stating the proportion of power losses in each of the following: (i) automotive transmission system, (ii) traction drive, (iii) universal and constant velocity joints, (iv) wheel bearings, and (v) drive chains. Describe the wear phenomenon in each of the listed tribo-sub-assembly.

	may be exposed to c. Properties and composition of the lubricant d. Changes in lubricant properties during service e. Test methods and standards (ASTM and ISO) f. current trend in the development of these lubricants, e.g. environmental friendliness, new viscometric properties etc.					
General Objective 6.0: Understand tribological issues in automotive gear systems and auxiliaries.						
9-10	6.1. Explain, preferably using power point, sketches of tribo-pairs and mechanisms of gear system and auxiliaries (axle, shock absorber, power steering, air conditioner, fuel, engine coolant, windshield washer). 6.2. Repeat the activities in 5.2 to 5.4 for the tribo-pairs in 6.1. 6.3. Justify spacers, tensioners, seals, or gasket materials as solid lubricants in automotive tribology.	Explain 6.1 to 6.3.	Recommended Textbook, White Marker Board, duster, Marker, projector, pointer. Samples of relevant automotive lubricants. Real life gear box, axle, shock absorber, power steering, air conditioner, fuel, engine coolant, windshield washer of modern passenger vehicle.	6.1 Establish the identity of the listed sub-assembly, the appropriate lubricant for the various use. 6.2 Dismantle each sub-assembly, clean examine and explain their worn surfaces. 6.3 Lubricate them and assemble them back. 6.4 Carry out laboratory test base on standard ASTM or ISO methods the lubricant use for each of the sub-assembly.	Supervise the students to Execute task 6.1 to 6.4.	Give details of the tribological phenomena of the automotive gear system and ancillaries.
General Objective 7.0: Know the layout of lubricating systems in S.I. & C.I. engines.						
11-12	7.1. Explain with sketches the layout of a forced feed lubricating system.	Explain activities 7.1-7.3, using notes and diagrams where	Recommended Textbook, White Marker Board, duster,	Identify all parts of the lubricating system from the real-life	Oversee the students to: -remove oil sump	Explain with sketches the layout of modern vehicle

	7.2. Account for the layout of dry and wet sump lubricating system. 7.3. State function and construction of the following: (i) gear type pump, (ii) pressure relief valve, (iii) full flow and by pass flow filter.	necessary.	Marker, projector, pointer. layout sketches, live modern vehicles. Complete tool Box, service pit.	modern vehicle.	-remove oil pump& filter, inspect and refit.	engine lubricating system
General Objective 8.0: Troubleshoot and fix friction and wear problems in automotive brake systems						
13	8.1 Explain the tribology of drum brakes and disc brakes. 8.2 Disclose the frictional performance characteristics of automotive brakes. Show a graph of brake effectiveness vs. brake lining friction coefficient. 8.3 Elucidate brakes wear mechanisms: thermal, abrasive, adhesion-tearing, fatigue, and macro-shear.	Explain 8.1 to 8.3.	Recommended Textbook, White Marker Board, duster, Marker, projector, pointer, brake dynamometer, live modern vehicles. Complete tool box, service bay.	Carry out brake dynamometer test on different brake parts using laboratory and then industrial test rigs.	Guide the students to perform brake dynamometer experiment using laboratory test rig and industrial test rig.	Explain the tribology of drum brakes and disc brakes. Itemize brake wear mechanisms.
General Objective 9.0: Know Tribology of Electric vehicles (EVs) and Hybrid vehicles (HVs)						
14-15	9.1 Give a background of EVs/HVs tribology, making mention of the proportion of mechanical losses in EV/HV. 9.2 Correlate the tribology of EV/HV to that of IC engine vehicles. 9.3 Classify the critical tribological systems and their components (e.g	Explain 9.1-9.8 with charts figures and videos could enhance delivery.	White Marker Board, duster, Marker, projector, PC, life hybrid vehicle and electric vehicle. Lubricating oil/ hydraulic fluid and greases, complete tool box.	1.1 Familiarizes the class with the tribosystem and lubricants of EV/HVs.	Escort the students to actualize 1.1	Correlate in details the tribology of EV/HV to that of IC engine vehicles.

	motor system - bearings, and brushes/slip ring assembly; transmission – gears, and dynamic seals; steering system; tyres; wheel bearings; constant velocity joints; comfort and safety gadgets; flywheel bearings) in EVs and HVs and the contribution of those systems and/or their components to mechanical losses. 9.4. Enumerate the components of HVs/EVs ball joints and state the advantages and disadvantages of high friction forces in them. Explain the technological advancement that has alleviated the disadvantages. 9.5. Explain the tribological perspective of squeak noise produced by the shock absorbers and the level of concerns it raised to drivers and passengers of modern EVs. Explain how this challenge can be mitigated. 9.6. Highlight the positive contributions of Micro-electro-mechanical systems to HVs and EVs.					

	Explain how stiction, dynamic friction and wear are negatively impacting the reliability of MEMSs as HVs and EVs sub-systems coordinating technology. 9.7. List the sources of friction and wear in 9.6 and the current means of reducing it. 9.8. Enumerate the types of HVs and EVs lubricants and their various areas of services in HVs/EVs sub-systems. That the properties and performances of these lubricants.					

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: VEHICLE DIAGNOSIS AND MAINTENANCE

COURSE: MEA 423

DURATION: 45 Hours (1Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 2.0

Course: VEHICLE DIAGNOSIS AND MAINTENANCE Semester: FOURTH	Code: MEA 423	Total Hours: 3 Hours/Week
	Pre-requisite: MEA 324	Theoretical hours: 1 Hours/Week
		Practical hours: 2 Hours/Week
Goal: The course is designed to acquaint students with the knowledge and skills of diagnostics techniques in maintenance of vehicles		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand vehicle diagnostic techniques.
2	Understand diagnostic tools and workshop equipment.
3	Understand vehicle wiring systems and their codes.
4	Understand emission and fuel economy in diesel and petrol engines.

VEHICLE DIAGNOSIS AND MAINTENANCE

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: VEHICLE DIAGNOSIS AND MAINTENANCE				COURSE CODE: MEA 423		CONTACT Hours: 1-0-2Hrs/Wk
Goal: The course is designed to acquaint students with the knowledge and skills of diagnostics techniques in maintenance of vehicles						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand vehicle diagnostic techniques.					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1 - 3	1.1 Explain the diagnostic procedure using the six stage process. 1.2 Explain Fault Identification, Tracing and Repair. 1.3 Explain diagnostic chart. 1.4 Explain the operation and application of on board diagnostic system (OBD).	Explain 1.1 – 1.4	Textbook, Marker, Related videos, Lecture notes, Tester apparatus Scanner Automotive Trainer	Demonstrate diagnostic procedure on petrol and diesel vehicles Troubleshoot petrol and diesel vehicles using scanner. Demonstrate using trainer to initiate fault and monitor the behaviour.	Guide students to carry out practical exercise.	Explain vehicle diagnostic techniques
	General Objective 2.0: Understand the basic concepts of Diagnostic tools and workshop equipment.					
4 – 8	2.1 Explain diagnostic tools and equipment. 2.2 State the functions of diagnostic tools and workshop equipment. 2.3 Describe diagnostic techniques. 2.4 Explain diagnosing of fuel control system fault. 2.5 Explain vehicle diagnostics subsystem: □ Power train, □ Body chassis and □ Communication.	Explain 2.1 – 2.5	Textbook, White Marker Board, Related videos, Lecture notes, Projector, Charts etc. Oscilloscope Analyzer, EML platforms, Diagnostic scanner CAT III meter.	2.1 Identify various diagnostics and basic components. 2.2 Demonstrate how to use vehicle diagnostic tool menu. 2.3 Conduct experiment to determine the use of oscilloscope for (exhaust and intake) manifold analysis. 2.4 Conduct experiment to determine the use of multiple equipment for fault finding. 2.5 Conduct practical with do it yourself (DIY) and professional scanning tools.	Guide students to carry out practical exercise.	.Explain the basic concepts of Diagnostic tools and workshop equipment

	General Objective 3.0: Understand vehicle wiring system and their codes.					
9-12	3.1 Explain vehicle electrical system. 3.2 Explain the concept of vehicle electronic systems. 3.3 Explain vehicle wiring codes and their functions. 3.4 Explain the concept of Instrumentation and Display systems 3.5 Explain the Signals, Wipers and Lighting. 3.6 List vehicle antitheft system 3.7 Describe different antitheft devices: □ Sensors □ Warning devices □ Immobilizing devices □ Tracking devices 3.8 Explain vehicle safety systems: • Body • Electrics • Control	Explain 3.1 – 3.8	Textbook, White Marker Board, Related videos, Lecture notes, Projector, Charts etc. Digital multi-meter Tester Alarm device Antitheft device Vehicle tracking device. Trainer.	Identify electrical wiring harness. Perform experiment to install alarm devices and antitheft system.		Explain vehicle wiring system and their codes.
	General Objective 4.0: Understand emission and fuel economy in diesel and petrol engines.					
13-15	4.1 Explain electronic control strategy of fuel systems. 4.2 Explain electronic control strategy of ignition systems. 4.3 List sensors, actuators and other components for emission systems. 4.4 Explain the sources of excessive vehicle emission and monitoring category.	Explain 4.1 – 4.4	Textbook, White Marker Board, Related videos, Lecture notes, Petrol engine Diesel engine Emission analyzer.	Perform experiment to determine vehicle emission.	Guide students to carry out practical exercise.	,Explain emission and fuel economy in diesel and petrol engines .

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Transport Management

COURSE CODE: MEA 424

DURATION: 30 Hours (2 Hours Lecture, 0 Hour Practical)

CREDIT UNIT: 2.0

Course: Transport Management	Code: MEA 424	Total Hours:	2 Hours/Week
		Theoretical hours:	2 Hours/Week
		Practical hours:	0 Hour/Week
Semester: FOURTH	Pre-requisite: NIL		
Goal: This course is designed to acquaint students with management techniques necessary for pricing, investment, planning and other public-policy decisions in the transport sector			

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know road transport legislation
2	Understand workshop equipment
3	Comprehend warehouse operations
4	Know transport service operations
5	Understand transport management

TRANSPORT MANAGEMENT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE OPTION)						
COURSE: TRANSPORT MANAGEMENT			COURSE CODE: MEA 424		CONTACT HOURS: 2-0-0 Hrs/wk	
Goal: This course is designed to acquaint students to acquaint students with management techniques necessary for pricing, investment, planning and other public-policy decisions in the transport sector						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Know Road Transport Legislation					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-3	1.1 Explain legislation regarding vehicle classification 1.2 Explain HGV testing and other legislative requirements 1.3 Describe carriage of toxic and dangerous materials 1.4 List ancillary handling equipment	Explain 1.1 to 1.4	Textbook, White Marker Board, Lecture notes, Projector, Charts, etc.			Explain Road Transport Legislation
	General Objective 2.0: Understand Workshop equipment					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
4-6	2.1 Describe workshop layout 2.2 List basic workshop equipment 2.3 List basic fuel dispensing equipment 2.4 Explain ancillary power needs	Explain 2.1 to 2.4	Textbook, White Marker Board, Lecture notes, Projector, Charts, etc			Describe Workshop equipment
	General Objective 3.0: Comprehend Warehouse Operations					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-10	3.1 Describe location of warehouses 3.2 Explain layout of warehouses 3.3 Explain material handling equipment: Fork lift, trucks, hoists and cranes	Explain 3.1 to 3.6	Textbook, White Marker Board, Lecture notes, Projector,			Explain Warehouse Operations

	3.4 Explain pallet handling & storage systems 3.5 Bulk handling 3.6 Loading and Stowing of cargo		Charts, etc			
	General Objective 4.0: Know Transport Service Operations					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11-13	4.1 Explain fuel storage and its issues 4.2 Explain fuel storage servicing 4.3 Discuss issue of accident & other repairs 4.4 Explain parts section	Explain 4.1 to 4.4	Textbook, White Marker Board, Lecture notes, Projector, Charts, etc			Discuss Transport Service Operations
	General Objective 5.0: Understand Transport Management					
Week	Specific Learning Outcome:	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	5.1 Explain how to determine transport and storage needs 5.2 Explain workshop administration: Vehicle receipt, Workshop instructions, Cost calculations and invoicing procedure.	Explain 5.1 to 5.2	Textbook, White Marker Board, Lecture notes, Projector, Charts, etc			Explain the concept of Transport Management

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Machine Tools Systems

COURSE CODE: MEM 425

DURATION: 45 Hours (1 Hour Lecture, 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Machine Tools Systems Semester: FOURTH	Code: MEM 425 Pre-requisite: NIL	Total Hours: 3 Hours/Week
		Theoretical hours: 1 Hour/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with advanced machine tools control systems and production methods		

GENERAL OBJECTIVES	
On completion of this course, students should be able to :	
1	Understand the principle of automatic control and its applications in machine tools (and transfer lines)
2	Understand the application of various systems in the operation and control of machine tools
3	Understand the operation and control of numerically controlled machine tools and their application to the Machining of typical components
4	Understand the application and operation of single spindle automatic lathe to the machining of typical components
5	Understand the principle and application of transfer machining

MACHINE TOOLS SYSTEMS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - AUTOMOTIVE OPTION						
COURSE: MACHINE TOOLS SYSTEMS				COURSE CODE: MEM 425		CONTACT Hours: 1-0-2Hrs/Wk
Goal: This course is designed to acquaint students with advanced machine tools control systems and production methods						
COURSE SPECIFICATION:THEORETICAL CONTENT				PRACTICAL CONTENT		
	General Objective 1.0: Understand the principle of automatic control and its applications in machine tools (and transfer lines)					
Week	Specific Learning Outcomes	Teachers Activities	Resources	Specific Learning Outcomes	Teachers Activities	Evaluation
1 - 2	1.1 Explain the concept “automatic control” 1.2 Distinguish between the degrees of control (non-mathematics treatment) of a machine tool in (a) manual control (b) Semi-automatic control (c) fully automatic control 1.3 State the factors to be considered which justify the use of automatic control. 1.4 State the principles of control systems and give examples of their application to the control of position and speed	Explain activities 1.1 to 1.4 with detailed notes, block diagrams and pictures.	Recommend ed Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. Practical Guide	1.1 Construct hydraulic and pneumatic circuits to operate a semi-automatic and fully automatic cycles. 1.2 Produce typical line diagrams of hydraulic and pneumatic circuits for the moving parts of a machine tool and explain the purposes and functions of the essential items in the circuit.	Demonstrate construction of hydraulic and pneumatic circuits to operate a semi-automatic and fully automatic cycles. Demonstrate typical line diagrams of hydraulic and pneumatic circuits for the moving parts of a machine tool and explain the purposes and functions of the essential items in the circuit.	Explain the principle of automatic control and its applications in machine tools (and – transfer lines)
	General Objective 2.0: Understand the application of various systems in the operation and control of machine tools					
3 – 6	2.1 Describe the characteristic features of the following systems used in the operation and control of machine tools (a) hydraulic (b) pneumatic (c) mechanical (d) electronic 2.2 Distinguish between the following hydraulic systems: (a) hydrostatic (b) hydrodynamic 2.3 Explain the reasons for the use of the systems in 2.1 mentioning any limitations and	Explain activities 2.1 to 1.3 with detailed notes, block diagrams and pictures.	Recommend ed Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. NC Lathe, Drilling and Milling	2.1 Prepare a point to point programme from a simple component drawing (using CNC machine languages) e.g. Heindemhani Plain language, etc.)	Demonstrate a point to point programme from a simple component drawing (using CNC machine languages) e.g. Heindemhani Plain language, etc.)	Explain the application of various systems in the operation and control of machine tools

	giving typical examples of their application in machine tools (for the operation and control of machine tools)		machines. Practical Guide			
	General Objective 3.0: Understand the operation and control of numerically controlled machine tools and their application to the machining of typical component					
7-10	3.1 Describe numerically controlled (NC) machine tools 3.2 Explain the operating principle of numerically controlled machine tools 3.3 Explain the binary numerical system and its application to tape coding 3.4 Explain monitoring systems (a) analogue (b) digital 3.5 Explain the following monitoring devices- (a) position transducers rotary type (b) optical gratings. 3.6 State the principles and applications of (a) point to point positioning control (b) continuous path control 3.7 Explain the influence of NC machines on drawing office practice 3.8 Explain the importance of ordinate planning and calculating in component drawings 3.9 Justify the use of NC machine in preference to conventional machines 3.10 Explain the operation of a machining centre.	Explain activities 3.1 to 3.10 with detailed notes, block diagrams and pictures.	Recommend ed Textbook, White Marker Board, Lecture notes, Projector, Charts, etc Turret lathe machine Cutting tools Practical Guide.	3.1 Identify numerically controlled (NC) machine tools 3.2 Identify the operating principle of numerically controlled machine tools	Demonstrate numerically controlled (NC) machine tools Demonstrate the operating principle of numerically controlled machine tools	Explain the operation and control of numerically controlled machine tools and their application to the machining of typical components
	General Objective 4.0: Understand the application and operation of single spindle automatic lathe to the machining of typical components					

11-12	4.1 Define automatic 4.2 Explain the operating principles of the following automatic machines (a) indexing turret (b) sliding headstock 4.3 Specify the type of work suitable for the machines in 4.2. 4.4 Describe typical tool used on the machine listed in 4.2 4.5 Prepare sequence of operations, including non-productive time, to produce a simple component on a turret type automatic lathe 4.6 Calculate cycle time for the production of a component from given data 4.7 Sketch the cam layout from given data	Explain activities 4.1 to 1.7 with detailed notes, block diagrams and pictures.	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. Capstan or turret.	4.1 Identify the following automatic machine tools - (a) indexing turret (b) sliding headstock 4.2 Identify typical tool used on the automatic machine tools. 4.3 Prepare sequence of operation, including non-productive time, to produce a simple component on a turret type automatic lathe. 4.4 Draw the CAM layout from given data.	Demonstrate the following automatic machine tools - (a) indexing turret (b) sliding headstock Demonstrate typical tool used on the automatic machine tools. Demonstrate sequence of operation, including non-productive time, to produce a simple component on a turret type automatic lathe. Demonstrate drawing of the CAM layout from given data.	Explain the application and operation of single spindle automatic lathe to the machining of typical components
General Objective 5.0: Understand the principle and application of transfer machining						
13-15	5.1 Define transfer machining 5.2 Describe the basic units of a transfer machine 5.3 State the advantages and limitations in the use of transfer machining 5.4 Explain the operation of the following transfer machining systems (a) in - line (b) rotary-type (c) drum (d) turret 5.5 Give examples of typical components that can be produced on the machine in 5.4	Explain activities 5.1 to 5.5 with detailed notes, block diagrams and pictures.	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc.	5.1 Identify transfer machining 5.2 Identify the basic units of a transfer machine 5.3 Identify the advantages and limitations in the use of transfer machining	Demonstrate transfer machining Demonstrate the basic units of a transfer machine Establish the advantages and limitations in the use of transfer machining	Explain the principle and application of transfer machining

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Machine Tools Processes

COURSE CODE: MEM 422

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Machine Tools Processes Semester: FOURTH	Code: MEM 422 Pre-requisite:	Total Hours: 4 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in the principles and operations of machine tools in order to enable them produce engineering components		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the theory of metal cutting
2	Know the uses and Properties of cutting tools
3	Understand the operation and application of capstan and turret lathes
4	Know milling operations
5	Understand the construction and application of planing machines and plan millers
6	Know the types and applications of boring machines
7	Understand the principles and application of screw thread production methods
8	Know principles and applications of gear cutting and gear shaping
9	Understand the principles and applications of broaching
10	Understand the principles and application of EDM, ECM and Ultrasonic machining
11	Know the sources of plastic moulding processes in common use

MACHINE TOOLS PROCESSES

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – MANUFACTURING OPTION						
Course: MACHINE TOOLS PROCESSES			Course Code: MEM 422			Contact Hours: 2-0-2 hrs/wk
Goal: This course is designed to acquaint students with knowledge and skills in the principles and operations of machine tools in order to enable them produce engineering components						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective: 1.0 Understand the theory of metal cutting			Demonstrate skills in metal cutting		
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1	1.1 Describe three types of chip formation. 1.2 List the factors responsible for types of chip formation 1.3 State the merits and demerits of the above 1.4 Explain orthogonal and oblique cutting. 1.5 Analyse cutting action using merchant theory	Explain 1.1 to 1.5	Recommend ed Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. • Tool Dynamometer	1.1 Carryout experiment involving Tool Dynamometer, to measure the actual cutting speed, force, etc.	Demonstrate for the students to learn and ask them to perform the activities.	Explain the theory of metal cutting
	General Objective: 2.0 Know the uses and properties of cutting tools					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
2	2.1 Describe the general properties required of a cutting tool 2.2 Explain the geometry of single point cutting tool using nomenclature 2.3 Explain the specification of various types of cutting tools in TSO standard system. 2.4 State the factors which affect tool life	Explain 2.1 to 2.4	Recommend ed Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. Lathe machine and its accessories • Practical guide	2.1 1 Select single point and multi-tooth cutting tool for use. 2.2 Select types of cutting tool (materials) e.g. H.S.S ceramic and tungsten - carbide for specific application	Demonstrate for the students to learn and ask them to perform the activities.	Explain the uses and properties of cutting tools
	General Objective: 3.0 Understand the operation and application of capstan and turret lathes			Demonstrate skills in the use of capstan and turret lathe machines		
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

3-4	3.1 Describe capstan and turret lathes 3.2 Compile: a. block diagram of a capstan lathe to show the motions and adjustments, the arrangement of steps; b. a schematic diagram to show the power transmission from the input shaft to the work and to the cutting tools 3.3 Explain the applications and differences between a capstan and turret lathe. 3.4 List three types of chucks and state their uses. 3.5 State the uses of driving dog and fish plate. 3.6 Define floor to floor time for machining a component.	Explain 3.1 to 3.6	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. capstan and turret lathes with accessories	3.1 Identify typical capstan and turret lathe 3.2 Estimate the floor to floor time for the production of a simple component on capstan lathe, using a selection of the different tooling. 3.3 Prepare an operation sheet (working sheet) and the tool layout for the machining of a typical engineering component, that will involve turning, thread cutting, drilling, chamfering, etc. 3.4 Carry out familiarization procedure on a capstan and turret lathes in respect of setting the tooling in the correct sequence to produce a simple component. 3.5 Carry out cylindrical turning, drilling, threading, parting, chamfering, etc. on a turret machine using turret index head. 3.6 Perform basic machining operations using capstan and turret lathes.	Demonstrate for the students to learn and ask them to perform the activities.	Explain the operation and application of capstan and turret lathes
General Objective: 4.0 Know milling operations				Demonstrate skills in the use of milling machine		
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	4.1 Describe milling operation 4.2 Explain types of milling	Explain 4.1 to 4.6	Recommended Textbook, White	4.1 Carryout familiarization procedure relating to the milling of constant rise lobes	Demonstrate for the students to learn and ask them to perform	Explain milling operations

5-6	e.g. up cut, down cut, gang and straddle milling 4.3 Classify milling machines 4.4 Describe at least five types milling machines (at least one from each group of the classifications) 4.5 Explain the use of dividing head, rotary table and types of indexing and how to carry out indexing using dividing head, on a universal milling machine 4.6 Explain in sequential order how a universal milling machine and dividing head can be used for (a) helical milling (b) can milling		Marker Board, Lecture notes, Projector, Charts, etc. • Milling machines and its accessories • Practical guide	on plate cans 4.2 Carryout milling of hexagonal-headed bolt	the activities.	
General Objective: 5.0 Understand the construction and application of planing machines and plan millers						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7	5.1 Explain planing operation 5.2 Complete block diagrams of the types and describe the essential features of (a) planing machines (b) Plano-millers 5.3 State the types of work suitable for machines in 5.2	Explain 5.1 to 5.3	• Planing machines and accessories. • Plane - millers • Practical guide	5.1 Carryout familiarization procedure relating to the planning of an engineering component. 5.2 Carryout planning of an engineering component with planning machine and plane millers.	Demonstrate for the students to learn and ask them to perform the activities.	.Explain the construction and application of planing machines and plan millers
General Objective: 6.0 Know the types and applications of boring machines						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	6.1 Explain boring operations 6.2 Classify and list types of boring machines 6.3 Compile block diagrams and explain the operating	Explain 6.1 to 6.7	White Marker Board, Lecture notes, Projector,	6.1 Carryout familiarization procedure relating to the boring of an engineering component. 6.2 Perform boring operation of an engineering	Demonstrate for the students to learn and ask them to perform the activities.	Explain the types and applications of boring machines

8-9	principles of the: (a) horizontal boring machine (b) vertical boring machine (c) jig borer 6.4 Describe the operations carried out in the horizontal boring machine 6.5 Calculate the coordinates for jig boring operation 6.6 State the type of work suitable for the machines in 6.2 above 6.7 Describe the operation of deep-hole boring		Charts, etc. Lathe machine with boring tools and accessories. Practical guide	component.		
General Objective: 7.0 Understand the principles and application of screw thread production methods						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10	7.1 List types of screw threads 7.2 Explain the principles of screw thread production on the capstan lathe by the following methods and collapsible tape (a) die heads (b) chasing (c) rolling 7.3 Describe the following methods of thread production (a) milling (including worm) (b) grinding (single rib and multi-rib wheel at the helix angle by thread in the processes to avoid interference) 7.4 Compare the relative merits by the processes in 7.2 and 7.3	Explain 7.1 to 7.4	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. • Lathe machine and accessories • Threading tools • Practical guide	7.1 Carryout familiarization procedure relating to screw thread production. 7.2 Perform screw thread cutting operation in a given component.	Demonstrate for the students to learn and ask them to perform the activities.	Explain the principles and application of screw thread production methods
General Objective: 8.0 Know principles and applications of gear cutting and gear shaping						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

11-12	8.1 List types of gear and methods of their cutting 8.2 Explain the principles of gear cutting as the universal milling machine and the limitations of the process to the production of accurate gears in quality 8.3 Describe the essential features of the following gear cutting machine (a) shaping (b) planning (c) hobbing 8.4 Explain the operating principles of the machines outlined in 8.3 for cutting spur gears 8.5 Explain the range of other standard profiles which may be produced on the machines in 8.3 8.6 State the factors, which influence the choice of each process in 8.3.	Explain 8.1 to 8.8	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc. Gear cutting and shaping machine with accessories.	8.1 Carryout familiarization procedure relating to Gear cutting and shaping 8.2 Carryout an exercise each involving spur and helical gear cutting. 8.3 Demonstrate spur gear shaping on a gear shaping machine. 8.4 Cut a helical gear by the hobbing method.	Demonstrate for the students to learn and ask them to perform the activities.	Explain the principles and applications of gear cutting and gear shaping
	8.7 Define gear finishing 8.8 Outline the following methods of gear finishing and give reasons why this process may be necessary	• Illustrate with diagrams and make notes.				
General Objective 9.0: Understand the principles and applications of broaching						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13	9.1 Explain broaching 9.2 Classify broaching machines 9.3 Explain the operating principles of the broaching machine 9.4 Explain the features (nomenclature) of a standard	Explain 9.1 to 9.8	Recommended Textbook, White Marker Board, Lecture notes,	9.1 Carryout familiarization procedures relating to broaching operation in broaching machine. 9.2 Design a simple broach from given data 9.3 Perform a broaching operation in a given	Demonstrate for the students to learn and ask them to perform the activities.	Explain the the principles and applications of broaching

	broach 9.5 Enumerate the factors which influence broach design 9.6 Describe the technique of internal and surface broaching 9.7 Produce a labelled outline drawing or sketch showing essential features of a typical internal broach 9.8 Justify the use of the broaching process with respect to other machining processes.		Projector, Charts, etc. Broaching machine and accessories.	component.		
General Objective: 10.0 Understand the principles and application of EDM, ECM and Ultrasonic machining						
Week	Specific Learning Outcome	Teachers Activities	Resources			
14	10.1 Explain the principles of the following machines (a) Electric Discharge Machining (EDM) (b) Electrochemical Machining (ECM) (c) Ultrasonic Machining (UM) 10.2 List the materials and components which may be produced on the machines in 10.1 10.3 State the advantages and limitations of the processes in 10.1 as compared with conventional machining. 10.4 Compare the characteristics of the processes (or machines) in 10.1 in terms of (a) tool wear (b) work finish (c) metal removal rates	Explain 10.1 to 10.4	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc.			Explain the principles and application of EDM, ECM and Ultrasonic machining

	General Objective 11.0: Know the sources of plastic moulding processes in common use					
Week	Specific Learning Outcome	Teachers Activities	Resources			
15	11.1 Describe, with the aid of sketches, the principles of the following moulding processes for plastic in common use: (a) compression (b) transfer (c) injection 11.2 Compare the advantages and limitations of the processes in 11.1 11.3 State the sources of danger in using the moulding processes in 11.1 11.4 List the forms of supply of plastic raw materials	Explain 11.1 to 11.4	Recommended Textbook, White Marker Board, Lecture notes, Projector, Charts, etc.			Explain the sources of plastic moulding processes in common use

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing Option)

COURSE TITLE: Press and Cutting Tools Design

COURSE CODE: MEM 423

DURATION: 45 Hours (1 Hour Lecture, 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Press and Cutting Tools Design Semester: FOURTH	Code: MEM 423	Total Hours: 3 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 1 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in design principles and application of press and metal cutting tools in the manufacture of engineering components		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Appreciate the basic principles of press tool design
2	Understand the principles of cutting as applied to single-point cutting known as oblique cutting
3	Know the materials used for cutting tools and appreciate the factors affecting their choices
4	Understand the general principles of tool design

PRESS AND CUTTING TOOLS DESIGN

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY – MANUFACTURING OPTION						
Course: PRESS & CUTTING TOOLS DESIGN			Course Code: MEM 423		Contact Hours: 1-0-2 Hrs/Wk	
Goal: This course is designed to acquaint students with knowledge and skills in design principles and application of press and metal cutting tools in the manufacture of engineering components						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective: 1.0 Appreciate the basic principles of press tool design					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 Define the three different ways of working sheet metal in press-shearing, bending drawing. 1.2 Illustrate the progressive deformation and the development of a shearing structure during the shearing process. 1.3 Sketch typical load penetration graph for shearing. 1.4 Illustrate the effect of clearance on the piercing of a moderately ductile metal. 1.5 Write an expression for the estimated work required for shearing 1.6 Describe shear as applied to press tools 1.7 Calculate the amount of shear to be incorporated on a die in order to reduce the work required for shearing	Explain 1.1 to 1.22	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid. • Practical guide.	1.1 Demonstrate the progressive deformation and development of a shearing structure during shearing process. 1.2 Demonstrate the effect of clearance on the piercing of a moderately ductile metal. 1.3 Demonstrate the load conditions required to produce a band. 1.4 Identify the basic features of metal draining operation i.e. punch black diameter, cut, die. 1.5 Demonstrate the deforming stresses in metal drawing. 1.6 Identify the tooling principles involved in drawing.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the basic principles of press tool design.
	1.8 Explain the concept of the displacement of the neutral plane during bending			1.7 Develop an empirical formula for the punch load during drawing.		

3	of a bar 1.9 Sketch a press tool for a simple bending operation. 1.10 Illustrate the load conditions required to produces a bend. 1.11 Derive an expression for the bending load 1.12 Give an expression for the maximum punch load required to over-come the friction between the component and the die walls.			1.8 Carry out calculations on drawing 1.9 Demonstrate the following ways of deepening the cup after the first draw, redrawing, ironing, pressure sinking		
4	1.13 Explain the terms “set the bends”, “flatten (planish) the workpiece”, “bottom the press as used in bending” 1.14 Write an expression for the planishing force 1.15 Describe a feature of cold bending known as spring back 1.16 Outline ways of countering spring-back in bending 1.17 Describe the basic features of a metal-drawing operation i.e. punch, blank diameter, cut, die. 1.18 Illustrate the deforming stresses in metal drawing. 1.19 Illustrate the tooling principles involved in drawing. 1.20 State the meaning of drawing ratio as applied to drawing. 1.21 State two properties,					

	which principally determine how well a metal, may draw.					
	1.22 Explain the need of lubrication in drawing.					
General Objective: 2.0 Understand the principles of cutting as applied to single-point cutting known as oblique cutting						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
5 - 6	2.1 Illustrate the general case of cutting known as orthogonal cutting. 2.2 Analyse the geometry of a single point cutting tool 2.3 Illustrate the elements of a single point tool i.e. flank, cutting edge, cutting part, shank, face base, height, width. 2.4 Sketch the wedge-cutting action and shear plane of a single-point cutting edge. 2.5 Explain the following general cutting terms feed, primary motion, work surface, transient surface, machined surface, depth of cut. 2.6 Describe the three types of a chip formation, i.e. continuous, continuous with built-up edge and discontinuous. 2.7 Outline the conditions that favour the formation of each of the three types of chip in 2.6 2.8 State the use of positive and negative rake cutting taking into account their limitations and advantages.	Explain 2.1 to 2.26	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid. • Practical guide. • Single point tool • Lathe machine	2.1 Demonstrate the general case of cutting known as orthogonal cutting. 2.2 Identify the elements of a single point tool i.e flank, cutting edge, cutting part, shank, face, base, height, width. 2.3 Demonstrate the chip formation and force systems as stipulated by merchant. 2.4 Determine using merchant"s theory the cutting forces. 2.5 Determine the constant in Taylor"s tool life equation given the required cutting test data	Demonstrate for the students to learn and guide them to perform the activities	Explain the principles of cutting as applied to single-point cutting known as oblique cutting

7-8	2.9 Indicate on a sketch, the forces acting on a single-point cutting tool 2.10 Sketch a single-component cutting tool dynamometer 2.11 Describe the operation of the dynamometer in 2.10 2.12 Illustrate the chip formation and force systems as stipulated by Merchant's theory to include forces at the shear plane, and the cutting force and thrust force 2.13 Draw Merchant's theory diagram 2.14 Illustrate by a worked example, Merchant analysis of work done in cutting. 2.15 Draw the vector diagram of velocities of the cutting tool tip 2.16 Calculate work done in shearing metal, against friction, and power consumed during cutting 2.17 State the factors that affect the cutting process 2.18 Explain the factors in 2.17. 2.19 Define metal removal rate and specific cutting pressure.					
	2.20 Give the relationship between specific cutting pressure with feed and rake angle 2.21 Calculate specific					

9-10	cutting pressure given other parameters 2.22 Analyse tool life, tool life criteria, tool failure and tool wear 2.23 Represent the relationship between cutting speed and tool cutting speed and tool life by the Taylor's empirical Law 2.24 Describe the parameters in Taylor's Empirical law 2.25 Illustrate graphically Taylor's tool life law 2.26 Carry out calculation on tool life					
General Objective: 3.0 Know the materials used for cutting tools and appreciate the factors affecting their choice						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11-12	3.1 List the materials used for cutting tools 3.2 State the requirements of cutting tools materials 3.3 List the factors affecting the choice of a particular cutting tool material for applications 3.4 Describe the cutting tool materials in 3.1 taking into considerations such factors as composition performance advantages and disadvantages, further development, specific characteristics, their applications 3.5 Define the machinability a work material 3.6 State two of the four	Explain 3.1 to 3.8	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid. • Practical guide. • Design guide.	3.1 Use the general principles of tool design involving such consideration as strength, heat dissipation and geometry. 3.4 Demonstrate motion study as applied to tool design 3.5 Demonstrate the economics of tool design such as tooling cost to quantity and ease of production. 3.6 Carryout the design consideration and analysis of any cutting tool.	Demonstrate for the students to learn and guide them to perform the activities	Explain the materials used for cutting tools and appreciate the factors affecting their choice

	variables that can be used to indicate machinability i.e tool life, finish, metal removal rate, power required 3.7 Describe how the following conditions of the material affect the machinability, heat-treatment, composition, microstructures inclusions, and hardness, aid toughness. 3.8 Describe the machinability ratings when used to indicate machinability					
General Objective: 4.0 Understand the general principles of tool design						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	4.1 Explain the general principles of tool design involving such consideration as strength heat dissipation and geometry 4.2 Describe motion study as applied to tool design 4.3 Analyse the economics of tool design such as tooling cost to quantity and rate of production	Explain 4.1 to 4.3	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid. • Practical guide.			Explain the general principles of tool design

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing and Plant Options)

COURSE TITLE: Machine Assembly, Installation and Commissioning

COURSE CODE: MEM 424

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 2.0

Course: Machine Assembly, Installation and Commissioning Semester: FOURTH	Code: MEM 424 Pre-requisite: NIL	Total Hours: 3 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 1 Hour/Week
Goal: This course is designed to acquaint students with the knowledge and skills in machine assembly, installation and maintenance		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Know the different types of devices for machine installation
2	Know how to prepare foundations for machine installation
3	Know installation and commissioning of machines
4	Appreciate maintenance systems, their planning and scheduling
5	Know functions of maintenance stores and material control
6	Understand the importance of maintenance reports and records
7	Understand machine dismantling and assembly techniques

MACHINE ASSEMBLY, INSTALLATION AND COMMISSIONING

PROGRAMME: HND IN MECHANICAL ENGINEERING TECHNOLOGY - MANUFACTURING AND PLANT OPTIONS						
COURSE: MACHINE ASSEMBLY, INSTALLATION & COMMISSIONING				COURSE CODE: MEM 424		CONTACT HRS: 2-0-1 Hrs/wk
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Goal: This course is designed to acquaint students with the knowledge and skills in machine assembly, installation and maintenance						
Week	General Objective: 1.0 Know the different types of devices for machine installation					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1	1.1 Describe different types of spirit level. 1.2 Describe the use of theodolite and/or autocollimator in obtaining levels of a surface. 1.3 Describe shims, levelling plates and adjustable levelling pads and explain their uses. 1.4 Describe the use of wedges	Explain activities 1.1 to 1.4 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid. Theodolite Autocollimator Optical square block • Leveling wedges adjustable levelling pods	1.3 Identify shims, levelling plates and adjustable levelling pads and explain their uses. 1.4 Demonstrate the use of wedges 1.2 Identify methods of levelling a machine tool e.g. a lathe, using installation devices in 1.0. 1.3 Carry out alignment tools on already existing machine tool making use of devices in 1.0 1.4 Perform the commissioning of a simple machine tool, (e.g. a drilling machine). 1.5 Explain load test using workpiece and the preparation of load-test chart.	Demonstrate shims, levelling plates and adjustable levelling pads and explain their uses. Demonstrate methods of levelling a machine tool e.g. a lathe, using installation devices in 1.0. Demonstrate the commissioning of a simple machine tool, (e.g. a drilling machine). Demonstrate load test using work piece and the preparation of load-test chart.	Explain the different types of devices for machine Installation
	General Objective 2.0: Know how to prepare foundations for machine installation					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
2	2.1 Interpret foundation plan and prepare template from it. 2.2 Explain how to locate foundation bolts with and without the template 2.3 Describe the different types of foundation bolts and	Explain activities 2.1 to 2.8 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard Marker Duster Lecture	2.1 Identify foundation plan and prepare template from it. 2.2 Identify how to locate foundation bolts with and without the template 2.3 Identify the different types of foundation bolts and	Demonstrate foundation plan and prepare template from it. Demonstrate how to locate foundation bolts with and without the template	Explain how to prepare foundations for machines from foundation drawing

	their uses 2.4 Describe the different methods of securing foundation bolts e.g. (raw bolts, flush ankles etc) 2.5 Explain the need to isolate foundation with the use of materials such as cork, etc.		notes Visual aid.	their uses 2.4 Identify the different methods of securing foundation bolts e.g. (raw bolts, flush ankles etc) 2.5 Identify the need to isolate foundation with the use of materials such as cork, etc.	Demonstrate the different types of foundation bolts and their uses Demonstrate the different methods of securing foundation bolts e.g. (raw bolts, flush ankles etc) Demonstrate the need to isolate foundation with the use of materials such as cork, etc.	
3	2.6 Explain the construction of form-work for foundation concrete 2.7 Explain the method of pouring foundation concrete. 2.8 Explain the use of vibrators and compressed air in foundation concrete work.					
Week	General Objective 3.0: Know installation and commissioning of machines					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
4	3.1 Explain material handling of a machine tool during installation 3.2 Explain the importance of the following operations before installation: (a) unpacking (b) inspection (c) breakage/damage reports 3.3 Explain the need of removing preventive coatings and rust 3.4 Describe methods of levelling a machine tool e.g. a lathe, using installation devices in 1.0 3.5 Illustrate the methods in 3.4 with sketches 3.6 Define machine alignment	Explain activities 3.1 to 3.8 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid. • Spirit levels parallel strips levelling wedges levelling plates/pads	3.1 Identify material handling of a machine tool during installation 3.2 Identify the importance of the following operations before installation: (a) unpacking (b) inspection (c) breakage/damage reports 3.3 Identify the need of removing preventive coatings and rust	Demonstrate material handling of a machine tool during installation Demonstrate the importance of the following operations before installation: (a) unpacking (b) inspection (c) breakage/damage reports Demonstrate the need of removing preventive coatings and rust	Explain the processes in installation and commissioning of machines

5-7	3.7 Explain methods of aligning machine tool components 3.8 Explain gout and describe the method of gouting a machine tool (e.g. lathe or drilling machine) 3.9 Describe methods of find levelling and alignment on 3.4 and 3.9 3.10 Explain necessary preparations for commissioning e.g. (a) cleaning of machine tool (b) supply of necessary lubricants (c) preparing test piece and test report format (d) ensuring correct electrical connections 3.11 Explain idle running of machine tool and the preparation of no-load - test report 3.12 Explain load-test using work piece and the preparation of load-test report			3.7 Identify methods of aligning machine tool components 3.8 Identify gout and describe the method of gouting a machine tool (e.g. lathe or drilling machine) 3.9 Identify methods of find levelling and alignment on 3.4 and 3.9	Demonstrate methods of aligning machine tool components Demonstrate gout and describe the method of gouting a machine tool (e.g. lathe or drilling machine) 3.9 Demonstrate methods of find levelling and alignment on 3.4 and 3.9	
	3.13 Explain with illustration the equipment acceptance certificate					
General Objective 4.0: Appreciate maintenance systems, their planning and scheduling						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8-9	4.1 Define maintenance 4.2 Name and describe the different types of maintenance strategies e.g. preventive, planned, breakdown, shut down, running and contract. 4.3 Explain the roles of each of the maintenance systems in 4.2	Explain activities 4.1 to 4.7 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard Marker Duster Lecture notes			Explain the concept maintenance systems, their planning and scheduling

	4.4 Explain the importance of maintenance in industries and the benefit derived from a successful maintenance system 4.5 Define maintenance planning and scheduling 4.6 Explain the role of forecasting in maintenance planning 4.7 Explain the scheduling of planned and preventive maintenance		Visual aid.			
General Objective 5.0: Know functions of maintenance stores and material control						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
10-11	5.1 Explain the functions of maintenance stores 5.2 Classify machine spare-parts and consumables 5.3 Explain the objective of material control documentation 5.4 Explain the problems relating to the operation of maintenance stores (e.g. organizational and procedure problems) 5.5 Define stock control and the use of Economic Order Quantity (EOQ)	Explain activities 5.1 to 5.5 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid.	5.1 Identify the functions of maintenance stores 5.2 Identifyify machine spare- parts and consumables 5.3 Identify the objective of material control documentation 5.4 Identify the problems relating to the operation of maintenance stores (e.g. organizational and procedure problems)	Demonstrate the functions of maintenance stores Demonstrate machine spare- parts and consumables Demonstrate the objective of material control documentation Demonstrate the problems relating to the operation of maintenance stores (e.g. organizational and procedure problems)	
General Objective 6.0: Understand the importance of maintenance reports and records						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12-13	6.1 State guidelines for troubleshooting and maintenance reporting 6.2 Develop format for reporting and evaluating maintenance work	Explain activities 6.1 to 6.3 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard Marker Duster			Explain the importance of maintenance reports and records

	6.3 State and analyse equipment records for periodic replacement of parts and lubrications		Lecture notes Visual aid.			
Week	General Objective 7.0: Understand machine dismantling and assembling techniques					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	7.1 State types of assembly lines (e.g. non-mechanized (manual, mechanized, semi-automatic and automatic assembly lines 7.2 Explain the assembly lines in 7.1 7.3 Draw typical assembly lines to illustrate the inter-relationship between assembly and work stations 7.4 Explain assembly flow-chart for a typical machine 7.5 Describe simple assembly tools e.g extractor, screw driver, mallet and hydraulic or arbor press	Explain activities 7.1 to 7.5 with detailed notes, block diagrams and pictures. Review the course appropriately, laying more emphasis in areas of weakness of the students	Textbook Whiteboard Marker Duster Lecture notes Visual aid. • Tool box complete with set spanners • Micrometer Vernier caliper,	7.1 Dismantle a typical machine in the workshop 7.2 Clean and identify the components of the machine 7.3 Check the components in 7.7 above for dimensional accuracy 7.4 Re-assemble the machine and check parts in position 7.5 Test run the re-assembled machine	Demonstrate by Dismantling a typical machine in the workshop Demonstrate the components of the machine Demonstrate the components in above for dimensional accuracy Demonstrate the machine assembly and check parts in position Test run the re-assembled machine	Explain procedure in machine dismantling and assembling techniques

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Manufacturing Option)

COURSE TITLE: Jigs and Fixtures Design

COURSE CODE: MEM 425

DURATION: 45 Hours (1 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 2.0

Course: Jigs and Fixtures Design Semester: FOURTH	Code: MEM 425	Total Hours: 3 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 1 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in jig and fixture as well as their application in mass production of engineering components.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the basic principles of jigs and fixtures
2	Understand the Operation of jigs
3	Understand the Operation of Fixtures

JIGS AND FIXTURES DESIGN

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - MANUFACTURING OPTION						
COURSE: JIGS AND FIXTURES DESIGN			Course Code MEM 425		Contact Hours: 1-0-2 Hrs/Wk	
Goal: This course is designed to acquaint students with knowledge and skills in jig and fixture as well as their application in mass production of engineering components.						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Know the basic principles of jigs and fixtures					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1 - 5	1.1 State the purpose and application of jigs and fixtures 1.2 Differentiate between jigs and fixtures 1.3 State the basic principles of location with reference to the six degrees of freedom. 1.4 List the main elements of design of jig and fixture 1.5 Explain the method of Location utilizing the surface of the component e.g. flat, external, cylindrical, and bore 1.6 Describe the following specific treatment methods and device, pin and button, rest pad, and plates, nest or cavity location stop screws	Explain activities 1.1 to 1.6 with detailed notes, diagrams and pictures.	Whiteboard marker, duster, textbook, lecture notes. Practical guide. Jigs and fixtures.	1.1 Identify jigs and fixtures used in machining operations. 1.2 Use jigs and fixtures in simple machining operations	Demonstrate for the students to learn and ask them to perform the activities	Explain the basic principles of jigs and fixtures
	General Objective 2.0: Understand the operation of jigs					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6 - 9	2.1 List the basic components of a jig. 2.2 State the advantages of using jigs 2.3 Describe the operation of a typical jig	Explain activities 2.1 to 2.4 with detailed notes, diagrams and pictures.	Whiteboard marker, duster, textbook, lecture notes.	Design jigs for the manufacture of simple components	Demonstrate for the students to learn • Ask students to design jigs for the manufacture. Four simple components	Explain the operation of jigs

					one for each week	
10 - 11	2.4 Describe the following methods of jig construction: build-up construction, fabricated and cast construction		Practical guide. Samples of jigs.			
General Objective 3.0: Understand the operation of fixtures						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
12 - 15	3.1 List the basic component parts of fixtures. 3.2 Describe the following types of fixtures: vice and fixtures for milling, boring, broaching, grinding and welding	Explain activities 3.1 to 3.2 with detailed notes, diagrams and pictures.	Whiteboard marker, duster, textbook, lecture notes. Practical guide. Samples of fixtures	Design fixtures for locating and damping simple components	Demonstrate for the students to learn • Ask students to design fixtures for locating and damping simple components	Explain the design and operation of fixtures

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology (Plant Option)

COURSE TITLE: Process, Construction and Mining Equipment

COURSE CODE: MEP 421

DURATION: 60 Hours (2 Hours Lecture, 2 Hour Practical)

CREDIT UNIT: 3.0

Course: Process, Construction and Mining Equipment Semester: FOURTH	Code: MEP 421	Total Hours: 4 Hours/Week
	Pre-requisite: NIL	Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Goal: This course is designed to acquaint students with knowledge and skills in the operation and maintenance of process, construction and mining equipment		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand the operations of the basic structure and mechanisms contained within the common maintenance requirement of Mobile equipment
2	Know deep mining special equipment
3	Comprehend material sizing

PROCESS, CONSTRUCTION AND MINING EQUIPMENT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY (PLANT OPTION)						
COURSE: PROCESS, CONSTRUCTION AND MINING EQUIPMENT			COURSE CODE: MEP 421		CONTACT HOURS: 2-0-2 Hrs/Wk	
Goal: This course is designed to acquaint students with knowledge and skills in the operation and maintenance of process, construction and mining equipment						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
General Objective 1.0: Understand the operations of the basic structure and mechanisms contained within the common maintenance requirement of Mobile equipment						
Week	Specific Learning Objective	Teachers Activities	Resources	Specific Learning Objective	Teachers Activities	Evaluation
1-3	1.1 Explain tractors and related equipment: Crawler and wheeled: a. Bulldozers b. Tractor-shovels (front end loaders) c. Scrapers	Explain activities 1.1 to 1.4 with detailed notes, diagrams and pictures.	Whiteboard marker, duster, textbook, lecture notes. Practical guide.	Demonstrate the use of tractors and related equipment: Crawler and wheeled: a. Bulldozers b. Tractor-shovels (front end loaders) c. Scrapers	Demonstrate for the students to learn and guide them to perform the activities.	Discuss application and maintenance requirement of mobile equipment
4-6	1.2 Explain excavating equipment a) Power shovels b) Draglines c) Hoes		Visit to sites	Demonstrate the use of excavating equipment a) Power shovels b) Draglines c) Hoes		
7-8	1.3 Describe material movement a) Rear dump truck b) Bottom dump truck c) Side dump wagons d) Bridge and Gantry cranes e) Conveyors and related equipment			Demonstrate the application of Rear dump truck: b) Bottom dump truck c) Side dump wagons d) Bridge and Gantry cranes e) Conveyors and related equipment		
9-10	1.4 Describe cutting and boring equipment a) Jackhammers b) Rotary drills c) Tunneling machines d) Pile drivers			Demonstrate the use of the following: cutting and boring equipment a) Jackhammers b) Rotary drills c) Tunneling machines		

				d) Pile drivers		
	General Objective 2.0: Know deep mining special equipment					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11-13	Describe the following: 2.1 Hoists 2.2 Pumps 2.3 Ventilation 2.4 Roof supports	Explain activities 2.1 to 2.4 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard , marker Duster Lecture notes Visual aid	Demonstrate the application of the following: 2.1 Hoists 2.2 Pumps 2.3 Ventilation 2.4 Roof supports	Demonstrate for the students to learn and guide them to perform the activities.	Explain deep mining special equipment
	General Objective 3.0: Comprehend materials sizing					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	Describe the following: 3.1 Crushing equipment 3.2 Drying equipment 3.3 Screening 3.4 Separation 3.5 Mixing	Explain activities 3.1 to 3.5 with detailed notes, diagrams and pictures.	Recommended textbook Whiteboard , marker Duster Lecture notes Visual aid	Demonstrate the use of the following: 3.1 Crushing equipment 3.2 Drying equipment 3.3 Screening 3.4 Separation 3.5 Mixing	Demonstrate for the students to learn and guide them to perform the activities.	Explain materials sizing

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: MAINTENANCE MANAGEMENT

COURSE CODE: MEP 422

DURATION: 60 Hours (1 Hour Lecture, 0 Hour Practical)

CREDIT UNIT: 1.0

Course: Maintenance Management	Code: MEP 422	Total Hours: 1 Hour/Week
Semester: FOURTH	Pre-requisite: NIL	Theoretical hours: 1 Hour/Week
		Practical hours: 0 Hour/Week
Goal: This course is designed to enable students acquire knowledge of increased productivity through improved maintenance techniques		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand types of Maintenance
2	Comprehend maintenance causes: identification and reduction
3	Know how to predict faults
4	Understand maintenance procedures
5	Know maintenance strategies

MAINTENANCE MANAGEMENT

PROPROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY- PLANT OPTION						
COURSE: MAINTENANCE MANAGEMENT			COURSE CODE: MEP 422		CONTACT HOURS: 1-0-0	
Goal: This course is designed to enable students acquire good knowledge of increased productivity through improved maintenance techniques						
COURSE SPECIFICATION: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand types of Maintenance			Demonstrate skills in types of maintenance		
	Specific Learning Outcome	Teachers Activities	Resource	Specific Learning Outcome	Teachers Activities	Evaluation
1-2	1.1 Explain maintenance need: efficiency, life, legal (Health & Safety & Environmental 1.2 Explain maintenance types: Planned, preventive, predicative, scheduled, correctives, breakdown, replacement. 1.1 Discribe maintenance monitoring	Explain activities 1.1 to 1.2 with detailed notes, diagrams and pictures.	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid PC with spreadsheet and data base	1.1 Identify the need for maintenance: Efficiency, life, legal (Health & Safety & Environmental 1.2 Perform different types of maintenance: Planned, preventive, predicative, scheduled, correctives, breakdown, replacement. 1.3 Carryout monitoring of maintenance	Demonstrate the need for maintenance: Efficiency, life, legal (Health & Safety & Environmental Demonstrate different types of maintenance: Planned, preventive, predicative, scheduled, correctives, breakdown, replacement. Demonstrate monitoring of maintenance	Explain types of Maintenance
	General Objective 2.0: Comprehend maintenance causes: identification and reduction			Demonstrate skills identification and prevention of materials degradation		
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

3-6	Explain the following as the main causes of maintenance: a. Wear and Tear b. Fatigue and other stresses c. Corrosion d. Operational damage e. Operational neglect and misuse f. Inappropriate design or selection, especially of maintainability	Explain activities 2.1 to 2.1 (a-f) with detailed notes, diagrams and pictures	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid PC with spreadsheet and data base	2.1 Identify the following: a. Wear and Tear b. Fatigue and other stresses c. Corrosion d. Operational damage e. Operational neglect and misuse f. Inappropriate design or selection, especially of maintainability. 2.2 Suggest ways to reduce, control and eliminate the degradation processes above.	Demonstrate 2.1 Identify the following: a. Wear and Tear b. Fatigue and other stresses c. Corrosion d. Operational damage e. Operational neglect and misuse f. Inappropriate design or selection, especially of maintainability. Demonstrate ways to reduce, control and eliminate the degradation processes above.	Explain maintenance causes: identification and reduction

	General Objective 3.0: Know how to predict faults			Demonstrate skills in fault prediction and identification		
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
7-10	3.1 Identify faults 3.2 Predict equipment or systems remaining life 3.3 Interpret manufactures" data	Explain activities 3.1 to 3.3 with detailed notes, diagrams and pictures	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	3.1 Identifying faults 3.2 Predicting remaining life 3.3 Identify Manufactures" data	Demonstrate Identifying faults Demonstrate predicting remaining life Demonstrate Manufactures" data	Explain how to how to predict faults
	General Objective 4.0: Understand maintenance procedures			Demonstrate skills in maintenance procedures		
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11-13	4.1 Explain Preparing procedures 4.2 Explain Preparing detailed instructions 4.3 Explain Data collection and analysis 4.4 Explain Plant maintenance schedule, including regulation compliance 4.5 Explain Staff scheduling	Explain activities 4.1 to 4.5 with detailed notes, diagrams and pictures	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	4.1 Preparing procedures 4.2 Preparing detailed instructions 4.3 Data collection and analysis 4.4 Plant maintenance schedule, including regulation compliance 4.5 Staff scheduling	Demonstrate Preparing procedures Demonstrate detailed instructions Demonstrate Data collection and analysis Demonstrate Plant maintenance schedule, including regulation compliance and Staff scheduling	Explain mainte nance proced ures
	General Objective 5.0: Know maintenance strategies			Demonstrate skills in maintenance strategies		
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
14-15	5.1 Explain effectiveness measures, availability, cost and hazard prevention 5.1 Explain Training - operator and serviceman 5.2 Explain Evaluating maintenance plans 5.3 Explain Spare parts requirements. 5.4 Explain Computerized maintenance management system CMMS.	Explain activities 5.1 to 5.3 with detailed notes, diagrams and pictures	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid PC with spreadsheet and data base	5.1 Identify Effectiveness measures, availability, cost and hazard prevention 5.1 Identify Training - operator and serviceman 5.2 Identify maintenance Evaluation plans and Spare parts requirements Identify Computerized maintenance management system CMMS.	Demonstrate Effectiveness measures, availability, cost and hazard prevention Demonstrate Training - operator and serviceman Demonstrate maintenance Evaluation plans and Spare parts requirements Demonstrate Computerized maintenance management system CMMS.	Explain mainte nance strateg ies

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Power Plant Engineering

COURSE CODE: MEP 423

DURATION: 60 Hours (2 Hours Lecture, 2 Hours Practical)

CREDIT UNIT: 3.0

Course: Power Plant Engineering	Code: MEP 423	Total Hours: 4 Hours/Week
		Theoretical hours: 2 Hours/Week
		Practical hours: 2 Hours/Week
Semester: FOURTH	Pre-requisite: MEA 321	
Goal: This course is designed to acquaint students with the knowledge and skills on the operation, layout and implementation of power plants		

GENERAL OBJECTIVES	
On completion of this module students should be able to:	
1	Understand the concept of power plant engineering and historical evolution
2	Understand the layout and operation of thermal power plants
3	Understand the layout and operation of hydroelectric power plants
4	Understand the layout and operation of diesel and gas turbine power plant
5	Understand the layout and operation of nuclear power plant
6	Understand safety issues of all the types of power plant

POWER PLANT ENGINEERING

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY - PLANT OPTION						
COURSE: POWER PLANT ENGINEERING			CODE: MEP 423		CONTACT 2-0-2HR/WK	
Goal: This course is designed to acquaint students with the knowledge and skills on the operation, layout and implementation of power plants						
Course Specification: Theoretical Content				PRACTICAL CONTENT		
Week	General Objective 1.0: Understand the Principle of Power Generation					
	Specific Learning Outcome	Teacher Activities	Resource	Specific Learning Outcome	Teacher Activities	Evaluation
1-5	1.1 Define power plant 1.2 List types of power plant 1.3 State the factors affecting location and choice of power plant. 1.4 Explain factors affecting the operation of power plant 1.5 Explain performance and operating characteristics of power plant	• Explain activities 1.1 to 1.5	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	1.1 Identify the various types of power plant	Arrange for industrial visits.	Explain the principle of power generation with suitable examples
	General Objective 2.0: Understand the layout and operation of thermal power plants					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
6-7	2.1 Explain the role of thermal power plant in power generation scenario 2.2 Explain the selection of site for thermal power plant 2.3 Give general lay out of a thermal power plant and its working principles. 2.4 State the advantages and disadvantages of thermal power plant 2.5 Describe the different types of boilers and characteristics of their fuels. 2.6 Describe with sketches the firing systems for solid, liquid and gaseous fuels. 2.7 Solve problems on boiler energy balance and draw the Sankay diagram.	• Explain activities 2.1 to 2.10	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	2.1 Visit some selected industries to acquaint student with types, operation and maintenance of thermal power plants. 2.2 Carryout a simple energy audit on a typical plant	Arrange for industrial visits. Demonstrate for the students to learn and guide them to perform the activity.	Explain various thermal power plant layout and operation

	2.8 Explain methods of boiler maintenance. 2.9 Analyze with sketches typical steam generation plant showing major components. 2.10 Describe with sketches the steam pipe layout and sizes.					
General Objective 3.0: Understand the layout and operation of hydroelectric power plant						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8-10	3.1 Explain the role of hydroelectric power plant in power generation scenario 3.2 Explain the selection of site for hydro power plant 3.3 Give general lay out of a hydroelectric power plant and its working 3.4 State the advantages and disadvantages of hydroelectric power plant	• -Explain activities 3.1 to 3.4	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	Visit some selected industries to acquaint student with types, operation and maintenance of hydroelectric power plants.	Arrange for industrial visits.	Explain the significance of hydroelectric power plant in the economy and technological development
General Objective 4.0: Understand the layout and operation of diesel and gas turbine power plant						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
11-12	4.1 Explain the layout of diesel and gas turbine power plants. 4.2 Explain components and the working of diesel power plant. 4.3 State the advantages and disadvantages of diesel power plant. 4.4 Describe gas turbine power plant- Schematic diagram, components and its working	Explain activities 4.1 to 4.4	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	Visit some selected industries to acquaint student with types, operation and maintenance of diesel and gas turbine power plants.	Arrange for industrial visits.	Explain the layout and operation of diesel and gas turbine power plant
General Objective 5.0: Understand the layout and operation of nuclear power plant						
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
	5.1 Explain the working principles and layout of nuclear power plant.	• Explain activities 5.1 to 5.3.	Recommended textbook			Explain the layout and

12-13	5.2 Describe thermal fission Reactors- PWR, BWR and gas cooled reactors 5.3 State the advantages and disadvantages of nuclear power plant		Whiteboard Marker Duster Lecture notes Visual aid			operation of nuclear power plant
	General Objective 6.0: Understand safety issues of all the types of power plant					
14-15	6.1 Explain plant safety concept 6.2 Explain safety policy to be observed in power plants 6.3 Describe safety practices to be observed in boiler operation	• Explain activities 7.1 to 7.3.	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid			Explain safety issues of all the types of power plant

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: Electro-Mechanical Controls

COURSE CODE: MEP 424

DURATION: 45 Hours (2 Hours Lecture, 1 Hour Practical)

CREDIT UNIT: 2.0

Course: Electro-Mechanical Controls Semester: FOURTH	Code: MEP 424 Pre-requisite: MEC 314	Total Hours: 3 Hours/Week
		Theoretical hours: 2 Hours/Week
		Tutorial hours: 1 Hour/Week
Goal: This course is designed to acquaint the students with knowledge and skills on the operation and maintenance of electro-mechanical control systems		

GENERAL OBJECTIVES	
On completion of this module students should be able to :	
1	Understand general control elements and systems
2	Understand how comparative is controlled
3	Understand humidity Control
4	Know refrigeration flow controls
5	Understand other electrical/electronic controls.
6	Understand control circuits

ELECTRO-MECHANICAL CONTROLS

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY- PLANT OPTION						
COURSE: ELECTRO-MECHANICAL CONTROLS			Course Code: MEP 424		Contact Hours: 2.0.1 Hrs/Wk	
Goal: This course is designed to acquaint the students with knowledge and skills on the operation and maintenance of electro-mechanical control system						
Course Specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective: 1.0 Understand general control elements and systems					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1	1.1 State the functions of control devices in R & A. 1.2 List elements such as: a. Sensing elements b. Signal transmission part.	Explain activities 1.1 to 1.2	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	1.1 Identify the functions of control devices in R & A. 1.2 Identify elements such as: a. Sensing elements b. Signal transmission part.	Demonstrate the functions of control devices in R & A. Demonstrate elements such as: a. Sensing elements b. Signal transmission part.	Explain general control element s and systems
2	1.3 Explain the functions of the elements listed in 1.2. 1.4 List the main control system such as: a. self-acting b. pneumatics c. hydraulic d. two position method e. proportional method f. floating method			1.3 Identify the functions of the elements listed in 1.2. 1.4 Identify the main control system such as: a. self-acting b. pneumatics c. hydraulic d. two position method e. proportional method f. floating method	Demonstrate the functions of the elements listed in 1.2. Demonstrate the main control system such as: a. self-acting b. pneumatics c. hydraulic d. two position method e. proportional method f. floating method	
	General Objective 2.0: Understand how thermostat is controlled					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3-4	2.1 Explain the function of thermostat. 2.2 Differentiate among the following types of thermostat: a. (electric, electronic pneumatic or clock types) b. pneumatic thermostats c. electronic thermostats	Explain activities 2.1 to 2.2	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	2.1 Identify the function of thermostat. 2.2 Identify differences among the following types of thermostat: a. (electric, electronic pneumatic or clock types) b. pneumatic thermostats c. electronic thermostats	Demonstrate the function of thermostat. Demonstrate among the following types of thermostat: a. (electric, electronic pneumatic or clock types) b. pneumatic thermostats c. electronic thermostats	Explain how ther most at is cont rolle d

	d. surface thermostat e. direct acting and indirect acting thermostats f. Insertion thermostats					
	2.3 Explain the operations of the thermostats listed in 2.2. 2.4 State the application of thermostats listed in 2.2 2.5 List the factor guiding the electronic thermostat.		• Lab equipment.	2.3 Identify the operations of the thermostats listed in 2.2. 2.4 Identify the application of thermostats listed in 2.2 2.5 Identify the factor guiding the electronic thermostat.	Demonstrate the operations of the thermostats listed in 2.2. Demonstrate the application of thermostats listed in 2.2 Demonstrate the factor guiding the electronic thermostat.	
	General Objective 3.0: Understand humidity control.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

5-7	3.1 State the need for humidity control. 3.2 List the sensing elements types of humidistat used in A.R such as a. non-first system b. sil moisture sensitive salts c. hair d. synthetic fibres e. resistance types (resistance changing with humidity used with wheatstone Bridge). f. Combined wet bulb and dry bulb temperature g. Length changing type 3.3 Explain the operation of humidistat types using the sensing elements listed in 3.2 3.4 State the application of humidistat. 3.5 List the factors guiding the solution of humidistat. 3.6 Explain the operation of	Explain activities 3.1 to 3.6	Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	3.1 Identify the need for humidity control. 3.2 Identify the sensing elements types of humidistat used in A.R such as a. non-first system b. sil moisture sensitive salts c. hair d. synthetic fibres e. resistance types (resistance changing with humidity used with wheatstone Bridge). f. Combined wet bulb and dry bulb temperature g. Length changing type 3.3 Identify the operation of humidistat types using the sensing elements listed in 3.2 3.4 Identify the application of humidistat.	Demonstrate the need for humidity control. Demonstrate the sensing elements types of humidistat used in A.R such as a. non-first system b. sil moisture sensitive salts c. hair d. synthetic fibres e. resistance types (resistance changing with humidity used with wheatstone Bridge). f. Combined wet bulb and dry bulb temperature g. Length changing type Demonstrate the operation of humidistat types using the sensing elements listed in 3.2 3.4 State the application of humidistat.	Explain humidity control

	the following devices. a. drier/dehydrator b. humidifier.					
	General Objective 4.0: Know refrigeration flow controls					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
8-10	4.1 List flow controls used in R/A system 4.2 State the needs for flow control in R/A systems 4.3 State the functions of the flow controls listed in 4.1 4.4 Explain the operation of the flow controls in 4.1. 4.5 State the application of the flow controls listed above. 4.6 List the factors, which guide the selection of the flow controls in 4.1.	Explain activities 4.1 to 4.6	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	4.1 Identify flow controls used in R/A system 4.2 Identify the needs for flow control in R/A systems 4.3 Identify the functions of the flow controls listed in 4.1 4.4 Identify the operation of the flow controls in 4.1. 4.5 Identify the application of the flow controls listed above. 4.6 Identify the factors, which guide the selection of the flow controls in 4.1.	Demonstrate flow controls used in R/A system Demonstrate the needs for flow control in R/A systems Demonstrate the functions of the flow controls listed in 4.1 Identify the operation of the flow controls in 4.1. Demonstrate the application of the flow controls listed above. Demonstrate the factors, which guide the selection of the flow controls in 4.1.	Explain refrigeration flow controls
	General Objective 5.0: Understand other electrical/electronic controls.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation

11-13	5.1 List other electrical/electronic controls used in R/A system a. motor cycling control b. electrical/electronic relays to interlock fans, pumps, etc. (amperage, potential, hot-wire types) c. solenoid and timers d. defrosting switch safety overload; full automatic and semi-automatic defrosting control e. motor starters f. damper motor g. float switch	Explain activities 5.1 to 5.5	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	5.1 Identify other electrical/electronic controls used in R/A system a. motor cycling control b. electrical/electronic relays to interlock fans, pumps, etc. (amperage, potential, hot-wire types) c. solenoid and timers d. defrosting switch safety overload; full automatic and semi-automatic defrosting control e. motor starters f. damper motor g. float switch	Demonstrate other electrical/electronic controls used in R/A system a. motor cycling control b. electrical/electronic relays to interlock fans, pumps, etc. (amperage, potential, hot-wire types) c. solenoid and timers d. defrosting switch safety overload; full automatic and semi-automatic defrosting control e. motor starters f. damper motor g. float switch	Explain the operation of other electrical/electronic control systems

	5.2 State the function of the controls listed in 5.1. 5.3 Explain the operation of the controls listed in 5.1. 5.4 State the application of the controls in 5.1. 5.5 List the factors that guide the selection of the controls.					
	General Objective 6.0: Understand control circuits					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
13-15	6.1 Interpret standard drawing, symbols of electro mechanical control, elements selector, check valves, etc. 6.2 Read control circuits for Air conditioning and Refrigeration system.	Explain activities 6.1 to 6.2	Recommended textbook Whiteboard Marker Duster Lecture notes Visual aid	6.1 Identify standard drawing, symbols of electro mechanical control, elements selector, check valves, etc. 6.2 Identify control circuits for Air conditioning and Refrigeration system.	Demonstrate standard drawing, symbols of electro mechanical control, elements selector, check valves, etc. Demonstrate control circuits for Air conditioning and Refrigeration system.	Explain control circuits

PROGRAMME: Higher National Diploma (HND) in Mechanical Engineering Technology

COURSE TITLE: FINAL YEAR PROJECT

COURSE CODE: MEC 400

DURATION: 45 Hours (0 Hour Lecture, 3 Hours Practical) – (Student Centred)

CREDIT UNIT: 3.0

Course: FINAL YEAR PROJECT	Code: MEC 400	Total Hours: 3 Hours/Week
		Theoretical hours: 0 Hour/Week
Semester: FOURTH	Pre-requisite: NIL	Practical hours: 3 Hour/Week
Goal: Final year project is designed to acquaint students with the knowledge and skills to solve practical industry related problems		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the collection and collation of experimental data
2	Know logical presentation of these data as a thesis
3	Know project defence.

FINAL YEAR PROJECT

PROGRAMME: HIGHER NATIONAL DIPLOMA IN MECHANICAL ENGINEERING TECHNOLOGY						
COURSE: FINAL YEAR PROJECT			Course Code: MEC 400		Contact Hours: 0-0-3 Hrs/Wk – Student Centered	
Course Specification: THEORETICAL CONTENT				PRACTICAL CONTENT		
Week	General Objective 1.0: Know the collection and collation of experimental data					
	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
1			Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	1.1 Collect relevant experimental data 1.2 Collate these data for synthesis 1.3 Draw appropriate graphs and other illustrations	Demonstrate for the students to learn and guide them to perform all the activities.	Explain the collection and collation of experimental data
	General Objective 2.0: Know logical presentation of data					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
3-4			Recommend ed textbook Whiteboard Marker Duster Lecture notes Visual aid	2.1 Write up project report in solid technical language 2.2 Ensure appropriate positioning of: abstract, introduction, scope of project, previous work or literature survey, experimental results, discussions and conclusion. 2.3 Acknowledge all forms of assistance –technical, literally, moral and material. 2.4 Choose appropriate reference citation.	Demonstrate for the students to learn and guide them to perform all the activities.	Explain the processes involved logical presentation of data
	General Objective 3.0: Know project defence.					
Week	Specific Learning Outcome	Teachers Activities	Resources	Specific Learning Outcome	Teachers Activities	Evaluation
		Explain activities 3.1	Recommend	3.1 Submit bound project	Demonstrate for the	Explain project

5-7		to 3.5	ed textbook Whiteboard Marker Duster Lecture notes Visual aid	report for evaluation by supervisor(s) 3.2 Collect tangible products of the project as exhibit. 3.3 Present and defend claims at viva voce	students to learn and guide them to perform all the activities.	defence

LIST OF WORKSHOPS AND LABORATORIES

S/N	Workshops	Laboratories
i	Machine Shop	i. Fluid Mechanics/Hydraulics
ii.	Fitting Shop	ii. Thermodynamics/Heat Engines Laboratory
iii.	Welding and Fabrication Workshop	iii. Mechanics of Machine/Metrology Laboratory
iv.	Foundry, Heat Treatment and Forge Workshop	iv. Materials Science/Strength of Materials Laboratory
v	Automotive Workshop	v. Automotive Laboratory
vi	Building Services, Refrigeration and Air-conditioning Workshop	vi. Power/Plant Laboratory
vii	CAD Room	vii. Refrigeration and Air-conditioning Laboratory

REQUIRED MINIMUM LIST OF EQUIPMENT IN THE WORKSHOPS AND LABORATORIES

A. Workshops

i. Machine Shop (ND)

S/N	Description of Equipment	Quantity Required
1.	Standard centre lathe with accessories	2
2.	Column/pillar drilling machine	1
3.	Universal milling machine complete with accessories	1
4.	Surface grinding machine complete with accessories	1
5.	Pedestal grinding machine	
6.	Power hacksaw	1
7.	Arbor/hydraulic press	1
8.	Shaping machine with accessories	1
9.	Universal tool and cutter grinder	1
10.	Box spanners	5
11.	Allen Keys (set)	5 sets
12.	Flat screw driver (set) 3 sets	3 sets
13.	Philips screw driver	3 sets
14.	Drift/pin punches (various sizes)	3 sets each
15.	Knurling tools	2 sets
16.	Parallel strips	3
17.	Vernier protractor	3
18.	Micrometers outside 0.25 mm 25-50 mm 50-75 mm and sets of Inside micrometers	3
19.	Depth gauge	5
20.	Steel rule 300 mm	5
21.	Calipers (inside and outside)	5
22.	Vee block with clamps	4
23.	Scribing block	4
24.	Surface plate	3
25.	Hand/machine reamers (sets)	3 each
26.	Oil Can	2
27.	Centre drills (set)	4 sets
28.	Twists drills (set)	4 sets

29.	Thread chaser (Assorted) 3 each	3 each
30.	Marking out table	2
31.	Combination set	4
32.	Screw gauges (assorted)	4
33.	Plug gauges (assorted)	4
34.	Dial indicator and stand	4
35.	Slip gauges (set)	2
36.	Grease gun	2
37.	Angle plates	3
38.	Engineer's square	5
39.	Measuring balls/rollers	2
40.	Limit gauges	5
41.	Fire Extinguisher & sand buckets	2 each

ii. Machine Shop (Additional Equipment for HND Manufacturing only)

S/N	Description of Equipment	Quantity Required
1.	Turret or Capstan Lathe with accessories	1
2.	CNC lathe or CNC drilling or CNC milling machine with accessories	1

iii. Fitting Shop (ND/HND)

S/N	Description of Equipment	Quantity Required
1.	Bench vice	15
2.	Sensitive bench drilling machine	2
3.	Marking out table	1
4.	Surface plate	1
5.	Multi-purpose furnace	1
6.	Flat rough file (300 mm) Round rough file (300 mm) Round smooth file (300 mm) Source rough file (300 mm) Flat smooth file 250 mm) Half round rough file (150 mm) Triangular rough file (150 mm)	10 each

	Half round smooth file (250 mm) Triangular smooth file (150 mm)	
7.	Guillotine	1
8.	Tri-square Dividers Steel rule Wallets of warding file 10 sets Scribers Vee block and clamp Scribing block Centre punches Cold chisels (set) Scrapers (set)	10 each
9.	Vernier Calliper Hacksaw frame Stock and dies (set) metric Taps and wrenches (set) metric Hand drill Centre drills Lot Tap extractor (set) Screw extractor (set)	3 sets each
10.	Screw driver (set) and Hammers (assorted weight)	2 each
11.	Measuring tapes Feeler gauges Rivet gun Goggles Drill set Electric Hand drill Electric hand grinder/sander Vernier height gauge Dial indicators and stand Mallets (rubber, wood/rawhide)/Number stamps	2 each
12.	Letter stamps Punches (cold) Plier (assorted) Hand shear	3 each
13.	Fire Extinguisher/sand buckets	2 each

iv. **Automotive Shop (ND/HND– Automotive and Plant options only)**

S/N	Description of Equipment	Quantity Required
1.	Digital engine diagnostic equipment	1
2.	Hydraulic jack	3
3.	Hydraulic press (100 tonne)	1
4.	Manual table press	2
5.	Standard service pit	1
6.	Brake testing equipment with control panel	1
7.	Sensitive drilling machine	1
8.	Electric vulcaniser	1
9.	Valve grinder	1
10.	Workshop service compressor	1
11.	Wheel balancing equipment (dynamic type)	1
12.	Wheel alignment equipment (digital type)	1
13.	Work benches	2
14.	Bench vices	4 (2 per work bench)
15.	Pneumatic tyre removal equipment	1
16.	Injector pump test bench	1
17.	Master cylinder test equipment	1
18.	Universal battery charger	1
19.	Engine mounting stand	3
20.	Hydro-meters	5
21.	Trolley Jacks	2
22.	Foot operated grease dispenser	2
23.	Complete mechanics tool kit	10
24.	Electric hand drill	2
25.	Breast drill (manual)	2
26.	Airline pressure gauge	4
27.	Portable tyre inflator (manual)	2
28.	Tyre repair kit	3
29.	Heavy duty tyre changer	1
30.	Exhaust gas analyser	1
31.	Portable crane	1

32.	Valve refacer	2
33.	Dynamometer	2
34.	Steam cleaner	1
35.	Diesel fuel pump test stand	1
36.	Carburettor service kit	1
37.	Chain wrench (for removing oil filter)	2
38.	Portable vehicle hoist	1
39.	Piston ring extractor	2
40.	Spark plug tester	2
41.	Pullers (various sizes)	6
42.	Grease gun	2
43.	Cylinder ridge remover	6
44.	Engine sump drainer	6
45.	Honing machine	1
46.	Head light tester	2
47.	Oil can	6
48.	2 stroke diesel engine	3
49.	4 Cylinder diesel engine	2
50.	6 Cylinder petrol engine	2
51.	Clutch testing machine	1
52.	Live and dead vehicles	2 each
53.	Spanners of assorted types and sizes	assorted
54.	Fire extinguishers, water, foam, dry powder, and sand buckets	2 each

v. Welding and Fabrication Shop (ND/HND – Manufacturing option only)

S/N	Description of Equipment	Quantity Required
1.	Universal welding machine (ProMIG-315DCMMA/TIG/MIG/MAG) with accessories	3
2.	Oxygen cylinder	5
3.	Acetylene cylinder	5
4.	Argon cylinders	2
5.	CO ₂ cylinders	2
6.	Oxy acetylene welding manifold (regulator)	2

7.	Weld joint teaching aids (diagrams)	2
8.	Apron (leather)	15
9.	Hand gloves	15
10.	Welding head shield	15
11.	Welding booth/cubicle	3
12.	Working benches, for each welding machine	3
13.	Safety charts	Assorted
14.	Safety boots	6
15.	Fire Extinguisher/sand buckets	2 each

vi. Foundry/Heat Treatment/Forge Shop (ND/HND – Manufacturing option only)

S/N	Description of Equipment	Quantity Required
1.	Oil-fired lift-out crucible furnace, 100 kg capacity, for melting soft pig iron and non-ferrous metals plus accessories (optional)	1
2.	Electrically heated lift-out crucible furnace with electrical rating 50kw, 3x450V supply, maximum furnace temperature 1300degree for melting steel grades, plus accessories and control	1
3.	Crucible pots (100kg capacity)	4
4.	Thermocouple/pyrometer for melt temperature measurement	1
5.	Moulding boxes, 310x310x100, 410x410x100 (metal)-	4 pairs each
6.	Core sand mixing machine	1
7.	Bentonite(foundry trade), 50 kg	10
8.	Parting Powder (20 kg bags)	10
9.	Soft pig iron ingots (2x2x5 inches)	50 pieces
10.	Pure aluminium ingots(2x2x5 inches)	50 pieces
11.	Sodium silicate liquid for core making, (foundry trade), 4 litre tins	10
12.	Charge make-up scale, 50kg capacity, with horizontal platform	1
13.	Core baking oven, temperature 300 C, 50HZ, single phase, 240V	1

14.	Fine silica sand for core making. (50kg bags)	10
15.	Foundry protective dress	15
16.	Foundry face shields	15
17.	Foundry heat resistant hand gloves	15 pairs
18.	Foundry safety shoes	15 pairs
19.	Core boxes	10
20.	Heat treatment furnace	1
21.	Crucible rest or stool	2
22.	Crucible lifting tongs	2
23.	Combined slag lifter and skimming ladle	2
24.	Hammers (assorted)	6 each
25.	Wire brush	2
26.	Hacksaw frame and blades	10
27.	Tapered shank drill bits	2 sets
28.	Straight shank drill bits	2 sets
29.	Drill drift	2 sets
30.	Moulding bench	10
31.	Bottom flask	20
32.	Moulding sand shovel	10
33.	Watering can	5
34.	Wheel-barrow	4
35.	Rammers (various types)	5
36.	Moulding trowels (various sizes)	5
37.	Strike-off-bars	5
38.	Gate cutter or spoon	5
39.	Sprue pins	5
40.	Vent rods	5
41.	Lifters	5
42.	Bubb sponges	5
43.	Draw pins	5
44.	Wet brush	5
45.	Bench vice	1
46.	Sand mixing machine	1
47.	G. Clamps	5
48.	Woodworking lathe	1

49.	Circular saw	2
50.	Band saw	2
51.	Jig saw	2
52.	Wood plane-machine	1
53.	Jointer	1
54.	Scraper	1
55.	Measuring and Marking out tools	10
56.	Sawing, planning, boring, turning etc tools	10 each
57.	Fire Extinguisher/Sand Buckets	2 each

vii. Building Services, Refrigeration and Air-conditioning Workshop (ND/HND – Automotive and Plant options only)

S/N	Description of Equipment	Quantity Required
1.	Vacuum pump	1
2.	Charging unit	1
3.	Internal cleaning apparatus	1
4.	Mechanical pressure gauge	4
5.	Electronic pressure gauge	4
6.	Recording pressure motor	4
7.	Differential pressure gauge	4
8.	Service man's thermometer	4
9.	Sensor dial thermometer (various degrees)	4
10.	Digital thermometer	4
11.	Heavy duty machine vice	1
12.	Portable electric drill	2
13.	Air compressor	1
14.	Recording hygrometer	1
15.	Avometer	1
16.	Gas flame leak detector	1
17.	Pipe vice	
18.	Bench vice	6
19.	Work bench	3
20.	Anvil	1
21.	Pliers (various sizes)	4 each
22.	Emergency lamp	1

23.	Respirator	10
24.	Safety face screen (face shield)	10
25.	Ear protector	10
26.	Working gloves	10 pairs
27.	Spanners (various sizes and shapes)	4 each
28.	Wrenches (various sizes)	2 each
29.	Hammers (various types and sizes)	2
30.	Screw drivers (various sizes)	6
31.	Files (assorted)	3 each
32.	Brushes	6
33.	Suction valve	2
34.	Shut - diff valve	10
35.	liquid level control	1
36.	Vibration absorber	2
37.	Fire extinguisher and sand buckets	2 each

B. Laboratories

i. Mechanics of Machines/Metrology Laboratory (ND)

A	Mechanics of Machines Section	
S/N	Description of Equipment	Quantity Required
1.	Screw jack apparatus	1
2.	Comprehensive fly wheel apparatus	1
3.	Bourdon tube pressure gauge	1
4.	Crank and connecting rod apparatus	1
5.	Slider crank mechanism apparatus	1
6.	Rope, belt and coil friction apparatus	1
7.	Cam and cam follower mechanism apparatus	1
8.	Extensometer and compression of springs apparatus	1
9.	Oldham coupling apparatus	1
10.	Torsion of bar apparatus	1
11.	Geneva stop mechanism apparatus	1
12.	Forces on beam apparatus	1
13.	Conservation of angular momentum apparatus	1

14.	Centrifugal/centripetal apparatus	1
B	Metrology Section	
1.	Comparator (Mechanical or Optical)	1
2.	Universal measuring microscope	1
3.	Angle gauge	1
4.	Set of slip gauge	1
5.	Sine bars with centers	1
6.	Engineer's level/ Engineer's Square	1 each
7.	Micrometers (assorted denomination)	2 each
8.	Vee blocks (assorted sizes)	2 each
9.	Magnetic vee block	1
10.	Vernier callipers	1 each
11.	Vernier height gauge	2
12.	Angle plate	1
13.	Limit gauges for holes, shafts, and threads 3 each	1
14.	Surface plate	1
15.	Marking out table	1
16.	Bevel protractor	2
17.	Dial gauges and magnetic stand	2
18.	Thread gauge	2
19.	Feeler gauge	2
20.	Steel rule	4
21.	Combination set	2
22.	Fire extinguisher and sand buckets	2each

ii. Mechanics of Machines Laboratory (Additional for HND only)

S/N	Description of Equipment	No. Required
1.	Static and dynamic balance apparatus	1
2.	Governor apparatus	1
3.	Clutch friction apparatus	1
4.	Gyroscope apparatus	1
5.	Angular acceleration apparatus	1
6.	Whirling of shaft apparatus	1
7.	Universal vibration apparatus	1
8.	Differentiate gear assembly	1

iii. Materials Science/Strength of Materials Laboratory (ND/HND Manufacturing option)

S/N	Description of Equipment	Quantity Required
1.	Universal hardness testing machine for Brinell, Vickers, Rockwell testing with accessories	1
2.	Universal testing machine (UTM) with accessories	1
3.	Polygon of forces apparatus	1
4.	Impact testing machine (Izod/Charpy)	1
5.	Strain gauge apparatus	1
6.	Young's Modulus apparatus	1
7.	Polishing Machine	2
8.	Metallurgical microscope with USB for PC picture processing	3
9.	Etching machine	2
10.	Specimen mounting screen	2
11.	Desiccators	2
12.	Parting machine	1
13.	Abrasive cutters	2
14.	Shearing force apparatus	1
15.	Bending moment apparatus	1
16.	Fire extinguisher and sand buckets	2 each

iv. Strength of Materials Laboratory (Additional Equipment for HND all options)

S/N	Description of Equipment	Quantity Required
1.	Thick cylinder apparatus	1
2.	Thin cylinder apparatus	1
3.	Strut rig apparatus	1
4.	Creep measuring apparatus	1
5.	Universal cantilever apparatus	1
6.	Portable strain meter	1
7.	Beam apparatus	1
8.	Close coiled spring apparatus	1
9.	Leaf spring testing machine	1

v. Thermodynamics/Heat Engine Laboratory (ND/HND Automotive and Plant Options)

S/N	Description of Equipment	Quantity Required
1.	Auto bomb calorimeter	1
2.	Boyle gas calorimeter	1
3.	Air compressor test rig	1
4.	Thermal conductivity apparatus	1
5.	Pressure cooker	1
6.	Rotary viscometer	1
7.	Pyrometer infrared, non-contact digital infrared	1
8.	Resistance thermometer	1
9.	Smoke tunnel	1
10.	Tachometer	1
11.	Stroboscope	1
12.	Thermal conductivity apparatus	1
13.	Marcet boiler	1
14.	Fire extinguisher and sand buckets	2 each

vi. Fluid Mechanics/Hydraulics Laboratory (ND)

S/N	Description of Equipment	Quantity Required
1.	Hydraulic bench with accessories for various experiments in fluid flow measurements: Weir tank, impact on jet, orifice, floating body, manometer, etc)	1
2.	Turbine set (Pelton, Francis or Kaplan)	1
3.	Rotameter	1
4.	Laminar/turbulent pipe flow apparatus	1
5.	Pitot static tube	1
6.	Water current meter	1
7.	Centrifugal and axial fan test rings	1
8.	Fire extinguisher and sand buckets	2 each

vii. Fluid Mechanics/Hydraulics Laboratory (Additional Equipment for HND all options)

S/N	Description of Equipment	Quantity Required
1.	Bernoulli apparatus	1
2.	Losses in fitting and pipe bending apparatus	1
3.	Universal pump test rig with parallel and series pumps	1
4.	Pelton wheel apparatus	1

viii. Automotive Laboratory (ND)

S/N	Description of Equipment	Quantity Required
1.	Automotive engine test bed	1
2.	Lubricating oil test rig	1
3.	Wear and friction bearing test apparatus	1
4.	Hydraulic dynamometer	1
5.	Vibration meter	1
6.	Steering geometry measuring device	1
7.	Compression meter	1
8.	Electrolytic tester	1
9.	PH meter	1
10.	Battery tester	4
11.	Exhaust emission unit	1
12.	Flash point apparatus	1
13.	Automobile final drive	1
14.	Digital Tachometer	1
15.	Coolant flow meter	1
16.	Fire extinguisher and sand buckets	2 each

ix. Automotive Laboratory (Additional for HND Automotive and Plant options only)

S/N	Description of Equipment	Quantity Required
1.	AC charging kit	1
2.	Radiator pressure tester	1
3.	Universal rear axle preload gauge	1
4.	Dial indicator with stands	2
5.	Spring balance	1
6.	Ignition timing light	1

7.	Avometer	2
8.	Digital Vernier caliper	2
9.	Vee blocks	4
10.	External micrometer: 25mm-50mm	2
	50mm-75mm	2
	75mm-100mm	2
11.	Internal micrometer	1
12.	Engine cylinder pressure tester	1

xii. Building Services, Air-conditioning & Refrigeration Laboratory (HND Automotive and Plant options only)

S/N	Description of Equipment	Quantity Required
1.	Surge in pipe apparatus	1
2.	Various sensor and incorporating actuators	1
3.	Experimental heat pump and air cooler	1
4.	Refrigeration cycle apparatus	1
5.	Barometer aneroid	1
6.	Solarimeter	1
7.	Windspeed meter	1
8.	Air-conditioning unit	1
9.	Refrigeration bench	1
10.	Refrigeration expansion devices	1
11.	Multipurpose air duct	1
12.	Sound level indicator	1
13.	Environmental light comparator	1
14.	Pressure-hydraulic and manual	1
15.	Pychrometer	1
16.	Fire extinguishers & Sand Buckets	1 each

xiii. Power and Plant laboratory (HND Automotive and Plant options only)

S/N	Description of Equipment	Quantity Required
1.	Air Flow Measurement Demonstration Air Flow test rig	1
2.	Smoke Tunnel	1
3.	Heat Transfer Apparatus-Parallel Counter Flow	1
4.	Double Pipe Heat Exchanger laboratory type	1
5.	Steam Power Plant with: Steam Boiler Condenser, Steam	1 Set

	Turbine, Steam Engine and Steam Fittings (Laboratory Type)	
6.	Engine Test Beds with: Petrol and Diesel Engine, CI and SI Two Stroke and Four stroke	1 Set each
7.	Tutor Gas Turbine	1
8.	Two Stage Compressor Test Set	1
9.	Pump and Hydro Turbine Test Set	1
10.	Air Heater, Dust Extractor, Fan	1 each
11.	Fire Extinguisher and Sand Buckets	2 each

IDEA GENERATION WORKSHOP TEAM LIST

S/N	Name	Contact Address	Phone Number	Email Address
1.	Tpl. Ekpenyong E. Ekpenyong, fnitp	Ag. Executive Secretary NBTE, Kaduna		ekpenyongee@gmail.com
2.	Mal. Musa Isgogo	Director, Polytechnic Programmes NBTE, Kaduna	08067185383	dugujiisgogo@gmail.com
3.	Engr. Dr. Ibraheem A. Abdul	Department of Mechanical Engineering Technology, Yaba College of Technology, Lagos	08023212275	dotun.abdul@gmail.com
4.	Engr. Sani Malami Suleiman	Department of Mechanical Engineering Technology, Kaduna Polytechnic, Kaduna	08023792886	Sanimalami1968@gmail.com
5.	Engr. Dr. Bona Ekwueze	Department of Mechanical Engineering Technology, Institute of Management and Technology (IMT) Enugu	08034068980	
6.	Engr. Shaibu U. Okene	Department of Mechanical Engineering Technology, Federal Polytechnic, Bida	08036545230	shamanokene@yaahoo.com
7.	Engr. Abba Mohammed Danmowa	NBTE, Kaduna	08034304850	abbadanmowa@yahoo.com
8.	Dr. Fatima Umar Kabir	NBTE, Kaduna	08034521639	fatikmama@yahoo.com
9.	Engr. Yusuf S. Ringim	NBTE, Kaduna	08034697876	alkujaja89@gmail.com
10.	Engr. Dr. Jonathan Item Ukpai	NBTE, Kaduna	08035552002	jonukpai@gmail.com
11.	Engr. Suleiman Muhammad	NBTE, Kaduna	08036423172	khalifas2006@yahoo.com
SECRETARIAL STAFF				
15.	Mrs. Abdullahi Hassana	NBTE, Kaduna	08037671945	hassabdalla.70@gmail.com
16.	Mustafa Aminu	NBTE, Kaduna	07032281995	mustafarimi@gmail.com
17.	Mrs. Sani Rabi	NBTE, Kaduna	08036913246	rabiyoynbo.70@gmail.com

PRE-CRITIQUE WORKSHOP TEAM LIST

S/N	Name	Contact Address	Phone Number	Email Address
1.	Tpl. Ekpenyong E. Ekpenyong, fnitp	Ag. Executive Secretary NBTE, Kaduna		ekpenyongee@gmail.com
2.	Engr. Muhyideen Alimi Yusuf	COREN Representative, COREN Headquarters, Abuja.	08033045327	almasconsult12@gmail.com
3.	Dr. Zamani Ishaya Waidung	Automotive Engineers Institute (AutoEI), National Engineering Centre, Abuja	07033503420	zdishaya@gmail.com
4.	Engr. Binfa Bongfa, PhD	Department of Mechanical Engineering Technology, Federal Polytechnic, Idah.	07086512294 09053972320	engrbinfabongfa@gmail.com
5.	Engr. Dr. Nazmat Toyin Surajudeen-Bakinde	Faculty of Engineering and Technology, University of Ilorin.	08137288435	deenmat1211@gmail.com
6.	Dr. Mohammed Tahir Abba	Department of Mechanical Engineering Technology, Air Force Institute of Technology (AFIT), Kaduna	09080165045	m.tahir.abba@gmail.com
7.	Engr. Dr. Ibraheem A. Abdul	Department of Mechanical Engineering Technology, Yaba College of Technology, Lagos	08023212275	dotun.abdul@gmail.com
8.	Engr. Mamaki Usman Peni	Waziri Umaru Federal Polytechnic, B/Kebbi	08033053194	mamakipeni94@gmail.com
9.	Mal. Musa Isgogo	Director, Polytechnic Programmes NBTE, Kaduna	08067185383	dugujiisgogo@gmail.com
10.	Engr. Abba Mohammed Danmowa	NBTE, Kaduna	08034304850	abbadanmowa@yahoo.com
11.	Dr. Fatima Umar Kabir	NBTE, Kaduna	08034521639	fatikmama@yahoo.com
12.	Engr. Yusuf S. Ringim	NBTE, Kaduna	08034697876	alkujaja89@gmail.com
13.	Engr. Dr. Jonathan Item Ukpai	NBTE, Kaduna	08035552002	jonukpai@gmail.com
14.	Engr. Suleiman Muhammad	NBTE, Kaduna	08036423172	khalifas2006@yahoo.com
SECRETARIAL STAFF				
15.	Mrs. Abdullahi Hassana	NBTE, Kaduna	08037671945	hassabdalla.70@gmail.com
16.	Mustafa Aminu	NBTE, Kaduna	07032281995	mustafarimi@gmail.com
17.	Mrs. Sani Rabi	NBTE, Kaduna	08036913246	rabiyoynbo.70@gmail.com

NATIONAL CRITIQUE WORKSHOP TEAM LIST

S/N	NAME	ADDRESS	PHONE NO.	E-MAIL
1.	Tpl. Ekpenyong E. Ekpenyong, fnitp	Ag. Executive Secretary NBTE, Kaduna		ekpenyongee@gmail.com
2.	Engr. Dr. Anthony Anyakora	General Services/Engineering NIPRD, Idu, Abuja. COREN Representative	08033174308	tonyanyakora@yahoo.com
3.	Engr. Abdussalam El-Suleiman, PhD	Mechanical Engineering Technology Department, Federal Polytechnic, Nasarawa	08034589003	a.elsuleiman@gmail.com
4.	Dr. Mohammed Tahir Abba	Mechanical Engineering Technology Department, AFIT, Kaduna	09080165045	m.tahir.abba@gmail.com
5.	Engr. Ahmed Muhammad Gusau	Mechanical Engineering Technology Department, Federal Polytechnic, Kaura-Namoda	08080356985	magusaux@gmail.com
6.	Engr. Ibrahim Salisu Iro	NSSTSB Minna, Niger State	08067361707	ibrahimsalisusaidu@yahoo.com
7.	Engr. Daniel Tobeche Ezemuo	Mechanical Engineering Technology Department, Federal Polytechnic, Oko Anambra State	08028892167	dantobeche@hotmail.com
8.	Engr. John Boniface Otuu	Mechanical Engineering Technology Department, Akanu Ibiam Federal Polytechnic, Unwana, Ebonyi State	08165221672	johnotuu@gmail.com
9.	Engr. Mary Samuel	Mechanical Engineering Technology Department, Nigerian Defence Academy, Kaduna	08023758440	marydibal267@gmail.com
10.	Engr. Yusuf Yakubu	FAAN, Ikeja, Lagos	08062853644	yyakubu13@gmail.com
11.	Engr. Dr. Dayo Hephzibah OLADEBEYE	Mechanical Engineering Technology Department, Federal Polytechnic, Ado-Ekiti, Ekiti State	08033881945	dayobeye@yahoo.com
12.	Engr. Yusuf M. Mamuda	Mechanical Engineering Technology Department, Kano State Polytechnic, Kano	08036967660	yusmaimam@yahoo.com
NBTE STAFF				
13.	Mal. Musa Isgogo	Director (Polytechnic Programmes) NBTE, Kaduna	08067185383	dugujiisgogo@gmail.com
14.	Engr. Abba M. Danmowa	NBTE, Kaduna	08034304850	abbadanmowa@yahoo.com
15.	Dr. Fatima Umar Kabir	NBTE, Kaduna	08034521639	fatikmama@yahoo.com

16.	Engr. Yusuf S. Ringim	NBTE, Kaduna	08034697876	alkujaja89@gmail.com
17.	Engr. Dr. Jonathan Item Ukpai	NBTE, Kaduna	08035552002	jonukpai@gmail.com
18.	Engr. Suleiman Muhammad	NBTE, Kaduna	08036423172	khalifas2006@yahoo.com
	SECRETARIAL STAFF			
19.	Mrs. Abdullahi Hassana	NBTE, Kaduna	08037671945	hassabdalla.70@gmail.com
20.	Mustafa Aminu	NBTE, Kaduna	07032281995	mustafarimi@yahoo.com
21.	Mrs. Sani Rabi	NBTE, Kaduna	08036913246	rabiyyinbo.70@gmail.com