NATIONAL BOARD FOR TECHNICAL EDUCATION

CURRICULUM AND COURSE SPECIFICATIONS

FOR

NATIONAL DIPLOMA (ND)

IN

MECHATRONICS ENGINEERING TECHNOLOGY

SEPTEMBER, 2022

Plot B, Bida Road P.M.B 2239, Kaduna – Nigeria
www.nbte.gov.ng

Foreword

The National Diploma in Mechatronics Engineering Technology programme is designed to reflect a FUNCTIONAL philosophy of education. While seeking to achieve academic excellence and promote the furtherance of knowledge, the Mechatronics Engineering Technology programme also seeks to aid the acquisition of appropriate mental and physical skills, abilities and competencies as well as the equipment of the individual to live in and contribute to the development of his society. The programme is, therefore, committed to the production of qualified and competent technicians who will be able to face the challenges concomitant with the aspiration of the country to be technological developed and the technicians that would be self-reliant after graduation.

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 technicians with sound knowledge and skills in Mechatronics Engineering Technology, 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 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 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.

Prof. Idris M. Bugaje
Executive Secretary,
NBTE, Kaduna

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GENERAL INFORMATION

1.0 CERTIFICATION AND TITLE OF PROGRAMME

The certificate to be awarded and programme title shall read:
NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY and A transcript showing all the courses taken and grades shall be issued together with the certificates.

2.0 GOAL AND OBJECTIVES

2.1 GOAL

The **National Diploma** programme in Mechatronics Engineering Technology is designed to produce Technicians with adequate knowledge, skills and competency to carry out Mechatronics engineering operations, installations and maintenance in line with standard best practices.

2.2 OBJECTIVES

At the end of the **National Diploma** programme in Mechatronics Engineering Technology, the diplomate will be able to:

i. Function as a technician in automotive, industrial and related fields;
ii. Draft Engineering drawings and schedules using relevant softwares;
iii. Interpret relevant Engineering drawings;
iv. Carry out necessary tests procedures with sophisticated diagnostic equipment in troubleshooting;
v. Carry out the construction and maintenance of Mechatronics Engineering works;
vi. Observe relevant safety precautions in Mechatronics Engineering practice;
vii. Operate automated machines, robots and manufacturing machines/engines to manage systems to meet the needs of the automotive, industrial and related fields;
viii. Adopt technical, creative, communication and team-work skills to meet the needs of the industry;
ix. Setup and manage an enterprise effectively and efficiently.

3.0 ENTRY REQUIREMENTS

3.1 The general entry requirements into the **National Diploma** in Mechatronics Engineering Technology programme are:

i. **S.S.S.C (NTC, NECO, WASC, GCE, etc.)** or its equivalent with credit level passes in five subjects in not more than two sittings which must include English Language, Mathematics, Physics, Chemistry and one other Science subject.
ii. In addition to (i) above, Unified tertiary Matriculation (UTME) results with the required cut-off mark and subject combination of English Language, Mathematics, Physics and Chemistry.

4.0 MANPOWER REQUIREMENTS:

4.1 Headship of The Department

The Head of Department (HOD) should be at least Senior Lecturer with a minimum of 12 years' experience and must hold first degree or equivalent and relevant M.Sc. degree in any of the following areas: Mechatronics, Electrical/Electronics, Mechanical or Computer Engineering. The HOD must also be a duly registered member of his/her relevant professional body (**COREN**).

4.2 Teaching Staff

4.2.1 Lecturer/Instructor Cadre

The first appointment of the core teaching staff for ND Mechatronics Engineering should be an Assistant Lecturer with first Degree (B.Sc., B.Eng. or B.Tech) in any of the engineering fields listed in 5.1 above, and should have at least a Second Class Lower Division (2:2). While the Instructor should have HND (at least Lower Credit Level) in any of the Engineering fields mentioned in 5.1 above.

4.2.2 Technologist Cadre

Technologist should have HND (at least Lower Credit) in any of the Engineering disciplines stated in 5.1 above

4.2.3 Technician Cadre

Technicians should have ND (at least Lower Credit) in any of the Engineering disciplines stated in 5.1 above.

4.3 Criteria for appointment of ND External Examiners

One External Examiner shall be appointed from among academic staff from Polytechnics/Industries with specialization in any of the Engineering field mentioned listed in 5.1 above in an alternating basis.

An External Examiner from the Academia should not be below the rank of Senior Lecturer while that of industry should have at least Eight (8) years' Industrial post qualification experience.

4.3.1 The External Examiners shall serve for a term of two academic sessions in the first instance and renewable for one more term only.

5.0 CAREER PROSPECTS

The Mechatronics Engineering Technology is an engineering programme that integrates the knowledge of Mechanical, Electrical, and Electronic engineering with Computer technology. The study of Mechatronics involves relevant aspects of electrical, electronic and mechanical engineering together with an understanding of manufacturing methods. It is a relatively new field of engineering with many exciting developments such as internet control of machines, autonomous robots and engine management systems. There is, and will continue to be, a strong demand for engineers who are capable of designing, implementing and operating these systems to meet an increasing need in industry where complexity of projects is done with limited resources.

5.1 Academic Progression

Holders of ND Mechatronics Engineering Technology Programme can proceed for further study at HND or B.Sc./ B. Tech/B. Engr. Levels in Automotive Mechatronics Engineering and Industrial Mechatronics Engineering.

5.2 Job Prospect

ND graduate of Mechatronics Engineering Technology may seek jobs from the following:

I. Automotive Industry
II. Aviation Industry
III. Manufacturing Industry
IV. Medical/Pharmaceutical Industry
V. Power Generation Industry
VI. Telecommunication Industry
VII. Extractive Industry
VIII. Oil and Gas Industry
IX. Marine Industry
X. Software and Computing Industry
XI. Academia
XII. Public sector at Federal and States. Etc.

6.0 CURRICULUM

6.1 The curriculum of the ND programme consists of four main components. These are:

i. General Studies/Education

ii. Foundation Courses
iii. Professional Courses
iv. Supervised Industrial Work Experience Scheme (SIWES)

6.2 The General Education component shall include courses in:
i. Art and Humanities - English Language, Communication and History. These are compulsory.

ii. Social Studies - Citizenship Education (the Nigerian Constitution), Political Science, Sociology, Philosophy, Geography, Entrepreneurship, Philosophy of Science and Sociology are compulsory.

iii. Physical and Health Education (one credit unit only).

6.3 The General Education component shall account for not more than 10% of total contact hours for the programme.

6.4 **Foundation Courses** include courses in Economics, Mathematics, Pure Science, Computer Applications, Technical Drawing, Descriptive Geometry, Statistics, etc. The number of hours will vary with the programme and may account for about 10-15% of the total contact hours.

6.5 **Professional Courses** are courses which give the student the theory and practical 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 depending on the programme.

6.6 **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 12.0.

7.0 CURRICULUM STRUCTURE

The structure of the ND programme consists of four semesters of classroom, laboratory and workshop activities in the college and two semesters (9-12 months) of Industrial Work Experience. 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.

8.0 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.

9.0 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.

10.0 GUIDANCE NOTES FOR TEACHERS

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-reliance 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 behavioral 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 acceptable 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 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.

12.0 GUIDELINES ON SIWES PROGRAMMES

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

12.1 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.

12.2 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.

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

12.4 The Institution-Based Supervisor: The institution-based supervisor should initial the log-book 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.

12.5 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.

12.6 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.

12.7. 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.

13.0 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 incorporates 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.

14.0 INDUSTRIAL WORK EXPERIENCE (IWE)

IWE is an attempt to bring about how best the practical skill acquisition can be achieved in real work environment. It involves attaching the ND graduates to the industry for a period one year. The ND graduate has to successfully complete the scheme before he/she can be admitted for Higher National Diploma Programme. See details of task inventory at page

YEAR ONE SEMESTER ONE

Course Code	Course Title	L	T	P	CU	CH
GNS 101	Use of English I	2	0	0	2	2
MTH 112	Algebra and Elementary Trigonometry	2	0	0	2	2
COM 111	Introduction to computing	1	0	2	3	3
MEC111	Technical Drawing	1	0	3	3	4
MEC 113	Basic Workshop Technology and Practice	1	0	3	3	4
MCE 111	Electrical Fundamental Elements & Networks	1	0	2	3	3
MCE 112	Fundamentals of Mechanical Engineering	1	0	2	3	3
MCE 113	Technical Report Writing	1	0	0	1	1
MCE 114	Basic Telecommunications	1	0	2	3	4
MCE 115	Fundamental of Mechatronics	1	0	2	3	3
TOTAL		**12**	**0**	**16**	**26**	**29**

YEAR ONE SEMESTER TWO

Course Code	Course Title	L	T	P	CU	CH
GNS 102	Communication Skills I	2	0	0	2	2
MTH 211	Calculus	2	0	0	2	2
COM 113	Introduction to Computer Programming	1	0	2	2	2
EEd 126	Introduction to Entrepreneurship	2	0	0	2	2
MCE 121	Fundamentals of Automotive Technology I	1	0	2	3	3
MCE 122	Electronic Devices and Circuits I	1	0	1	2	2
MCE 123	Electronic Instrumentation & Measurements	1	0	2	3	3
MCE 124	Machine Communication Technology	1	0	1	2	2
MCE 125	Mechatronic Devices and Applications	2	0	2	3	4
MCE 126	Thermo Fluids	1	0	2	3	3
MEC 224	Properties of Materials	2	0	2	3	4
TOTAL		**16**	**0**	**14**	**27**	**29**

YEAR TWO SEMESTER ONE

Course Code	Course Title	L	T	P	CU	CH
GNS 111	Citizenship Education	2	0	0	2	2
MTH 202	Logic & Linear Algebra	2	0	0	2	2
EEd 216	Practice of Entrepreneurship	2	0	0	2	2
MCE 211	Computer Aided Design & Drafting	0	0	2	2	2
MCE 212	Electronic Devices and Circuits II	1	0	2	3	3
MCE 213	Mechanisms of Machines	1	0	2	3	3
MCE 214	Fundamentals of Automotive Technology II	1	0	2	3	3
MCE 215	Control System I	1	0	2	3	3
MCE 216	Hydraulic and Pneumatics Systems	1	0	1	2	2
MCE 217	Electrical Drives & Control	1	0	1	2	2
MCE 218	Introduction to CNC Machines	1	0	2	3	3
MCE 219	Emerging Mechatronics & Automation Technologies	1	0	0	1	1
TOTAL		**14**	**0**	**14**	**28**	**28**

YEAR TWO SEMESTER TWO

Course Code	Course Title	L	T	P	CU	CH
MTH 122	Trigonometry and Analytical Geometry	2	0	0	2	2
MCE 221	Digital Electronics	1	0	1	2	2
MCE 222	Automotive Electricity & Electronics	1	0	2	3	3
MCE 223	Mechatronics Technology and Practice	1	0	3	4	4
MCE 224	Mechatronics Drafting	1	0	2	3	3
MCE 225	Supervisory Management	1	0	0	1	1
MCE 226	Industrial Automation& Robotics	1	0	2	2	3
MCE 227	Manufacturing Process	1	0	2	3	3
MCE 228	Introduction to Engineering Programming Softwares	1	0	2	3	3
MCE 229	Project	0	0	3	3	3
TOTAL		**10**	**0**	**17**	**26**	**27**

Key	
L	Lecture
T	Tutorial
P	Practical
CU	Credit Unit
CH	Credit Hour

Note: See General Studies Courses (GNS) in GNS Curricula.
See MTH 2022 Reviewed Electrical/Electronic or Biomedical Engineering Curricula.

YEAR ONE SEMESTER ONE COURSES

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Introduction to Computing**

COURSE CODE: **COM 111**

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

CREDIT UNIT: **3.0**

Course: Introduction to Computing	**Code: COM 111**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: First	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the basic concepts of computing**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Appreciate the Computer System
2	Appreciate Interfacing Devices
3	Know Data Processing
4	Understand Storing of Data
5	Understand the Operating System
6	Understand Computer Networks and Internet
7	Appreciate Software and Hardware Concepts

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Introduction to Computing		**COURSE CODE:COM 111**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the basic concepts of computing.						
General Objective 1.0: Appreciate the Computer System						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Describe the History of Computing 1.2 Explain the Evolution of Computers' Generations 1.3 Explain the following; • Desktop • Notebook • Tablet PCs • Handheld PCs (PDAs) • Smart Phones 1.4 Explain the following use of computers in organizations • Network Servers • Mainframes • Minicomputers • Super Computers 1.5 Describe the Applications of Computers in different fields.	Explain activity 1.1 to 1.5	White board and markers, textbooks, etc.	-	-	Explain the evolution of computers' generations
GENERAL OBJECTIVE 2.0: Appreciate Interfacing Devices						
	2.1 Define the interfacing device	Explain the activities in 2.1 to	Whiteboard and markers,	-	-	Explain the basic

3-4	2.2 List the computer interfacing devices 2.3 Describe different types of interfacing devices; 2.4 Define the Printers 2.5 List the type of printers 2.6 Describe the printers in 2.5 above. 2.7 Explain the basic concepts of plotters.	2.7.	duster, textbooks			concepts of plotters
GENERAL OBJECTIVE 3.0 Know Data Processing						
5 –7	3.1 Define Data in computer 3.2 Explain the representation in Computer 3.2 Explain the number system in computing 3.3 Explain the parts required for data processing 3.4 Describe the components of CPU 3.5 List types of Memories 3.6 Explain following terms; • Registers • Data Bus • Address Bus • Cache Memory	Explain activities in 3.1 to 3.6.	White board, markers duster, recommended textbooks	-	-	Explain the number system in computing
GENERAL OBJECTIVE 4.0: Understand Storing of Data						
8 - 9	4.1 Explain the Types of Storage Devices 4.2 Describe the types of Magnetic Storage Media	Explain the activities in 4.1 to 4.4	White board, markers duster, textbooks	-	-	Explain the Types of Storage Devices

	4.3 Describe the types of Optical Storage Media 4.4 Describe the types of Solid State Storage Media					
GENERAL OBJECTIVE 5.0: Understand the Operating System						
10 - 12	5.1 Define operating system 5.2 Explain the functions of the operating system 5.2 Describe the following operating systems; • DOS • Microsoft Operating System • The Macintosh Operating System • UNIX • Linux • Operating systems for Server (Windows/UNIX)	Explain the activities in 5.1 to 5.2	White board, markers duster, recommended textbooks	Carry out experiment to demonstrate the installation of I/O devices, printers and installation of operating system	Guide the student to perform the experiments.	Explain the functions of the operating system
GENERAL OBJECTIVE 6.0: Understand Computer Networks and Internet						
	6.1 Explain the computer network 6.2 List the types of computer networks. 6.3 Explain the networks in 6.2 above. 6.4 Explain the Network Topologies 6.5 Describe the wired and wireless network mediums 6.5 Describe the following	Explain the activities in 6.1 to 6.12	White board, markers duster, textbooks	Carry out experiment to demonstrate the establishment of an internet connection. Carry out experiment to demonstrate the browsing and downloading of information from internet. Carry out experiment to demonstrate the;	Guide the student to perform the experiments.	Explain the Network Topologies

	network hardware; • Network Cards • Network Linking 6.6 Describe the following network devices; • Hubs • Bridges • Routers • Switches 6.8 Explain the Data Communications technologies 6.9 Define the Internet 6.10 Describe the History of Internet 6.11 Explain the Working of World Wide Web 6.12 Explain Internet Search Engines			• Sending an e-mail • Creating a message • Creating an address book • Attaching a file with e-mail message • Receiving a message • Deleting a message		
GENERAL OBJECTIVE 7.0: Appreciate Software and Hardware Concepts						
	7.1 Define system and application software 7.2 List the system and application softwares 7.3 Describe the system and application softwares 7.4 Explain the types of application software 7.5 Define word processing programs 7.6 Explain how to use it. 7.7 Explain the Installation of Window / Linux. 7.8 Describe the features of	Explain the activities in 7.1 to 7.11	White board, markers duster, textbooks	Carry out experiment to demonstrate the Installation of various components of computer system and installing system software and application software Carry out experiment to demonstrate how to create a document using a suitable word processing package, like MS Word, with at least	Guide the student to perform the experiments.	Explain the concept of the operating System.

	Open Office/Ms Office 7.9 Explain the Block diagram of a computer. 7.10 List the components of computer system. 7.11 Explain the different components of the computer system			three paragraphs and perform editing operations. Carry out experiment to demonstrate how to create a formal letter using a suitable word processing package, like MS Word, to place a purchase order for procurement of books. Use tables for list of books. Carry out experiment to demonstrate the Creation of a Spreadsheet in MS-EXCEL and enter the marks of a student, calculate total and print grade if the student has passed in all subjects. Carry out experiment to demonstrate the creation of a Power-point presentation with at least 6 slides.		

PROGRAMME: **National Diploma (ND) in Mechatronics 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**
		Theoretical hours: 1 Hour/Week
Semester: First	**Pre-requisite: NIL**	**Practical hours: 3 Hours/Week**
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

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS 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 activities in 1.1 - 1.3	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments	Identify the different types of drawing instruments, equipment and materials. Observe the precautions necessary to preserve the items identified above. Use each of the items mentioned above. Maintain the various instruments and equipment.	Demonstrate for the 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					
3-4	2.1 Explain different types of graphic communications. 2.2 Describe various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre	Explain activities in 2.1 - 2.6	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments	Illustrate the 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.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the essentials of graphical communications

	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			Prepare drawing sheets with the following (a) Margins (b) Title block etc. State the various standards of drawing sheets. Print letters and figures of various forms and characters. Illustrate conventional signs, symbols and appropriate lettering characters.		
	General Objective 3.0: Know the construction of simple geometrical figures and sections					
5-7	3.1 Explain the purpose of geometrical construction in drawing parallel lines. 3.2 Define geometric figures (circle, 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)	Explain activities in 3.1 – 3.4	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	Construct parallel and perpendicular lines. Construct and bisect lines, angles and areas. Divide a straight line into given number of equal parts. Identify polygons (regular or irregular). Construct regular polygons with N sides in a given circle, given (a) distance across flats (b) distance across corners. Carryout simple	Demonstrate for the students to learn and guide them to perform the activities.	Explain the steps in construction of simple geometrical figures and sections

	Projection method (b) Measurement method (c) Transposition method.			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) 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 Construct ellipse by using (a) trammal method (b) concentric circle method. Construct plane scales and diagonal scales, using appropriate instruments.		
	General Objective 4.0: Know the construction of isometric and oblique drawing and projection					
	4.1 Explain isometric and oblique projections.	Explain 4.1	Marker, Whiteboard,	Draw a square in isometric and oblique	Demonstrate for the students to	Explain steps in construction of

8-10			Duster, Textbooks, Complete set of drawing instruments	forms. Draw a circle in Isometric and oblique forms. Draw an ellipse in Isometric and oblique forms. Draw a polygon with a minimum of eight sides in Isometric and oblique forms. Dimension holes, circles, arcs and angles correctly on isometric and oblique projections. Use appropriate convention symbols and abbreviations.	learn and guide them to perform the activities.	isometric and oblique drawing and projection
	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 activities in 5.1 - 5.3	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	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		Draw the lines of intersections of the following regular solids and planes in	Demonstrate for the students to learn and guide them to perform the	Explain the intersections of regular solids

				both first and third angles. a. Two square-prisms meeting at right angles. b. Two dissimilar square prisms meeting 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	activities.	

PROGRAMME: **National Diploma (ND) in Mechatronics 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**
		Theoretical hours: 1 Hour/Week
Semester: First	**Pre-requisite: NIL**	**Practical hours: 3 Hours/Week**
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

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Basic Workshop Practice and Technology		**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 Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**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 Explain 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 .	Demonstrate all safety rules and regulations in the workshop Use safety equipment and Personal Protection Equipment Follow safety procedures and precautionary measures	Demonstrate for the students to 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 2.4 Explain how to carry out safety inspections on the following equipment: • Air receivers	Emphasize the use of relevant personal protective equipment while on inspection	Books, Whiteboard, marker, Videos of safety inspections Safety charts Workshop equipment	Inspect the following equipment in the workshops: Air receivers Ropes and Chains Pulley blocks Forklift carriage Mobile and overhead cranes	Guide students to carry out the practicals.	Explain the importance of safety inspection in the workshop

	• Ropes and Chains • Pulley blocks • Forklift carriage • Mobile and overhead cranes • Derricks and gantries		.	Derricks and gantries		
	General Objective 3.0: Use basic marking out, metal removal and filing tools					
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 Scribers Scribing blocks, Inside and outside calipers Surface plate Dividers Centre punches, Files, Scrapers, etc	Use marking-out tools on the bench correctly Produce simple objects using bench/hand tools such as files, chisels, scrapers, saws etc. 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. Guide students to identify this bench cutting tools 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: _Scribers _Inside and outside caliper _Centre _Files, _Scrapers _File card
General Objective 4.0: Use basic measuring and testing equipment						

6-7	4.1 Explain: 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.	Perform simple measuring exercises using steel rules, vernier calipers and micrometers. Use dial indicators to (i) set up jobs on the lathe (ii) roundness testing etc. Carry out exercises involving flatness, squareness, straightness and surface finish test. Perform taper measurement on jobs using vernier protractor and sine bars. Inspect jobs using simple comparators	Demonstrate for the students to 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						

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 and sensitive drilling machine Explain types of drilling machine a. Pillar b. Column c. Multi spindle etc	Radial drilling machine Bench drilling machine Pillar drilling machine Column type drilling machine Counter boring drills Counter sinking drills Centre drills. Pedestal grinding machine attached with a twist drill grinding attachment	Operate different types of drilling machine Carry out drilling operations such as counter-boring and counter-sinking Grind drill bits accurately Select correct drilling speeds Indicate the nomenclature of a twist drill. a. clearance angle b. rake angle c. point angle etc. Calculate the speeds of various sizes of drills using appropriate formulae.	Demonstrate for the students to learn and guide them to perform the activities.	Explain the type of drilling operation that can be carried out on the following: Radial drilling machine Bench drilling machine Pillar drilling machine Column type drilling machine
GENERAL OBJECTIVE 6.0: Perform various metal joining operations						
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	Fabricate metal container by Knock-up joining Join metals by the grooving	Guide students the various metal joining operations Guide students to fabricate metal container by Knock-up joining	Describe the process of joining metals using the following methods:

			Flash gas lighter Soldering flux Stock and dies (set) metric	technique Fabricate metal container by knock-up joining Carry out soft soldering	Guide students to Join metals by grooving technique.	Brazing Threaded Fasteners Soldering
General Objective 7.0: Perform the various wood working tools and operations						
12	7.1 Explain the applications of the following: Geometric/marking out tools e.g. tri square, dividers and gauges planing tools e.g. Jack, smooth, spoke shaves, etc. Cutting tools e.g. saws, chisels, knives, boring tools, Impelling tools e.g. hammer and mallets, Pneumatic tools 7.2 Describe portable electric hand tools in wood work, e.g. portable saw, portable planer, portable drill, portable sander and jig saw. 7.3 Explain the operations of basic wood working machines such as: 1. Surface planing and thickening machine i. Circular sawing Machine	Explain the need for care in the use of the tools and machines listed in 7.1 – 7.3 Explain the methods of maintenance of the tools and machines listed in 7.1 – 7.3 State the safety precaution on the tools and machines listed in 7.1 – 7.3	Tri Square Divider Gauges Jack planes Smooth plane, Panel saws Chisels Knives Boring tools Hammers Mallets Portable saw Portable planer Portable drill Portable sander Jig saw	Identify the tools used for wood work Mark out and prepare wood for various operations as described in 7.2 Carry out various woodwork operations using the tools in 7.1 - 7.3 Maintain all tools and machines used	Demonstrate for the students to learn and guide them to perform the activities.	Describe the steps and the tools involved in making a simple machine part using wood as material

	2. Mortising machine ii. Drilling machine 3. Single ended planing machine 4. Band sawing machines and safety precaution in their operations					
General Objective 8.0: Perform reaming operations						
13	8.1 Describe reaming operations 8.2 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	Carry out reaming operations: i. on the bench ii. on drilling/lathe 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						
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	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,	Select correct tapping drill size Select correct taps Carry out tapping operation (i) on the work bench (ii) on drilling	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

	a. Pitch b. No. of starts c. Profile of thread d. Direction of thread 9.4 State the correct tapping drill size. 9.5 Explain how to correct Taps		machine	machine (iii) on lathe		
General Objective 10.0: Perform basic operations on plastics						
15	10.1 Differentiate between thermo-setting and thermo-plastics. 10.2 Describe how to 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 Explain the result of using conventional metal cutting tools for operation on thermo-setting and thermo-setting plastic.	Set of drill Wood turning lathe HSS cutting tools Evostik glue Thermo-setting and thermo-plastic	Identify various types of plastic groups such as thermo-setting and thermo-plastic Use conventional metal cutting tools to perform operations on plastics. Carryout joining operations using plastics	Demonstrate the characteristics of each type of plastic. Guide students to join the thermo-setting and thermo-plastic.	Describe the three processes of joining plastics together

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Electrical Fundamental Elements & Networks**

COURSE CODE: **MCE 111**

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

CREDIT UNIT: **3.0**

Course: Electrical Fundamental Elements & Networks	**Code: MCE 111**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: First	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the basic concepts of electrical circuits, devices and networks.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the concepts of electrical circuits and devices
2	Appreciate the Components of The Basic Electrical Circuit
3	Comprehend DC Circuit Fundamentals
4	Understand the basic concepts of Network theorems
5	Comprehend the concepts of Magnetic circuits
6	Understand Electrostatics and Capacitive circuits
7	Appreciate the fundamentals of Alternating Current Circuits

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Electrical Fundamental Elements & Networks			**COURSE CODE:MCE 111**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**	
Goal: The course is designed to acquaint students with the basic concepts of electrical circuits, devices and networks.						
General Objective 1.0: Understand the concepts of electrical circuits and devices						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define electric current, potential difference (pd), electromotive force (e.m.f) and resistance. 1.2 State the units and symbols of 1.1 above. 1.3 Explain the concepts of current and electron flow 1.4 State multiples and sub-multiples of Electric quantities. 1.5 Differentiate between conductors, insulators and semi- conductors.	Explain activity 1.1 to 1.5 with detailed notes.	White board and markers, textbooks, etc. Different types of diodes Insulated Electric cables, etc.	Identify conductors, semiconductors and insulators.	Guide students to identify conductors, semiconductors and insulators.	Differentiate between conductors, insulators and semiconductors.
GENERAL OBJECTIVE 2.0: Appreciate the Components of The Basic Electrical Circuit						
3-4	2.1 Define electric circuit. 2.2 Describe the following components of the electric circuit; • Power supply • Connectors • Control device • Load 2.3 Explain the resistive, capacitive, and inductive loads	Explain the activities in 2.1 to 2.7 with detailed notes.	Whiteboard, markers and textbooks	Identify the basic electric circuit components Identify the symbols of various circuit components Make a simple circuit to operate a load e.g. a bulb	Guide students to conduct practical activities.	Enumerate different basic electric components and symbols.

	2.4 Describe the electric network. 2.5 Explain the electric network topology 2.6 Explain the following terminologies with their interrelationships; • Branch • Node • Loop 2.7 Identify the symbols of various circuit components					
GENERAL OBJECTIVE 3.0: Comprehend DC Circuit Fundamentals						
5 –7	3.1 Define DC current. 3.2 State the analogy between current flow and water flow. 3.3 Describe basic DC circuits 3.4 State Ohm's law. 3.5 Solve problems using Ohm's law. 3.6 Define resistively and Conductivity of a conductor. 3.7 State the relationship between resistance of a conductor, its resistivity, length and area 3.8 Differentiate between series and parallel circuits 3.9 Solve problems involving	Explain activities in 3.1 to 3.30 with detailed notes	White board, markers duster, textbooks, basic electricity kits, power supply, resistors, millimeters, breadboards, connectors, batteries, solar panels etc.	Demonstrate Ohm's Law. Demonstrate the effect of Ohm's Law with Rise in temperature Demonstrate the assembly of a series and parallel circuits Measure voltage and current using voltmeter and ammeter in a series and parallel circuits Demonstrate the use of a Variable resistor	Guide students to conduct the practicals.	Differentiate between series and parallel circuit. Calculate the value of resistor using Color coding.

	resistivity and conductivity 3.10 Deduce the equivalent resistance of series and parallel circuits. 3.11 State Kirchoff's laws. 3.12 State Superposition principles. 3.13 Solve problems involving series and parallel circuits using Kirchoff's laws and superposition Principles 3.14 Define Resistance 3.15 State the Laws of Resistance 3.16 Explain the specific resistance, conductance and conductivity of a conductor 3.17 Explain the effect of temperature on resistance and temperature coefficient of resistance 3.18 Solve problems on 3.16 and 3.17 3.19 Explain the concept of Power, Energy, their units and calculations 3.20 Define Resistor 3.21 Explain Power dissipation in resistors 3.22 Describe the use and					

	working of Variable Resistor 3.23 State the application of resistors 3.24 Explain the resistor color coding 3.25 Explain DC source 3.26 List the Types of DC sources 3.27 Explain the Types of cells; primary and secondary cells 3.28 Describe the Lead acid batteries 3.29 Describe the Solar cell 3.30 Explain the Internal resistance of a cell					
GENERAL OBJECTIVE 4.0: Understand the basic concepts of Network theorems						
8 - 9	4.1 Explain Superposition theorem for complex circuits. 4.2 Explain Thevenin's Theorem. 4.3 Explain Norton's theorem and current source concept. 4.4 Solve problems on 4.1 to 4.3	Explain the activities in 4.1 to 4.4 with detailed notes	White board, markers duster, textbooks, resistors, millimeters, breadboards, connectors, power supply etc.	Implement the Thevenin's Theorem Implement the Norton's Theorem Implement the Superposition's Theorem	Guide students to conduct practicals	Differentiate between the different network theorems
GENERAL OBJECTIVE 5.0: Comprehend the concepts of Magnetic and inductive circuits						
10 - 12	5.1 Describe the concept of magnetism 5.2 Define the following with their units; • Magnetic Line of	Explain the activities in 5.1 to 5.11 with detailed notes	White board, markers duster, recommended textbooks,	Demonstrate magnetic lines of force using the permanent magnet. Demonstrate magnetic induction using laboratory	Guide students to conduct the practical	Explain the solenoids, cork screw and the left hand rules.

	Force, • Flux, • Flux Density, • Permeability, • Reluctance 5.3 Describe the properties of magnetic lines of force 5.4 Explain the concept of electromagnetism 5.5 Define Electromagnetism, field intensity, and ampere turns/meter 5.6 Explain magnetic induction 5.7 Explain electromagnetic induction 5.8 Describe the magnetic field around a current carrying conductor. 5.9 Explain the solenoids cork screw and left hand rules 5.10 Explain Faraday's law of Electromagnetic induction 5.11 Explain Lenz's law		permanent magnet, iron filings, magnetic compass, field strength meter, different inductors, resistors, power supply, etc.	components. Measure the intensity of magnetic field using magnetic field strength meter. Identify different Inductors Demonstrate electromagnetic induction using laboratory components. Determine the value of an inductor Determine the output of resistive and Inductive circuit.		
GENERAL OBJECTIVE 6.0: Understand Electrostatics and Capacitive circuits						
	6.1 Describe the principal of electrostatic, positive and negative charges. 6.2 Define the Laws of electrostatics 5.3 Explain Electrostatic	Explain the activities in 6.1 to 6.11 with detailed notes	White board, markers duster, textbooks, RLC meter.	Identify capacitors Determine the rating of capacitors Demonstrate output on a resistive and capacitive circuits	Guide students to carry out practicals	Explain the equivalent capacitance for series, parallel and series

	5.4 induction and field strength 5.5 Describe the properties of electric line of force and comparison with magnetic lines 6.6 Explain Dielectric, dielectric strength and its importance permeability and breakdown voltage 6.7 Describe Capacitance and capacitors. 6.8 Explain the capacitance of parallel plate capacitor 6.9 Explain the equivalent capacitance for series, parallel and series parallel combination of capacitors 6.10 Explain the energy stored in capacitors 6.11 Describe the Color code, tolerance and rating of capacitors					parallel combination of capacitors Describe the Color code, tolerance and rating of capacitors
GENERAL OBJECTIVE 7.0: Appreciate the fundamentals of Alternating Current Circuits						
	7.1 Explain the simple AC generator 7.2 Define the following with their SI units; • Sine Wave • Wavelength • Period • Frequency 7.3 Describe the AC sine wave form and its	Explain the activities in 7.1 to 7.6 with detailed notes	White board, markers duster, recommended textbooks, oscilloscope, signal generator, millimeter,	Observe the properties of an AC signal using the oscilloscope. Study DC/AC output waves on an oscilloscope and the rectified wave	Guide students to carry out experiments.	Explain AC through pure resistor, pure inductor and pure Capacitor

	characteristics. 7.4 Describe the types of alternating wave forms 7.5 Define AC circuits 7.6 Explain AC through pure resistor, pure inductor, pure Capacitor and their phasor quantities					

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Fundamentals of Mechanical Engineering**

COURSE CODE: **MCE 112**

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

CREDIT UNIT: **3.0**

Course: Fundamentals of Mechanical Engineering	**Code: MCE 112**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: First	**Pre-requisite: NIL**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to equip students with the basic knowledge of Forces, Tribology and Motion of bodies**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Understand the concept and effect of forces and their moments
2	Understand the effect of Friction and the law governing it
3	Understand Linear and Angular motions of bodies and units of some fundamental and derived quantities
4	Understand curvilinear motion of bodies
5	Understand Momentum of Bodies
6	Understand the concept of Work, Energy and Power
7	Understand General principle of operation of simple machines
8	Know simple harmonic motion

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: FUNDAMENTALS OF MECHANICAL ENGINEERING		**Course Code: MCE 112**		**Contact Hours 1-0-2 Hours/Weekk**		
Goal: This course is designed to equip students with the basic knowledge of Forces, Tribology and Motion of bodies						
General Objective 1.0: Understand the concept and effect of forces and their moments.						
Course Specification: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1 – 2	1.1 Define force 1.2 Explain how to construct parallelogram of forces. 1.3 Calculate the resultant of a system of two forces 1.4 State the principle of triangle of force 1.5 Resolve forces into Components. 1.6 Resolve a force into force and couple 1.7 State the conditions for the equilibrium of co-planar forces 1.8 Define moment of a Force. 1.9 State the principles of moments. 1.10 Solve problems related to 1.1 to	Explain in details the concept and effects of forces and their moments Guide the students to solve problems relating to forces and their moments. .	Textbooks, White Board, Markers, Force Board, Lecture notes, etc.	Construct parallelogram of force. Draw triangle of forces Draw polygon of forces Verify Lami's theorem using a force board Verify the parallelogram law of forces	Guide students to conduct the practicals.	Resolve forces and calculate the resultants of two forces.

	1.9 above.					
General Objective: 2.0 Understand the effect of Friction and the law governing it.						
3 - 4	2.1 Define friction 2.2 State advantages and disadvantages of friction. 2.3 Define coefficient of Friction. 2.4 Define limiting angle of friction. 2.5 Define angle of Repose. 2.6 Solve problems related to 2.1 to 2.5.	Explain in details the principles and effects of friction and the laws governing it. Guide the students to solve problems relating to friction.	Recommended textbook, White Board, Markers, Lecture notes, Specimens of masses and inclined plain set-up, Protractor, smooth and rough surfaces, lubricants, etc.	Determine the co-efficient of friction by means of an inclined plane. Exhibit practical applications of friction. Demonstrate instances where friction is required and where it is not required	Guide students to conduct the practicals.	Calculate the coefficient of friction for wet and dry surfaces. Determine an angle of repose for an inclined object.
General Objective 3.0: Understand Linear and Angular motions of bodies and units of some fundamental and derived quantities.						
5- 6	3.1 Define displacement, speed, distance, velocity and acceleration. 3.2 State units of displacement, speed, distance, velocity and acceleration. 3.3 Derive the relationship between displacement,	Explain in details the concepts of linear motion of bodies. Guide the students to draw velocity - time graph and solve problems relating to displacement, velocity and acceleration.	White Board, Markers, Duster, Recommended textbooks, Lecture notes, Graph/plain sheets, etc.	Demonstrate how to draw the distance – time and velocity – time graphs. Show the relationship between distance and displacement, speed and velocity and velocity and acceleration. Draw the graphical representation of circular motions.	Guide students to conduct the practicals.	Draw the graphical relationships between the various quantities.

	velocity and acceleration. 3.4 Draw velocity time graph. 3.5 Add velocities vector ally. 3.6 Define relative velocity. 3.7 Solve simple problems related to 1.1 to 1.6 above. 3.8 Define angular motion of a body in a circle. 3.9 Derive the relationship between angular velocity and acceleration.	Explain in details how to convert from linear to angular velocity and vice versa.				
General Objective 4.0: Understand curvilinear motion of bodies.						
7	4.1 Develop the relationship between angular and linear motions. 4.2 Define circular motion. 4.3 Explain centrifugal acceleration and centrifugal force. 4.4 Develop expressions for centripetal and centrifugal forces. 4.5 Give examples of centrifugal effects	Explain in details the concept of curvilinear motion of bodies. Guide students to develop expressions for centripetal and centrifugal forces and solve problems on them.	White Board, Markers, Duster, Recommended textbooks, Centrifugal apparatus. Fletcher's trolley Weights, Lecture notes, etc.	Show that centrifugal force varies with mass, speed of rotation, and the distance of the mass from the centre of rotation using centrifugal force apparatus. Verify the equation of motion using Fletcher's trolley.	Guide students to conduct the practicals.	Prove that centrifugal force varies with mass, speed of rotation and the distance of the mass from the center of rotation.

	e.g. Planetary motion, Conical pendulum, etc.					
General Objective 5.0: Understand Momentum of Bodies.						
8-9	5.1 Define Mass and Weight of a body. 5.2 State Newton's Laws of motion. 5.3 Define Impulse and Momentum. 5.4 State the Law of Conservation of Momentum. 5.5 Define Angular Momentum. 5.6 Define Radius of Gyration. 5.7 Explain Moment of inertia. 5.8 Solve problems related to 5.1 to 5.7.	Describe in details the concepts and principles of momentum. Guide the students to solve problems relating to momentum. Describe radius of gyration and moment of inertia.	White Board, Markers, Duster, set of flywheels/discs, vernier calliper, stop watch, Recommended textbooks, Lecture notes, etc.	Determine moment of inertia. Verify the law of conservation of moment on Fletcher's trolley. Use radius of gyration to determine the pressure exerted at a point on a body. Derive the law of conservation of momentum from Newton's second law of motion.	Guide students to conduct the practicals.	Define Angular Momentum
General Objective 6.0: Understand the concept of Work, Energy and Power						
10-11	6.1 Define Work, Energy and Power. 6.2 State the units of work, energy and power. 6.3 Develop expressions for Work, Energy and Power. 6.4 Define Torque and work done by Torque. 6.5 Explain Tractive	Explain in details with the concepts of work, energy, torque and power. Guide the students to solve problems on work, energy, power	White Board, Markers, duster, metre rule, knife edge, set of known masses, Recommended textbooks, Lecture notes, etc.	Determine tractive force and driving torque of a system. Determine kinetic energy of rotation.	Guide students to conduct the practicals.	Explain Mechanical Efficiency in Power transmission.

	Force and driving Torque of a system. 6.6 Differentiate between Kinetic Energy and Potential Energy. 6.7 Explain Kinetic Energy of rotating bodies. 6.8 Explain Mechanical Efficiency in power transmission. 6.9 Explain power transmission by flat belts and spur gears.	and torque. Explain in details the concept of power transmission in flat belts and spur gears. Guide the students to determine mechanical efficiency in power transmission.				
General Objective 7.0: Understand General principle of operation of simple machines.						
12-13	7.1 Define simple machine. 7.2 Give examples e.g. Lever, Pulley, Screw Jack, etc. 7.3 Explain the operations of 5.2 above. 7.4 Define (i) Mechanical Advantage (ii) Velocity Ratio (iii) Mechanical Efficiency 7.5 Develop the relationship for Mechanical	Explain in details the features, types and principle of operation of simple machines. Guide the students to derive the expression for the Mechanical Advantage, Velocity Ratio and Efficiency of wheel, pulley and screw jack and solve	Chalk, Chalkboard, Duster, Recommended textbooks, Lecture notes, etc.	Determine the velocity ratio, mechanical advantage and mechanical efficiency of a screw jack. Determine the velocity ratio and efficiency of simple pulley system.	Guide students to conduct the practicals.	Practical guide, screw jack and pulley system.

	Advantage, Velocity Ratio and Efficiency of a wheel, pulley and screw jack 7.1 Solve simple problems related to 5.1 to 5.5 above.	problems				
Week	**General Objective 8.0: Know simple harmonic motion.**			**General Objective 8.0: Demonstrate simple harmonic motion.**		
14-15	8.1 Describe periodic motion 8.2 Describe period, frequency and amplitude in simple harmonic motion. 8.3 Develop expressions for 6.3 above. 8.4 Analyse the motion of a simple pendulum. 8.5 Solve problems related to the above.	Explain in details the features and principles of Simple Harmonic Motion (SHM). Guide the students to derive expression for period, frequency and amplitude of SHM and solve problems on them	Chalk, Blackboard, Duster, Recommended textbooks, Lecture notes, etc. Simple Pendulum	Determine experimentally the period and frequency of oscillation of a simple harmonic motion.	Guide students to conduct the practical.	Explain the concepts of periodic motion.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**
COURSE TITLE: **Technical Report Writing**
COURSE CODE: **MCE 113**
DURATION: **15 Hours (1 Hour Lecture and 0 Hour Practical)**
CREDIT UNIT: **1.0**

Course: Technical Report Writing	**Code: MCE 113**	**Total Hours: 1 Hours/Week**
		Theory: 1 Hour/Week
Semester: First	**Pre-requisite:**	**Practical: 0 Hour/Week**
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

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: TECHNICAL REPORT WRITING		**COURSE CODE: MCE 113**		**CONTACT HOURS: (1-0-0) 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 Outcomes**	**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						
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	Explain 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						

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 • Conclusion • Recommendation/Further Work • References • Appendices	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
General Objective 4.0: Comprehend the information that is required in technical report writing						

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. 4.5 Determine critical analysis of case studies 4.6 Produce summary. 4.7 Make propositions (Author's propositions) 4.8 Develop conclusion to a technical report 4.9 Write a bibliography in standard format 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.	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, .	-	-	State the various types of information that would be required in technical report
	General Objective 5.0: Understand the style and format of technical report writing					
13-15	5.1 Appreciate the following style and required formats:	Explain the activities in 5.1	Recommended textbooks, whiteboard,	-	-	Explain Writing Styles and

	• 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		marker, lecture notes, library catalogue for books and articles, Internet for authoritative websites. etc.			Required Formats

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**
COURSE TITLE: **Basic Telecommunications**
COURSE CODE: **MCE 114**
DURATION: **45Hours (1 Hour Lecture and 2 Hour Practical)**
CREDIT UNIT: **3.0**

Course: Basic Telecommunications	**Code: MCE 114**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: 1	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: This course is designed to develop students' knowledge and skills on basic principles and applications of telecommunications		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the basic principles of telecommunication system
2	Comprehend the basic principles of modulation and demodulation
3	Understand the principle of the radio receivers.
4	Appreciate the various frequency bands within the radio spectrum
5	Understand the Basic principles of radio wave propagation

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Basic Telecommunications		**COURSE CODE:MCE114**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: This course is designed to develop students' knowledge and skills on basic principles and applications of telecommunications						
General Objective 1.0: Understand the basic principles of telecommunication system						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1Explain the basic concepts of Telecommunications. 1.2 Draw the block diagram of a simple communication system showing: - i. Input and output transducers; ii. Transmitter; iii. Transmission channel; iv. Receivers; 1.3 Explain the function of the blocks listed in 1.2 above. 1.4 Define the transducer. 1.5 List the types of transducers	Explain activity 1.1 to 1.5 with detailed notes	White board and markers, Recommended textbooks, etc.	Identify different types of transducers Demonstrate simple communication system using a communication module	Guide students to carry out experiments.	Mention components of a radio receiver
COURSE SPECIFICATION 2.0: Comprehend the basic principles of modulation and demodulation						
3-5	2.1 Explain the significance of modulation and demodulation in communication systems. 2.2 Explain the following modulation processes: - a. Amplitude modulation;	Explain the activities in 2.1 to 2.10 with detailed notes.	Whiteboard and markers, duster, recommended textbooks, AM and FM radio receiver	Perform experiment on amplitude modulation with signals in audio frequency band Perform experiment on amplitude demodulation with AM modulated	Guide students to conduct the practicals.	Explain amplitude modulation process

	b. Frequency modulation. 2.3 Explain the following regarding amplitude modulation: • side frequencies; • side band; • modulation index; • modulation envelope; • bandwidth. 2.4 Solve problems involving the following: • Modulation index; • Bandwidth. 2.5 Explain the following terms regarding frequency modulation: - a. modulation index; b. deviation ratio; c. frequency deviation; d. system deviation; e. frequency swing. 2.6 Explain why F.M. has a wider bandwidth than A.M. 2.7 Compare the parameters of F.M. with A.M. 2.8 Solve problems involving 2.6 and 2.7 above. 2.9 Explain the working principles of amplitude demodulators 2.10 Explain the working		and transmitter modules.	signal Perform experiment to determine the frequency deviation with FM modulated signal Carryout experiment on frequency demodulation with FM modulated signals		

	principles of frequency demodulators					
GENERAL OBJECTIVE 3.0: Understand the principle of the radio receivers.						
6–8	3.1 Draw the block diagram of the following radio receivers. a. straight; b. superheterodyne. 3.2 Explain the function of each block diagram in 3.1. 3.3 Explain the choice of intermediate frequency in the superheterodyne receiver. 3.4 Explain the function of the automatic gain control (A.G.C.) 3.5 Explain with the aid of a block diagram, the working principle of an F.M. radio receiver.	Explain activities in 3.1 to 3.5 with detailed notes	Whiteboard and markers, duster, textbooks AM and FM demonstration units, oscilloscope, frequency generator, RF and AF demonstration units, superheterodyne receiver	Perform experiments on superheterodyne radio receiver Carryout experiment to determine impedance, radiation resistance, gain, beam-width and radiation power of aerials	Guide students to conduct the practicals.	Explain the function of the automatic gain control (A.G.C.)
GENERAL OBJECTIVE 4.0: Appreciate various frequency bands within the radio spectrum						
9 –11	4.1 Define the radio spectrum 4.2 List the frequency ranges allocated to each of the following bands and their uses; a. (e.l.f.) extremely low frequency; b. (v.l.f.) very low frequency c. (l.f.) low frequency;	Explain the activities in 4.1and 4.2 with detailed notes	Whiteboard and markers, duster and textbooks	-	-	List the frequency ranges allocated to the radio frequency bands

	d. (m.f.) medium frequency; e. (h.f.) high frequency; f. (v.h.f.) very high frequency; g. (u.h.f.) ultra-high frequency; h. (s.h.f.) super high frequency; i. (e.h.f.) extremely high frequency.					
GENERAL OBJECTIVE 5.0: Understand the Basic principles of radio wave propagation						
12-15	5.1 Explain the following terms in relation to wave propagation; a. Ground waves; b. Sky waves; c. Space waves. 5.2 Explain the existence and usefulness of the troposphere. 5.3 Explain the effects of the troposphere on propagation below 30MHZ. 5.4 Explain the various layers of the ionosphere such as: a. The D-layer; b. The E-layer; c. The F-layer. 5.5 Explain critical and maximum usable frequency.	Explain the activities in 5.1 to 5.6 with detailed notes	Whiteboard and markers, duster, recommended textbooks	-	-	Explain critical and maximum usable frequency.

	5.6 Explain optimum working frequency. 5.7 Solve problems involving wave propagation.					

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Fundamentals of Mechatronics**

COURSE CODE: **MCE 115**

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

CREDIT UNIT: **3.0**

Course: Fundamentals of Mechatronics	**Code: MCE 115**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: First	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the basic knowledge of mechatronics system		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand Mechatronics and Automation Systems
2	Know Mechatronics Systems
3	Know sensor and Transducer Principles
4	Understand Drive Technology
5	Know the basic Concepts of the CNC Machines
6	Appreciate The Basic Concepts of Artificial Intelligence

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Fundamentals of Mechatronics		**COURSE CODE:MCE 115**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the basic knowledge of mechatronics system						
General Objective 1.0: Understand Mechatronics and Automation Systems						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define Mechatronics. 1.2 List the disciplinary foundations of mechatronics. 1.3 Explain the evolution of mechatronics. 1.4 Explain the levels of mechatronics. 1.5 Describe the mechatronics system 1.6 List the types of mechatronics systems 1.7 Explain the five basic elements of the mechatronics system 1.8 Describe the functions of mechatronic system 1.9 State the applications of mechatronics. 1.10 Describe the basic concepts of Automation 1.11 Explain the significance of Mechatronics and Automation in modern industries	Explain activity 1.1 to 1.12 with detailed notes	White board and markers, Recommended textbooks, etc.	Identify household items that can be characterized as mechatronic System. Identify the components that help you classify them as mechatronic Systems. Identify household mechatronic systems containing microprocessors, describe the function that are performed by the micro-processor.	Guide the student to conduct the practicals	Explain the levels of mechatronics. List the application of mechatronics

	1.12 Explain the relationship between Mechatronics and Automation					
GENERAL OBJECTIVE 2.0: Know Mechatronics Systems						
3-4	2.1 Define a system 2.2 Describe different types of system 2.3 Differentiate between measurement and control systems 2.4 Identify measurement and control systems and their elements along with their functions 2.5 Explain the Modeling Electrical and Mechanical systems and identifying their responses to various inputs 2.7 Explain the following in relation to mechatronic system signal: • Sensing • Signals acquisition • System actuation • System Control.	Explain the activities in 2.1 to 2.7 with detailed notes.	Whiteboard and markers, duster, recommended textbooks	Carry out system Measurements using appropriate measuring instruments.	Guide the students to conduct the practical	Explain the elements of the control system
GENERAL OBJECTIVE 3.0: Know sensor and Transducer Principles						
5 –7	3.1 Define Sensor 3.2 Mention the different types of sensors. 3.3 Define Transducer 3.4 Explain the following transducers; • Force transducer	Explain activities in 3.1 to 3.6 with detailed notes	White board, markers duster, recommended textbooks	Identify different sensors and transducers. Carry out experiment to measure the characteristics of humidity, flow and	Guide the student carry out the experiments.	Explain the ultrasonic transducer

	• Pressure transducer • Motion transducer • Ultrasonic transducer • Temperature transducer / sensor 3.5 Differentiate between a sensor and a transducer. 3.6 Explain calibration and signal conditioning			pressure sensors.		
GENERAL OBJECTIVE 4.0: Understand Drive Technology						
8 - 9	4.1 Define the actuator 4.2 Classify Actuator 4.3 Explain the principles of operation of the actuator 4.4 Explain different types of actuator and their applications 4.5 Define valves 4.6 Explain the principles of operation of the valve 4.7 Describe the different types of valves and their application	Explain the activities in 4.1 to 4.7 with detailed notes	White board, markers duster, recommended textbooks	Carry out identification of different drives	Guide students to conduct the practical	List the different types of actuators
GENERAL OBJECTIVE 5.0: Know the basic Concepts of the CNC Machines						
10 - 12	5.1 Define the CNC machines 5.2 Describe the principle of operation of the CNC machine 5.3 List the types of CNC machines 5.4 Describe the element of CNC system	Explain the activities in 5.1 to 5.5 with detailed notes	White board, markers duster, recommended textbooks	Identify different types of CNC machines and their respective component parts.	Guide the students to identify the systems and their associated parts.	Explain the element of CNC system

	5.5 State the advantages & disadvantages of CNC machines					
GENERAL OBJECTIVE 6.0: Appreciate The Basic Concepts of Artificial Intelligence						
	6.1 Explain the basic concepts of artificial intelligence 6.2 Explain the basic concepts of Fuzzy logic systems 6.3 Explain the basic concepts of Expert systems 6.4 Explain the basic concepts of Neural networks	Explain the activities in 6.1 to 6.4 with detailed notes	White board, markers duster, textbooks	-	-	Explain the basic concepts of experts systems

YEAR ONE SEMESTER TWO COURSES

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Introduction to Computer Programming**

COURSE CODE: **COM 113**

DURATION: **30 Hours (1 Hour Lecture and 2 Hour Practical)**

CREDIT UNIT: **2.0**

Course: Introduction to Computer Programming	**Code: COM 113**	**Total Hours: 2Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Two	**Pre-requisite: COM 111**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the fundamental knowledge of C programming**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Appreciate Algorithm and Program Development
2	Understand Fundamentals of C Programming
3	Understand I/O statements and Control Structures of C
4	Understand C Programming Language
6	Understand the procedure in solving a programming problems

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
Introduction to Computer Programming		**COURSE CODE:COM 113**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the knowledge of programming using C.						
General Objective 1.0: Appreciate Algorithm and Program Development						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain the steps in development of a program 1.2 Explain flow-charts, algorithm development 1.3 Explain the approaches towards Programming 1.4 Explain various computer languages high level language(HLL), machine language (ML) and Assembly Language 1.5 Explain Translators: Assembler, Compiler, Interpreter	Explain activity in 1.1 to 1.5	White board and markers, textbooks, etc.	-	-.	Explain the approaches Towards Programming
GENERAL OBJECTIVE 2.0: Understand Fundamentals of C Programming						
3-4	2.1 Explain the basic concepts and history of C 2.2 List the Features of C 2.3 Explain the characteristics of C	Explain the activities in 2.1 to 2.5	Whiteboard and markers, duster, textbooks	-	-	Explain the characteristics of C

	2.4 Explain the structure of C 2.5 Explain Header Files.					
GENERAL OBJECTIVE 3.0 Understand I/O statements and Control Structures of C						
5 –7	3.1 Explain the following I/O statements; i. Input output statements, Assignment statements, Variables, ii. Constants, iii. Data Types Operators & Expressions with their precedence, iv. Standard Formatted v. and Unformatted I/O Functions. 3.2 Explain Control Structures Decision and Loop Statements: if-else, while i. do- while, for loops ii. breaks iii. switch	Explain activities in 3.1-3.2	White board, markers duster, textbooks	Carry out programming exercise on simple IF statement. Programming exercise on IF… ELSE statement. Carry out programming exercise on SWITCH statement. Carry out programming exercise on GOTO statement. Carry out programming exercise on DO-WHILE statement. Carry out programming exercise on FOR statement.	Guide the students to carry out the practicals.	Explain the standard formatted I/O statement
GENERAL OBJECTIVE 4.0: Understand Functions and Arrays in C						
10 -12	4.1 Explain the following in relation to a function in C; i. Definition ii. Declaration 4.2 Explain parameter passing- Call by value-Call By Reference 4.3 Explain the following; i. Storage class Specifies, ii. Local and Global Variables,	Explain the activities in 4.1 to 4.6.	White board, markers duster, textbooks	Carry out programming exercise on one dimensional arrays. Carry out programming exercise on defining variables and assigning values to variables.	Guide the students carry out the practicals.	Explain the WHILE…DO loop statement.

	iii. standard library functions, iv. Recursion. 4.4 Define Arrays in C programming. 4.5 Explain Array Declaration and Initialization, 4.6 Explain the following arrays; i. Single and multidimensional ii. Character					
GENERAL OBJECTIVE 5.0: Understand Pointers and Structures in C						
	5.0 Define pointers 5.1 Explain the following in relation to pointers; i. Declaration and Initialization, ii. Address Operators and Pointers to various data types iii. pointers in parameters passing, iv. pointers to function. 5.2 Define a structure 5.3 Explain the following in relation to structure; i. Declaration of a structure, pointer to structure ii. union and array of structure iii. Self-Referential	Explain the activities in 5.1 to 5.3.	White board, markers duster, textbooks	.	.	Explain pointers to function.

	Structures					
GENERAL OBJECTIVE 6.0: Understand Strings and data Files in C						
	6.1 Explain string processing 6.2 Explain functions and standard library function in C. 6.3 Define data files in C 6.4 Explain the following; i. File handling and manipulation, file reading and writing ii. Binary and ASCII files iii. file records using standard function type mouse.	Explain the activities in 6.1 to 6.4.	White board, markers duster, textbooks	.	.	Explain functions and standard library function in C..

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Fundamentals of Automotive Technology I**

COURSE CODE: **MCE 121**

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

CREDIT UNIT: **3.0**

Course: Fundamentals of Automotive Technology I	**Code: MCE 121**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: 2	**Pre-requisite: NIL**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to equip students with the basic knowledge of internal combustion engines, power transmission and lubrication		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the evolution process of the automobile and personnel function
2	Appreciate the engine and its working cycles
3	Know the engine cylinder and its arrangement
4	Understand power transmission in automobiles
5	Appreciate the lubrication, wear and tear

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONIC ENGINEERING TECHNOLOGY						
COURSE: FUNDAMENTALS OF AUTOMOTIVE TECHNOLOGY I			**Course Code: MCE 121**		**Contact Hours 1-0-2 Hours/Week**	
Goal: This course is designed to equip students with the basics of internal combustion engines, power transmission and lubrication						
General Objective 1.0: Understand the evolution process of the automobile and personnel function						
Course Specification: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1	1.1 Explain the development of the motor vehicles 1.2 Enumerate the various prime movers e.g. (i) the steam engine (ii) the electric motor (iii) internal combustion engine. 1.3 State the advantages and disadvantages of 1.2. 1.4 Explain the role of the automotive engineering technologist and the set-up in the automotive industry.	Explain to the students the development of the motor vehicle. Describe the various arms of the automotive industry - Automotive services, - Auto dealers. - Auto spare parts, Auto fleet garages	Charts and pictures of the chronological evolution of the vehicles. Standard automobile workshop. Recommended textbooks, Lecture notes, Manuals, White Board, Markers, Duster, etc.	Identify the evolution of cars from the earliest to the latest.	Guide students to identify the evolution of cars using chart and pictures.	Mention the reasons why cars have evolved.
General Objective 2.0: Appreciate the engine and its working cycles						
2-3	1.1 Define internal combustion engine. 1.2 Define external combustion engine. 1.3 Identify the type used in motor vehicle. 1.4 Explain the two and four strokes cycle operation.	Explain to the students the concept of internal and external combustion engines. Identify the type used in motor vehicle.	Recommended textbooks, White Board, Markers, Force Board, Internal Combustion engine models, tool/toolbox, charts, Lecture	Display to the students the parts of the engine involved in internal combustion. Display the differences between a two stroke and four stroke engines.	Guide the students to identify engine components involved in combustion.	Describe why an internal combustion engine is called with the name internal combustion.

	1.5 Identify the major differences, advantages and disadvantages of two stroke and four stroke cycles.	Explain the sequence of operation of two and four stroke cycle of an engine. Explain to the students how the name internal combustion is derived	notes, etc.	Show an assembled engine.		Explain the differences between two stroke and four stroke cylinder engine.
General Objective 3.0: Know the engine cylinder and its arrangement						
4-5	3.1 Identify various engine and components. 3.2 Differentiate between single and multi-cylinder engines. 3.3 Explain inline and V-engines. 3.4 Explain valve-operating principle. 3.5 Explain valve timing Operation.	Explain the various engine components. Differentiate between inline and v-engine. Explain valve operation, valve timing and firing order.	Recommended textbooks, lecture notes, manuals, White Board, Markers, Force Board, Internal Combustion engine models, tool/toolbox, White Board & Marker etc.	Display the types of engines. Disassemble the engine. Identify the component parts of the engine. Show the various valve position when the engine is working.	Guide students to conduct the practical	Explain firing order. Explain the relationship between valve timing and firing order.
General Objective 4.0: Understand power transmission in automobiles						
6-7 8-10	4.1 Explain the purpose of transmission units 4.2 Describe the power flow train from the engine to road wheels. 4.3 List out the types of transmission system	Explain with good diagrams the features and functions of transmission units. Explain in details, with good diagrams	Recommended textbooks, whiteboard, duster, lecture notes, charts, marker, transmission cut-outs/models etc.	Identify transmission units and its purposes in motor vehicle. Display the manual and automatic Gear boxes	Guide students to conduct the practical Demonstrate activities for the students to learn and allow them to practice till they become competent.	Explain the differences between manual and automatic transmission. Explain the

11-13	and their functions. 4.4 Describe how the manual and automatic transmission systems work. 4.5 Describe the function of the clutch. 4.6 Explain the connection between the clutch assembly, engine and transmission. 4.7 List the types of clutch assembly operations. 4.8 Explain the various clearances in the clutch system and reasons for that. 4.9 Explain the operation of the fluid couplings and torque converter. 4.10 Explain the differences in fluid couplings and torque converters. 4.11Explain the principles of synchronization, gear ratio, driving torques, bearing load and types of meshing. 4.12 Calculate gear, speed/torque ratios. 4.13 State the purpose of locking and interlocking devices	the features, types and functions of transmission systems. Explain with good diagrams the features, types and operations of clutches, fluid coupling and torque converter. Explain in detail, with good diagrams, the features, principles of operations and functions of gears. Enumerate locking and interlocking devices. Describe speedometer, types of drive gears, drive shaft and propeller shafts.	Recommended textbooks, whiteboard, duster, lecture notes, Cut-out of Clutches Fluid Coupling Torque Converters Gearboxes charts, marker, CBT, cut-outs etc Recommended textbooks, whiteboard, chalk, duster, lecture notes, charts, markers, CBT etc.	Demonstrate the Power flow train down to road wheels Identify a clutch and its role in power transmission. Disassemble and assemble a clutch. Display the disassembled fluid couplings and torque converter. Identify the types of gears and compute the gear ratio for meshing gears. Identify the drive shaft and propeller shaft and link them to power transmission Display the concept of sliding mesh and constant mesh.	Demonstrate activities for the students to learn and allow them to practice till they become competent.	effects of engaging and disengaging clutch in automobile power transmission. Derive the gear ratio of two meshing gears.

	in the selector mechanism and the function of the fly wheel and overdrive units. 4.14 Explain types of gears and gearings, e.g. spur, helical and double helical. 4.15 State advantages of constant mesh over the sliding mesh. 4.16Explain speedometer, types of drive gears, drive shafts and propeller shafts.					
General Objective 5.0: Appreciate the lubrication, wear and tear						
14-15	5.1 Explain lubrication principles. 5.2 Describe various lubrication methods in the transmission systems and units. 5.3 Explain the principles of operations of Epicyclic gearing in automatic gearboxes. 5.4 Explain the principle of lubrication in the engine.	Explain in details, with good diagrams, the principles, methods and functions of lubrication methods in transmission systems. Illustrate the principles of operations, features and functions of epicyclic gearing and automatic gear boxes. Explain the principle	Recommended textbooks, whiteboard, duster, engine oil, transmission fluid, oil filter, lecture notes, charts, markers, CBT etc	Identify various lubrication points and methods in transmission systems and units. Describe the various lubrication methods in transmission systems and units. Illustrate how the engine lubrication system works.	Demonstrate activities for the students to learn and allow them to practice till they become competent.	Explain the reason for lubrication.

		of lubrication in relation to wear and tear, cooling and friction reduction.				

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Electronic Devices and Circuits I**

COURSE CODE: **MCE 122**

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

CREDIT UNIT: **2.0**

Course: Electronic Devices and Circuits I	**Code: MCE 122**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: 2	**Pre-requisite: NIL**	**Practical hours: 1 Hour/Week**
Goal: The course is designed to familiarize the students with the characteristics and design of Basic Electronic Devices and Circuits		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Analyze the characteristics of different electronic devices such as diodes, transistors etc.
2	Comprehend the structure, properties and operation of a bipolar transistor
3	Understand Zener diode characteristics and applications
4	Appreciate Fundamentals of Field Effect Transistor**s (FETs)**
5	Know Transistor Biasing Circuits and their appropriate Applications

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Electronic Devices and Circuits I		**COURSE CODE:MCE 122**		**CONTACT HOURS: (1-0-1)HOURS/WEEK**		
Goal: The course is designed to familiarize the students with the characteristics and design of Basic Electronic Devices and Circuits						
General Objective 1.0: Analyze the characteristics of different electronic devices such as diodes, transistors etc.						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Outline energy levels in materials and the electron as a carrier of electricity or charge. 1.2 Explain the following: i. Valence bands ii. Conduction bands iii. Fermi energy levels. 1.3.Distinguish between conductors, semiconductors, and insulators using band gap. 1.4 Explain intrinsic and extrinsic semiconductors. 1.5.Explain carriers in semi-conductors. 1.5 Enumerate the effect of Temperature on the conductivity of semi-conductors and conductors.	Explain activity 1.1 to 1.6 with detailed notes	White board and markers, textbooks, Terminals and Connectors, Resistors, Switches, Transistors, etc.	Identify different electronic devices Demonstrate the effect of temperature on the conductivity of a semi conductor.	Guide students to conduct the practicals.	Differentiate between conductors and semi-conductors List the effect of temperature on the conductivity of semi-conductors and conductors.
GENERAL OBJECTIVE 2.0: Comprehend the structure, properties and operation of a bipolar transistor						
4-6	2.1 Explain the structure and operation of a bipolar transistor (NPN and	Explain the activities in 2.1 to 2.5 with detailed	Textbooks, charts, basic electronic	Determine the biasing of the transistor.	Guide students to conduct the practicals.	Outline the different type of transistor

	PNP). 2.2 Explain the biasing arrangements of NPN and PNP bipolar transistors. 2.3 Explain the circuit configurations of NPN and PNP bipolar transistors: i. the common base configuration ii. the common collector configuration iii. the common emitter configuration. 2.4 Sketch the static characteristics curves of NPN and PNP bipolar transistors for 2.3 (i.) and 2.3 (ii). 2.5 Determine the input and output resistances, current and voltage gains from 2.4.	notes	trainers, breadboards, connecting cables, different types of Bipolar Transistors (NPN and PNP), DC power supply.	Determine the input and output resistances, current and voltage when bipolar transistors are configured		configuration.
GENERAL OBJECTIVE 3.0: Understand Zener diode characteristics and applications						

7-9	3.1 Identify the circuit symbols for PN junction diode. 3.2 Explain zener diode Characteristics 3.3 List the types of zener diodes. 3.3 Identify the symbols for 3.3 above 3.4 Explain the zener effect phenomenon 3.5 Explain the applications of zener diode (clipping, clamping, stabilization etc.)	Explain the activities in 3.1 to 3.5 with detailed notes.	Whiteboard and markers, duster, textbooks, basic electronic trainer, power supply trainer,	Identify the different types of zener diode applications Carryout an experiment to rectify and stabilize a DC circuit. Carry out an experiment on zener diode using clipping, clamping and stabilizing system	Guide students to carryout practical activities	Enumerate characteristics of zener diode Explain areas where zener diode can be applied
GENERAL OBJECTIVE 4.0: Appreciate Fundamentals of Field Effect Transistors (FETs)						
10-12	4.1 Explain the basic constructional features of FET's (junction gate and insulated gate). 4.2 Plot the output and transfer characteristic from data given. 4.3 Determine mutual conductance and drain resistance for the device. 4.4 State precautions necessary when using FET's. 4.5 Obtain voltage gain, input and output resistance from output characteristic.	Explain activities in 4.1 to 4.5 with detailed notes	White board, markers duster, recommended textbooks, basic electronic trainer, power electronic trainer.	Identify Different types of FETs Transistors Determine mutual conductance using FET devices	Guide students to conduct the practicals	List all necessary precautions when using FETs

GENERAL OBJECTIVE 5.0: Know Transistor Biasing Circuits and their appropriate Applications						
13-15	5.1 Explain the concept of transistor biasing. 5.2 Explain selection of operating points of a transistor. 5.3 Describe the need for stabilization of operating points 5.4 Describe different types of biasing circuit. 5.5 Explain the operation of the single stage transistor amplifier circuit 5.6 Explain the concept of DC and AC load line in 5.5.	Explain the activities in 5.1 to 5.6 with detailed notes	Textbooks, charts, Current Source Inverter, Voltage Source Inverter, Rectifiers(Diodes)	Construct a single stage transistor amplifier. Carryout experiment to plot the input and output characteristics of the amplifier. Calculate the parameters of various configurations.	Guide students to conduct the practicals.	State the different types of biasing circuit.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Electronic Instrumentation and Measurement**

COURSE CODE: **MCE 123**

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

CREDIT UNIT: **3.0**

Course: Electronic Instrumentation and Measurement **Semester: 2**	**Code: MCE 123** **Pre-requisite: NIL**	**Total Hours: 1Hours/Week** **Theoretical hours: 1 Hours/Week** **Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint the students with operation and application of electrical/electronic instruments for laboratory and industrial measurements**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Identify various types of electrical and electronic instruments.
2	Understand different types of error in measurement
3	Know the features, functions and uses of moving coil instruments.
4	Understand the working principle and construction of ohmmeter and megger
5	Understand the factors for selection of instruments
6	Appreciate the importance of instrumentation in industries

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: ENGINEERING MEASUREMENT			**Course Code: MEC 123**			**Contact Hours 3hrs/wk**
Course Specification: Theoretical Content				Practical Content		
Week	**General Objective 1.0: Identify various types of electrical and electronic instruments**					
	Specific Learning Outcome	**Teachers Activities**	**Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Evaluation**
1-2	1.1 List various types of Electrical and Electronic Measurement Instruments. 1.2 Identify the instruments listed in 1.1 above 1.3 State the applications of the instruments listed in 1.1 above 1.4 State the range of type of each instrument mentioned in 1.1 above where necessary.	Explain the major types of electrical and electronics instruments.	White board, maker, Textbooks, Measuring Instruments.	Identify the various type of measuring instrument.	Guide the students to identify various types of measuring instruments.	Differentiate the various type of measuring instruments.
General Objective 2.0: Understand different types of error in measurement						
3-4	2.1 Define error. 2.2 State different types of errors. 2.3 Give practical examples of the errors stated in 2.1 above.	State the types of errors with practical examples	White board, marker, textbooks, Posters showing sources of errors, standard measuring instruments etc.	Identify sources of errors in measurement such as equipment errors, operational interference, and installation and ways of eliminating them.	Guide students to conduct the practical.	State the errors associated with Comparator, Limit gauges, steel rule, Dynamometers, Thermometer, etc.

	General Objective 3.0: Know the features, functions and uses of moving coil instruments.					
5-7	3.1 Sketch the permanent magnet moving Coil Instrument 3.2 Explain the operation of moving Coil Instrument 3.3 Show how the moving Coil Instrument can be used as a. Ammeter and b. Voltmeter. 3.4 Show how a multiplier and Shunt can be used to increase the range of Voltmeter and ammeter respectively. 3.5.Calculate the Values of the multiplier and shunt 3.6 Calibrate a moving Coil Instrument. 3.7 Measure Voltage and Current by connecting Multiplier and Shunt respectively.	Explain the activities in 3.1 to 3.8.	White board, marker, textbooks, Posters showing sources of errors, standard calibrators, multimeters, power supply etc.	Identify Permanent magnet moving coil manometer. Calibrate a moving coil instrument Demonstrate shunt as a multiplier.	Guide the students to conduct practical activities.	How do you calibrate an instrument?
	General Objective 4.0: Understand the working principle and construction of ohmmeter and megger					

8-10	4.1 Draw a block diagram of the following Digital Meters: a. Digital Voltmeter b. Frequency Counter 4.2 Explain the operation of the instruments in 4.1 above. 4.3 Use Digital Voltmeter to measure Voltage. 4.4 Use Frequency Counter to measure frequencies up to 100KHz.	Describe the essential features of Digital Instrument	Recommended textbooks, charts, Whiteboard, maker, Lecture notes, digital multimeter, frequency counter. etc.	Calibrate Digital multimeter. Demonstrate the precautions to be observed during measurement of voltage and frequency.	Guide students to conduct the practicals.	Draw block diagram of digital voltmeter.
	General Objective 5.0: Understand the factors for selection of instruments					
11-12	5.1 Draw the block diagram of Cathode Ray Oscilloscope (CRO) 5.2 Explain the function of each block in 5.1 5.3 Draw the diagram of Cathode Ray Tube (CRT) 5.4 Explain the operation of C.R.T. a. CRT Vertical and horizontal amplifiers b. Time base, c. Triggering d. Sweep generator 5.5 Measure D.C. Voltage with C.R.O. 5.6.Measure the following a/c. parameters using C.R.O: a. Amplitude	Explain the functions of CRO's block diagram	White board, maker, Textbooks, Cathode ray tube, wattmeter	Identify Analog oscilloscope and Digital oscilloscope Measure Power in Single phase Circuit Measure Power in 3-phase Circuit	Guide students to conduct the practicals.	Using the oscilloscope, display various signal from the output of signal generator,

	b. Phase and c. Frequency 5.7 Sketch electrodynamics of Power meter 5.8 Explain the operation of the power meter 5.9 Explain the use of three meters and two meters in measuring power in 3-phase Circuit 5.10 Measure Power in Single phase Circuit 5.11 Measure Power in 3-phase Circuit 5.12 Calculate Power factor.					
	General Objective 6.0: Appreciate the importance of instrumentation in industries					
13-15	6.1 Explain the importance of the following factors in selecting measurement instruments: a. Range b. Accuracy c. Response d. Stability e. Reliability f. Sensitivity 6.2 Explain the importance of instrument in industries 6.3 List importance of measurement in industries.	Explain the activities in 6.1 to 6.6	Textbooks, charts, lecture notes, whiteboard, maker, etc,	-	-	What are the important factors in selecting measurement instruments?

	6.4 Explain why the variables in 6.2 above are important. 6.5 Classify instruments into the following: a. Indicating b. Recording c. Controlling 6.6 Give examples of each in 6.5 above					

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Machine Communication Technology**

COURSE CODE: **MCE 124**

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

CREDIT UNIT: **2.0**

Course: Machine Communications Technology	**Code: MCE 124**	**Total Hours: 2Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Second	**Pre-requisite: MCE 114**	**Practical hours: 1 Hour/Week**
Goal: The aim of this course is to equip the students with the knowledge of various aspects and forms of data communication technology**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the basic concepts of computer networks
2	Understand the concepts of Data Communication
3	Understand the basics of serial communications
4	Analyze the hardware and protocols for networked communications
5	Compare the technology used for short-range wireless communications

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Machine Communications Technology		**COURSE CODE: MCE 124**		**CONTACT HOURS: (1-0-1)HOURS/WEEK**		
Goal: The aim of this course is to equip the students with the knowledge of various aspects and forms of data communication technology						
General Objective 1.0: Understand the basic concepts of computer networks						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define a computer network 1.2 Describe the data Communication requirements and evolution of computer networks 1.3 Explain the computer network Topologies 1.4 List the different computer network architectures 1.5 List the different computer network topologies 1.6 Explain the following; Network Protocols • OSI Model • TCP/IP model	Explain activity 1.1 to 1.6 with detailed notes	White board and markers, textbooks, Repeater, Hub Switch Router, Gate Way, etc.	Identify differ network devices;	Guide the students to conduct the practical.	Explain the TCP/IP model
COURSE SPECIFICATION 2.0: Understand the concepts of Data Communication						
3-5	2.1 Explain the concept of data communication 2.2 Explain the components of Data Communication 2.3 Explain how to measure the Capacity of	Explain the activities in 2.1 to 2.8 with detailed notes.	Whiteboard and markers, duster, textbooks	-	-	Enumerate the Switching Techniques

	Communication Media 2.4 State the types of Data Communication 2.5 Enumerate the Switching Techniques 2.6 Explain the different wireless technologies 2.7 Explain the mobile Telecommunication Technologies 2.8 Explain different communication channels					
GENERAL OBJECTIVE 3.0 Understand the basics of serial communications						
6–8	3.1 Define serial communications 3.2 Explain serial communications standards 3.4 Describe the basics of the following technologies: • USB • I C • RS-232 • RS-422/485 3.5 Explain the types of serial Communication Protocols 3.6 Explain the transmission Modes in Serial Communication 3.6 Define the following: • Synchronous Serial Interface • Asynchronous Serial	Explain activities in 3.1 to 3.7 with detailed notes	Whiteboard and markers, duster, textbooks, network cables, crimping tools. USB, I C, RS-232, RS-422/485	Identify different types of Network cables. Identify serial communication hardware's Implement the cross-wired cable and straight through cable using clamping tool.	Guide students to conduct the practicals	Explain serial communications standards

	Interface • Baud Rate • Framing • Synchronization • Error Control • SPI Protocol 3.7 Describe the following serial communication devices; • Serial to Ethernet Converter • Serial Media Converters • Multiport Serial Cards • Industrial Serial to Wireless Devices • Fieldbus Gateway • Industrial USB Devices					
GENERAL OBJECTIVE 4.0: Analyze the hardware and protocols for networked communications						
9 –11	4.1 Describe network and communication concepts. 4.2 List the protocols used in network communications 4.3 Explain the purpose of network hardware and protocols 4.4 Explain the Network Hardware 4.5 Explain the network architecture 4.6 Explain the basic attributes of Ethernet	Explain the activities in 4.1to 4.7 with detailed notes	Whiteboard and markers, duster, textbooks etc.	-	-	What is purpose of network hardware

	4.7 Explain the basics of TCP/IP, in relation to: • Internet layer protocols: IP, ARP, ICMP • Host-to-Host layer protocols: TCP, UDP • IPv4/IPv6 addressing					
GENERAL OBJECTIVE 5.0: Compare the technologies used for short-range wireless communications						
12-15	5.1. Describe the following technologies in terms of principle of operation, range, and application areas: • Infrared/Sony IR • Low Power Radio (LPR) • IEEE802.11 (Wi-Fi) • IEEE802.15.4 5.2. Identify emerging trends in machine communication technologies	Explain the activities in 5.1 and 5.2 with detailed notes	Whiteboard and markers, duster, textbooks	-	-	Explain IEEE802.11principle of operation

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Mechatronic Devices and Applications**

COURSE CODE: **MCE 125**

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

CREDIT UNIT: **3.0**

Course: Electrical Fundamental Elements & Networks	**Code: MCE 125**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 2 Hours/Week
Semester: Second	**Pre-requisite: MCE 115**	**Practical hours: 2 Hour/Week**
Goal: The Course is Designed To Acquaint Students with The Knowledge of Mechatronic Devices and Their Applications		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand Sensor and transducers.
2	Know the Applications of Sensors and Transducers
3	Understand Drive Technology Application
4	Know Electromechanical Actuation Principles
5	Know The Electromechanical Actuation Applications
6	Understand Micro-processors and Microcontrollers
7	Understand Micro-Processor Interfacing

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Mechatronic Devices and Applications		**COURSE CODE:MCE 125**		**CONTACT HOURS: (1-0-0)HOURS/WEEK**		
Goal: Course is Designed To Acquaint Students with The Knowledge of Mechatronic Devices and Their Applications						
General Objective 1.0: Understand Sensor and transducers.						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain the types of sensors 1.2 Describe the static and dynamic sensor characteristics and the environmental impacts on characteristics of the sensor 1.3 Explain the position and Level sensors 1.4 Explain the flowmeter 1.5 Explain the chemical sensors: humidity, gas sensor, etc. 1.6 Explain the following measurements; • High temperature • kinematic quantities • Force and torque 1.7 Explain the transducer 1.8 List the types of transducer 1.9 Explain the main source of error of the transducer.	Explain activity 1.1 to 1.9 with detailed notes	White board and markers, Recommended textbooks, etc.	Identify different sensors and transducers Carry out measurement of angular position, linear displacement, rotational speed, force, pressure, strain, flow rate, temperature, etc.	Guide the students to carry out the practical	Differentiate between conductors, insulators and semiconductors,
GENERAL OBJECTIVE 2.0: Know the Applications of Sensors and Transducers						

3-4	2.1 Explain the application of the following Sensors: Ultrasonic, Distance sensor, Color sensors, Level sensors, Temperature and humidity sensors, Gas sensor, Light sensors, Acceleration sensor, Vibration sensor, Pressure sensor 2.2 Describe the Applications of sensors in the measurement of Angular position, linear displacement, rotational speed, force, pressure, strain, flow rate, temperature, etc. 2.3 Describe the applications of transducers in the measurement of flow rate, temperature, strain, pressure, force, rotational speed, linear displacement, angular position, etc.	Explain the activities in 2.1 to 2.3 with detailed notes.	Whiteboard and markers, duster, recommended textbooks	-	-	Explain the application of transducers in the measurement of flow rate
GENERAL OBJECTIVE 3.0 Understand Drive Technology Application						
5 –7	3.1 Describe the basic concepts of drives 3.2 Identify the different types of drives 3.3 Explain the different types of drives 3.4 Explain the application	Explain activities in 3.1 to 3.4 with detailed notes	White board, markers duster, recommended textbooks	-	-	List different types of drives

	of drives in 3.3 above.					
GENERAL OBJECTIVE 4.0: Know Electromechanical Actuation Principles						
8 - 9	4.1 Explain the basic concepts of Actuation. 4.2 Define electromechanical actuator. 4.3 Explain the basic electromechanical principles 4.4 Explain the basic principles of power transmission. 4.5 Describe the principle of operation of the following electromechanical Actuators; DC Motors, AC Motors, Linear Motors, Stepper Motors, Midget Motors 4.2 Identify Electromechanical systems. 4.5 Explain the principle of conversion of rotary to linear motion. 4.6 Explain the Basic electromechanical Principles involved in Power transmission.	Explain the activities in 4.1 to 4.6 with detailed notes	White board, markers duster, recommended textbooks	Carry out rotary to linear conversion using electromechanically devices. Carry out the transmission of power through the use of electromechanical devices.	Guide the students to conduct the practicals	State the principles of power transmission
GENERAL OBJECTIVE 5.0: Know The Electromechanical Actuation Applications						
10 -12	5.1 Explain the Applications of Electromechanical devices 5.2 State the advantages	Explain the activities in 5.1 to 5.3 with detailed notes	White board, markers duster, recommended	Identify various electromechanical coupling devices; gearing, belts, pulley, bearings, etc.	Guide the students to conduct the practical	State the application of electromechanical derives

	and disadvantages of each of the devices identified 5.3 Explain the applications of electromechanical devices in coupling, gearing, belts, pulley, bearings, etc.		textbooks			
GENERAL OBJECTIVE 6.0: Understand Micro-processors and Microcontrollers						
	6.1 Define micro-processor. 6.2 Explain the classification of the microcontroller according to; Bits, Memory, Memory architecture, and instruction set 6.3 List the different component parts of a micro-processor 6.4 Explain the different component of the micro-processor. 6.5 List the types of micro-processors 6.6 Explain the application of the micro-processor 6.7 Define the micro-controller 6.8 Describe the characteristic and types. 6.9 Explain the applications of the micro-controller 6.10 Differentiate between the micro-controller and micro-processor.	Explain the activities in 6.1 to 6.10 with detailed notes	White board, markers duster, recommended textbooks	Identify the component parts of a microcontroller	Guide the students to conduct the practical	List the types of micro-processor

GENERAL OBJECTIVE 7.0: Understand Micro-Processor Interfacing						
	7.1 Define interfacing 7.2 Describe microprocessor interfacing 7.3 Explain the application of micro-processor interfacing, Bus timing, A/D, D/A 7.4 Explain interfacing the microcontroller to the microprocessor.	Explain the activities in 7.1 to 7.4 with detailed notes	White board, markers duster, recommended textbooks	Identify the component parts of a Microprocessor. Carry out microprocessor interfacing, bus timing, A/D, D/A conversion	Guide the students carry out the practicals	Explain the microprocessor interfacing.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Thermo fluids**

COURSE CODE: **MCE 126**

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

CREDIT UNIT: **3.0**

Course: Thermo fluids	**Code: MCE 126**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hour/Week
Semester: Second	**Pre-requisite: NIL**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to equip students with the basic knowledge of thermodynamics and fluid mechanics		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Understand the basic principles of thermodynamics
2	Appreciate thermodynamic processes
3	Know the basic properties of different quality of steams
4	Know the classifications, types of fluids and their properties
5	Understand the concept of pressure and the principles of its measurement

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONIC ENGINEERING TECHNOLOGY						
COURSE: THERMO FLUIDS		**Course Code: MCE 126**		**Contact Hours 1-0-2 Hours/Week**		
Goal: This course is designed to equip students with the basic knowledge of thermodynamics and fluid mechanics						
General Objective 1.0: Understand the basic principles of thermodynamics						
Course Specification: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-4	1.1 Define thermodynamics. 1.2 List the different thermodynamic processes and their characteristics 1.3 Identify the internal energy of gases 1.4 Compare the two heats 1.5 Find the ratio of 1.4 above in the form of $R= C_P/C_V$ 1.6 State Boyle's and Charle's Law for gases 1.7 Derive the characteristic equation of ideal gases i.e. PV = MRT 1.8 State the Zeroth Law of Thermodynamics 1.9 Define thermometric substances	Explain the activities in 1.1 to 1.13	A well laid-out apparatus, Graphic books, Practical guide, textbooks, whiteboard, duster, lecture notes, charts, markers, drawing sheet, thermometers etc.	Determine experimentally, temperature when the thermometric property value at certain fixed points are given and a scale of temperature is prescribed. Plot a graph combining Boyle's and Charles' Laws and derive the characteristic equation. Identify different thermometric substances. Determine experimentally specific heat capacities for some solids, liquids and gases.	Guide students to carryout practicals	Solve problems involving change of pressure, volume and temperature for ideal gases. State the advantages of mercury in glass over alcohol in glass thermometer

	1.10 Solve simple problems on determination of temperature when the thermometric property values at certain fixed points are given and a scale of temperature is prescribed. 1.11 State the First Law of Thermodynamics 1.12 State the relationship between heat transfer Q, Work Transfer W, and related changes in the properties of the working substance or system 1.13 Derive the energy equation i.e. Heat Supplied = work done + change in internal energy for nonflow processes					
General Objective 2.0: Appreciate thermodynamic processes						
5-6	2.1 Explain the constant volume process 2.2 Show that the work done is equal to zero for non-flow processes 2.3 Explain constant pressure process.	Explain the activities in 2.1 to 2.8	Textbooks, whiteboard, bomb calorimeter, duster, lecture notes, charts, markers etc	Determine the constant volume process. Determine the constant pressure process.	Guide students to carryout practicals	Show that the work done = change in internal energy and heat added

	2.4 Show that the work done = change in internal energy and heat added 2.5 Explain constant temperature process and determine the work done 2.6 Explain adiabatic process 2.7 Show that work done = change in internal energy 2.8 Explain polytropic process.					
General Objective 3.0: Know the basic properties of different quality of steams						
7-8	3.1 Define gas and vapour 3.2 Describe the generation of steam at constant pressure 3.3 Draw the temperature enthalpy diagram to illustrate the properties of steam 3.4 Explain heat, latent heat and degree of superheat 3.5 Differentiate between dry saturated and wet saturated steam	Explain the activities in 3.1 to 3.9	Textbooks, whiteboard, Steam calorimeter, boiler, thermometers, thermocouples, duster, lecture notes, charts, markers etc	Determine the quality of wet steam using the steam calorimeter	Guide students to carryout practicals.	State the application of the different classes of steam.

	3.6 Describe dryness fraction 3.7 Describe the properties of steam using steam tables 3.8 Define Dalton's law of partial pressures 3.9 Describe the steam calorimeter					
General Objective 4.0: Know the classifications, types of fluids and their properties						
9-10	4.1 Define a fluid 4.2 List different types of fluids 4.3 Explain for liquids the following forms: Ideal, Real, Newtonian, Non-Newtonian, Plastic, Slurry, Suspension 4.4 Explain for gases, the following forms: Ideal, Perfect and vapour 4.5 Explain the following fluid properties for liquids and for gases. Pressure, density, viscosity, adhesion, cohesion, surface tension, compressibility, capillarity. 4.6 State Newton's Law of Viscosity.	Explain activities in 4.1 to 4.8	Textbooks, whiteboard, Viscometer, stop clock, Fall sphere apparatus, Hydraulic test benches and samples of different of different fluids, duster, lecture notes, charts, markers etc	Observe and identify different samples of fluid in the laboratory. Investigate Boyle's law to explain PV for perfect gas. Draw F and M Curves for liquids and gases and draw a conclusion from it. Obtain experimentally viscosities of some liquids.	Guide students to carryout practicals.	Differentiate between Newtonian and non-Newtonian fluids.

	4.7 Explain the effects of viscosity in fluids 4.8 Explain sketches the relations between F & M for liquids and for gases.					
General Objective 5.0: Understand the concept of pressure and the principles of its measurement						
11-15	5.1 Explain how a fluid exerts pressure due to its own weight 5.2 Derive an expression for the pressure at a point in a fluid. 5.3 Explain why the pressure in a fluid varies with depth 5.4 Explain the concepts of absolute gauge and vacuum pressures in gas. 5.5 Explain vapour pressure 5.6 Explain the principles of pressure measurement in liquids and gases. 5.7 Describe the following Fluid pressure measuring instruments: Common Gauge, Piezometer, Pitot tube, U - tube	Explain activities in 5.1 to 5.8	Textbooks, whiteboard, Pitot tube, Manometer, Hydrostatic forces on plane surfaces, Bermouth's apparatus. Piezometer, Aneroid Barometer, U-tube manometer, duster, lecture notes, charts, markers etc	Demonstrate by experiment how a fluid exerts pressure due to its own weight Calibrate the bourdon pressure gauge. Measure vapour using a simple water vessel. Measure fluid pressure with the following: - Common gauge, -Piezometer -Pitot tube -U-tube manometer -Bourdon gauge and -Aneroid Barometer Derive an expression for the total thrust acting on a plane vertical surface submerged in a liquid. Conduct experiment using the different pressure measuring apparatuses and compare the results.	Guide students to carryout practicals.	Solve simple problems related to pressure measurements. Explain the principle of operation of aneroid barometer.

	manometer, Bourdon gauge and Aneroid Barometer. 5.8 Explain their construction and uses					

PROGRAMME: **National Diploma (ND) in Mechatronics 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**
		Theoretical hours: 2 Hour/Week
Semester: Second	**Pre-requisite:**	**Practical hours: 2 Hours/Week**
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

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS 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 Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1	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' 1.6 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.	Demonstrate for the students to learn and guide them to perform the practical activities.	Explain mechanical properties of materials
	General Objective 2.0: Understand the structure of solids					

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	Demonstrate for the students to learn and guide them to perform the activities.	Explain the structure of solids
	General Objective 3.0: Know ferrous metals and their alloys					

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 impurities on them: pig iron, cast Iron and wrought iron. 3.3 List classification of carbon steels with their compositios 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	Explain 3.1 to 3.8 with diagrams and detailed notes where necessary.	Whiteboard, marker, text books, duster, etc.	Identify all Ferrous Metals and its Alloys. Demonstrate the applications of all the Ferrous Metals and its Alloys	Demonstrate for the students to learn and guide them to perform the activities.	Explain Ferrous Metals and its Alloys
	General Objective 4.0: Understand non-ferrous metals and their alloys					

6-7	4.1 Explain the properties and uses non-ferrous metals: Aluminium, Copper, Tin, Lead, Zinc, Magnesium and Nickel. 4.2 Describe the properties, composition and uses of the following: - Copper Alloys : Brass, Bronze - Aluminium Alloys: Duralumin, Hindalium, Magnelium - 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.	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. Demonstrate the applications of the non-Ferrous Metals and its Alloys	Demonstrate for the students to learn and guide them to perform the activities.	Explain non-Ferrous Metals and its Alloys
GENERAL OBJECTIVE: **5.0 Understand simple phase transformations**						
8-9	5.1 Explain thermal equilibrium diagrams.	Explain 5.1 to 5.4 with diagrams	Whiteboard, marker, text	Construct simple iron-carbon (Fe-C) thermal	Guide the students to conduct the	Explain simple

	5.2 Describe on phase diagrams in the following transformations: Eutectic, Eutectoid, Peritectic reactions 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 Describe simple process of nucleation and grain growth in metals	and detailed notes where necessary	books, duster, etc. Emery clothes, Etchants, Metallurgical microscope, alloy specimens, furnaces. Phase diagrams Metallurgical microscope, alloy specimens, furnaces, phase diagrams etc.	equilibrium 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. Identify solidus and liquidus lines. Distinguish between:- Eutectic and eutectoid, solidus and liquidus lines. Examine the micro-structure of alloy specimens and make sketches of the structure	practicals	phase transformations
	GENERAL OBJECTIVE: 6.0 Understand the non-metallic materials in engineering applications.					
10-11	6.1 Describe non-crystalline atomic structure of nonmetals (plastics, glass, wood, etc) 6.2 Classify common plastics. 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	Explain 6.1 to 6.5 with diagrams and detailed notes where necessary	Whiteboard, marker, text books, duster, etc.	Identify non-metallic materials such as plastics, ceramics, wood, rubber and concrete, their compositions and properties.	Demonstrate for the students to learn and guide them to perform the activities.	Explain non-metallic materials in engineering application

	ceramics, wood, rubber and concrete.					
	General Objective 7.0: Understand materials testing techniques					
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	Demonstrate for the students to learn and guide them to perform the activities.	Explain materials testing techniques
GENERAL OBJECTIVE 8.0: Comprehend hot working and cold working processes						
14	8.1 Describe hot working and cold working processes. 8.2 Differentiate hot working from 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	Explain 8.1 to 8.4 with diagrams and detailed notes where necessary	Recommended textbooks, Lecture notes, whiteboard, marker	Carry out hot and cold working processes on a given metal specimen.	Demonstrate for the students to learn and and guide them to perform the activities.	Explain hot working and cold working processes

	accuracy and surface finish					
GENERAL OBJECTIVE 9.0: Understand the basic principles of heat treatment as applied to steels.						
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.	Construct iron-carbon equilibrium Carry out some heat treatment exercise e.g hardening, annealing, normalising and tempering.	Guide the students to conduct the practicals	Explain the basic principles of heat treatment as applied to steels

YEAR TWO SEMESTER ONE COURSES

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Computer Aided Design and Drafting**

COURSE CODE: **MCE 211**

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

CREDIT UNIT: **2.0**

Course: Computer Aided Design And Drafting	**Code: MCE 211**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 1 Hour/Week
Semester: Third	**Pre-requisite: MEC 111**	**Practical hours: 1 Hours/Week**
Goal: This course is designed to develop students' knowledge and skills on how to use computer for engineering drafting purposes		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Comprehend design and drafting processes using computer
2	Know how to construct basic geometric shapes
3	Apply the different edit boxes in drawing
4	Understand how to create layers in drawing
5	Understand how to create linear and aligned dimensions
6	Draw standard parts drawing

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Computer Aided Design And Drafting			**Course Code: MCE 211**		**Contact Hours: (1-0-1) Hours/Week**	
Goal: This course is designed to develop students' knowledge and skills on how to use computer for engineering drafting purposes						
General Objective 1.0: Comprehend design and drafting processes using computer						
Course Specification: Theoretical Contents				**Practical Content:**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1 - 3	1.1 State the advantages of computer in the design process. 1.2 Explain the links between CAD and CAM. 1.3 Explain the principles of operation capabilities and system requirements of latest version of AutoCAD. 1.4 Identify the main parts of the screen of AutoCAD. 1.5 Explain the functions of the 1.4 above. 1.6 Apply the different input devices for drawing. 1.7 List the different coordinate systems.	Explain the activities from 1.1 to 1.7.	Complete Computer Sets with AutoCAD and other software installed, Printer or Plotters on a Network, Digitiser Projector, Manuals, textbooks, mouse keyboards, digitizers and scanners.	Install the AutoCAD Software correctly. Demonstrate the use of different menus in AUTOCAD.	Guide the students to carryout practicals.	Use AutoCAD to draw some basic objects.
General Objective 2.0: Know how to construct basic geometric shapes.						
4-5	2.1 Explain how to draw basic shapes, hatch the shapes drawn and change the hatch pattern and scale. 2.2 Explain how to construct Polygons, ellipses, and	Explain activities from 2.1 to 2.3.	Complete Computer Sets, Printer or Plotter on a Network, digitizer, projector manuals,	Produce a simple drawing. Hatch the various shapes drawn.	Guide the students to carryout practicals.	Construct circles, polygons and ellipses and hatch them.

	arcs to given dimensions. 2.3 Produce a simple drawing as in 2.1 and 2.2 above.		design software, Textbooks etc.	Construct shapes of different types.		
General Objective 3.0: Apply the different edit boxes in drawing						
6-8	3.1 Explain the different edit Boxes. 3.2 Explain how to use different edit boxes and their attributes. 3.3 Explain how to select the shapes using edit boxes. 3.4 Explain how to use the offset command. 3.5 Demonstrate how to move objects accurately using both snap commands and coordinates. 3.6 Demonstrate how to copy objects from one position to another accurately using snap and coordinate entry. 3.7 Explain how to erase object. 3.8 Explain how to trip an object. 3.9 Demonstrate how to fillet and chamfer angles	Explain the activities in 3.1 to 3.9	Complete Computer Sets with design software installed, Printer or Plotters on a Network, Digitiser Projector, Manuals, Textbooks etc.	Use array command to draw both polar and rectangular arrays. Edit objects using edit boxes. Choose shapes using edit boxes. Apply offset command	Guide the students to carryout practicals.	Select various shapes using the edit boxes and offset the shapes.
General Objective 4.0: Understand how to create layers in drawing						

	4.1 Explain how to create layers in drawing. 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.	Explain the activities in 4.1 to 4.5	Complete Computer Sets with AutoCAD software installed, Printer or Plotters on a Network, Digitiser Projector, Manuals, and Textbooks.	Create layers. Change colour of layers. Amend the line types of a layer. Move objects from one layer to another. Carry out switching of layers on and off.	Guide the students to carryout practicals.	Create layers with different line colours and switch over objects from one layer to another.
General Objective 5.0: Understand how to create linear and aligned dimensions.						
9-10	5.1 Explain how to create linear and aligned dimensions. 5.2 Describe how to create angular dimensions. 5.3 Demonstrate how to add tolerances to dimensions. 5.4 Demonstrate how to create leader lines. 5.5 Demonstrate how to add single line and multiple line texts to drawings. 5.6 Demonstrate how to edit dimensions and text.	Explain activities in 5.1 to 5.6	Complete Computer Sets with design software installed., Printer or Plotters on a Network, digitiser Projector, manuals, textbooks.	Add tolerances to dimensions. Create leader lines. Add single and multiple line texts to drawings. Produce angular dimensions Carry out editing of dimensions and text.	Guide the students to carryout practicals..	Draw objects and insert different dimension styles.
General Objective 6.0: Draw standard parts drawing						

11 – 14	6.1 Select parts of a drawing in order to do further work. 6.2 Demonstrate how to produce a full drawing from a real engineering object. 6.3 Show how to produce a fully dimensioned drawing of an appropriate engineering component, showing all the views with full specifications.	Explain activities in 6.1 to 6.3	Complete Computer Sets with design software, printer or Plotters on a network, digitiser, projector, manuals, textbooks. Etc.	Create a standard drawing. Draw a real engineering object. Produce a fully dimensioned drawing of an appropriate engineering component with full specifications.	Guide students to carryout practicals.	Create a standard drawing of an engineering object.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**
COURSE TITLE: **Electronic Devices and Circuits II**
COURSE CODE: **MCE 212**
DURATION: **45 Hours (1 Hour Lecture and 2 Hour Practical)**
CREDIT UNIT: **3.0**

Course: Electronic Devices and Circuits II	**Code: MCE 212**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hour/Week
Semester: 4	**Pre-requisite: MCE 122**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to guide students on how to construct different classes of an amplifier and apply them in a simple mechatronics circuit.		

GENERAL OBJECTIVES	
On completion of this course, students should be able to :	
1	Understand the feedback effects in electronic circuits and their applications
2	Appreciate the nature and functions of a current feedback system
3	Comprehend the Properties and functions of oscillators and Multivibrators
4.	Appreciate the Properties and Functions and uses of Thyristors
5.	Appreciate special diodes and transistors

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY		
COURSE: Electronic Devices and Circuits II	**COURSE CODE:MCE 212**	**CONTACT HOURS: (1-0-2)HOURS/WEEK**
Goal: To guide students on how to construct different classes of an amplifier and apply them in a simple mechatronics circuit.		
General Objective 1.0: Understand the feedback effects in electronic circuits and their applications		

COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain the different types of biasing arrangement of a Transistor amplifier. Fixed bias. Collector-base bias without and with De-coupling capacitor. Potential divider bias. Junction FET simple bias. 1.2 Draw the circuit diagram of a single stage common emitter and source transistor amplifier having resistive load, transformer and tuned circuit loads. 1.3 Calculate the voltage and power gains of	Explain activity 1.1 to 1.4 with detailed notes	Whiteboard and markers, Recommended textbooks, Electronic Laboratory, Power Supply Units, Amplifier Modules, Oscilloscopes, Signal Generator, Practical Manuals, Practical Notebooks etc.	Determine by experiment the performance of Amplifier using different biasing methods. Determine by experiment the gain/frequency curve of a transistor amplifier.	Guide students to conduct the practicals	Explain the principle Of operation of the circuit based on specified configurations Calculate the voltage and power gains of the amplifier based on specified configurations

	the amplifier in 1.2 above. 1.4 Explain the principle of operation of the circuit in 1.2 above.					
GENERAL OBJECTIVE 2.0: Appreciate the various functions of a circuit feedback system						
3-5	2.1 Define the Input and output of a system (e.g. voltage, or current in an amplifier). 2.2 Describe the general nature of positive and negative feedback in systems. 2.3 Show that the GAIN of a system is mainly determined by the feedback function and independent of forward gain. 2.4 Explain the general expression for stage gain of a basic feedback in amplifiers.	Explain the activities in 2.1 to 2.4 with detailed notes.	Whiteboard and markers, duster, textbooks, Electronic Laboratory, Power Supply Units, Amplifier Modules, Oscilloscopes, Signal Generator, Practical Manuals, Practical Notebooks etc.	Carryout experiment to investigate the effect (i.e. on a distorted signal, input and output impedances) of negative feedback on amplifiers. Carryout experiment to investigate the conditions necessary for oscillation, and measure the frequency and amplitude of a sinusoidal signal of an LC Colpitts oscillator.	Guide students to carryout practicals	Describe the general expression for stage gain of basic feedback in amplifiers. Determine the Input and Output of a system in current or a voltage
GENERAL OBJECTIVE 3.0: Comprehend the Properties and Functions of oscillators and Multivibrators						
9 –11	3.1 Explain how oscillators can be produced from an	Explain the activities in 3.1	Recommended textbooks, charts,	Carry out experiment to investigate the factors	Guide students to conduct the	Describe how oscillators can be

	amplifier with positive feedback. 3.2 Explain the operation of: i. R- C oscillator ii. L-C oscillator (Hartley & Colpitts Oscillators) 3.3 Describe methods of achieving frequency stability of oscillators e.g. piezo - electric crystal. 3.4 Explain with the aid of suitable sketches the operation of various types of multivibrators. 3.5 Explain simple applications of multivibrators circuits. 3.6 Solve simple problems on multivibrators.	to 3.6 with detailed notes	Electronic Laboratory, Power Supply Units, Amplifier Modules, Oscilloscopes, Signal Generator, Practical Manuals, Practical Notebooks etc.	which affect the operation of LC Hartley oscillator and measure the frequency and amplitude of a generated signal. Carryout experiment to investigate basic factors, which influence the operation of, Transistorized as table multivibrator. Carryout experiment to investigate the principle of operation of a bistable multivibrator. Carryout experiment to investigate the operation of a monostable multivibrator.	practicals	produced from an amplifier with positive feedback Explain simple applications of Multi-vibrators circuits.
GENERAL OBJECTIVE 4.0: Appreciate the Properties and Functions and uses of Thyristors						
12-15	4.1 Define Thyristors and their Properties 4.2 Explain applications of Thyristor, in creating: - a. 1-single phase b. 3-phase rectifying circuits to drive DC	Explain the activities in 4.1 to 4.5 with detailed notes	Recommended textbooks, charts, Electronic Laboratory, Power Supply Units, Amplifier Modules,	Conduct Experiment with students on types of thyristors. Carryout Experiment on how the thyristors work.	Guide students to conduct practical	List types of Thyristors and their uses Explain applications of Thyristor,

	motors. 4.3 Explain Types of thyristors and their uses i. Thyristors with turn-on capability (Unidirectional control) ii. Thyristors with turn-off capability (Unidirectional control) iii. Bidirectional control 4.4. Describe How thyristors work. 4.5 Explain following Thyristors Circuit Modes: a. Reverse blocking mode b. Forward blocking mode c. Forward conducting mode		different forms of Thyristors, Practical Manuals, Practical Notebooks etc.			
GENERAL OBJECTIVE 5.0: Appreciate special diodes and transistors						
	5.1 Explain the construction and characteristics of the following; • Schottky diode • Diac and Triac • Unijunction Transistor (UJT) • Photo diode • Photo transistor • Light Activated SCR	Explain the activities in 5.1 to 5.2 with detailed notes	Recommended textbooks, charts, power electronic trainers, Schottky diode, Diac and Triac, Unijunction Transistor (UJT), Photo diode, Photo transistor,	Identify special diodes and transistors Determine the characteristics of diodes and transistors.	Guide the students to carry out the practical activities.	List the application of photodiode

	(LASCR) • Opto-coupler 5.2 Explain the applications of the diodes and transistors in 5.1		Light Activated SCR (LASCR), Opto-coupler			

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Mechanisms of Machines**

COURSE CODE: **MCE 213**

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

CREDIT UNIT: **3.0**

Subject: MECHANISMS OF MACHINES	**Code: MCE 213**	**Total Hours: 3 Hours/Week**
		Theory: 1 Hour/Week
Semester: Third	**Pre-requisite: NIL**	**Practical: 2 Hours/Week**
Goal: This course is designed to accustom students with the knowledge and skills in the relative motions of machines and their characteristics**.**		

GENERAL OBJECTIVES	
On completion of this module students should be able to:	
1	Understand the basic concepts of links and plane mechanisms
2	Comprehend the applications of kinematic theories to real-world machinery
3	Know the theoretical study of kinematics and their different motions
4	Comprehend the motion characteristics of a machine and simple mechanisms
5	Understand the basic principles of velocity in mechanisms
6	Understand the concepts of forces and acceleration acting in mechanisms
7	Understand the static and dynamic force acting on mechanisms

PROGRAMME: NATIONAL DIPLOMA (ND) IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: MECHANICS OF MACHINES			**COURSE CODE: MCE 213**		**CONTACT HOURS: (1-0-2) Hours/Week**	
Goal: This course is designed to accustom students with the knowledge and skills in the relative motions of machines and their characteristics						
General Objective 1.0: Understand the basic concepts of links and plane mechanisms						
COURSE SPECIFICATION:THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1 – 2	1.1 Define the following terms: machine, link mechanism, dynamics, kinematics pairs, 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 Explain the difference between mechanism and machine. 1.5 Outline the different types 1.6 of mechanisms 1.6 Solve problems involving 1.1 to 1.5.	Explain activities 1.1 - 1.6 with detailed notes.	Textbooks Marker, Whiteboard, Duster, Press jack apparatus Sliding block, force board, etc.	Identify various links and plane mechanisms in machines (slider crank, Oldham coupling, etc.). Demonstrate the operation of these mechanisms in the laboratory.	Guide students to carryout practicals.	Explain the basic concepts of links and plane mechanisms.
General Objective 2.0: Comprehend the applications of kinematic theories to real-world machinery						
	2.1 Outline the basics of Kinematics 2.2 Explain the three types of motions in relation to kinematics	Explain 2.1 - 2.8		Conduct experiment to determine the co-efficient of friction between thread and nut using the screw jack apparatus.	Guide students to to perform the activities.	Explain the application of friction and its effects

3 – 4	2.3 Describe the relation between: • Linear and angular motions • Linear and angular quantities of motion 2.4 State the applications of kinematics in real-life situation. 2.5 Explain the kinematic analysis of mechanisms – Analytical and graphical methods 2.6 Explain various types of kinematic chains 2.7 State the various types of kinematic chains 2.8 Describe the types of joints in a chain			Perform experiment on sliding block with (i) No lubrication (ii) Thin film lubrication (iii) Rolling support		
General Objective 3.0: Know the theoretical study of kinematics and their different motions						
5 – 6	3.1 Explain the three types of motions in relation to kinematics 3.2 Describe the relationship between linear and angular motions 3.3 Explain the angular and linear quantities of motion	Explain activities 3.1 to 3.3	Marker, white board, projector, Textbooks,	Demonstrate the various types of motions in kinematics	Guide students to carryout practicals.	Explain the relationships between angular and linear motions.
General Objective 4.0: Comprehend the motion characteristics of a machine and simple mechanisms						
	4.1 Explain the differences between a machine and a structure	Explain activities 4.1 - 4.6	Marker, whiteboard, projector,	Demonstrate inversion of mechanism	Demonstrate for the students to learn and ask them	Explain the functions and

7 – 8	4.2 Explain the types of constrained motions 4.3 Demonstrate the concept of degrees of freedom for plane mechanisms 4.4 Explain the applications of the following in relation to plane mechanisms: • Kutzbach's criterion • Gruebler's criterion 4.5 Explain the concept of inversion of mechanisms 4.6 Solve problems in 4.3 to 4.5		Slider crank mechanism, scotch yoke, Textbooks, Lecture notes		to perform the activities.	application of Kutzbach and Gruebler's criteria
	General Objective 5.0: Understand the basic principles of velocity in mechanisms					
9 – 10	5.1 Describe the methods of determining velocity of a point on a link 5.2 Describe the concept of determining velocity of a point on a link by: • Instantaneous centre method • Relative velocity method 5.3 Explain the method of determining the number of instantaneous centres in a	Explain activities 5.1 - 5.8	Marker, white board, Duster, projector, computer to play the video clips, Slider crank mechanism, textbooks, etc.	Demonstrate the method of determining and locating instantaneous centres in mechanisms	Guide students to carryout practicals.	Determine velocity of a point on a link by instantaneous centre and Relative velocity methods

	mechanism. 5.4 State Aronhold Kennedy's Theorem 5.5 Describe the method of locating instantaneous centres in a mechanism. 5.6 Determine the velocities in a slider crank mechanism 5.7 Determine the rubbing velocity at a pin joint. 5.8 Solve problems in 5.1 to 5.7.					
	General Objective 6.0: Understand the concepts of forces and acceleration acting in mechanisms					
11 – 13	6.1 Explain acceleration diagram for a link 6.2 Analyze acceleration of a point in a link 6.3 Explain acceleration in the slider crank mechanism 6.4 Explain Coriolis component of acceleration 6.5 Explain straight line mechanisms 6.6 Explain the exact straight	Explain activities 6.1 to 6.8	Marker, white board, Duster, projector, slider cranks mechanism textbooks, etc.	Demonstrate how to determine acceleration in the slider crank mechanism	Guide students to carryout practicals.	Determine the Coriolis component of acceleration

	line motion mechanisms made up of turning pairs 6.7 Explain the exact straight line motion consisting of one sliding pair – Scott Russell's mechanism 6.8 Solve problems in 6.1 to 6.7.					
	General Objective 7.0: Understand the static and dynamic force acting on mechanisms					
14 – 15	7.1 Determine the forces including inertia acting on a mechanism 7.2 Explain the concept of static equilibrium 7.3 Analyze a two-force member sliding friction force 7.4 Differentiate between mass and weight 7.5 Explain Center of Gravity 7.5 Define mass moment of inertia of basic shapes 7.7 Solve problems in 7.1 to 7.6	Explain activities 7.1 to 7.7	Marker, white board, Duster, projector, slider and crank, cylinder, thin disk, rectangular block textbooks, etc.	Demonstrate how forces act on a mechanism	Guide students to carryout practicals.	Determine mass moment of inertia of basic shapes

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Fundamentals of Automotive Technology II**

COURSE CODE: **MCE 214**

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

CREDIT UNIT: **3.0**

Course: Fundamentals of Automotive Technology II	**Code: MCE 214**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hour/Week
Semester: Third	**Pre-requisite: MCE 121**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to equip students with the basic knowledge of fuel supply system, braking system and tyres		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Understand the petrol engine fuel supply system
2	Know the Diesel Fuel Systems
3	Appreciate the concept of electric vehicle
4	Understand the concept of braking system
5	Know the concept of automobile tyres

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONIC ENGINEERING TECHNOLOGY						
COURSE: FUNDAMENTALS OF AUTOMOTIVE TECHNOLOGY II			**Course Code: MCE 214**		**Contact Hours 1-0-2 Hours/Week**	
Goal: This course is designed to equip students with the basics of fuel supply system, braking system and tyres						
General Objective 1.0: Understand the petrol engine fuel supply system						
Course Specification: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Define the fuel supply system. 1.2 Explain petrol engine fuel system. 1.3 State the functions of the various elements of fuel supply system. 1.4 Explain the Design and operation of a simple carburator. 1.5 Explain the operating principle of the fuel injection system.	Explain the activities in 1.1 to 1.5	Textbooks, whiteboard, Functioning and non-functioning fuel units, Fuel filters, Gauges, transmitters, Fire extinguishers, Hand tools, Service manuals, Carburetor chart, Carburetor, injector, injector cleaners, clean towel, brush, simulators. etc.	Dismantle and assemble a typical fuel system. Identify common filter and gauge faults and rectify them. Carry out cleaning of a dirty carburetor. Carry out cleaning of clogged injector nozzle.	Guide students to carryout practicals.	State the functions of the various elements of fuel supply system. Differentiate between fuel injection system and a carburator.
General Objective 2.0: Know the Diesel Fuel Systems						

4-5	2.1 Explain the elements of a diesel fuel systems circuits. 2.2 State the functions of the various parts/elements in the systems. 2.3 Draw a simple circuit of diesel fuel system. 2.4 Explain the circuit Principles of diesel fuel system.	Explain activities in 2.1 to 2.4	Textbooks, Whiteboard & Maker, duster, lecture notes, Diesel fuel system circuit, CBT Workshop Manual etc.	Identify the elements of diesel fuel systems circuits. Draw the circuit of diesel fuel systems. Demonstrate the functions and principles of the various parts/elements in the system.	Guide students to carryout practicals.	Dismantle the diesel fuel system circuit with all the component parts.
General Objective 3.0: Appreciate the concept of electric Vehicles						
6-7	3.1 Explain the principle of Electric vehicles. 3.2 State the functions of batteries and their charging. 3.4 State the effects of using electric vehicles on air pollution. 3.5 State examples of some common electric vehicles manufacturers. 3.6 Describe the process of developing battery bank.	Explain activities in 3.1 to 3.6	Textbooks, Whiteboard & Marker, duster, Lithium-ion batteries, lecture notes, CBT Workshop Manual etc.	Demonstrate the process of battery charging Illustrate how a typical electric vehicle functions. Couple a battery bank from small pieces of Li-Fe-Po batteries.	Guide students to carry out practicals.	Perform coupling of battery bank.
General Objective 4.0: Understand the concept of braking systems						
8-12	4.1 Explain the purpose of brake systems in	Explain activities in 4.1 to 4.11.	Textbook, lecture notes,	Identify the different component parts of the brake	Guide students to carryout practicals.	Dismantle and reassemble a

	automobile. 4.2 Define pressure, friction and Pascal's principles in relation to brake system. 4.3 Explain the types of brake fluids, e.g. Dot 3 and Dot 4. 4.4 Analyse the characteristics of brake fluids. 4.5 Classify the various brake systems in automobile. 4.6 Explain antilock brake system (ABS). 4.7 Highlight the purposes of ABS. 4.8 Explain different types of ABS system. 4.9 List major ABS components and explain their functions. 4.10 Explain the principles of operation of the ABS. 4.11 Explain the relationship between ABS and normal brake system		whiteboard, marker, duster, Duo check equipment, complete brake system of a motor vehicle, brake fluids and Hand tools, a car fitted with ABS or ABS trainer etc.	system in a motor vehicle. Trace faults in brake system. Dismantle, service and reassemble master cylinder. Dismantle, service and reassemble disc and drum brake systems. Carry out bleeding of the hydraulic brake system. Identify components of an ABS system. Dismantle, inspect and reassemble ABS system. Trace and rectify fault in an ABS system.		hydraulic brake system. Explain the safety feature associated with ABS.
General Objective 5.0: Know the concept of automobile tyres						

13-15	5.1 Identify types of tyres and wheels. 5.2 State the purpose of rims/tyres. 5.3 Describe the construction of tyres and state the rims/tyre sizes and marking. 5.4 Distinguish between tyre designs e.g. radial, cross-ply and tubeless tyres. 5.5 Describe tyre servicing such as standard tyre pressure gauging, vulcanizing, wheel balancing and alignment.	Explain activities in 5.1 to 5.5	Marker White board, Duster, textbooks Models of wheel/rim and tyres, compressor, tyre patch tools, wheel balancing and alignment machines, Crew/hydraulic jack, wheel spanners/ pneumatic wrenches, Lecture notes etc.	Show tyre thread pattern and rims/tyre sizes and markings. Carryout wheel balancing. Carryout tyre inflation and fitting. Carryout wheel alignment exercise using computerized alignment gauge.	Guide the students to carry out practicals. .	Carry out complete wheel servicing process.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Control System 1**

COURSE CODE: **MCE 215**

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

CREDIT UNIT: **3.0**

Course: Control System 1	**Code: MCE 215**	**Total Hours: 3Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Third	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: This course is designed to acquaint students' with basic knowledge on control system.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know the general concepts of control
2	Understand the composition and formulation of control system block diagram
3	Understand the derivation of transfer functions of control elements/systems.
4	Appreciate the components and transducer commonly used in Control systems
5	Understand the simplification of block diagram of a complex system
6	Know time response of first and second order control systems and their applications
7	Understand frequency response of a linear control system element

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
	Course: Control System I		**Course Code: MCE 215**		**Contact Hours: 1/0/2**	
Goal: This course is designed to acquaint students' with basic knowledge on control system.						
	Course Specification: Theoretical Content			**Practical content**		
WEEK	**General Objective:1.0 Know the general concepts of control systems**					
	Specific Learning Outcome	**Teachers Activities**	**Resources**	**Specific Learning outcome**	**Teachers Activities**	**Evaluation**
1-2	1.1 Outline the common features of control systems 1.2 Give typical example of control systems in: Engineering, Medical Sciences and Management Sciences 1.3 Explain open loop and closed loop control systems. 1.4 Give typical examples of systems listed in 1.3.	Explain activities in 1.1 to 1.4	Writing materials, textbooks, Magnetic writing boards, lecturer notes.	-	-	State examples of control system in engineering fields
	General Objective 2.0 Understand the composition and formulation of control system block diagram.					
3-4	2.1 Explain the following composition of an open-loop system:- i. Reference signal or input signal ii. Process or plant iii. Controlled output 2.2 Explain the following composition of a simple closed loop system:- i. Reference signal or input signal; ii. Process or plant	Explain activities in 2.1 to 2.3	Writing materials, textbooks, lecturer notes, magnetic writing board.	-	-	Draw block diagram of simple closed loop control system

	iii. Control output iv. Feedback signal v. Comparator or Summing element vi Error signal or actuating signal 2.3 Draw block diagrams of some engineering control systems, e.g.:-Water – level Control system: Refrigerator and air –conditioner.					
	General Objective 3.0 Understand the derivation of transfer functions of control elements/systems.					
5-7	3.1 Define transfer function of control system. 3.2 Explain the general methods of deriving the differential equation of a given control element e.g. RC passive network. 3.3 Derive transfer function in the plane (Laplace transform), for the following systems. i. RC, RL, RLC Circuits ii. Potentiometer iii. Active networks involving operational amplifier iv. Field controlled and armature-controlled motors	Explain the activities in 3.1 to 3.3.	Writing materials, recommended textbooks, lecturer notes, magnetic board	-	-	Explain transfer function of a control system.

	v. D.C generator vi. Simple mass-spring damper system, vii. Simple gas system. viii. Thermal system ix. Hydraulic system x. Pneumatic system xi. Complex systems xii. Single-capacity system xiii. Multi-capacity system					
	General Objective 4.0 Appreciate the Components of transducer commonly used in Control systems.					
8-9	4.1 Explain the principle of operation and characteristics of the following as control elements: i. resistive and inductive potentiometers; ii. Linear variable differential iii. transformer; iv. Tachogenerator; v. Thermocouple and resistance vi. thermometers vii. Strain gauges; viii. Thermistor ix. Photo resistor, x. Photo-diodes, xi. photo- transistors xii. Magnetic amplifiers. 4.2 State the field of application of the Components in 4.1 above.	Explain the activities in 4.1 to 4.2	Writing material, textbooks lecture notes, magnetic writing board, LVDT, tachogenerator, strain gauges, thermometers, etc.	Identify different control element.	Guide students to conduct practicals.	Mention the control element used in control system.
	General Objective 5.0 Understand the simplification of a block diagram in a complex system					

10-12	5.1 Explain with a block diagram, the canonical form of a feedback control system. 5.2 Derive expressions for the following: - i. Closed –loop transfer function; ii. Primary feedback; iii. Error ratio; iv. Characteristic equation. 5.3 Explain the following transformation theorems: - i. Blocks in Cascade; ii. Blocks in parallel; iii. Moving a summing point, a head of a point; iv. Moving a summing point behind a block; v. Moving a takeoff point ahead of a block; vi. Moving a takeoff point behind a block; vii. Reducing a feedback loop. 5.4 Apply transformation theorems to reduce complex block diagrams. 5.5 Derive the transfer function of the reduced block diagram in 5.4 above. 5.6 Derive the output signal of a control system with more than one input. 5.7 Derive error ratio (ε) from a	Explain the activities in 5.1 to 5.7	Magnetic writing board, Writing materials, textbooks, and lecturer notes, drawing materials.	-	-	How do you reduce complex block diagrams to simple block diagram using the transformation theorem?

	given close loop control system.					
	General Objective 6.0 Know time response of first and second order control systems and their applications.					
13-15	6.1 Explain time response of a control system as a combination of transient and steady state response. 6.2 Define the type of test signals used for time response i.e. i. Step ii. Ramp iii. Impulse iv. parabolic v. Sinusoidal. 6.3 Classify control systems according to type, order and class. 6.4 Derive the time response of a first order system to signals in 6.2 (i) to (iii). 6.5 Sketch the output response of first order systems to input in 6.2 (i) to (iii). 6.6 Derive the time response of a second order system to a step input 6.7 Sketch output response of a second order system to a step input. 6.8 Explain using the sketch in 6.7, the following terms; i. Overshoot ii. Period of damped	Explain the activities in 6.1 to 6.11	Writing materials, lecturer notes, magnetic board, textbooks, control trainers.	Carry out experiment to determine the time response of first and second order control systems.	Guide students to conduct the practical.	What are the test signals used in time response?

	oscillation; iii. Rise time; iv. Settling time. 6.9 Define damping ratio. 6.10 State the effects of different values of damping ratio on the response in 6.7 above. 6.11 Explain the standard transfer function of a second over system.					

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**
COURSE TITLE: **Hydraulics and Pneumatics Systems**
COURSE CODE: **MCE 216**
DURATION: **30 Hours (1 Hour Lecture and 1 Hour Practical)**
CREDIT UNIT: **2.0**

Course: Hydraulics and Pneumatics Systems	**Code: MCE 216**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: 4	**Pre-requisite: NIL**	**Practical hours: 1 Hour/Week**
Goal: The course is designed to acquaint students with the basic concepts of electrical circuits, devices and networks**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the basic concepts of hydraulic and pneumatic systems
2	Appreciate the Elements of the Hydraulic System
3	Understand Fundamentals of Pneumatics
4	Know the Pneumatic Elements
5	Understand the Hydraulic and Pneumatic Circuits

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Hydraulics and Pneumatics Systems		**COURSE CODE:MCE 216**		**CONTACT HOURS: (1-0-1)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the basic concepts of electrical circuits, devices and networks.						
General Objective 1.0: Understand the basic concepts of hydraulic and pneumatic systems						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 State the basic concepts of fluid power 1.2 Classify Fluid Power Systems 1.3 Describe the concept of hydraulic and pneumatic 1.4 Define the following; • Hydrostatic and hydrodynamic • properties of fluid, • Pascal's law, 1.5 Explain the Continuity equation and Bernoulli's equation 1.6 Describe the components of; • Hydraulic System • Pneumatic System 1.7 Differentiate between Hydraulic and Pneumatic Systems 1.8 Explain the properties of compressed air 1.9 Describe the pneumatic	Explain activity 1.1 to 1.11with detailed notes	White board and markers, Recommended textbooks, etc.	-	-	Explain the properties of compressed air

	equipment economy. 1.10 State equation of gases 1.11 Describe the following; • Compressed air properties. • State equation of gases • Compressed air production • Compressed air supply • Compressed air preparation 1.11 Describe the advantages and limitations of hydraulic and pneumatic systems.					
GENERAL OBJECTIVE 2.0: Appreciate the Elements of the Hydraulic System						
3-4	2.1 Explain the following in hydraulic Pipes; • Type, materials • Designations • Pressure ratings • Selection criteria 2.2 Explain the concept and rules/norms of the piping layout 2.3 Explain the following for the hydraulic pump; • Type • Construction	Explain the activities in 2.1 to 2.6 with detailed notes.	Whiteboard and markers, duster, recommended textbooks	Demonstration of various hydraulic devices/elements.	Demonstrate the task to the students	Explain the working of the hydraulic pump

	• Working applications • Selection criteria 2.4 Explain the following for the control valves; • Type • Designation • Symbols • Working • Applications 2.5 Explain the following for the hydraulic actuators; • Type • Working • Applications 2.6 Explain other elements such as filters, manifold, receivers, coolers and connecters.					
GENERAL OBJECTIVE 3.0 Understand Fundamentals of Pneumatics						
5 –7	3.1 Explain the following concepts; • Compressible fluid flow, • Mass flow rate, • Types of compressible fluid 3.2 Explain the principles of pneumatics systems 3.3 Describe the structure of the pneumatic systems 3.4 Explain the pneumatic system circuit diagram 3.5 Explain the direct actuation of cylinders	Explain activities in 3.1 to 3.5 with detailed notes	White board, markers duster, recommended textbooks	Demonstration of various pneumatic devices/elements	Demonstrate the task to the students	Explain the principles of pneumatics systems

GENERAL OBJECTIVE 4.0: Know the Pneumatic Elements						
8 - 9	4.1 List the types of pneumatic pipes 4.2 Describe the designations, applications and properties of pneumatic pipes. 4.2 Explain the working and selection criteria for the reciprocating and rotary air compressor 4.2 List the types of pneumatic cylinders. 4.3 Explain the following for the pneumatic cylinder; • Symbol • Cushion • Assemblies • Mounting and installation 4.4 List the types of air motors 4.5 Explain the working principle and applications of air motors. 4.6 List the types of pneumatic valves 4.7 Explain the symbols, working, applications and selection criteria for the pneumatic	Explain the activities in 4.1 to 4.9 with detailed notes	White board, markers duster, recommended textbooks		Demonstrate the task.	Explain the working principle of air motors.

	valves 4.8 Explain the following elements of the pneumatic system; • Air Receivers • Filters • Pressure Regulator • Lubricator					
GENERAL OBJECTIVE 5.0: Understand the Hydraulic and Pneumatic Circuits						
10 -12	5.1 Explain the concepts of hydraulic and pneumatic circuits 5.2 Explain the meaning and ISO symbols 5.3 Explain basic hydraulic and pneumatic circuits-type 5.4Explain the following circuit diagrams; • Circuit Diagram for one cylinder • Direct and Indirect Actuation • Circuit Diagram for two cylinders 5.5 State the Rules/ Norms for designing hydraulic and pneumatic circuits.	Explain the activities in 5.1 to 5.5 with detailed notes	White board, markers duster, recommended textbooks	Operate hydraulic circuits based on simple system requirement Operate, pneumatic circuit based on simple systems requirements (at least 3)	Guide students to conduct the practicals	Compare hydraulic and magnetic circuits

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Electric Drives and Control**

COURSE CODE: **MCE 217**

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

CREDIT UNIT: **2.0**

Course: Electric Drives and Control	**Code: MCE 217**	**Total Hours: 2Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Third	**Pre-requisite: MCE 111**	**Practical hours: 1 Hour/Week**
Goal: The aim of this course is to equip the students with the knowledge of electric drives and control.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the fundamental principles of Electrical Drives
2	Understand the basic concepts of Electric Drives
3	Understand Concept of Starters for Motors
4	Appreciate Speed Control in Motors
5	Understand Motor Circuits and Control

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Electric Drives and Control		**COURSE CODE:MCE 217**		**CONTACT HOURS: (1-0-1)HOURS/WEEK**		
Goal: The aim of this course is to equip the students with the knowledge of electric drives and control.						
General Objective 1.0: Understand the fundamental principles of Electrical Drives						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 State the major energy conversion principles. 1.2 Derive the general energy balance equation applicable to all situations. 1.3 Represent by suitable block diagrams the energy balance equation. 1.4 Derive induced voltage and electrical energy input in singly excited systems. 1.5 Derive the energy in the magnetic field of a singly excited system. 1.6 Derive the mechanical force in the system in 1.5 above. 1.7 Derive energy balance equation. 1.8 Develop the dynamic equation of singly excited electro-mechanical system. 1.9 Solve problems involving	Explain activity 1.1 to 1.14 with detailed notes	White board and markers, textbooks, Industrial loads.	-	-	Explain the Multi-motor drive

	1.2 to 1.7 above. 1.10 Perform an experiment to show the conversion of energy in singly excited systems. 1.12 Explain electric Braking in DC motors 1.13 List the types of breaking in DC motors 1.14 List the applications of breaking in DC motors					
COURSE SPECIFICATION 2.0: Understand the basic concepts of Electric Drives						
3-5	2.1 Define Electric drives 2.2 Describe the basic elements of electric drives 2.3 List the factors influencing the choice of electrical drives 2.4 Classify electric drives with the factors in 2.3 2.5 Explain the following; • Group drive • Individual drive • Multimotor drive 2.6.Describe the load conditions in motor 2.7 List types of motor loads 2.8 List different type of industrial loads 2.9 Explain the heating and cooling curves 2.10 List the classes of	Explain the activities in 2.1 to 2.11 with detailed notes.	Whiteboard and markers, duster, textbooks, Different loads.	Identify the different motors Loads	Guide the students to carry out the experiment	Explain electric braking in DC shunt motor

	motor duty 2.11 Explain the following; -Continuous duty and constant load -Continuous duty and variable load -Short time rating of Motor					
GENERAL OBJECTIVE 3.0 Understand Concept of Starters for Motors						
6–8	3.1 Explain the concept of Starting Methods 3.2 State the Prime Purpose of Starters for Motors 3.3 List the protective devices in A Dc/Ac motor starter 3.4 Define DC motor starter 3.5 Describe the following starters; • Two Point Starter • Three Point Starter • Four Point Starter 3.6 Describe the AC starters 3.7 Explain the following; • Necessity for Starter • Prime Purpose of Motor starter • Need for Starter in an Induction Motor 3.8 Describe the following starters; • D.O. L Starter • Stator Resistance	Explain activities in 3.1 to 3.8 with detailed notes	White board, Whiteboard and markers, duster, textbooks. different starters	Identify and study of different types of starters	Guide the students to carry out the experiments	List the motor protective devices

	(Or) Primary Resistance Starter • Primary Reactance Starter (Or) Auto Transformer Starters • Star –Delta Starter • Rotor Resistance Starters					
GENERAL OBJECTIVE 4.0: Appreciate Speed Control in Motors						
9 –11	4.1 Explain the basic concept of speed control of drives 4.2 Explain the solid state speed control of DC and AC drives 4.3 Derive the expression for speed for a dc motor 4.4 Explain the conventional methods of speed control 4.5.Describe the speed control of the following motors; • DC Shunt Motors • DC Series Motors 4.6 Explain the speed control of three phase induction motor	Explain the activities in 4.1 to 4.6 with detailed notes	Whiteboard and markers, duster, textbooks, DC motors, speed control module,	Carry out experiment to test the firing circuit of three phase half controlled bridge converter. Carry out experiment to obtain the speed control of dc shunt motor by armature Control Carry out experiment to obtain the speed control Of DC Shunt Motor By Armature Control	Guide the student to carry out the experiments	What is purpose of DC motor speed control
GENERAL OBJECTIVE 5.0: Understand Power Electronics Control of A.C. / D.C. Motors						
12-15	5.1 Explain the speed control of dc motors employing 3-phase full-wave controlled rectifier circuits 6.2 Describe the speed control of DC motors	Explain the activities in 6.1 and 6.6 with detailed notes	Whiteboard and markers, duster, textbooks, Power electronics trainer, DC	Perform an experiment to study the working of 1-phase full-wave inverter circuit Perform an experiment to study the working of 3-	Guide the student to carry out the experiments,	Explain the speed motor control circuit

	employing 1-phase fully controlled circuit, with the help of circuit & waveform 6.3 Draw circuit for a 3-phase fully phase controlled, 4-quadrant speed control of DC motors 6.4 Draw circuit & waveform for 3-phase AC variable output voltage employing semi-conductor devices 6.5 Draw circuit & waveform for 3-phase AC variable frequency circuits employing semi-conductor devices 6.6 Explain the methods employing SCRs & diodes for 3-phase variable voltage, variable frequency (AC to AC conversion) as applied to induction motor speed control, using circuits, & waveform		motor, speed control module.	phase full-wave inverter Perform an experiment to study the 3-phase full-wave control circuit for DC motors		

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Introduction to CNC Machines**

COURSE CODE: **MCE 218**

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

CREDIT UNIT: **3.0**

Course: Introduction to CNC Machines	**Code: MCE 218**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hour/Week
Semester: Third	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the concepts, workings and programming of Computer Numerical controlled (CNC) Machines.		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Understand the basic concept of CNC machine
2	Know CNC machines construction and tooling
3	Understand CNC System Devices
4	Appreciate CNC Part Programming
5	Understand the Problems in CNC Machines

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Introduction to CNC Machines		**COURSE CODE:MCE 218**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with concepts and working and programming of the Computer Numerical Controlled (CNC) Machines.						
General Objective 1.0: Understand the basic concept of CNC Machine						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1- 3	1.1 Define CNC machine 1.2 Describe the working principles of CNC machine 1.3 Explain the basic Elements of a CNC Machine 1.4 Describe the parts of CNC Machine 1.5 Explain the types of CNC Machines 1.6 Differentiate between CNC and NC Machines 1.7 Describe the main CNC machining processes 1.8 Describe CNC Axes identification. 1.9 Describe the CNC cutting tools and tool materials 1.10 Explain the process of selecting components for CNC machining.	Explain activities in 1.1 to 1.10 with detailed notes	White board and markers, textbooks, etc.	Identify the constructional details of CNC lathe machine. Demonstrate constructional details of CNC milling machine.	Guide students to carryout practicals	Explain the types of CNC Machines Explain the selection of components for CNC machining
GENERAL OBJECTIVE 2.0: Know CNC machines construction and tooling						

4 - 6	2.1 Explain the Design features and specifications of CNC machines. 2.2 Describe the use of sideways, balls, rollers and coatings. 2.3 Explain the following: • Motor and leadscrew • Swarf removal • Safety and guarding devices 2.4 Describe the various cutting tools for CNC machines. 2.5 Explain the concepts of CNC tool holder, different pallet systems and automatic tool changing system. 2.6 Explain the tool room Management	Explain the activities in 2.1 to 2.6 with detailed notes.	Whiteboard and markers, duster, textbooks, CNC lathe and milling trainers.	Demonstrate the use of slideways, balls and rollers. Perform an experiment with various CNC machine cutting tools.	Guide students to carryout practicals.	Explain the concept of CNC tool holder
GENERAL OBJECTIVE 3.0:Understand CNC System Devices						
7–9	3.1 Explain open loop and closed loop control system. 3.2 Explain the concept of Actuators and its application to the CNC machine 3.3 Explain transducers and sensors its application to the CNC machine 3.4 Explain tachometer,	Explain activities in 3.1 to 3.5 with detailed notes	White board, markers duster, textbooks	-	-	Explain open loop and closed loop control system Explain the use of potentiometers for encoding and decoding.

	LVDT, opto-interrupters and their applications to the CNC machine 3.5 Explain the use of potentiometers for linear and angular position encoder, decoder and axis drives.					
GENERAL OBJECTIVE 4.0: Appreciate CNC Part Programming						
10 -12	4.1 Define CNC Part programming 4.2 Explain the concept of part programming 4.3 Describe the following; • NC words • Part programming formats • Simple programming for rational components 4.4 Explain part programming using canned cycles, subroutines and do loops. 4.5 Explain the following; • Tool off sets • Cutter radius compensation • Tool wear compensation 4.6 Explain the following programming functions; • G-Code • M-code • "S" command • Feed rate	Explain the activities in 4.1 to 4.9 with detailed notes	White board, markers duster, textbooks, Mastercam,	Develop a part program for the following lathe operations and make the jobs on CNC lathe: • Plain turning and facing operation. • Taper turning operation. • Circular interpolation. Develop a part program for the following milling operation and make the job on CNC milling: • Plain milling. • Slot milling. • Contouring. • Pocket milling. Prepare a work instructions for machine operator. Use software for Turning and Milling operation on CNC Turning and Milling	Guide students to carryout practicals.	Explain the G-code function

	• Tool number • Tool length offset call up 4.7 Compare Manual Programming vs CAM vs Conversational 4.8 Compare mill vs lathe Programming 4.9 Describe the Mastercam			Machine Center.		
GENERAL OBJECTIVE 5.0: Understand the Problems in CNC Machines						
13 -15	5.1 List the common Problems with CNC Machine Tools 5.2 Explain the common problems in CNC machines related to mechanical, electrical and pneumatic and Electronic components. 5.3 State the common problems and remedies of CNC machines. 5.4 Explain the use of on-time fault finding diagnosis tools in CNC machines	Explain the activities in 5.1 to 5.4 with detailed notes.	White board, markers duster, textbooks, Mastercam, etc.	Prepare preventive maintenance schedule for CNC machine.	Guide the students to carryout practicals.	Explain the common problems in CNC machines related to mechanical and electrical components

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Emerging Mechatronics & Automation Technologies.**

COURSE CODE: **MEC 219**

DURATION: **30 Hours (1 Hour Lecture and 0 Hour Practical)**

CREDIT UNIT: **1.0**

Course: Emerging Mechatronics & Automation Technologies **Semester: Third**	**Code: MCE 228** **Pre-requisite: MEC 115 & MEC 125**	**Total Hours: 1Hours/Week** **Theoretical hours: 1 Hours/Week** **Practical hours: 0 Hour/Week**
Goal: The course is designed to acquaint students with the fundamental knowledge of C programming**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Appreciate Micro Electro-Mechanical Systems
2	Understand Fundamentals of Artificial Intelligence
3	Appreciate Image Processing and 3-D Printing
4	Understand Haptic Interfaces
5	Appreciate Nanotechnology
6	Know the Applications of Mechatronics & Automation in Medicine

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Emerging Mechatronics & Automation Technologies			**COURSE CODE:MCE 219**		**CONTACT HOURS: (1-0-0)HOURS/WEEK**	
Goal: The course is designed to acquaint students with the programming using C and Python Languages.						
General Objective 1.0: Appreciate Micro Electro-Mechanical Systems						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define Micro Electro-Mechanical systems (MEMs) 1.2 Explain the general concept of MEMs. 1.3 State the advantages of MEMs 1.4 Explain the fabrication of MEMs 1.5 Explain the economy of MEMs manufacturing 1.6 List the applications of MEMs	Explain activity 1.1 to 1.6	White board and markers, textbooks, etc.	-	-.	Explain the general concept of MEMs.
GENERAL OBJECTIVE 2.0: Understand Fundamentals of Artificial Intelligence						
3-4	2.1 Define artificial Intelligence 2.2 Explain the general concepts of artificial intelligence	Explain the activities in 2.1 to 2.6	Whiteboard and markers, duster, textbooks	-	-	Explain the general concepts of artificial intelligence

	2.3 List the features of an Intelligent system 2.4Explain the features listed in 2.3. 2.5 Explain the different tests/approaches in artificial intelligence; i. Agents and abstraction ii. Searching and states 2.6 List the applications of artificial intelligence.					
GENERAL OBJECTIVE 3.0 Appreciate Image Processing and 3-D Printing						
5 –7	3.1 Define image processing 3.2 Explain the concepts of images, points, pixels and functions 3.3 Explain histogram analysis and mapping 3.4 Explain filtering in image processing. 3.5 List the applications of image processing and 3.6 Define 3-D printing 3.7 Explain the concept of 2-D and 3-D 3.8 Explain the tools used for 3-D designing / Printing	Explain activities in 3.1 - 3.10	White board, markers duster, recommended textbooks	-	-	Explain filtering in image processing. Explain the tools used for 3-D designing / Printing

	3.9 Explain the application Software(s) for 3-D designing / Printing 3.10 List the applications of 3-D printing					
GENERAL OBJECTIVE 4.0: Understand Haptic Interfaces						
10 -12	4.1 Explain the basic concepts of haptic interfaces 4.2 Explain the existing application of haptic 4.3 Explain the methods for sensing the position of and actuating haptic interfaces 4.4 Explain the salient features of haptic device design 4.5 List types of haptic interfaces Character 4.6 Explain the types of hepatic interfaces in 4.5	Explain the activities in 4.1 to 4.6.	White board, markers duster, textbooks	-	-	Explain the methods for sensing the position of and actuating haptic interfaces
GENERAL OBJECTIVE 5.0: Appreciate Nanotechnology						
	5.1 Explain the basics and history of Nanotechnology. 5.2 Explain nano-scale electronics	Explain the activities in 5.1 to 5.5.	White board, markers duster, textbooks	.	.	Explain nano-scale electronics.

	5.3 Explain Magnetism on Nano-scale 5.4 Explain Nano-scale materials and photonics 5.5 List the applications of Nano technology.					
GENERAL OBJECTIVE 6.0: Know the Applications of Mechatronics & Automation in Medicine						
	6.1 List the mechatronic applications in medicine: 6.2 Explain the mechatronics and automation applications in; i. Magnetic Resonance Imaging Scanning (MRIs) ii. Neurosurgery iii. Urological surgery and orthopedics iv. High intensity focused ultrasound v. Blood sampling 6.3 Explain the simple procedures I each of the applications in 6.2	Explain the activities in 6.1 to 6.3.	White board, markers duster, recommended textbooks	-	-	Explain the Magnetic Resonance Imaging Scanning (MRIs) procedure.

YEAR TWO SEMESTER TWO COURSES

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Digital Electronics**

COURSE CODE: **MCE 221**

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

CREDIT UNIT: **2.0**

Course: Digital Electronics	**Code: MCE 221**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Fourth	**Pre-requisite: NIL**	**Practical hours: 1 Hour/Week**
Goal: To familiarize the students with the Basic Digital Electronics and Devices		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand Number Systems in Digital System.
2	Know the different codes used in digital systems.
3	Understand the Simple Combinational Logic Circuit
4	Know the Various Minimization Methods.
5	Understand the basic principles and Applications of Flip-flops
6.	Understand integrated circuit (IC) technologies

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
Course: DIGITAL ELECTRONICS	**Course Code MCE 221**				**Contact Hour:1-0- 1 Hrs/Week**	
Goal: To familiarize the students with the Basic Digital Electronics and Devices						
General Objective 1.0: Understand Number Systems in Digital System						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcome**	**Teachers Activities**	**Learning Resources**	**Specific Learning Outcome**	**Teachers Activities**	**Evaluation**
1-2	1.1 Define analog and digital quantities 1.2 State in a tabulated form the merits and demerits of analog and digital quantities 1.3 Define basic terms related to digital electronics 1.4 Define digits of a number. 1.5 Explain the base of a number. 1.6 List the number of digits of figures available in various number systems: - Base 10 Base 8 Base 2 Base 16 1.7 Outline the significance of weighting of digits in a number system. 1.8 Convert other number systems to decimal and vice-versa.	Explain activity 1.1 to 1.12 with detailed notes	Whiteboards, writing materials, lecturer notes, recommended textbooks, magnetic writing board and calculator.	-	-	Explain why binary number system is used in digital system.

	1.10 Explain why binary number system is used in digital system. 1.11 State the special relationship between binary, octal and hexa-decimal. 1.12 Explain the advantages of octal and hexa-decimal over the binary data.					
General Objective 2.0 Know the Different Codes Used in Digital Systems						
3-4	2.1 Explain the following binary operations; addition, subtraction, multiplication, and division. 2.2 Explain signed Binary number system. 2.3 Explain the different between the representation of positive and negative numbers. 2.4 Define 'N's complement where N is any number. 2.5 Perform addition and subtraction using 1's complement. 2.6 Explain the limitation of 1's complement. 2.7 Explain 2's complement. 2.8 Perform addition and subtraction using 2's complement.	Explain activity 2.1 to 2.11 with detailed notes	Writing materials, Lecture notes, recommended textbooks, magnetic writing board, calculator Digital circuit construction deck with accessories, Basic logic IC logic gates, PDC power supply.	Demonstrate practically the binary operations of the BCD, Excess-3, Gray codes and Seven segment display code.	Guide students to carry out the experiment.	Explain signed Binary number system.

	2.9Identify fixed point and floating point numbers. 2.10 Explain the mantissa and characteristics of a floating-point number. 2.11 Describe the various binary based codes: - i. BCD code ii. Excess-3 code; iii. Gray codes; iv. ASC II code; v. Seven –segment display code.					
General Objective 3.0: Understand the Simple Combinational Logic Circuit						
7-8	3.1 Define the combinational logic circuit 3.2 Explain the principle of operation of combinational logic. 3.3 Write down a logical sum of product equations. 3.4 Describe the operation of all basic logic gates. 3.5 Describe the operation of XOR and ENOR logic. 3.6 Describe the timing diagrams. 3.7 Differentiate between TTL and CMOS gates 3.8 Draw circuit diagram that implements the equation of the; AND OR, NOT, NOR, Exclusive-OR and NOR functions.	Explain activity 3.1 to 3.10 with detailed notes	Writing materials, drawing materials textbooks, magnetic writing board, lecture notes, Digital circuit trainers practical notebook/logbooks, practical manuals	Perform experiment to verity the truth tables for AND, OR, NOT, NOR, NAND, XOR Gates ICs	Guide the students to carry out the experiment.	Explain the principle of operation of combinational logic.

	3.9 Explain the truth table 3.10 Draw the truth tables of the following gates; AND OR, NOT, NOR, Exclusive-OR and NOR					
General Objective 4.0 Know the Various Minimization Methods						
9-10	4.1 Describe the basic rules of Boolean logic statements. 4.2 Explain the use of De Morgan's theorem to simple Boolean expressions. 4.3 Explain how to convert truth tables to sum of products logic. 4.4 Define the Karnaugh map (k-map) 4.5 Explain the use of K-map to simplify logic statements containing no more than 4 variables. 4.6 Explain the use of NAND and NOR gates to implement any logic.	Explain activity 4.1 to 4.6 with detailed notes	Writing materials, recommended textbooks, magnetic writing board, lecture notes.	-	-	Explain how to convert truth tables to sum of products logic.
General Objective 5.0 Understand The Basic Principles and Applications of Flip-Flop						
	5.1 Define a latch and flip-flop 5.2 Differentiate between a latch and a flip-flop. 5.3 Explain how various types of flip-flops differ in operation. 5.4 Apply flip-flops in basic applications. 5.5Differentiate between synchronous and	Explain activity 5.1 to 5.7 with detailed notes.	Digital circuit trainers, electronic registers, notebook/logbooks, practical manuals	Carry our experiment to verify the functions of RS Flip-Flop Carry our experiment verify the functions of Clocked RS Flip-	Guide students to carry out the experiments.	Differentiate between synchronous and asynchronous operation

11-12	asynchronous operation. 5.6 Explain the basic counter and shift register 5.7 List applications of counters and shift register applications.			Flop Carry our experiment verify the functions of D Flip-Flop Identify and verify the functions of JK Flip-Flop		
General Objective 7.0 Understand integrated circuit (IC) technologies.						
13	6.1 Describe the noise margins for various devices. 6.2 Explain how propagation delay affects operating speed. 6.3 Explain the use and interpretation of data sheets. 6.4 Explain and determine fan-out for any device. 6.5 Differentiate between totem pole and open collector outputs. 6.7 Describe the operation of tristate devices.	Explain activity 6.1 to 6.6 with detailed notes	Writing materials, recommended textbooks, magnetic writing board, lecture notes.	-	-	Explain the use and interpretation of data sheets

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Automotive Electricity and Electronics**

COURSE CODE: **MCE 222**

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

CREDIT UNIT: **3.0**

Course: Automotive Electricity and Electronics **Semester: Fourth**	**Code: MCE 222** **Pre-requisites: MCE 211 & 217**	**Total Hours: 3 Hours/Week** **Theoretical hours: 1 Hours/Week** **Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the basic concepts of Automotive Electricity and Electronics.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the Automotive Starters Batteries
2	Know the Modern Automotive Charging System
3	Understand the Starting System Operational principles
4	Understand the Motor Vehicle Lighting System Principle
5	Understand Automotive Sensors And Actuators
6	Understand Automotive System Controls
7	Know modern automotive instrumentations

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Automotive Electricity and Electronics		**COURSE CODE:MCE 222**		**CONTACT HOURS: (1-0-0)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the basic concepts of Automotive Electricity and Electronics.						
General Objective 1.0: Understand the Automotive Starters Batteries						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 State the function and purpose of a battery. 1.2 Explain the construction of a lead-acid cell. 1.3 Explain the chemistry of charging and discharging processes. 1.4 Explain the process of Electrolyte preparation. 1.5 Explain battery charging process. 1.6 State and explain factors which affect battery life. 1.7 State general safety precautions when handling automotive batteries. 1.8 Explain modern procedures for batteries connection and disconnecting batteries to and from modern vehicles to avoid loss of stored system codes and information.	Explain activity 1.1 to 1.8 with detailed notes	White board and markers, Recommended textbooks, Battery charging kit, handheld battery tester etc.	Carryout battery charging process. Carryout battery capacity and functionality test. Demonstrate modern procedures for connecting and disconnecting batteries to and from modern vehicles to avoid loss of stored system codes and information.	Guide students to conduct practicals.	Differentiate between conductors, insulators and semiconductors,
GENERAL OBJECTIVE 2.0: Know the Modern Automotive Charging System						
	2.1 State the purpose of	Explain the	Whiteboard	Identify the charging	Guide students to	Explain a

3-4	the charging system 2.2 list components that make up the system. 2.3 Outline common types used in vehicles. 2.4 Describe the principles of generator operation. 2.5 Differentiate between generators and alternators. 2.6 Describe the dynamo 2.7 Mention the limitations of the dynamo. 2.8Explain a typical charging system circuit diagram. 2.9Explain the methods of carrying out functionality test of the system.	activities in 2.1 to 2.9 with detailed notes.	and markers, duster, textbooks, dynamo, starting system motor, non-functional charging system	system components Identify the symbols of various circuit components Identify and study the generator, motor and dynamo Identify a typical charging system of a modern vehicle, its components and Functions Carry out functionality test of the system. Dismantle, service and reassemble a modern alternator and test for functionality.	conduct practicals.	typical charging system
GENERAL OBJECTIVE 3.0 Understand the Starting System Operational Principles						
5 –7	3.1 State the function of the starting system 3.2 List the components that make up the system. 3.3 Describe the D.C motor principles of operation. 3.4 Describe the power, torque and current requirements for starting. 3.5Mention types of starter motors in use. 3.6 State common faults associated with the	Explain activities in 3.1 to 3.7 with detailed notes	White board, markers duster, textbooks, multimeter, non-functional starter.	Perform experiment on a single loop DC. Perform simple measurements in the starting system using electrical measuring tools Identify the starting system, its components and functions. Dismantle, service, reassemble and test a	Guide the students to perform experiments.	State common faults associated with the starting

	starting. 3.7 Describe the duration and frequency of use in the starting circuit.			typical. starter motor for functionality		
GENERAL OBJECTIVE 4.0: Understand the Motor Vehicle Lighting System						
8 - 9	4.1 Explain the need for the lighting system in vehicles. 4.2 Explain the legal requirements for an ideal lamp and their effects. 4.3 Explain reasons for the following: - • Writing of lamps in parallel. • Anti-dazzle controls. • Use of dipped and main beams. 4.4 Explain the need for: • Overload protection. • Fuses, their uses and Sizes. • Headlamp relays. 4.5 Explain the principle of direction indicating devices e.g. the flasher unit.	Explain the activities in 4.1 to 4.5 with detailed notes	White board, markers duster, textbooks,	Identify a typical lighting system circuits, its components and functions. Demonstrate fault tracing on lamp circuits.	Guide students to perform the experiments.	Explain the need for the vehicle lighting system
GENERAL OBJECTIVE 5.0: Understand Automotive Sensors And Actuators						
10 -12	5.1 Define; • Sensor • Actuator 5.2 Explain the operation of sensors and actuators.	Explain the activities in 5.1 to 5.7 with detailed notes	White board, markers duster, textbooks, Sensor and	Identify and study the following sensors; a. Mass airflow sensor b. Engine Speed Sensor c. Oxygen Sensor	Guide students to conduct the experiments.	Explain the operation of sensors and actuators.

	5.3 List the sensors and actuators for automotive applications 5.4 Explain the following; • Mass airflow sensor • Engine Speed Sensor • Oxygen Sensor • Spark Knock Sensor • Coolant Sensor • Manifold Absolute Pressure (MAF) Sensor • Fuel Temperature Sensor • Voltage sensor • Camshaft Position Sensor • Throttle Position Sensor • Vehicle Speed Sensor 5.5 Explain car sensors according to classification and Application 5.6 Describe Vehicle Electrical Actuators 5.7 Describe common automotive actuators 5.8 Describe the actuation type and principle in; • Steering wheel • Headrest • Seats • Rear view mirrors • Headlights • Lid of the gasoline deposit • Engine block		actuators.	d. Spark Knock Sensor e. Coolant Sensor f. Manifold Absolute Pressure (MAF) Sensor g. Fuel Temperature Sensor h. Voltage sensor i. Camshaft Position Sensor j. Throttle Position Sensor k. Vehicle Speed Sensor Identify the following actuators; a. Fuel Pump b. Injectors c. Fuel pressure Regulator d. Idle Speed Actuator e. Spark Plugs f. Ignition Coils g. Exhaust Gas recirculation h. Purge Solenoid Valve Control i. Cooling Fan Control j. Generator Current Control k. A/C compressor control l. Control Relay Control		

	• Trunk					
GENERAL OBJECTIVE 6.0: Understand Automotive System Controls						
	6.1 Explain control system input and output signals. 6.2 Define engine control system 6.3 Explain the following; • Fuel exhaust gas recirculation (EGR) • Electronic spark • Integrated engine control systems. 6.4 Describe the automotive Motion control systems.	Explain the activities in 6.1 to 6.4 with detailed notes	White board, markers duster, recommended textbooks	Identify component parts of an engine electronic control system. Identify motion Control mechanisms in vehicles	Guide students to carry out experiments.	Explain the Fuel exhaust gas recirculation (EGR)
GENERAL OBJECTIVE 7.0: Know modern automotive instrumentations						
	7.1 Explain modern vehicle; instrumentation; • Signal processing • Sampling • Sample period 7.2 Describe instrumentation For the following; • Fuel quantity • Coolant temperature • Oil pressure • Vehicle speed measurements 7.3 Describe Instrumentation for electronic display devices for trip information and engine diagnostic 7.5 Explain Instrument	Explain the activities in 7.1 to 7.4 with detailed notes	White board, markers duster, recommended textbooks	-	-	Explain the instrumentation for Fuel quantity

	Cluster					

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Mechatronics Technology and Practice**

COURSE CODE: **MCE 223**

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

CREDIT UNIT: **3.0**

Course: Mechatronics Technology and Practice **Semester: Fourth**	**Code: MCE 223** **Pre-requisite: MCE 115, MCE 125, MCE 217**	**Total Hours: 3 Hours/Week** **Theoretical hours: 1 Hours/Week** **Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the knowledge of mechatronics technology and practice		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know Basic Electronics
2	Understand Electronic Scale
3	Know the temperature controllers
4	Understand Cartridge Control
5	Understand the transducers Deployment
6	Understand The Concept Of Dc Motor Speed Control
7	Conduct Industry tour of mechatronic company

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE:		**COURSE CODE:MCE 223**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the knowledge of mechatronics technology and practice						
General Objective 1.0: Know Basic Electronics						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	6.3 Identify electronic components and instrumentation, i.e. light-controlled switch. 6.4 State the functions of light-controlled switch in controlling vehicle lighting components, (e.g. LDR, photo resistor) including Instrument cluster, fog light, headlamps, etc.	Explain activity 1.1 to 1.2 with detailed notes	White board and markers, Recommended textbooks, etc.	Demonstrate the use of light-controlled switch in controlling vehicle lighting components.	Guide the students to carry out the practical	State the functions of light-controlled switch in controlling vehicle lighting components.
GENERAL OBJECTIVE 2.0: Understand Electronic Scale						
3-4	2.1Define electronic scale 2.2 Use function generator to determine the input frequency of light-dependent resistor. 2.3 Explain the functions and uses of amplifiers.	Explain the activities in 2.1 to 2.3 with detailed notes.	Whiteboard and markers, duster, textbooks Oscilloscope, Photo Resistors, LDR, audio amplifier, speakers, lamps,	Carry out experiments to determine the input frequency of photo resistor, LDR, etc. Use oscilloscope to measure the characteristic features of the above mentioned semiconductor devices. Demonstrate the use of amplifiers as booster in	Guide the students to carry out the experiments.	Explain the operation of the light dependent resistor.

				speakers, sound systems, lamps, cooling system, etc.		
GENERAL OBJECTIVE 3.0 Know The Temperature Controller						
5 –7	3.1 Describe analog temperature controller. 3.2 Describe digital temperature controller. 3.3 State the differences between digital and analog temperature controllers. 3.4 State the advantages of the item in 3.2.	Explain activities in 3.1 to 3.4 with detailed notes	White board, markers duster, recommended textbooks	Demonstrate using star compact tool as a closed loop to find out the sensor and other related sensors, e.g. pre-heating devices, coil sensor, fuel sensor, tyre pressure sensor, ESP sensor, ABS, etc.	Guide the students identify carry out the practical.	Explain the digital temperature controller
GENERAL OBJECTIVE 4.0: Understand Cartridge Control						
8 – 9	4.1 Describe cartridge control 4.2 List the uses of the cartridge control. 4.3 Explain the functions of cartridge control. 4.4 Explain the cartridge valve operation 4.5 List the features of a cartridge valve 4.6 List the application of the cartridge valve	Explain the activities in 4.1 to 4.6 with detailed notes	White board, markers duster, textbooks	Demonstrate the use of Cartridge control mechanism to control side mirror, trafficator lamps, sun roof, central locking system, etc.	Guide the students to carry out the experiment.	Differentiate between the different network theorems
GENERAL OBJECTIVE 5.0: Understand the Transducers Deployment						
10 -12	5.1 Describe the importance of transducers. 5.2 Explain the application of transducers in; • Medical Diagnostic Equipment	Explain the activities in 5.1 to 5.6 with detailed notes	White board, markers duster, textbooks	Carry out checks to determine the amount of angular deviation on axle suspension to effect level control in wheel alignment system.	Guide the students carry out the experiments.	Explain the Calibration process. Explain the application of

	• Strain Gauges • Research Equipment • Measuring Distance • Air conditioning Heating and Ventilation Devices • Load Estimation of an Engine • Knock of the Engine • Leak Testing • Thermocouple • Pressure Level Indicators using Bourdon Tube 5.3 Explain the concept of calibration. 5.4 Identify the different types of transducer Calibration. 5.5Describe the use of potentiometer for angular rotation measurement. 5.6 Explain the use of the inclinometer to check wheel alignment			Demonstrate the use of potentiometer for angular rotation measurement. Demonstrate the		transducers in Medical Diagnostic Equipment
GENERAL OBJECTIVE 6.0: Understand The Concept Of DC Motor Speed Control						
	6.1 Explain dc motor. 6.2 Explain the importance of speed control in dc motor 6.3 Explain the DC speed control in; • control of motors used in traction for controlling speed of railway • control used in lifts	Explain the activities in 6.1 to 6.4 with detailed notes	White board, markers duster, textbooks	Carry out identification of dc motor, tachometer, and analog closed loop speed control. Demonstrate using a servo-mechanism of position control, e.g. in steering unit, electro-pneumatic/ hydraulic	Guide the students carry out the experiments.	Explain the importance of speed control in dc motor

	• speed of fan, blower as per requirement • of small household mixers and big industrial mixers. • control of power tools like drill machine, chap saw etc. • Electric crane, electric vehicle, robotics 6.4 Build a dc motor analog speed controller.			actuators and vehicle audio antenna, etc.		
GENERAL OBJECTIVE 7.0: Industry tour of mechatronic company						
	7.1 Identify Mechatronic Companies around. 7.2 Conduct industrial tour	Guide students to undertake an industrial tour	White board, markers duster, recommended textbooks	Identify Mechatronics Companies around. Conduct Industrial tour	Guide students to carryout industrial visit	Mention Mechatronics Companies around you.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Mechatronics Drafting**

COURSE CODE: **MCE 224**

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

CREDIT UNIT: **3.0**

Course: Mechatronics Drafting **Semester: Fourth**	**Code: MCE 224** **Pre-requisite: MEC 111, MCE 211**	**Total Hours: 3 Hours/Week** **Theoretical hours: 1 Hours/Week** **Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the knowledge of Mechatronics Drafting		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Know basic mechatronic drafting symbols
2	Understand the concept of computer aided drafting
3	Know How to Create Pneumatic and Hydraulic Control System Diagrams
4	Understand the concept of Electromechanical Drawings
5	Understand Ladder Logic Diagrams

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Mechatronics Drafting		**COURSE CODE:MCE 224**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the knowledge of Mechatronics Drafting						
General Objective 1.0: Understand job analysis						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Identify the following mechatronic drafting symbols; Control Valves; Actuators; Hydraulic components; Pneumatic components; Sources Actuators; Control Elements; Pumps; Gauges 1.2 Identify electronic components and instrumentation symbols.	Explain activity 1.1 to 1.2 with detailed notes	White board and markers, Recommended textbooks, etc.	Identify Mechatronics Drafting Symbols Identify electronic components and instrumentation symbols	Guide students to conduct the practicals	Use computer to draft the following: Control valves, pumps, gauges and actuators.
GENERAL OBJECTIVE 2.0: Understand the concept of computer aided drafting						
3-4	2.1 Explain the concept of computer aided drafting 2.2 Explain Instrumentation Drawings 2.3 Explain the concept of computer aided instrumentation drafting package. 2.4 Describe the drafting environment configuration, File menu,	Explain the activities in 2.1 to 2.10 with detailed notes.	Whiteboard and markers, duster, recommended textbooks	-	-	Explain the concepts of sequential flow diagrams (SFC)

	edit menu, view menu, Layout menu. 2.5 Describe the concept of the sequential flow diagrams (SFC) 2.6 Describe the sequential function charts 2.7Explain the following; • Creating/drawing SFC, • Configuration and animations using SFC, 2.8Describe the SFCs structure, control sequences, Functional Boxes. 2.9Describe the diagram Editor 2.10 Explain creating and editing diagrams using the following; • Inbuilt component libraries • Configuring the diagram editor • Simulation of a simple hydraulic/ pneumatic circuit					
GENERAL OBJECTIVE 3.0 Know How to Create Pneumatic and Hydraulic Control System Diagrams						
5 –7	3.1 Describe the hydraulic and pneumatic diagrams 3.2 Identify the control valves, gauges, actuators,	Explain activities in 3.1 to 3.3 with detailed notes	White board, markers duster, recommended textbooks	Identify control valves, gauges, actuators, sources, pumps, accumulators, proximity sensors	Guide the students to carry out the practicals	State the importance of hydraulic

	sources, pumps, accumulators, proximity sensors symbols 3.3 Create a pneumatic or hydraulic control system diagram using Microsoft Visio			symbols. Create a pneumatic or hydraulic control system using Microsoft Visio		and pneumatic diagrams.
GENERAL OBJECTIVE 4.0: Understand the concept of Electromechanical Drawings						
8 - 9	4.1 Define Electromechanical drawing 4.2 Explain the basic concept of electromechanical drawing 4.3 Identify the following electromechanical drawing symbols; Terminals Fastener relays Solenoids Cable drawings Protection components 4.4 Draft the electromechanical symbols in 4.3 above. 4.5 Create simple electromechanical drawing using the relevant software.	Explain the activities in 4.1 to 4.5 with detailed notes	White board, markers duster, recommended textbooks	Identify the following electromechanical drawing symbols; Terminals Fastener relays Solenoids Cable drawings Protection components Draft the electromechanical symbols above. Create simple electromechanical drawing using the relevant software.	Guide the students to carry out the practicals	Explain the basic concept of electromechanical drawing
GENERAL OBJECTIVE 5.0: Understand Ladder Logic Diagrams						
10 -12	5.1 Explain the Ladder Logic diagrams and symbology 5.2 Explain the creation of low level design (LLD)	Explain the activities in 5.1 to 5.4 with detailed notes	White board, markers duster, recommended	Create the following using simulation: -Ladder logic diagrams and symbology	Guide the students to conduct the practicals	Explain the concepts of panel drawing.

	and rung Simulation. 5.3 Explain Panel drawing 5.4 Explain wiring diagrams and tags		textbooks	-Low level design -Panel drawing -Wiring diagrams and tags		

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Supervisory Management**

COURSE CODE: **MCE 225**

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

CREDIT UNIT: **1.0**

Course: Supervisory Management	**Code: MCE 225**	**Total Hours: 1 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Fourth	**Pre-requisite: NIL**	**Practical hours: 0 Hours/Week**
Goal: This course is designed to equip students with the basic concept of planning and control		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Know basics of a workshop and workshop events
2	Understand Organizational structure and organogram
3	Appreciate the concept of planning and control
4	Understand human relations & industrial psychology
5	Know the concept of motivation

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONIC ENGINEERING TECHNOLOGY						
COURSE: SUPERVISORY MANAGEMENT		**Course Code: MCE 225**		**Contact Hours 1-0-0 Hour/Week**		
Goal: This course is designed to equip students with the basic concept of planning and control						
General Objective 1.0: Know basics of a workshop and workshop events						
Course Specification: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Describe single workshop organization chart. 1.2 Explain workshop procedure and its application. 1.3 Explain workshop procedure and controls 1.4 Explain simple chart of events in the workshop. 1.5 Explain the function of reception tech. in the workshop. 1.6 Explain the process of work schedule.	Explain the activities in 1.1 to 1.6	Whiteboard and Marker Textbook Automotive /Journal (internet)	-	-	State workshop procedure and its control
General Objective 2.0: Understand Organizational structure and organogram						
4-6	2.1 Describe mechatronics engineering workshop staff organization. 2.2 State the various types of organization structure 2.3 Draw and label organization structure	Guide students on the organization of staff in a mechatronics engineering workshop.	Whiteboard & Marker Sample of organogram Textbook, Flip chart, Organisational Chart Model, etc	-	-	Draw and label organization structure
General Objective 3.0: Appreciate the concept of planning and control						

7-11	3.1 Explain the concept of planning and control. 3.2 Differentiate planning and control. 3.3 Identify the importance of time sheet. 3.4 Explain direct costs and indirect costs.	Explain activities in 3.1 to 3.4	Whiteboard, Marker Textbook Supervisor Management Sample of time sheet, flip Chart	-	-	State the differences between planning and control. Enumerate the importance of time sheet. List the direct and indirect costs.
General Objective 4.0: Understand human relations & industrial psychology						
12-13	4.1 Explain human relations and industrial psychology (details of bonus scheme sing a four-part job card set). 4.2 Explain customer relations.	Explain activities in 4.1 to 4.2	Whiteboard, marker, textbooks, flip chart	-	-	State the reasons for ensuring good customer relation
General Objective 5.0: Know the concept of motivation						
14-15	5.1 Explain elements of motivation. 5.2 Describe MASLOW Hierarchy of needs.	Explain activities in 5.1 to 5.2	Whiteboard, marker, flipchart	-	-	List the elements of motivation.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Industrial Automation & Robotics**

COURSE CODE: **MCE 226**

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

CREDIT UNIT: **2.0**

Course: Industrial Automation & Robotics	**Code: MCE 226**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Fourth	**Pre-requisite: MCE 213, MCE 216, MCE 212,**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the basic concepts of automation and Robotics**.**		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Understand the Basic Concept of Automation and Robotics
2	Know The Principles and Operation of The PLC
3	Appreciate the Basic Concepts Of SCADA & DCS
4	Understand the Instrumentation Buses
5	Understand the Concepts of Robotics
6	Know the Elements of Robots
7	Understand the Fundamentals of Robot Controls

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Industrial Automation & Robotics		**COURSE CODE:MCE 226**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the basic concepts of automation and Robotics.						
General Objective 1.0: Understand the Basic Concept of Automation and Robotics						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define automation 1.2 State the historical development of automation as: -Early developments -Modern developments 1.3 State Principles and theory of automation 1.3 Describe different automation components; Relays, Switches, Contactors etc. 1.4 Explain the concept of machine programming 1.5 Explain the basic concept and development in robotics 1.6 Explain the manufacturing applications of automation and robotics as follows: -Automated production lines -Numerical control -Automated assembly -Robots in manufacturing	Explain activity 1.1 to 1.6 with detailed notes	White board and markers, Recommended textbooks, etc.	Identify automation components; • Relays • Switches • Contactors etc	Help the students identify conductors, semiconductors and insulators.	Explain the concept of machine programming

	-Flexible manufacturing systems -Computer process control -Computer-integrated manufacturing					
GENERAL OBJECTIVE 2.0: Know the principles and operation of the PLC						
3-4	2.1 Explain the concept of Programmable logic controllers (PLCs) 2.2 List the types of PLCs 2.3 Describe the basic components of a PLC system. 2.4 State the fundamental operating principles behind using a PLC. 2.5 Explain the concept of PLC programming 2.6 Explain Good installation practice. 2.7 Describe the guidelines to troubleshooting of PLCs.	Explain the activities in 2.1 to 2.7 with detailed notes.	Whiteboard and markers, duster, textbooks, PLC trainer	Identify the basic components of the PLC Identify the symbols of various circuit components Write a simple PLC program and test the program	Guide the students to carry out the experiments.	Explain Good installation practice.
GENERAL OBJECTIVE 3.0 Appreciate the Basic Concepts of SCADA & DCS						
5 –7	3.1 Basic concept of Supervisory control and data acquisition (SCADA) 3.2 Describe the different elements of SCADA 3.3 Explain the fundamental principle of SCADA 3.4 Basic concepts of Distributed Control	Explain activities in 3.1 to 3.9 with detailed notes	White board, markers duster, textbooks	-	-	Differentiate between DCS and SCADA

	System (DCS) 3.5 Describe the architecture of Distributed Control System 3.6 Explain the principles principle of DCS System operation 3.7Describe distributed control system elements 3.8 Differentiate between DCS and SCADA 3.9 Compare DCS and SCADA					
GENERAL OBJECTIVE 4.0: Understand the Instrumentation Buses						
8 – 9	4.1 Explain the concept of the following; • Bus • Sensor Bus • Device bus • Field bus 4.2 Explain the working Principle, salient and application features of the following; • Ethernet • HART • Foundation field Bus • ASI Bus • Mod bus • Device-net • Profibus 4.3 Describe the wireless Gateways and wireless thum.	Explain the activities in 4.1 to 4.3 with detailed notes	White board, markers duster, textbooks.	-	-	Describe the wireless Gateways

GENERAL OBJECTIVE 5.0: Understand the concepts of Robotics						
10 -12	5.1 Define a Robot 5.2 Explain the follow; • Need for a robot • Robot terminology • Robot motion 5.3 Classify the robot based on physical configuration. 5.4 State the advantages and disadvantages of the robot 5.5 Explain the application of robot's in; • Material transfer • Machine loading and unloading • Painting, packaging • Inspection • Welding	Explain the activities in 5.1 to 5.5 with detailed notes	White board, markers duster, recommended textbooks	-	-	Describe robot motion.
GENERAL OBJECTIVE 6.0: Know the Elements of Robots						
	6.1. Describe the Basic structure of a robot 6.2 Classify the robotic systems- accordingly to the following; • Types of system • Control loop • Structure of manipulator (Cartesian, cylindrical, spherical and articulated). • Degree of freedom. 6.3 Describe the robot end effectors according to; • Types • Working principle and	Explain the activities in 6.1 to 6.7 with detailed notes	White board, markers duster, textbooks	-	-	Explain the concept of robot sensing devices Explain types and application with working principle of drives

	applications drives 6.4 Explain types and application with working principle of drives 6.5 Explain the concept of robot sensing devices 6.6 Describe the following; • Optical sensor • Proximity sensor- LVDT • Force sensor (strain gauges and piezoelectric) • RTD and thermocouple • Motion encoders 6.7Explain the selection criteria for robot.					
GENERAL OBJECTIVE 7.0: Appreciate the Concept of Robot Control						
	7.1 Explain the basic concepts of robot controls 7.2 Describe the types of Robot control 7.3 Explain the 3 levels of robot control 7.4 Describe the robot device and work cell controller 7.5Explain the servo and non-servo control systems 7.6 Explain the limitations of some control system; • Adaptive control • Computed Torque Technique • New minimum time control	Explain the activities in 7.1 to 7.6 with detailed notes	White board, markers duster, recommended textbooks	-	-	Explain the 3 levels of robot control

	• Resolved motion control					

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Manufacturing Process**

COURSE CODE: **MCE 227**

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

CREDIT UNIT: **3.0**

Course: Manufacturing Process	**Code: MCE 227**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hour/Week
Semester: Fourth	**Pre-requisite: MEC 113**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to equip students with the basic concepts of manufacturing processes, measurements and metal inspection techniques.		

GENERAL OBJECTIVES	
On completion of this course students should be able to:	
1	Know the fundamentals of manufacturing methods of iron and steel
2	Comprehend the principles of Measurement systems and Metal Inspection techniques
3	Recognize the various methods of metal forming and Sheet Metal Working methods
4	Appreciate the various Joining methods, their advantages, limitations and industrial applications
5	Understand the concepts of metal machining, metal machining methods and 3D Printing

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Manufacturing Process			**COURSE CODE:MCE 227**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**	
Goal: The course is designed to equip students with the basic knowledge and skills in manufacturing processes, measurements and metal inspection techniques.						
General Objective 1.0: Know the fundamentals of manufacturing methods of iron and steel						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Define manufacturing process 1.2 Outline the various methods of manufacturing iron and steel 1.3 Explain the classifications of manufacturing processes 1.4 Explain mechanization and automation of manufacturing 1.5 Outline the concept of design for manufacturing	Explain activities in 1.1 to 1.5 with detailed notes	White board and markers, textbooks, sample of mild, stainless and galvanized steels, etc.	Demonstrate mechanization and automation process of a typical manufacturing process.	Guide students to carryout practicals.	Carry out simple automation of a manufacturing process.
GENERAL OBJECTIVE 2.0: Comprehend the principles of Measurement systems and Metal Inspection techniques						
4-6	2.1 State the basic principles of measurement system. 2.2 Explain the different types of tools used for measurement in manufacturing. 2.3 Outline the	Explain the activities in 2.1 to 2.5 with detailed notes.	Whiteboard and markers, duster, textbooks, basic measuring and hand	Demonstrate the use of slideways, balls and rollers. Perform an experiment with various CNC machine cutting tools.	Guide students to carryout practicals.	Explain the concept of measurement and carry out metal inspection.

	miscellaneous hand tools used in manufacturing process. 2.4 Explain the process of inspection and quality control of iron and steel 2.5 Explain the reasons for metal inspection and testing of metals in manufacturing process.		tools			
GENERAL OBJECTIVE 3.0: Recognize the various methods of metal forming and Sheet Metal Working methods						
7–9	3.1 Outline the types of manufacturing industries 3.2 Enumerate the materials used in manufacturing processes 3.3 Explain properties of materials 3.4 Explain the different processing operations 3.5 Outline the various metal forming processes. 3.6 Sheet metal working methods: • Shearing operations. • Bending operations. • Drawing operations.	Explain activities in 3.1 to 3.6 with detailed notes.	White board, markers duster, textbooks, bending machine, assorted hammers, punches, hand shears, etc.	Carry out some metal forming processes. Perform some bending on sheet metals.	Guide students to carryout practicals.	List the materials used in manufacturing processes. Explain how to carryout the bending of metal to different shapes.
GENERAL OBJECTIVE 4.0: Appreciate the various Joining methods, their advantages, limitations and industrial applications						
10 -12	4.1 Outline the basic metal joining techniques such as: • Welding • Brazing • Riveting, etc.	Explain the activities in 4.1 to 4.3 with detailed notes	White board, markers duster, Sheet metals, pipes, rivets, riveting	Perform welding of metal sheets and pipes. Rivet two metal profiles together.	Guide students to carryout practicals.	Perform some basic metal joining processes.

	4.2 Explain the advantages and disadvantages of the processes in 4.1 above. 4.3 State the various applications of the processes in 4.1 above.		machine, welding machine and electrodes, brazing rod, epoxy, etc. textbooks	Join two parts together with bolts and nuts.		
GENERAL OBJECTIVE 5.0: Understand the concepts of metal machining, metal machining methods and 3D Printing						
13 -15	5.1 Explain the concepts of the following machining processes: • Turning • Milling • Grinding • Boring 5.2 Explain the concept of 3D printing and its applications. 5.3 Outline the advantages and disadvantages of 3D printing 5.4 Enumerate the types of 3D printing filaments	Explain the activities in 5.1 to 5.4 with detailed notes	White board, textbooks, markers duster, Lathe machine, Milling machine, Grinding machine, etc.	Guide students to carry out turning operation on rectangular solid rod.	Guide students to carryout practicals.	Perform machining processes on some selected workpiece.

PROGRAMME: **National Diploma (ND) in Mechatronics Engineering Technology**

COURSE TITLE: **Introduction to Engineering Design Softwares**

COURSE CODE: **MCE 228**

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

CREDIT UNIT: **3.0**

Course: Introduction to Engineering Softwares	**Code: MCE 228**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hours/Week
Semester: Fourth	**Pre-requisite: NIL**	**Practical hours: 2 Hour/Week**
Goal: The course is designed to acquaint students with the programming using C and Python Languages.		

GENERAL OBJECTIVES	
On completion of this course students should be able to :	
1	Appreciate the Basic concepts of Programming Languages
2	Understand Algorithms and Flowcharting
3	Understand the principles of designing algorithms for common programming problem
4	Understand C Programming Language
5	Understand Python Language
6	Understand the procedure in solving a programming problems

PROGRAMME: NATIONAL DIPLOMA IN MECHATRONICS ENGINEERING TECHNOLOGY						
COURSE: Introduction to Engineering Softwares		**COURSE CODE:COM 211**		**CONTACT HOURS: (1-0-2)HOURS/WEEK**		
Goal: The course is designed to acquaint students with the programming using C and Python Languages.						
General Objective 1.0: Appreciate the Basic concepts of Programming Languages						
COURSE SPECIFICATION: THEORETICAL CONTENT				**PRACTICAL CONTENT**		
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define a program. 1.2 Explain features of good program (Accuracy, maintenance, efficiency, reliability, etc.) 1.3 Explain the Components of a computer program 1.4 Describe the purpose of Compilers and Interpreters 1.5 Explain the Programming types; • Machine Language • Assembly Language • Higher-Level Language 1.6 Explain Data types 1.7 Explain Arithmetic operations and functions 1.8 Describe the assignment statement 1.9 Explain the Input/output	Explain activity 1.1 to 1.15	White board and markers, textbooks, etc.	View some programming languages in computer Carryout demonstration on the correct use of headers and identify different compiler errors	Guide the student to perform the task.	Explain the evolution of computers' generations

	statements 1.10 Describe the syntax errors 1.11 Explain the Logical statements 1.12 Describe Loops and decisions 1.13 Explain the following; • Functions • Recursion 1.14 Define Arrays 1.15 Describe the following in relation to arrays; • Declaring of arrays • Manipulating arrays • Searching an array • Sorting arrays					
GENERAL OBJECTIVE 2.0: Understand Algorithms and Flowcharting						
3-4	2.1 Define algorithm on a general basis. 2.2 Explain features of an algorithm (e.g. please, effective, finite). 2.3 Describe the methods of algorithm representation of English language, flowchart, pseudocode, decision table, data flow diagram (DFO) etc. 2.4 Describe main ANSI flowcharts as describe algorithms. 2.5 Draw flowcharts to	Explain the activities in 2.1 to 2.5	Whiteboard and markers, duster, recommended textbooks	Draw flowcharts for simple programming problems	Guide the student to perform the task..	Explain features of an Algorithm List the steps required to draw flowcharts

	implement some simple programming tasks					
GENERAL OBJECTIVE 3.0 Understand the principles of designing algorithms for common programming problem						
5 –7	2.3 Design algorithm for problems involving. i. Strictly sequence control structure ii. Selection control Structure. iii. Iteration control Structure.	Explain activities in 3.1	White board, markers duster, recommended textbooks	Write simple programs using different control structure	Guide the student to perform the experiments.	Explain the strictly sequence control structure
GENERAL OBJECTIVE 4.0: Understand C Programming Language						
8 - 9	4.1 Describe algorithms 4.2 Explain the concepts of Programming with C language 4.3 Explain the data Types and Variables in C 4.4 Explain C operators and expressions 4.5 Explain the control structures in C 4.6 Describe the basic input output 4.7 Explain the functions in C 4.8 Explain the data Structures 4.9 Explain dynamic data Structures	Explain the activities in 4.1 to 4.9	White board, markers duster, textbooks	Design an algorithm using a flow chart for a given problem, write the solution using C Programming language following coding standards, execute and debug the Programme.	Guide the student to perform the experiments.	Explain the Types of Storage Devices
GENERAL OBJECTIVE 5.0: Understand Python Language						
10 - 12	5.1 Explain python programming language 5.2 Explain the concepts of	Explain the activities in 5.1 to 5.7.	White board, markers duster,	Carry out experiment to demonstrate the installation of I/O devices,	Guide the student to perform the experiments.	Explain the K nearest neighbor

	programming with python language 5.3 Explain the following; i. Syntax, ii. Built in libraries 5.4 Explain the data types and variables in python 5.5 Explain python operators and expressions (logical relational operators) 5.6 Explain the control structures in python 5.7Explain the functions in Python; i. K nearest neighbor ii. Neural network iii. Artificial Neural Network iv. Convolutional Neural Network 5.7 Explain python data Structures.		recommended textbooks, python software.	printers and installation of operating system		function in python.
GENERAL OBJECTIVE 6.0: Understand the procedure in solving a programming problems						
	6.1 Explain how to identify the problem and confirm it solvable. 6.2 Describe how to design algorithm for the chosen method of solution with flowcharts or pseudo codes. 6.3 Explain the coding of the algorithm by using a suitable programming language.	Explain the activities in 6.1 to 6.4	White board, markers duster, textbooks, C software.	Carryout the coding of a simple algorithm using C or Python language.	Guide the student to perform the experiments.	Explain how to test run the program on the computer

	6.4 Test run the program on the computer.					

ONE YEAR POST ND

Industrial Work Experience - In-Plant Training (IWE) TASK Inventory

TASK INVENTORY (First Six Months)

GENERAL OBJECTIVES	
On completion of this Industrial Work Experience, the students should be able to:	
1	Understand the objectives and structure of organization
2	Identify tools (hand, machine and power) and use them.
3	Know the general safety regulations of the establishment
4	Know the utility services required for operations of the establishment
5	Choose or select tools for specific jobs
6	Determine dimensional characteristics of engineering components
7	Identify and select suitable engineering material for optimum performance
8	Know the importance of keeping log book

POST ND INDUSTRIAL WORK EXPERIENCE (IWE) TASK INVENTORY		
General Objective 1.0 Understand the objectives and structure of organization		
Specific Learning Objective	**Supervisors Activities**	**Resources**
1.1 List the objectives of the organization. 1.2 Draw the organizational chart/organogram of the company. 1.1 Maintain cordial relationship with the members of staff. 1.4 Make safe and adequate use of equipment, instruments, tools and materials. 1.5 Put on appropriate protective clothing. 1.6 Record and maintain a log-book for day-to-day activities.	Supervise the students on monthly basis to check log-book in accordance with the expectations here. Request and mark reports. Grade report	Personnel and Human resources department
General Objective 2.0 Identify tools (hand, machine and power) and use them.		
2.1 Identify hand tools and be able to use them. 2.2 Identify power tools and be able to use them. 2.3 Identify machine tools and be able to use them. 2.4 Observe safety precautions in the use of tools. 2.5 Care for and maintain hand, machine and power tools.	Supervise the students regularly. Check log-book and reports. Grade report	Fitting shop
General Objective 3.0 Know the general safety regulations of the establishment		
3.1 Apply various safety measures in operation within the organisation/establishment 3.2 Apply first aid instruction 3.3 Apply safety devices/measures required in performing various engineering operations 3.4 Operate firefighting equipment	Supervise the students regularly. Check log-book and reports. Grade report	Machine Shop/Fitting shop
General Objective 4.0 Know the utility services required for operations of the establishment		

4.1 Operate the equipment connected with generation, transmission and utilization of the following: a. steam b. compressed air c. water supply (hot and cold) d. waste disposal 4.2 Operate the electrical power generating equipment 4.3 Diagnose the maintenance need of all the utilities equipment.	Supervise the students regularly. Check log-book and reports. Grade report	Service/Maintenance Shop
General Objective 5.0 Choose or select tools for specific jobs		
5.1 Select the correct types and sizes of spanners or screwdrivers to loosen or tighten nuts, bolts and screws. 5.2 Select the suitable grade of saw to cut metals 5.3 Select the correct type and size of hammer for each job.	Guide the students to perform activities 5.1 to 5.3 and ask them to perform the activities. Grade report	Service shop
General Objective 6.0 Determine dimensional characteristics of engineering components		
6.1 Use calibrated instruments such as rule, calipers and micrometers to carry out measurements. 6.2 Use gauges such as go not go, feelers and thread to determine the acceptability or otherwise of parts. 6.5 Use thermometer and manometers to determine the temperature and pressure of substances.	Guide the students to perform activities 6.1 to 6.3 and ask them to carry out the activities. Grade report.	Tool boxes, thermometers, manometers, etc.
General Objective 7.0 Identify and select suitable engineering material for optimum performance		
7.1 Identify practically various engineering material e.g. by sound, grinding etc 7.2 Select appropriate engineering material for specific purposes.	Guide students to perform activities 7.1 and 7.2 and ask them to carry out the activities. Grade student.	Work pieces of different materials for engineering practice.
General Objective 8.0 Know the importance of keeping log book		
8.1 Describe the importance of keeping log-book	Guide students to perform activities 8.1	Work pieces of different materials

8.2 Keep proper records of daily task 8.3 Compile and present weekly report as outlined in the log-book. 8.4 Prepare and submit final report in approval format	and 8.4 and ask them to carryout the activities. Grade student.	for engineering practice.

TASK INVENTORY (Last Six Months)

GENERAL OBJECTIVES	
On completion of this Industrial Work Experience, the students should be able to:	
1	Know operational procedure of plant/equipment
2	Know the need for maintenance of plant/equipment within the organisation
3	Demonstrate practical skills in maintenance and repairs of various system in automobile e.g engine, clutch, brake, suspension, electrical etc
4	Carry out operational procedure for various electronics equipment
5	Acquire practical skills in servicing, maintenance and repairs of electronics equipment and gadgets
6	Acquire practical skills in assembling of electronic equipment and gadgets

POST ND INDUSTRIAL WORK EXPERIENCE (IWE) TASK INVENTORY		
General Objective 1.0 Know operational procedure of plant/equipment		
Specific Learning Objective	**Supervisors Activities**	**Resources**
1.1 Carry out procedures. 1.2 Run the plant, observe and interpret the control indicators 1.3 Carry out shut down operations 1.4 Carry out the emergency shut down operations	Supervise the students on monthly basis to check log-book in accordance with the expectations here . Request and mark reports.	Service shop
General Objective 2.0 Know the need for maintenance of plant/equipment within the organization		
2.1 Determine various types of maintenance operations within the establishment e.g. planned, preventive and breakdown maintenance. 2.2 Carry out simple maintenance operations	Supervise the students regularly. Check log-book and reports.	Service shop
General Objective 3.0 Demonstrate practical skills in maintenance and repairs of various system in automobile e.g engine, clutch, brake, suspension, electrical etc.		
3.1 Dismantle, inspect, diagnose and rectify faults in	Guide the students to perform activities	Service shop

various components of clutch 3.2 Bleed hydraulic clutch system 3.3 Replace, brake lining and calipers where. necessary. 3.4 Maintain and adjust hand brake 3.5 Bleed the brake system 3.6 Dismantle, diagnose faults and effect repairs in the suspension and steering system 3.7 Effect maintenance work on the wheel bearings. 3.8 Remove tyres, check bearing, the pressure in the tyre and use the wheel alignment gauge and adjust the steering geometry. 3.9 Remove and service door panels and under-take minor repairs. 3.10 Service and repairs window winders. 3.11 Maintain starter motor, alternator and dynamo. 3.12 Service the voltage regulating system and windscreen wiper motor 3.13. Adjust headlight beam diagnose and rectify faults on horn 3.13 Carry out routine maintenance on the battery 3.14 Adjust the ignition system including setting of the spark plug gap	3.1 to 3.14 and ask them to perform the activities. Grade report.	
General Objective 4.0 Carry out operational procedure for various electronics equipment		
4.1 Read and interpret electronic symbols and manuals for equipment 4.2 Operate various electronic equipment in accordance with equipment manual 4.3 Observe general handling requirement like positioning movement, storage particularly of test equipment such as multimeters, oscilloscope, etc. 4.4 Check and recalibrate test equipment before use.	Guide the students to perform activities 4.1 to 4.4 and ask them to carryout the activities. Grade report..	Electronic Shop Tool boxes, test equipment, manometers, etc.
General Objective 5.0 Acquire practical skills in servicing, maintenance and repairs of electronics equipment and gadgets		

5.1 Solder/Desolder properly components into/from electronic circuits using appropriate soldering iron. 5.2 Diagnose faults in equipment by performing any or both of the following: a. Test static test on electronic component and circuits using appropriate test and measuring equipment. b. Dynamic test on electronic component and circuits using appropriate tools and measuring equipment. 5.3 Effect repairs of the faults identified in 5.2 5.4 Maintain and service electronic equipment and gadgets	Guide students to perform activities 5.1 and 5.4 and ask them to carry out the activities. Grade student.	Work pieces of different materials for engineering practice.
General Objective 6.0 Acquire practical skills in assembling of electronic equipment and gadgets		
6.1 Assemble components correctly using appropriate tools and equipment 6.2 Test for effectiveness of equipment.	Guide the students to perform activities 6.1 to 6.2 and ask them to carryout the activities. Grade report..	Electronic Shop Tool boxes, test equipment, manometers, etc.

REQUIRED MINIMUM LIST OF PHYSICAL FACILITIES
LIST OF WORKSHOPS, LABORATORIES AND STUDIOS

S/N	Workshops	Laboratories	Studios
i	Mechatronics Workshop	Mechatronics	CAD Room
ii.	Machine Shop	Control Engineering	Drawing Studio
iii.	Fitting Shop	Basic Electricity, Measurement and Instrumentation	
iv.	Welding and Fabrication Shop	Electronics	
v		Fluid Mechanics	
vi		Mechanics of Machines	
vii		Pneumatics/Hydraulics	

REQUIRED MINIMUM LIST OF EQUIPMENT IN THE WORKSHOPS AND LABORATORIES

A. WORKSHOPS

i. Mechatronics Workshop

S/N	Description of Equipment	Quantity Required
1.	Digital engine diagnostic equipment	1
2.	Digital alignment unit	1
3.	Fuel Injection testing unit	1
4.	Modern Live vehicle	1
5.	Modern Engines	
	- Diesel	1
	- Petrol engines	1
6.	Test Instruments	
	- Digital Clamp Meters	2
	- Digital Infrared Thermometers	2
	- Temperature & Humidity Testers	2
	- Refrigerant Leak Detector	2
	- Digital Hygrometer	2
	- Digital Anemometer	2
	- Ambient CO Detector	2
	- Combustible Gas Leak Detector	2
	- Insulation Resistance Tester	2
	- Cable Length Meter	2
	- Lamp tester	2
	Professional Thermal Imaging camera	2
7.	Industrial Maintenance Tools	
	- Set of Pliers	2
	- Fish Tape	3
	- Steel Tape	5
	- Wire Crimpers	5
	- Electric drill	4
	- Hand drill	5

	- Soldering Station - Wire gauge - Circular saw and chop saw - Socket Ratchet set - Slide Range - L-Key - Allen Keys - Micrometre - Impact wrenches - Crescent wrenches - Portable electric sander - Portable grinder. - Mechanical levelling gauge - Chain hoist - Air compressor - Maintenance toolbox	3 3 3 2 4 3 sets 3 sets 3 3 2 2 2 2 1 2 2
8.	Manual transmission units	1
9.	Automatic transmission units	1
10.	Digital wheel balancing machine	1
11.	Manual cranes	1
12.	Vulcanizing units (mobile and stationary)	1 each
13.	D.C. charging kits	1
14.	Mobile tool boxes	3
15.	Bench vices	5
16.	Table drilling machine	1
17.	Measuring and marking out tables	1
18.	Work bench with a.c. plug-in facilities	1
19.	Hydraulic brake testing unit	1
20.	Hydraulic jacks	2
21.	Hydraulic stands	2
22.	Floor jacks (6 ton capacity)	1
23.	Axle stands - Mobile - Stationary	 1 1

24.	Cable stands	1
25.	Modern training facilities (multimedia & overhead **projectors**, mobile board, board fax, etc.)	1

ii. Machine Shop

S/N	Description of Equipment	No. Required
1.	Tool room lathe with swing 483 mm and bed 200 mm	1
2.	Centre lathe with the swing of 330 mm and length of bed 150 mm with com Plate accessories	3
3.	Column/pillar drilling machine	1
4.	Universal milling machine complete with accessories	1
5.	Universal engraving machine complete with accessories	1
6.	Surface grinding machine complete with accessories	1
7.	Universal cylindrical grinding machine with accessories	1
8.	Pedestal grinding machine	1
9.	Power hacksaw	1
10.	Arbor/hydraulic press	
11.	Shaping machine with accessories	1
12.	Universal tool and cutter grinder	1
13.	Box spanners	5
14.	Allen Keys (set)	2 sets
15.	Flat screw driver (set) 3 sets	2 sets
16.	Philips screw driver	2 sets
17.	Drift/pin punches (various sizes)	2 sets each
18.	Knurling tools	2 sets
19.	Parallel strips	3
20.	Vernier protractor	3
21.	Micrometers outside 0.25 mm 25-50 mm 50-75 mm and sets of Inside micrometers	3
22.	Depth gauge	5
23.	Steel rule 300 mm	5
24.	Calipers (inside and outside)	5
25.	Vee block with clamps	4

26.	Scribing block	4
27.	Surface plate	3
28.	Wheel dresser	2
29.	Hand/machine reamers (sets)	2 each
30.	Oil Can	2
31.	Centre drills (set)	2 sets
32.	Twists drills (set)	2 sets
33.	Thread chaser (Assorted) 3 each	2 each
34.	Marking out table	2
35.	Combination set	4
36.	Screw gauges (assorted	4
37.	Plug gauges (assorted)	4
38.	Radius gauges (assorted)	4
39.	Dial indicator and stand	4
40.	Slip gauges (set)	2
41.	Grease gun	2
42.	Angle plates	3
43.	Engineer's square	5
44.	Measuring balls/rollers	2
45.	Limit gauges	5
46.	Fire Extinguisher/Sand Buckets	2 each

iii. Fitting Shop

S/N	Description of Equipment	No. Required
1.	Bench vice	20
2.	Pillar drilling machine	1
3.	Radial drilling machine	1
4.	Sensitive bench drilling machine	2
5.	Marking out table	1
6.	Surface plate	1
7.	Pedestal grinder with drill grinding attachment	1

8.	Power hacksaw	1
9.	Multi-purpose furnace	1
10.	Arbor press	1
11.	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)	5 Each
12.	Guillotine	2
13.	Try-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
14.	Vernier Caliper 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
15.	Screw gauges (assorted) Screw driver (set) and Hammers (assorted weight)	2 each
16.	Measuring tapes	2 each

	Feeler gauges Rivet gun pairs Goggles 10 pairs Drill set 4 sets Electric Hand drill Electric hand grinder/sander Vernier height gauge Dial indicators and stand Mallets (rubber, wood/rawhide)/Number stamps	2 4 pairs 10 pairs 4 sets 4 2 4 4
17.	Letter stamps Hydraulic press Punches (cold) Plier (assorted) Hand shear Welding chipping hammer Wire brush (bench type) Welding shield	3 each 3 3 3 3 3 3
18.	Profile cutting machine	1
19.	Foot operated guillotine machine	1
20	Assorted cutting snips	1
21.	Twist drill sets	2
21.	Aprons	10
23.	Fire Extinguisher/sand buckets	2 each

iv. Welding and Fabrication Shop

S/N	Description of Equipment	No. Required
1.	Welding transformer	6
2.	MIG welding set	1
3.	TIG Welding set	1
4	Arc Welding Machine	1
5	Gas Welding Equipment	1
6	Acetylene gas cylinder	4
7	Oxygen gas cylinder	4

8	Welding table (gas)	3
9	Welding table (arc)	3
10	Argon cylinders	2
11	Protection screen	4
12	Grinding machine (pedestal type)	1
13	Bench drilling machine	1
14	Bench polishing machine	1 (opt)
15	Bench shearing machine	1
16	Power hacksaw	1
17	Bench grinding machine	1
18	Bench vice	6
19	Anvil and stand	2
20	Electrode holder	5
21	Clamp	5
22	Argon cylinders	2
23	CO_2 cylinders	5
24	Oxy acetylene welding manifold	2
25	Weld joint teaching aids (diagrams)	3
26	Apron (leather)	10
27	Hand gloves	10
28	Welding head shield	10
29	Electrode oven	2
30	Working benches, for each welding machine	10
31	Portable profile gas cutting cylinder machine	10
32	Soldering iron	20
33	Oxy acetylene regulators	5
34	Booth screen	5
35	Gas welding goggles	20
36	Electrode holder	10
37	Welding chipping Hammers	10
38	Wire brush (bench type)	10
39	Gas cylinder trolley	5
40	Spark lighter	5
41	Brazing rods	10kg

42	Soldering flux	10t
43	Argon regulators	2
44	Leggings	5
45	Safety charts	Assorted

B. LABORATORIES

i. Mechatronics Laboratory

S/N	Description of Equipment	Quantity Required
1.	Avometer (model 410)	4
2.	Potentiometer	5
3.	Ohmmeter	5
4.	Oscilloscopes: - Single trace 5MHz Probe - Dual trace 15 MHz 5 - 100Mhz	 2 2 1
5.	DC Power Supply	5
6.	Personal Computers	5
7.	Printers	2
8.	Function Generator RF AF	 2 2
9.	MATLAB software	1
10	PLC system modules -Process module -Power supply -Communication interface -Input module -Output module	 1 1 1 1 1
11	CNC Lathe Machine Trainer	2
12	Sensor Trainer Kit for Laboratory	2

ii. Control Engineering Laboratory

S/N	Equipment	Required Quantity
2.	DC Servo Control Trainer, for Laboratory	2
3.	Analog Closed Loop Control System, For Laboratory	2
4.	Process Trainer	2
5.	Training Kit For Transducer.	2
6.	Digital Phase Meter	2
7.	Digital Computer/Printer	2
8	LVDT Sensor Laboratory Trainer	2
9	Tachogenerator	2

iii. Basic Electricity, Measurement and Instrumentation Laboratory

S/N	Equipment	Required Quantity
1.	Electricity Trainer	10
2.	Ammeters (Various ranges)	
	0- 25 A DC	5
	0- 25 A AC	5
3.	Milliammeter	
	0- 1000mA DC	5
	0- 1000mA AC	5
4.	Voltmeter:	
	0- 500V DC	5
	0- 500V AC	5
5.	Millivolt meter (0- 1000mV DC)	5
6.	Ohmmeter:	
	0- 5 ohms	5
	0- 25 ohms	5
	0- 50 ohms (Multirange)	5
7.	Galvanometer (triple range)	
	(35-0-35mA)	-
	50-0-50mA	10

	500-0-500mA 5-0-5 mA	10 10
8.	Wattmeter Single phase Three phase	 2 2
9.	Megger tester	2
10.	Wheatstone Bridge	5
12.	Potentiometer	5
13.	Electronic Trainer Units	5 units
14.	Oscillators Training Kit	2
15.	Power Supply Training kit	2
16.	Rheostats (Various ranges)	10
17.	Earth-loop tester	4
19	Avometer (model 410)	5
20	Oscilloscopes: - Single trace 5MHz Probe - Dual trace 15 MHz 5 - 100Mhz	 2 2 1

iv. Electronics Laboratory

S/N	Equipment	Required Quantity
1.	Semiconductor Diode Characteristics Apparatus	4
3.	Amplitude Modulation & Demodulation Kit	4
	Frequency modulation and Demodulation kit	4
4.	Analog Lab Trainer Kit	5
5.	Transistor Characteristics demonstrator	5
6.	Oscilloscopes: - Single trace 5MHz Probe - Dual trace 15 MHz 5 - 100Mhz	 2 2 1
7.	Signal generators (AF, RF)	2 each
9.	Transistor tester	3
10	Amplifier Characteristics Apparatus	3

11	FET Tester	3
12	Power supply unit 0-60v/3A	5 units
13	BJT Amplifier Training kit	3
14	Feedback Amplifier Trainer Kit	3
15	Sweep generator	2
16.	Multirange DC voltmeters	4
17.	Multirange AC voltmeter	4
18.	Multirange AC ammeter	4
19.	Multirange DC ammeter	4
20.	Circuit construction deck	10
21.	DC power supply out-put 0 - 20V/0-2A	5
22.	Milliameters: 0- 1000m A DC 0- 1000m A AC	 5 5
23.	Microammeter: 0- 1000 µA DC 0- 1000 µA AC	 5 5
24.	Millivolmeter 0- 1000m V DC	 5
25.	Galvanometer (triple pole range) 30-0-30m A 500-0500m A 5-0-5m A 10	 10 10 10
26.	Portable Handheld RLC bridge	2
27.	Avometer (model 410)	5
28	Power Electronics Trainer	4
29	Universal IC Tester	4
30	Digital Electronics Trainer Digital Trainer Kit Digital IC Trainer Flip Flop Trainer	 1 2 2

v. Fluid Mechanics Laboratory

S/N	Description of Equipment	No. Required
1.	Hydraulics Bench with accessories for various experiments in fluid flow measurements	3
4	Floating Body Apparatus	1
5.	Manometer	1
6.	Rotameter	1
7.	Laminar/turbulent pipe flow apparatus	1
8.	Pilot static tube	1
9.	Water current meter	1
10.	Surge in pipe apparatus	1
11.	Air flow demonstration apparatus	1
12.	Centrifugal and axial pump	1 each
16.	Fire extinguisher and sand buckets	2 each

vi. Mechanics of Machines Laboratory

S/N	Description of Equipment	No. 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.	Differential gearing system apparatus	1
6.	Slider crank mechanism apparatus	1
7.	Rope, belt and coil friction apparatus	1
8.	Cam and cam follower mechanism apparatus	1
9.	Extensometer and compression of springs apparatus	1
10.	Oldham coupling apparatus	1
11.	Torsion of bar apparatus	1
13.	Forces on beam apparatus	1
14.	Conservation of angular momentum apparatus	1
15.	Centrifugal/centripetal apparatus	1
16.	Extension and compression of springs apparatus	1
13.	Fire extinguisher and sand buckets	2each

xii. Pneumatics/Hydraulics Laboratory

S/N	Equipment	Required Quantity
1.	Hydraulic Trainer	2
2.	Shut off Valve	5
3.	Connecting lead	1
4.	Limit Switch	4
5.	Hose set	5
6.	Flow resistant Measuring Hose	1
7.	Selector Switch	1set
8.	Relay	4
9.	Testing Station	1
10.	Pneumatic training unit	2
11	Hydraulic board	1

C. STUDIOS

i. CAD ROOM

S/No.	Description	Qty
1.	Computer (PC)	40
2.	Printer	2
3.	Scanner	2
4.	UPS	40
5.	AUTOCAD	Assorted
6.	Projector	1

ii. **Drawing Studio-:** Drawing Studio (At least 40Nos Adjustable Drawing Tables and Stools)

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