NATIONAL BOARD FOR TECHNICAL EDUCATION

PLOT 'B' BIDA ROAD, P. M. B.2239, KADUNA

CURRICULUM AND COURSE SPECIFICATION
FOR
NATIONAL DIPLOMA (ND) IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY

FEBRUARY, 2022

FOREWORD

The National Diploma (ND) in Petroleum and Gas Processing Engineering Technology curriculum is to be used by training institutions to produce manpower for industry. The acute shortage of professionally trained manpower in petroleum and gas processing industry 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 curriculum.

It is my belief that this curriculum and the course specifications is the minimum requirement to produce technicians with sound knowledge and skills in Petroleum and Gas Processing Engineering Technology. If properly implemented with the required resources (qualified teaching staff in adequate number and mix specializations, 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 Kaduna Polytechnic for collaborating with the Board to fund the development of this curriculum. The invaluable contributions of all the members of the committee for the development of the curriculum are appreciated.

I hope that the curriculum would be properly implemented, so as to produce the required Work Force of International Best Practices.

Prof. Idris M. Bugaje
Executive Secretary
NBTE, Kaduna

GENERAL INFORMATION FOR ND PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY

GENERAL INFORMATION

1.0 TITLE OF THE PROGRAMME: The title of the programme is National Diploma in Petroleum and Gas Processing Engineering Technology

2.0 PHILOSOPHY OF THE PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY PROGRAMME

The National Diploma in Petroleum and Gas Processing 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 Petroleum and Gas Processing Engineering Technology programme also seeks to aid the acquisition of appropriate mental and physical skills, abilities and competence 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.

3.0 GOALS AND OBJECTIVES OF THEPROGRAMME

The programme is designed to produce Petroleum and Gas Processing Engineering Technicians who will be equipped with techniques and processes that shall serve the Upstream, Midstream and Downstream sector of the petroleum industry.

4.0 OBJECTIVES OF THE PROGRAMME:

On completion of the Programme, the diplomate should be able to:

1. Assist in the development of process and equipment for petroleum and gas operations.
2. Select suitable process and equipment to accomplish Petroleum and gas operations
3. Assist in production operations and upgrade of Petroleum and gas operations systems
4. Assist in petroleum refining operations and catalyst development.
5. Carry out routine inspection of Petroleum and gas process equipment.
6. Assist in maintenance and repairs of Petroleum and gas process equipment
7. Use Computing Systems in design and application of basic Petroleum and gas operations.
8. Apply safety measures in Petroleum and related industries.
9. Apply the skills of welding to fabricate Process equipment

10. Use effective communication skills to manage enterprise.

5.0 MINIMUM ENTRY REQUIREMENTS

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

(i) Senior Secondary School Certificate (**SSSC**) with credit level passes in five subjects in not more than two sittings which must include English Language, mathematics, Chemistry, Physics and any other Science subject;

(ii) GCE ´O' Level or its equivalent (West African School Certificate) with credit level passes in five relevant subjects as specified in (i) above;

(iii) National Technical Certificate (**NTC**) with credit passes in mathematics, chemistry, physics, English Language and other Science subject;

(iv) In addition to any one of the above, Unified Tertiary Matriculation Examination (UTME) result have the required cut-off mark and subject combination of English Language, Mathematics, Physics and Chemistry.

6.0 MAN POWER REQUIREMENT:

*6.*1 HEADSHIP OF THE DEPARTMENT

The HOD should at least be a Senior Lecturer with a minimum of twelve (12) years' experience as well as a relevant M.Sc. degree in any of the following engineering areas: Petroleum and Gas Processing Engineering, Chemical Engineering, Petrochemicals Engineering or Process Engineering provided that the staff can show evidence of having done undergraduate (Bachelor's degree) or post-graduate courses in above mentioned fields.

The HOD must also be a duly registered member of his/her relevant professional body.

6.1.1The first appointment of the core teaching staff for ND Petroleum and Gas Processing Engineering Technology should be an Assistant Lecturer with a first degree (BSc. BTech or HND+PGD) in any of the engineering courses listed in 6.1 above. The Instructor should have HND (Minimum Lower Credit) in any of these courses listed in 6.1.

6.1.2Technical Staff

Specialization: Same as 6.1.2 above

6.1.3 Technologist

Technologists should have an HND (Minimum Lower Credit) in any of the disciplines as stated in 6.1 above.

6.1.3.1 Technician

Technicians should have ND (Minimum Lower Credit) as stated in 6.1 above.

6.2 Criteria for appointment of ND External examiners

6.2.1. An External Examiner shall be appointed from among Academic Staff from other Institutions with specialization in any of the following areas: Petroleum and Gas processing Engineering, Chemical Engineering, Petrochemicals Engineering or Process Engineering provided that the staff can show evidence of having done undergraduate (Bachelor's degree) or post-graduate courses in Petroleum and Gas processing Engineering, Chemical Engineering, Petrochemicals Engineering or Process Engineering.

6.2.2 Two External Examiners shall be appointed; one from the Polytechnic not below the rank of a Principal Lecturer and one from the Industry with at least Ten (10) years' experience

6.2.3 The External Examiner shall serve for a term of two years in the first instance and renewable for one more term only

6.3 AREAS IN WHICH ND PETROLEUM AND GAS PROCESSING ENGINEERING HOLDERS CAN GET EMPLOYMENT (CARRIER PROSPECTS)

Successful graduates of the ND Petroleum and Gas processing Engineering Technology programme can proceed further to HND. An ND graduate and a graduate of HND may seek job from the following:

i) Refinery
ii) Petrochemicals
iii) Oil and Gas Fields
iv) Power Plants
v) Ministry of Petroleum Resources at Federal and State level
vi) Fertilizer Plants
vii) Gas Processing Industry
viii) Polymer Industry
ix) Pharmaceutical Industry
x) Academia
xi) Public Sector at Federal and State levels, etc.
xii)

7.0 DURATION

The duration of the programme is two academic sessions consisting of four semesters of 17 weeks each.

8.0 CURRICULUM

8.1 The curriculum of ND programme consists of five main components. These are:

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

8.1 The General Education component shall include courses in:

i. Art and Humanities - English Language, Communication, History.
ii. Social Studies - Citizenship Education, Political Science, Sociology, Philosophy, Geography and Entrepreneurship, are compulsory.
iii. Physical and Health Education (where applicable) - One semester credit only.
iv. The General Education component shall account for not more than 15% of the total contact hours for the programme.
v. Foundation courses include courses in Economics, Mathematics, Pure Sciences, Technical Drawing, Descriptive Geometry, Statistics, etc. The number of hours for the Programme may account for about 10-15% of the total contact hours.
vi. Professional courses are core courses of the programme which give the student the theory and professional skills he needs to practice his field of calling at the technician/technologist level. These may account for between 60-70% of the contact hours.
vii. Student Industrial Work Experience Scheme (SIWES) shall be taken during the long vacation following the end of the second semester of the first year. See details of SIWES at section 11.0
viii. Personal Logbook: The students to maintain a personal Logbook to record all the daily and weekly summary of all the practical activities for all the semesters.

9.0 CURRICULUM STRUCTURE

The structure of the National Diploma programme consists of four semesters of classroom, laboratory, workshop activities and field trip, and 4 months of student Industrial Work Experience Scheme (SIWES). Each semester shall be of 17 weeks duration made up as follows:

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

b. 2 weeks for examinations and registration.

SIWES shall take place at the end of the second semester of the first year.

10.0 ACCREDITATION

The National Diploma programme shall be accredited by the National Board for Technical Education 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 from the office of the Executive Secretary, National Board for Technical Education, Plot "B", Bida Road, P.M.B. 2239, Kaduna, Nigeria.

11.0 AWARD OF NATIONAL DIPLOMA

Institutions offering accredited programmes will award the National Diploma to candidates who successfully completed the programme after passing prescribed course-work, examinations, diploma project and the supervised industrial work experience. Such candidates should have completed a minimum of between 90 and 100 semester credit units. National Diploma Certificates shall be awarded based on the following:-

i. Grading of Courses: Courses shall be graded as follows:

MARKED 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	0.0

ii. Classification of Diplomas: Diploma Certificate shall be awarded based on the following classifications:

Distinction	-	CGPA 3.50-4.00
Upper Credit	-	CGPA 3.00-3.49
Lower Credit	-	CGPA 2.50-3.00
Pass	-	CGPA 2.00-2.49

12.0 GUIDANCE NOTES FOR TEACHERS

12.1 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 wishes to transfer the units already completed in an institution to another one of similar standard from which he/she is transferring.

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

12.3 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 a slight departure in the presentation of the performance based curriculum which requires the conditions under which the performance are expected to be carried out and the criteria for the acceptable levels of performance. It is a deliberate attempt to further involve the staff of the department teaching the programme to write their own curriculum stating the conditions existing in their institution under which performance can take place and to follow that with the criteria for determining an acceptance level of performance. Departmental submission on the final curriculum may be vetted by the Academic Board of the institution. Our aim is to continue to see to it that a solid internal evaluation system exists in each institution for ensuring minimum standard and quality of education in the programmes offered throughout the Polytechnic system.

12.4 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.

13.0 LOGBOOK

A personal Logbook 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.

14.0 GUIDELINES ON SIWES PROGRAMMES

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

14.1 *Responsibility for placement of students.*

a. Institutions offering the National Diploma programme shall arrange to place the students in the relevant 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 office of the Executive Secretary, National Board for 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:

(i) 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.

(ii) The industry-based supervisor of the students during the period should note that he or she should weight the final grading of the students during the period of attachment more on the evaluation.

14.2 *Evaluation of students during SIWES*. In the evaluation of the student, cognizance should be taken of the following items:

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.

14.3 *Grading of SIWES:* To ensure uniformity of grading scales, the institution should ensure that the uniform grading of students' work which all polytechnics have agreed to is adopted.

14.4 *The Institution-Based Supervisor: He or she* should initial the logbook during each visit. This will enable him to check whether minimum standard/requirement are being met and to assist students having any problems regarding the specific

assignments given to them by their industry-based supervisor.

14.5 *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.

14.6 *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.

14.7 *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. 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.

15.0 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, but reporting should be on individual basis. The project should, as much as possible incorporate basic elements 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.

GUIDELINES FOR TEXT BOOK WRITERS
NATIONAL DIPLOMA AND HIGHER NATIONAL DIPLOMA

The following guidelines are suggestions from the Science and Technology Committees to the writers of the textbooks for the new curricula. They are intended to supplement the detailed syllabuses which have been produced, and which define the content and level of the courses.

Authors should bear in minds that the curriculum has been designed to give the students a broad understanding of applications in industry and commerce, and this is reflected in the curriculum objectives.

- One book should be produced for each syllabus
- Page size should be A4
- The front size should be 12 point for normal text and 14 point where emphasis is need
- Line spacing should be set to 1.5 lines
- Headings and subheadings should be emboldened
- Photographs, diagrams and charts should use extensively thought the book, and these items must be up-to-date
- In all cases the material must be related to industry and commerce, using real life examples wherever possible so that the book is just a theory book. It must help the students to see the subject in the content of the 'real word"
- The philosophy of the courses is one of an integrated approach to theory and practice, and as such the books should reflect this by not making an artificial divide between theory and practice.
- Illustrations should be labeled and numbered.
- Examples should be drawn from Nigeria wherever possible, so that the information is set in a country context.
- Each chapter should end with student self-assessment quotations (SAQ) so that student can check their own master of the subject.
- Accurate instructions should be given for any practical work having first conducted the practical to check that the instructions do indeed work
- The books must have a proper index or table of contents, a list of references and an introduction based on the overall course philosophy and aims of the syllabus.
- Symbols and units must be listed and a unified approach used throughout the book
- In case of queries regarding the contents of the books and the depth of information, the author must contact the relevant curriculum committee via the National Board for technical Education.
- The final draft version of the books should be submitted to Nigeria members of the curriculum working groups for their comments regarding the content in relation to the desired syllabus.

CURRICULUM TABLE FOR PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY

ND I SEMESTER ONE

COURSE CODE	COURSE TITLE	L	P	CU	CH	PRE-REQUISITE
GNS 111	Use of English	2	-	2	2	- -
GNS 102	Citizenship Education	2	-	2	2	- -
EEd 116	Introduction to Entrepreneurship	2	2	1	4	
STAT 111	Introduction to Statistics	**1**	**1**	2	**2**	- -
MTH 112	Algebra and Elementary Trigonometry	2	-	2	2	- -
COM 111	Introduction to Computing	2	2	4	4	- -
PGP 111	Introduction to Petroleum and Gas Processing Calculations	2	-	2	2	- -
PGP112	Basic Petroleum and Gas Production Technology	2	-	2	2	- -
PGP113	Process Engineering Graphics	1	2	3	3	- -
PGP114	Petroleum Chemistry	2	-	2	2	- -
PGP 115	Engineering Physics	2	-	2	2	- -
TOTAL		**21**	**6**	**24**	**27**	- -

ND I SEMESTER TWO

COURSE CODE	COURSE TITLE	L	P	CU	CH	PRE-REQUISITE
GNS 102	Communication in English I	2	-	2	2	- -
GLT 111	General Laboratory Techniques	2	-	2	2	- -
CHE 106	Plant Maintenance and Services	1	-	1	1	
PGP 121	Transport Phenomena I	2	-	2	2	- -
PGP 122	Separation Process I	2	-	2	2	- -
PGP123	Basic Notions of Utilities	2	-	2	2	- -
PGP124	Basic Engineering Mathematics	2	-	2	2	- -
PGP125	Petrochemical Process Chemistry	3	-	3	3	- -
PGP 126	Basic Chemical Laboratory Technology I	-	2	2	2	- -
PGP 127	Technical Report Writing	1	-	1	1	- -
TOTAL		**17**	**2**	**19**	**19**	- -

ND II SEMESTER ONE

COURSE CODE	COURSE TITLE	L	P	CU	CH	PRE-REQUISITE
CHE 203	Chemical Engineering Thermodynamics	2	-	2	2	- -
CHE 215	Corrosion and Material Science	2	-	2	2	- -
EEd 216	Entrepreneurship Development	2	2	4	4	
PGP 211	Petroleum Processing Technology	2	-	2	2	- -
PGP 212	Basic Petrochemicals Processing Technology	2	-	2	2	PGP 121
PGP 213	Gas Processing Technology I	2	-	2	2	PGP 126
PGP 214	Basic Computer Application in Processing Engineering	1	1	2	2	- -
PGP215	Transport Phenomena II	2	-	2	2	- -
PGP216	Basic Chemical Laboratory Technology II	-	2	2	2	- -
PGP217	Industrial Safety	1	1	2	2	- -
PGP 218	Process Equipment Fabrication	1	2	2	3	
PGP 219	Project	-	3	-	3	- -
TOTAL		**17**	**11**	**24**	**28**	- -

ND II SEMESTER TWO

COURSE CODE	COURSE TITLE	L	P	CU	CH	PRE-REQUISITE
CHE 226	Chemical Process Analysis	2	-	2	2	- -
PGP 221	Gas Processing Technology II	2	1	2	3	PGP 213
PGP 222	Kinetics and Catalysis of Chemical Processes	2	1	2	3	-
PGP 223	Basic Petroleum Plant Design	2	-	2	2	-
PGP 224	Separation Process II	2	-	2	2	PGP 122
PGP 225	Petrochemical Processing Technology	2	-	2	2	- -
PGP 226	Polymer Science and Technology	2	-	2	2	- -
PGP 227	Oil Movement, Jetty and Depot Operation	2	-	2	2	- -
PGP 228	Process Instrumentation and Control	2	-	2	2	- -
PGP 229	Project	-	3	3	3	- -
TOTAL		**18**	**5**	**21**	**23**	- -

FIRST SEMESTER COURSES
(YEAR 1 SEMESTER 1)

Programme: National Diploma in Petroleum and Gas Processing Technology		
Course Title: Introduction to Petroleum and Gas Processing Calculations	**Code: PGP 111**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year:1 Semester: 1		**Practical : 0 hours/week**

Goal: This Course is designed to enable the Student become Acquainted with the Tools of Process Calculations and their Applications in Petroleum and Gas Operations

General Objectives:

On the completion of the course, the student should be able to:

1.0 Appreciate basic unit of measurement and their conversions
2.0 Compute mass balance unit operations
3.0 Apprehend some basic thermodynamics and thermochemistry
4.0 Apprehend combined mass and energy balance unit operations
5.0 Comprehend Physical and Chemical data
6.0 Appreciate the use of Graphs
7.0 Appreciate Gas laws and its applications

Programme: National Diploma in Petroleum and Gas Processing Technology						
Course Title: Introduction to Petroleum and Gas Processing Calculations			**Code: PGP 111**		**CH:2**	**CU:2**
General Objective 1.0 : Understand basic unit of measurement and their conversions						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain the different dimensions and units 1.2 Identify the basic and units in the STCGS and American Engineering (AE) systems for mass, length, temperature, time, density, volume, area, force etc and their equivalent 1.3 Convert one set of unit in a function or equation into another set of	Give the unit of Mass used for mass balance calculation for different unit systems Define clearly the mole, molar, volume etc Use numerical problems to highlight, convert from one unit to another	Recommended textbooks, Lecture notes etc	-	-	Show dimensional consistency of some given units

	units 1.4 Apply the concept of dimensional consistency to determine the validity of an equation or function					
General Objectives 2.0 Compute mass balance unit operations						
3-5	2.1 Explain the principles and practice of conducting mass balance for unit operations and process with and without chemical reactions 2.2 Define steady-state and unsteady-state processes and specify advantages of assuming the forms 2.3 Define mass output, mass inventory and state the mass balance	• Show clearly how a mass balance is carried out • Explain the differnces between steady and unsteady state processes, mass input, mass output, recycle bye pass, reflux ratio etc. • Use enough numerical examples to ensure proper understanding of the above concept	Recommended textbooks, Lecture notes etc	-	-	Differentiate between steady state and study state processes List examples of steady state and unsteady processes

	equations according to the law of conservation of mass 2.4 Define recycle, by-pass, reflux ratio, concurrent and counter current processes and 2.5 Define the single operating process and consecutive current processes 2.6 Calculate masses of materials entering and leaving a process in and consecutive operating process by component balances 2.7 Calculate the masses of materials entering and leaving a process when	Take students through to Calculate masses of materials entering and leaving a process in and consecutive operating process by component balances, masses of materials entering and leaving a process when there is a recycle stream.				Differentiate between single operating process and consecutive current process List examples of single operating process and consecutive current process Calculate mass of material entering and leaving a process with a recycle stream

	there is a recycle stream.					
General Objectives 3.0 Apprehend some basic thermodynamics and thermo chemistry						
6-7	3.1 Define specific heat capacity, molar heat capacity and mean molar heat capacity. 3.2 Define integral heat of solution. 3.3 Calculate heat of mixing using published heat of solution data 3.4 Evaluate thermodynamic parameters e.g. humidity, enthalpy and heat capacity using monographs and charts.	Explain the concept of thermodynamics and thermo chemistry and specific heat capacity, molar heat capacity and mean molar heat capacity	Recommended textbooks, lecture notes, etc.	-	-	State the difference between heat capacity and molar heat capacity? Evaluate thermodynamic parameters using monographs and charts.
General Objectives 4.0 Apprehend combined mass and energy balance unit operations						
8-10	4.1 Explain the Principles and practice of conducting energy balances for unit operations and	Explain activities in 4.1 to 4.6. Take students through, to Calculate the energy entering and leaving a	Recommended textbooks, lecture notes, etc.	-	-	Write the energy balance equation according to law of conservation of energy

	processes. 4.2 Define energy input, energy output and energy inventory. 4.3 State the energy balance equations according to the law of conservation of energy. 4.4 Calculate the energy entering and leaving a process in a variety of streams in a single operating process. 4.5 Calculate the energy entering and leaving process in a consecutive operating process. 4.6 Calculate the energy entering and leaving a process when there is a recycle stream.	process in a variety of streams in a single operating process. Calculate the energy entering and leaving process in a consecutive operating process. Calculate the energy entering and leaving a process when there is a recycle stream.				
General Objectives 5.0 Comprehend Physical and Chemical Data						
11-12	5.1 Explain the use of tables, charts,	Explain how charts and tables are used to extract	Charts, graphs, standard tables	-	-	Evaluate density, solubility, expansion

	graphs and monographs in the presentation data 5.2 Explain the utilization of interpolation and extrapolation 5.3 Evaluate density, solubility, expansion coefficient, specific heat, viscosity etc from published data on crude and its product	data				coefficient and viscosity of crude from published data on crude and its product
General Objectives 6.0 Comprehend the use of graphs						
13-14	6.1 Plot on a linear graph paper and evaluate slope intercept values 6.2 Plot on a semilog graph paper and evaluate slope intercept and their interpretation 6.3 Graphically correlate and predict physiochemical properties of petroleum and its products.	Explain how to draw graphs as well as how to calculate slopes and how to obtain intercept to graphically correlate and predict physiochemical properties of petroleum and its products.	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments Computer set Relevant software. .	-	-	Graphically correlate and predict physiochemical properties of petroleum and its products.

General Objectives 7.0 Appreciate gas laws and its applications						
15	7.1 Explain ideal and real gases 7.2 State ideal and real gas laws and utilize to calculate your properties 7.3 Apply gas laws to petroleum gas processing plants	Explain the differences between real and ideal gas, applying gas law.	Recommended textbooks, lecture notes, etc.	-	-	Differentiate between an ideal gas and a real gas with examples Write equations of ideal gas and real gas laws

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Basic Petroleum and Gas Production Technology	**Code: PGP 112**	**Credit Hour: 2** **Credit Unit:2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year: 1 Semester: 1		**Practical : 0 hours/week**

Course main Goal: This course is designed to introduce students to the fundamentals of exploration, drilling, production and storage of crude oil and gas.

General Objectives:

On the completion of the course, the student should be able to:

1.0 Appreciate the Earth's Origin and The Origin of Oil and Gas.
2.0 Outline exploration Methods.
3.0 Comprehend drilling and well engineering
4.0 Appreciate Well Completion and Wellhead Equipment
5.0 Apprehend the Development of Oil and Gas Fields
6.0 Apply Production Techniques
7.0 Comprehend Oil and Gas Measurements
8.0 Recognize Oil and Gas Production Layout

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Basic Petroleum and Gas Production Technology			**Code: PGP 112**		**CH:2**	**CU:2**
Theoretical Content			**Practical Content**			
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
General Objective 1.0: Appreciate the Earth's Origin and the Origin of Oil and Gas.						
1-2	1.1 Define the earth and its structure. 1.2 Explain the evolution of sedimentary basin 1.3 Explain the origin of oil and gas. 1.4 Explain the movements, faults, folds and unconformity. 1.5 Explain the types of traps.	• Describe the processes involved in oil and natural gas formation in a source rock. • Describe the various stages involve in the formation of petroleum system • Describe the earth movements, and trap types.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Explain the origin of petroleum and gas Explain different types of traps
General Objectives 2.0 Outline Exploration Methods						
3	2.1Describe aerial surveying method. 2.2 Explain the following: geological exploration methods, geophysical exploration (seismic, gravimetric).	• Explain the exploration methods. • Describe the equipment used in geological	Whiteboard, Computer related software, PowerPoint projectors, recommended	Identify the equipment used in geological exploration.	Guide students to identify the equipment used in geological exploration.	Describe equipment used for geological exploration

	2.3 Identify the equipment used in geological exploration.	exploration.	text books, flip charts, lecture notes, and related journals. Geological equipment			
General Objectives 3.0 Comprehend drilling and well engineering						
4	3.1 Explain the following: 3.2 Appraise drilling. • Exploratory drilling. • Development drilling. • Deviated drilling. • Directional drilling. • Horizontal drilling. • Describe a drilling rig • Explain the drilling process • Describe offshore and swamp drilling.	• Explain the types of drilling. • Explain the drilling process. • Explain the types of drilling rigs. • Explain offshore drilling.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	List and explain various types of drilling equipment Briefly discuss offshore drilling
General Objectives 4.0 Appreciate Well Completion and Wellhead Equipment						
5-6	4.1 Describe casing, tubing, and single dual. Describe multilateral completion. 4.2 Explain the following well completion procedures: • Perforating • DST • Packers • Sand	• Explain well completion techniques. • Explain the functions of well completion • Explain the uses of well head	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes,	-	-	List and explain the types of well completion procedures

	consolidation. 4.3 Describe the use of the following well head equipment. • Casing head flanges • Tubing head • Tubing hangers • Adapter flanges • Christmas trees 4.4 Identify the equipment stated above.	equipment.	and related journals.			
General Objectives 5.0 Apprehend the Development of Oil and Gas Fields						
7-8	5.1 Describe the following: • Oil and gas wells • Manifolds • Flow lines • Flow stations • Oil and gas discharge lines, terminals and pipelines. 5.2 Explain the roles of 5.1 above in the development of oil and gas field.	Describe the oil and gas field development	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Explain the role of flow lines in the development of oil and gas field.
General Objectives: 6.0 Apply Production Techniques						
9-10	6.1 Describe the special Forms of flowing wells. 6.2 Explain the term "bringing in" of a flow well. 6.3 Describe well head jackets and production barge.	• Explain oil and gas production techniques. • Describe production testing				Explain techniques involve in oil and gas production.

	6.4 Identify well head jackets and productions barges. 6.5 Explain production testing. 6.6 Explain the relevance of seal loading lines and floating buoy moorings.					
General Objective 7.0 Comprehend Oil and Gas Measurements						
11-13	7.1 State the oil and gas measurement methods. 7.2 Describe well gauging and sampling methods for crude oil. 7.3 Describe density and specific gravity measurements of gas. 7.4 Explain the use of orifice meter. 7.5 Carry out the various measurements of crude oil and gas.	• Describe the measurement techniques of oil and gas. • Explain the determination of specific gravity and density of gas.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts	-	-	Describe how specific gravity of gas is determined.
General Objectives: 8.0 Recognize Oil and Gas Production Layout						
14-15	8.1 Describe production development layout. 8.2 Describe the methods of production planning and reporting. 8.3 Describe the job of a production foreman, technician, technologist and engineer.	• Explain the field development layout. • Describe production planning and reporting.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts			List and Explain methods of production planning

PROGRAMME: National Diploma (ND) in Petroleum and Gas Processing Engineering Technology		
Course: Process Engineering Graphics	**Code: PGP 113**	**Total Hours: 3 Hours/Week**
		Theoretical hours: 1 Hour/Week
First Semester Year One	**Pre-requisite: NIL**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to acquaint students with the fundamentals of technical drawing and how to present process equipment in a simplest form**.**		

GENERAL OBJECTIVES	
On completion of this course, the students should be able to:	
1.0	Appreciate different drawing instrument, equipment and materials
2.0	Comprehend the essentials of graphical communications
3.0	Appreciate the construction of simple geometrical figures and sections
4.0	Comprehend the symbolic representation of process Equipment and installments
5.0	Comprehend the selection of appropriate symbols for formulation or interpretation of process & instruments diagrams.
6.0	Comprehend the production and interpretation of process and instruments flow diagrams
7.0.	Appreciate the application of some process flow diagram design soft wares like Visio, Aspen Hysys, etc

PROGRAMME: NATIONAL DIPLOMA IN PETRCHEMICALS AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Process Engineering Graphics			**COURSE CODE: PGP 113**		**CONTACT HOURS: 1-0-2 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: Appreciate different drawing instrument, equipment and materials					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Define the following: drawing instrument; drawing equipment and drawing materials. 1.2 List different types of drawing instruments, equipment and materials. 1.3 Outline the uses of the various instruments, equipment and materials. 1.4 State the precautions necessary to preserve	Explain drawing instrument; drawing equipment and drawing materials.	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 in 1.1 above. Use each of the items in 1.1 above. Maintain the	Guide students to conduct practical the activities	Describe different drawing instrument, equipment and materials.

	items 1.1 above.			various instruments and equipment.		
	General Objective 2.0: Comprehend the essentials of graphical communications					
3-4	2.1 Define graphical communication 2.2 Explain different types of graphic communications. 2.3 Describe various conventions present in graphical productions of construction lines, finished lines, hidden and overhead details projections, centre lines, break lines, dimensioning of plane, elevation and sections of objects. 2.4 State the various standards of drawing sheets. 2.5 Print letters and figures of various forms and characters.	Explain communication and 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.	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments .	Demonstrate 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. Prepare drawing sheets with the following (a) Margins (b) Title block etc. State the various standards of	Demonstrate for the students to learn and guide them to perform the practical activities.	Explain the essentials of graphical communications

	2.6 Describe conventional signs, symbols and appropriate lettering characters			drawing sheets. Print letters and figures of various forms and characters. Illustrate conventional signs, symbols and appropriate lettering characters.		
	General Objective 3.0: Appreciate 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,	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	Demonstrate for the students to learn and guide them to perform the practical activities.	Explain the steps in construction of simple geometrical figures and sections

	tangent, circumference etc. 3.3 Define an ellipse. 3.4 Explain the following drafting techniques: (a) Projection method (b) Measurement method (c) Transposition method.			irregular). Construct regular polygons with N sides in a given circle, given (a) distance across flats (b) distance across corners. Carryout simple geometrical constructions on circles e.g. (a) diameter of a circle of a circle of a given circumference. (b) the circumference to a circle of a given diameter (c) a circle to pass through 3 points (d) a circle to pass through 2 points and touch a given line (e) a circle to touch a given smaller circle and		

				a given line (f) 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: Comprehend the symbolic representation of process Equipment and installments.						
8-10	4.1 Explain the symbolic representation of process equipment in accordance with the logical flow sequence from raw material source to finished product. 4.2 State the standard numerical and alphabetical abbreviation in flow charting. 4.3 State the general rules guiding the identification of any type of process equipment and instruments. 4.4 Identify basic abbreviation representing process equipment and instruments	Explain the symbolic representation of process equipment and the standard of numerical and alphabetical abbreviation in flow-charting. Explain the general rules guiding the identification of any type of process equipment and instruments and also the basic abbreviation representing process equipment and instruments	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments Computer set Relevant software. .	Identify basic abbreviation representing any process equipment and instruments	Guide students to identify basic abbreviation representing process equipment and instruments	State the standard numerical and alphabetical abbreviation in flow charting.
	General Objective 5.0: Comprehend the selection of appropriate symbols for formulation or interpretation of process & instruments diagrams					
	5.1 State letter symbols with their meanings.	Explain appropriate and standardized	Marker, Whiteboard,	Show symbols used in piping design and valve	Guide students to identify	State the British and American

11-12	5.2 State appropriate and standardized graphic symbols notifications adopted for plants up-dating, designing, construction and maintenance. 5.3 Show symbols used in piping design and valve identification. 5.4 State the British and American Institute standards	graphic symbols notifications adopted for plants up-dating, designing, construction and maintenance.	Duster, Textbooks, Complete set of drawing instruments Computer set Relevant software. .	identification.	symbols used in piping design and valve identification.	Institute standards
General Objective 6.0: Appreciate the production and interpretation of process and instruments flow diagrams						
13- 14	6.1 Represent general equipment such as pumps, compressors, motors, turbines, etc. 6.2 Represent piping and instrumentation, cathodic protection symbols and essential electrical symbols. 6.3 Apply examples of graphic symbols to selected industrial processes.	Explain activities in 6.1 to 6.4	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments Computer set Relevant software. .	Represent general equipment such as pumps, compressors, motors, turbines, etc. Represent piping and instrumentation, cathodic protection symbols and essential electrical symbols.	Guide students to represent equipment such as: pumps, compressors, motors, turbines, etc. Guide students to represent piping and instrumentation, cathodic protection symbols and	Explain how to interpret process and instruments flow diagrams.

	6.4 Interpret typical complete process flow diagram.			Interpret typical complete process flow diagram.	essential electrical symbols. Guide students to interpret typical complete process flow diagram.	
General Objective 7.0: Appreciate the application of some process flow diagram design soft wares like Visio, Aspen Hysys, etc						
15	7.1 Explain the use of flow charting soft wares like Visio, Aspen Hysys, etc 7.2 Explain the use of the application of software to design process flow diagrams for a number of production processes.	Explain the use of flow charting soft wares like Visio, Aspen Hysys, etc and the use of the application of software in the design process flow diagrams for a number of production processes.	Marker, Whiteboard, Duster, Textbooks, Complete set of drawing instruments Computer set Relevant software. .	Use flow charting soft wares like Visio, Aspen Hysys, etc Use application software to design process flow diagrams for a number of production processes.	Guide students to practice the use flow charting soft wares like Visio, Aspen Hysys, etc Guide students to use application software to design process flow diagrams for a number of production processes	List process flow diagram software.

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Petroleum Chemistry	**Code: PGP 114**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite: NIL	**Theoretical: 2 hours/week**
Year: 1 Semester: 1		**Practical : 0 hours/week**

Goal: This course is designed to acquaint students with the general physical and chemical characteristics of petroleum and its products.

General Objectives:

On the completion of the course, the student should be able to:

1.0 Recognize the structure of atoms, molecules, and their composition

2.0 Comprehend chemical thermodynamic

3.0 Appreciate the properties and reactions of acids, bases and salts

4.0 Familiarize with surface phenomena and colloidal systems

5.0 Identify chemical equilibrium

6.0 Comprehend the use of stoichiometry in chemical reactions

7.0 Appreciate organic chemistry and application of aliphatic hydrocarbons

8.0 Recognize the chemistry of aromatic compounds

9.0 Comprehend the relationship between energy distribution within a reacting system and the factors that affect rate of reaction

Programme : National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Petrochemical Process Chemistry			**Code: PGP 114**		**CH:2**	**CU:2**
Theoretical Content			**Practical Content**			
General Objective 1.0 : Recognize the structure of atoms, molecules, and their composition						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1Explain the experimental basis of atomic theory using the Bohr's theory of hydrogen atom and many electron atoms. 1.2 Describe atomic spectra particularly the atom emission spectrum 1.3 Explain the Energy States of the hydrogen atom in the Bohr model and relate these Energy States to the observed emission spectra 1.4 Explain limitations of the Bohr model 1.5 Describe the wave-particle duality of	Explain atomic theory using the Bohr's theory of hydrogen atom and many electron atoms. Explain with illustration the qualitatively, the Energy States of the hydrogen atom in the Bohr model and relate these Energy States to the observed emission spectra explain the wave-particle duality of electrons and energy	Textbooks direct vision spectroscope Bunsen burner, nichrome wire fixed to a cork handle, concentrated HCl, solid chlorides of : barium, calcium, potassium, sodium and strontium beakers and Watched glasses. Workshop resources and representative mass spectra iron, Sulphur, Bunsen	View the visible emission spectra of several metals in some of their compounds Interpret the mass spectrum of representative elements such as Oxygen, Carbon, and Chlorine etc.	Guide and supervise the students on Bohr"s theory of hydrogen and electron atoms	What is the basis of atomic theory using the Bohr's theory of hydrogen atom and many electron atoms? Enumerate qualitatively, the Energy States of the hydrogen atom in the Bohr model and relate these Energy States the observed emission spectra What are Bohr model limitation Enumerate different main

	electrons and energy 1.6 Define the following:: (i) Atomic number, (ii) Mass number, (iii) Atomic mass, Based on12C 1.7 Explain valency and chemical bonding. Explain the octet and duplet rules 1.8 Distinguish between the following types of bonds: ionic: covalent; metallic, co-ordination bond. 1.9 List out energy considerations in ionic bonding and lattice energy 1.10.Explain the formation of covalent bonds, bond length and bond energy, electro negativity and bond polarity, 1.11 Explain Van der Waal's forces.	Explain the significant of the four quantum numbers Explain in details determination; o relative atomic and molecular masses. Describe the following:: (i) Atomic number, (ii) Mass number, (iii) Atomic mass, Based on12C State different between ionic: covalent; metallic, co-ordination bond.	burner, glassware, magnets			energy levels of an atom, namely K, L. and Correlate the energies of the electron in the K,L,M,N,…shells with the values of the principal quantum no n=1,2,3,4. What is atomic mass number ,etc What is valency and chemical bonding that re-occur in between types bonding Define structurally covalent; metallic, co-ordination bond bonding and lattice energy

General Objectives 2.0 Comprehend chemical thermodynamic						
3	2.1 Describe thermodynamic systems e.g. open system, closed system, isolated system. 2.2 Explain thermodynamic functions in; enthalpy, entropy, free energy. 2.3 Explain the first and second laws of thermodynamics and their significance. 2.4 Explain thermo chemistry as heat effects that accompany chemical reactions	Explain thermodynamic systems and its functions in; enthalpy, entropy, free energy. Explain the first and second laws of thermodynamics and their significance and also the thermo chemistry as heat effects that accompany chemical reactions	Classroom resources Chemicals calorimeter silica tin	Measure heat of reaction by simple experiments e.g. heat of neutralization of NaOH, HCl i.e. strong acid and strong base Measure heat of reaction in an open, closed, and isolated system	Guide students to measure heat of reaction by simple experiments e.g. heat of neutralization of NaOH, HCl i.e. strong acid and strong base Guide students to measure heat of reaction in an open, closed, and isolated system	What is first , second law of thermodynamics Define thermo function in entropy, entropy, free energy. State heat of Reaction that accompanies the chemical reaction in thermodynamics
General Objectives 3.0 Appreciate the properties and reactions of acids, bases and salts						
4-5	3.1 Define an acid and a base according to Arrhenius, Bronsted – Lowry and Lewis concepts. 3.2 Identify acids and	Explain acid, bases and salts and the equations to dissociation constant and derive expression for it to work out	Chemicals Conductance meters pH meters colour charts indicators burettes	Carry out acid base titration	Guide students on how to carry out acid-base reaction in the laboratory	What is an acid ,base according to Arrhenius, Bronsted – Lowry and Lewis concepts.

	bases in chemistry equations. 3.3 Explain the meaning of the terms conjugates acid and conjugate base 3.4 Distinguish between a strong and weak acid or base. 3.5 Write the expression for the dissociation constant for an acid HA(aq) 3.6 Write the equation for the degree of dissociation and concentration, M. (mole dm^3) for a dilute solution of weak acids. 3.7 Explain Ostwald's Dilution law and dissociation constant, K.	simple calculations on degree of dissociation of weak acid and base.	glassware	Identify indicators and use indicators in acid base titration	Guide students on how to Identify indicators and use indicators in acid base titration	Differentiate between strong and weak acid with example State Ostwald's Dilution law and i)calculate the dissociation constant, K. ii) the degree of dissociation of a weak acids given the molarity and dissociation constant K.

General Objectives 4.0 Familiarize with surface phenomena and colloidal systems						
6	4.1 Explain surface phenomena and colloidal system 4.2 Explain the following; • colloidal gels • surface tension • absorption, • emulsion • gels • flotation • chromatography 4.3 Differentiate between adsorption and absorption	Explain colloidal gels surface tension, absorption, emulsion, gels, flotation, chromatography.	Finely cut leaves Chromatograph tank Paper chromatograph	Carry out surface phenomenal experiment	Guide students to carry out surface phenomenal	What is surface phenomena and colloidal system Compare the following; a. surface tension b. absorption, c. emulsion d. gels e. flotation f. chromatography What is the difference between adsorption and absorption
General Objectives 5.0 Identify chemical equilibrium						
7	5.1 Explain chemical equilibrium 5.2 State the factors affecting chemical equilibrium 5.3 Explain reversible reaction in relation to chemical equilibrium.	Explain chemical equilibrium And factors affecting chemical equilibrium	test tubes, gloves, potassium chromate,	Carry out procedures on chemical equilibrium	Guide students to carry out procedures on chemical equilibrium	Define chemical equilibrium List the factors that are affecting chemical equilibrium

General Objectives: 6.0 Comprehend the use of stoichiometry in chemical reactions						
8-9	6.1 Define the Mole 6.2 Describe molar mass Inter conversion of Moles, mass, and number of species 6.3 Calculation of mass percent from the chemical formula 6.4 Define empirical formulas 6.5 Define molecular formulas 6.6 Define combustion analysis 6.7 Explain chemical formulas and the structures of molecules that enable to determine the formula of an unknown compound.	Explain chemical formula, empirical, molar mass Inter conversion of Moles, mass, and number of species. Explain chemical formula and molecular Classroom resources	copper strip (15 x 1 cm) emery paper filter paper balance iodine crystals (0.3 g) boiling tube Bunsen burner Determine the formula of a compound from experimental data Explain chemical formulas and the structures of molecules that enable to determine the formula of an unknown compound. Prepare a standard solution of dilute NaOH or HCl or similar	Carry out experiment on mole, molar mass and calculate the empirical formular of each.	Guide students on the practical aspect on mole, molar mass.	What is; molar mass moles, mass, and number of species, molecular formula, empirical formula. Calculate the molecular formulate of an unknown compound

General Objective 7.0: Appreciate organic chemistry and application of aliphatic hydrocarbons						
10-12	7.1 Classify organic compounds by functional groups. 7.2 Explain homologous series with examples 7.3 State the members of a homologous series and their physical properties. 7.4 Define the functional group. 7.5 Identify functional groups in alkanols, alkanals, alkanones, armines, alkanoic, acids, phenols, nitriles ethers, esters, amides etc. 7.6 Name alkanes by using the IUPAC nomenclature 7.7 List the industrial	Classify organic compounds by functional groups. Explain homologous series with examples State the members of a homologous series and their physical properties. Define the functional group. Identify functional groups in alkanols, alkanals, alkanones, armines, alkanoic, acids, Explain the use of alkenes in the production of polymers e.g.	Classroom resources Glassware Chemicals (bromine or bromine water, cyclohexene, or similar Solvents styrene dodecanoyl peroide toluene, balance, source of hot water Acetanilide may be made impure by adding small amounts of	Determine qualitatively the elements present in an organic compound. Identify functional groups in organic compounds via qualitative chemical tests (reactions) Use IR spectroscopy to identify functional groups in unknown organic compounds and to identify organic	Guide students to conduct practical activities.	Mention major classification of organic compounds by functional groups. What are homologous series with examples States functional groups of the following compounds; alkanols, alkanals, alkanones, armines, alkanoic, acids, phenols, nitriles ethers, esters, amides, Describe bonding in carbon as Sp^3 hybridized in alkane, and state the general formula, CnH2n+2 to represent alkanes What are natural sources of alkene

	uses of alkanes. 7.8 List natural sources of alkanes 7.9 State the general formula, CnH2n to represent alkenes 7.10 Explain the use of alkenes in the production of polymers e.g. PVC, polyethene polystyrene etc 7.2 Represent Describe the industrial uses of alkynes e.g. production of oxyacetylene flame, production of vinyl chloride in the production of polymers	PVC, polyethene polystyrene Explain the chemical tests for the unsaturation in alkenes and alkynes and the industrial uses of alkynes e.g. production of oxyacetylene flame, production of vinyl chloride in the production of polymers		compounds from a list of possibilities Carry out laboratory procedures on production of polymers	Guide student on chemical test on alkene and alkynes and related compound	Write Structurally the cis-trans isomeric structures of butane and the use of curly arrows to represent reaction mechanisms Mention the use of alkenes and enumerate the preparation of alkene in laboratory Write structure and reaction of alkynes by means of simple equation e.g. reaction with H_2. Br_2 and HBr.. Write chemical tests for the unsaturation alkenes and alkynes.

				Carry out chemical test on unsaturated alkene and alkyenes		Enumerate the industrial uses of alkynes e.g. production of oxyacetylene flame, production of vinyl chloride in the production of polymers
General Objective 8.0: Recognize the chemistry of aromatic compounds						
13-14	8.1. Write the structures of benzene and its homologues. 8.2 Explain aromaticity: resonance, resonance theory 4Π + 2 rule. 8.3. Explain the fulfilment of the rule in Benzene and its homologues. 8.4Explain the physical properties of benzene and alkyl benzene, e.g. M.P. and b.p. 8.5.Describe the	Illustrate with examples the structures of benzene and its homologues. Explain aromaticity: resonance, resonance theory 4Π + 2 rule. Outline the fulfilment of the rule in Benzene and its homologues. Outline the physical and chemical properties of benzene and	Laboratory resources Laboratory resources Nitration of bromobenzene Bromobenzene Con nitric conc. sulphuric acids etc	Prepare paracetamol in the lab by acylation of aminophenol Prepare bromobenzene in the laboratory using Con nitric conc. sulphuric acids	Ensure students prepare paracetamol in the laboratory using acylation of aminophenol Guide and supervise	Draw the structure of a named aromatic compound and it homologues series List physical chemical properties of benzene Explain the reaction of benzene with Alkylation Acylation) Nitration, Sulphonation andhalogenation.

	physical and chemical properties of benzene	reaction of it with Alkylation and Acylation) Nitration, Sulphonation and halogenation. Illustrate with examples nucleophlic substitution of benzene			students in the preparation of bromobenzene in lab.	Write a nucleophlic reaction of benzenes with Br, Cl
General Objective 9.0: Comprehend the relationship between energy distribution within a reacting system and the factors that affect rate of reaction						
15	9.1 Define reaction rate Average, Instantaneous, and Initial Rate 9.2. Explain the effect of the following factors on the rate of reaction: (a) temperature, (b) concentration (or pressure of gas), (d)catalysis 9.3.Express rate in terms of reactant and product concentrations 9.4 Explain why the order of reaction is	Explain reaction rate Average, Instantaneous, and Initial Rate Explain the effect of temperature, (b) concentration (or pressure of gas), (d)catalysis Express rate in terms of reactant and product concentrations Explain order of reaction viz: first order reactions;	Laboratory resources; flasks stop- clock thermometer Bunsen measuring cylinders chemicals As above but use different concentration of sodium thiosulphate	Measure and plot the effect of temperature on the reaction between sodium thiosulphate and dilute hydrochloric acid. Use the iodine Clock methods to fin the order of reactions	Guide students to measure rate by placing an x on paper beneath the reaction)	What is reaction rate Average, Instantaneous, and Initial Rate State the effects of the following on rate of reaction (a)temperature, (b) concentration of pressure of gas), (c)catalysis

	commonly a whole number such as 0, 1 or 2. 9.5.Explain the characteristics of a catalyst	second order reactions	Potassium peronxodisulphate VI. Sodium thiosulphate, Potassium iodide, test tubes, burrettes-Thermometers etc.			

Programme: National Diploma (ND) in Petroleum and Gas Processing Engineering Technology		
Course Title: Engineering Physics	**Code: PGP 115**	**Credit Hour: 2** **Credit Unit:2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year: 1 Semester: 1		**Practical : 0hours/week**

Goal: This course is designed to acquaint students with the fundamentals of basic physics

General Objectives:

On the completion of the course, the student should be able to:

1.0 Appreciate rotational motion of rigid bodies and surface tension
2.0 Comprehend periodic motion.
3.0 Appreciate the behaviour of fluids in motion.
4.0 Comprehend specific heat capacity, heat transfer and Newton's cooling correction
5.0 Comprehend the concept of static electricity, capacitance, and conductors
6.0 Comprehend the chemical effects of electric current
7.0 Comprehend the concept of magnetic field
8.0 Comprehend the principles of optics and photometry
9.0 Comprehend the phenomena of waves

Programme: National Diploma (ND) in Petroleum and Gas Processing Engineering Technology						
Course Title: Engineering Physics			**Code: PGP 115**		**CH:2**	**CU:2**
Theoretical Content			**Practical Content**			
General Objective 1.0: Appreciate rotational motion of rigid bodies and surface tension						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain the concept of the moment of inertia about an axis 1.2 Explain the expression for moment of inertia of the following: 1.3 Explain radius of gyration 1.4 Calculate the radius of gyration for each of the bodies 1.5 Define Torque of a body about an axis. 1.6 Define angular momentum of a body about an axis. 1.7 Establish the relationship between torque τ and angular momentum(L) i.e. $\tau = \frac{dL}{dt}$ where t is time. 1.8 State the law of conservation of angular momentum. 1.9 Explain the reduction in	Solve numerical problems using the expressions stated in 1.2. Lecture and apply the expression in the calculation of kinetic energy and acceleration of rolling and sliding rigid bodies e.g. cylinder sphere, disc, ring etc. Solve some numerical	Flywheel of standard pattern with wall support. Mass attached to a length of cord. Vernier Caliper, Stop clock/watch, Meter rule. Two heavy stands and clamps, two threaded corks, meter rule, brass rod, stop clock/watch. Lecture notes Reference texts Inclined plane Cylinder, sphere, disc Ring, uniform rod rectangular plate.	Determine experimentally the moment of inertia of a flywheel. Determine the moment of inertia of a uniform rod using bifilar suspension. Demonstrate the existence of surface tension Determine experimentally the surface tension of a liquid by capillary rise method using travelling microscope. Determine experimentally the surface tension of a liquid using a	Describe the theoretical basis and guide the students to perform experiment to (i) determine the moment of inertia of a flywheel and (ii) determine the moment of inertia of a uniform rod using bifilar suspension. .	Explain moment of inertia about an axis Determine of moment of inertia of a flywheel Determine of moment of inertia of a uniform rod using a bifilar suspension.

	speed of a rotating body when struck by a small mass applying the law of conservation of angular momentum. 1.10 Write the expression for the kinetic energy of rotation of a rigid body. 1.11 Calculate moments of inertia about some axes of interest of the following, using the appropriate formulae 1.12 Explain the phenomenon of surface tension 1.13 Explain the origin of surface tension using the molecular theory. 1.14 Define the coefficient of surface tension (stating its units). 1.15 Explain adhesive and cohesive forces. 1.16 Define angle of contact 1.17 Explain capillary action giving examples of every day situation. 1.18 Explain the variation of surface tension with temperature. 1.19 Explain surface tension in terms of surface energy. 1.20 Relate surface tension to	problems and give assignment. Use examples e.g. water and mercury etc to illustrate adhesive and cohesive forces.	Water, mercury etc., Glass dish, Needle Tissue paper Beaker Water Tap Travelling Microscope set of glass capillary, beaker dilute nitric acid caustic soda solution distilled-water stand with clamp Torsion balance. Beaker containing a liquid, large bottle filled with dropping funnel, an outlet tube bent twice at right angles/ To the end of the tube is forced a length of tubing which is immersed To a given depth in the liquid. A manometer filled with xylol, a travelling	torsion balance. Demonstrate the variation of surface tension with temperature using Jaeger's method.		

	specific latent heat. 1.21Calculate the surface tension of soap solution and soap bubble using the appropriate equations.		Microscope.			
General Objectives 2.0 Comprehend periodic motion						
3	2.1Explain the following:- (i) Periodic motion (ii) simple harmonic motion 2.2 List examples of systems performing simple harmonic motion 2.3 Define the parameters associated with simple harmonic motion (amplitude "a"; period T; angular velocity ωetc) 2.4 Explain the expression for the period of oscillation of the following:- i) a simple pendulum ii) compound pendulum iii) loaded elastic spring etc 2.5 Draw the graphs of potential energy, kinetic energy and total energy against distance from equilibrium position. 2.6 Calculate velocities of bodies in periodic and	Explain activities 2.1 to 2.6	Lecture notes Reference texts	Determine 'g' (acceleration due to gravity) experimentally using: i) compound pendulum ii)loaded spiral spring iii)loaded cantilever	Describe the theoretical basis, demonstrate and guide students to perform experiments to Determine acceleration due to gravity (g) using (i) compound pendulum, (ii) loaded spiral spring and (iii) loaded cantilever.	Ask students in turn to identify systems in simple harmonic motion and establish relation between period and length of oscillator.

	simple harmonic motion when other parameters are known.					
General Objectives 3.0 Appreciate the behaviour of fluids in motion						
4-5	3.1 Explain viscosity applying molecular theory 3.2 Define velocity gradient in a fluid 3.3 Distinguish between streamline and turbulent flow. 3.4 Explain Newton's formula for viscosity:- $F = \eta A \frac{dv}{dx}$ where F = frictional force in a liquid η = coefficient of viscosity A = the area of liquid surface $\frac{dv}{dx}$ = velocity gradient between successive layers of the liquid. 3.5 Define coefficient of viscosity S stating the units. 3.6 State the expression for the steady flow of liquid through a pipe i.e. Poiseulle'sformula:	Explain activities in 3.1 to 3.16	Measuring cylinder with marks for distance, stop clock/watch. Steel sphere of different diameters, micrometer screw gauge, etc..	Determine experimentally the coefficient of Viscosity of a low density liquid using porseuille's formula.	Describe the theoretical basis and guide students to perform experiments to (i) determine the coefficient of viscosity of a low density liquid using porseuille's formula; (ii) determine the terminal velocity of small ball bearings; (iii) investigate the variation of viscosity with temperature; (iv) determine the value of coefficient of viscosity of a liquid based on Poiseulle'sformula; and (v) determine the viscosity of a high density liquid.	Distinguish between streamline and turbulent flow; Explain terminal velocity and state the importance of viscosity in lubrication; Solve numerical problems using Poiseiulle's and terminal velocity formulae; Derive Bernoulli's equation and solve numerical problems using the equation.

	$Volper\sec = \frac{\pi pa^4}{8\eta L}$ where: π = a constant (3.14) P = pressuredifference a = radius of tube L = length of tube η = coefficient of viscosity 3.7 Explain the motion of a small spherical body falling through a viscous fluid. 3.8 Explain terminal velocity 3.9 Explain stoke's law – $F = 6\pi\eta av$ where: F = frictional force in liquid v = terminal velocity a = radius of spherical ball π = a constant (3.14) η = coefficient of viscosity 3.10 Write the expression for the terminal velocity of a small spherical ball i.e. falling through a liquid column: $v_0 = \frac{2ga^2(\rho_s - \rho_l)}{9\eta}$ where: ρ_s = density of the ball bearing's material ρ_l= density of the liquid		Set of long tubes of different diameters, short inlet tubes, outer jackets for tubes, number of small steel ball bearings of different diameters, stop watch/clock. Set of long tubes of different diameters, short inlet tubes, outer jackets for tube and stir, thermometer, number of small still ball bearings of different diameters, Vernier callipers, stop clock/watch. Cylindrical cylinder marked at different intervals, ball bearing, stop	Determine experimentally the terminal velocity of small ball bearings. Demonstrate experimentally the variation of viscosity with temperature. Determine experimentally the value of the coefficient of viscosity of a liquid based on Poiseulle'sformula. Use stoke's theorem to measure the viscosity of a liquid of high density.		

	a = radius of the ball bearing g = acceleration due to gravitation η = coefficient of viscosity 3.11 Explain the importance of viscosity in lubrication. 3.12 Explain the effect of temperature on the viscosity of a liquid. 3.13 Derive Bernoulli's equation. $P + \frac{1}{2}\rho v^2 + \rho g$□ $= constant$ where: p = pressure ρ= density □= elevation g = acceleration due to gravity 3.14 List some applications of Bernoulli's principles e.g. action of filter pumps and carburetors etc. 3.15 State the dimensions of coefficient of viscosity. 3.16 Calculate the terminal velocity of steel balls or other bodies falling under gravity in liquids.		clock/watch, micrometer Screw gauge.			
General Objectives 4.0 Comprehend specific heat capacity, heat transfer and Newton's cooling correction						

6-7	4.1 Define temperature using concept of thermal equilibrium. 4.2 Define temperature in terms of thermometric properties, length of liquid column, pressure of a gas under constant pressure, resistance of a wire, e.m.f. of thermocouple, radiation from a hot body. 4.3 Define temperature scale: Celsius scale; Kelvin scale; and ideal gas scale. 4.4 Convert Celsius to Kelvin scale. 4.5 Compare the ideal gas scales and other scales. 4.6 List the basic fixed points on the international temperature scales. 4.7 Describe the appropriate uses of thermometers 4.8 State Newton's laws of cooling $\frac{d\theta}{dt} = Ks\,(\theta - \theta_0)$ where: θ = the body's temperature s = the area of the body's surface θ_0 = temperature of its surrounding	Explain activities in 4.1 to 4.14	Liquid in glass thermometers (choice of appropriate liquid). Resistance thermometer. Thermocouple Pyrometers Gas thermometer Clinical thermometers Minimum and maximum thermometers Glass blowing laboratory .Mercury, Capillary tube, mercury, copper and platinum wire. Hot and cold sources. Calorimeter	Identify the different types of thermometers:- Liquid in glass thermometers (choice of appropriate liquid). Resistance thermometer. Thermocouple Pyrometers Gas thermometer Clinical thermometers Minimum and maximum thermometers Construct and calibrate a liquid in glass thermometer resistance thermometer, Thermocouple and Gas Thermometers. Conduct experiment to ascertain the sensitivity of thermometers constructed by comparing with standard ones.	Provide different types of thermometers and first allow students to identify them using their previous knowledge of thermometry. Divide students into project groups for the work Guide students to determine specific heat capacity of solid and liquid using electrical methods. Guide students to determine specific capacity of liquid by continuous flow method. Guide students to verify Newton's law of cooling	Define temperature using concept of thermal equilibrium. Define temperature in terms of thermometric properties, length of liquid column, pressure of a gas under constant pressure, resistance of a wire, e.m.f. of thermocouple, radiation from a hot body. Define temperature scale: Celsius scale; Kelvin scale; and ideal gas scale. Convert Celsius to Kelvin scale. Compare the ideal gas scales and other scales.

	K = cooling constant 4.9 Explain cooling corrections in measurements of quantity of heat. 4.10 Explain heat current. 4.11 Explain Thermal conductivity of a material. 4.12 Explain Stefan's law of radiation. 4.13 Explain greenhouse effect and its every day applications. 4.14 Explain black body radiation.		Heater Thermometer Stop Clock/Watch -Ammeter -Voltmeter - Source of EMF Calendar and Barnes apparatus. Stop Clock/Watch. Source of EMF. -Ammeter -Voltmeter - Resistance Thermometer. Thermometer Stirrer made of copper wire. Stop watch/clock Paraffin Beaker. Copper calorimeter provided with a lid and supported on corks inside a double walled vessel containing cold water between the	Determine specific heat capacity of solid and liquid using electrical methods. Determine specific capacity of liquid by continuous flow method. Verify Newton's law of cooling experimentally Determine Thermal conductivity of copper using Searle's method. Determine Thermal conductivity of ebonite by Lees' Disc method.	experimentally Guide students to determine cooling corrections in heat experiment. Note: (i) Supervise the practicals. (ii) Group the students for the purpose of the practicals. (iii) Demonstrate the experiment for the students before allowing them to work in groups Guide students to determine Thermal conductivity of copper using Searle's method.	List the basic fixed points on the international temperature scales. Explain cooling corrections in measurements of quantity of heat. Explain heat current. Explain Thermal conductivity of material. Explain Stefan's law of radiation.

			walls. Standard form of Searle's apparatus with steam heater. Beaker, stop clock/watch Callipers. Standard laboratory form of Lees' Disc apparatus, stop clock/watch and screw gauge		Guide students to determine Thermal conductivity of ebonite by Lees' Disc method.	

General Objectives: 5.0 Comprehend the concept of static electricity, capacitance, and conductors						
8-9	5.1 Describe the principles of electrostatics shielding. 5.2 State Coulomb's law. 5.3Explain the principles of operation of the Vande Graff generator. 5.4 State the expression for Coulomb's force in a medium of permittivityε $F = \frac{q_1 q_2}{4\pi\varepsilon r^2}$ 5.5 Calculate the resultant force between two or more charges using coulomb 'slaw. 5.6 Draw lines of force due to:- an isolated point charge two similar charges two unlike charges. 5.7 Define Electric field intensity. 5.8 Calculate field intensity due to a point charge and a dipole.	Explain activities in 5.1 to 5.26.	Van de Graff generator. Mica, paraffin, waxed, electrolytic, variable, air capacitors, etc Standard resistors such as carbon black and wire wound resistors, and variable resistors such as rheostat and resistance boxes.	Draw lines of force due to:- an isolated point charge two similar charges two unlike charges.	Guide students to draw lines of force due to:- an isolated point charge two similar charges two unlike charges.	Define Electric field intensity Explain Dielectric strength of a medium State the relationship between current and charge.

	5.9 Explain the terms electrostatic potential, potential difference and electron volt. 5.10 Explain the meaning of potential gradient. 5.11 State the relation between electric potential gradient and electric field. 5.12 Calculate the force and acceleration of an electron placed in electric fields of know intensities. 5.13 Calculate the work done in bringing closer two positively or negatively point charges placed at a distance apart. 5.14 Calculate the potential and electric field between any two of three charges placed respectively at the corners of an equilateral triangle of known dimension. 5.15Explain the meaning of capacitor.					

	5.16Define capacitance. 5.17Describe the different types of capacitors. 5.18List the uses of the capacitor 5.19Explain the factors affecting the capacitance of the parallel plate capacitor (Area, distance and dielectric material). 5.20Define permittivity and relative permittivity (or dielectric constant) 5.21Explain Dielectric strength of a medium 5.22Explain why metals are good conductors of electricity using a free electron model. 5.23Define potential difference and electromotive force(e.m.f.) 5.24State the relationship between current and charge. 5.25Write an expression for drift velocity in metals and 5.26 Explain the symbols used to express drift velocity.					

General Objectives: 6.0 Comprehend the chemical effects of electric current						
10	6.1 Explain electrolysis and voltammeter 6.2 Define electrodes (Anodes and Cathode) 6.3 Explain with examples the term electrolyte. 6.4 Explain ionization process in an electrolyte 6.5 Explain the mechanism of electrolytic conduction. 6.6 Define electrochemical equivalent and equivalent weight. 6.7 State faraday's laws of electrolysis 6.8 Describe electrolysis of water using Hoffman voltameter 6.9 List the applications of electrolysis e.g. electroplating 6.10 Describe the construction of these cells in4.2 above. 6.11 Explain charging, discharging and care of the accumulators. 6.12 Calculate the e.m.f's of cells from energy consideration given the necessary data.	Explain activities in 6.1 to 6.15.	Hoffman apparatus and copper voltammeter. Daniel cell, Laclanche cell (dry and wet) lead Accumulator, Nife cell and western cell, Charger.	-	-	Explain ionization process in an electrolyte Explain charging, discharging and care of the accumulators.

	6.13 Calculate the mass of a substance liberated during electrolysis using M=ZIt where m = mass. Z is electrochemical equivalent of the substance; I is current and t is time. 6.14 Calculate the back e.m.f. produced in a water voltammeter connected to an accumulator given other necessary data. 6.15 Solve problems involving the concept of electrolysis.					
General Objectives: 7.0 Comprehend the concepts of magnetic field						
11	7.1 Explain the concept of magnetic field. 7.2 Explain the nature of the magnetic field. 7.3 Explain the principle of operation of the magnetometer.	Explain 7.1 to 7.3	Bar magnet, Solenoid, straight current carrying conductor, Circular coil, iron fillings, Magnetometer.	-	-	Explain the principle of operation of the magnetometer
General Objectives: 8.0 Comprehend the principles of optics and photometry						

12-13	8.1 Revise previous work on reflection and refraction at curved surfaces. 8.2 Define refractive index in terms of velocities of light in vacuum and in a medium. 8.3 Explain the use of spherometer. 8.4 Explain the application of total internal reflection in the construction of the following: Submarine periscope, binoculars, optical fibre and kaleidoscope. 8.5 Determine the focal length of two thin lenses in contact using the formula: $\frac{1}{f} = \frac{1}{f_1} + \frac{1}{f_2}$ 8.5 Explain defects of lenses (spherical and chromatic aberration) and their corrections 8.6 Explain the magnifying action of lens. 8.7 Write expression for angular magnification of a lens. 8.8 Explain the working of: ii) Simple microscope iii) Compound	Explain 18.1 to 8.18	Spherometer, piece of plane glass, convex mirror. Concave mirror, liquid, retort stand. Clamp. Pin, meter rule. Illuminated object, meter rule, convex lens, stands and screen. Light box, screen, cardboard tube with lens inside and having window on both ends. Travelling microscope with Vernier scale, glass block, tank with glass sides, lycopodium powder, fine sand. Microscope	Determine the radius of curvature of a convex mirror using a spherometer. Determination of the refractive index of liquid using a concave mirror. Determination of the focal length of a convex lens by the displacement method. Determination of the focal length and position of a lens mounted in an inaccessible position inside a tube. Determination of refractive index of (i) glass, liquid using a travelling	Guide students to perform an experiment to determine the radius of curvature of a convex mirror using a spherometer. Guide students to perform an experiment to determine refractive index of liquid using a concave mirror. Guide students to carryout experiment to determine the focal length of a convex lens by the displacement method. Guide students should perform an experiment to determine the focal length and position of a lens mounted in an inaccessible	Explain the use of Spherometer; Explain defects of lenses and their remedy. Use lenses formula to solve problem. Explain the magnification of a lens and with the aid of a diagram

	microscope iv) Astronomical telescope v) Galilean telescope vi) Terrestrial telescope 8.9 Define radiant power, radiant flux, luminous flux. 8.10 Define luminance and luminous intensity. 8.11 Describe the international standard source of light. 8.12 Define solid angle. 8.13 Define luminous efficiency. 8.14 State the relationship between illuminance and luminous flux; luminous intensity and luminous flux. 8.15 State cosine law and inverse square law. 8.16 Describe lummer – Brodhun photometer and the flicker photometer. 8.17 Compare intensities of light sources. 8.18 Calculate the luminous intensity I, and luminous flux F, of a source. 8.18 Calculate the luminance	.	Light sources of different intensities, meter rule, photometer.	microscope. Demonstrate the use of microscope Compare light intensities	position inside atube. Perform experiment to determine refractive index of i) glass, (ii) Liquid using a travelling microscope. Guide students to use microscope to view minute particles. Guide students to compare light intensities using photometer.	Distinguish between radiant power, radiant flux and luminous flux. State the relationship between luminance and luminous flux; luminous intensity and luminous flux. Determine luminous intensity (I) and luminous flux (F) of a source by calculation.

	of a surface.					
General Objectives: 9.0 Comprehend the phenomenon of waves						
14-15	9.1 Explain sound waves in air columns and waves in strings. 9.3 Define resonance. 9.3 List examples of resonance in other physical events. 9.4 Identify the factors that affect the velocity of sound waves in pipes. 9.5 Establish the relationship between the frequency of waves in a straight string and the length and tension: $f = \frac{\sqrt{\frac{T}{m/L}}}{2L}$ Where: f = Frequency T = Tension in string L = Length of string M = Mass of string 9.6 Explain what is meant by Doppler effect. 9.7 List examples of Doppler effect in sound and light. 9.8 Explain the terms:- i) Reflection ii) Refraction iii) Super position iv) Interference and	Explain activities in 9.1 to 9.13	Glass resonance tube about 100 cm long and 3cm in diameter, clamp, rubber bung, set of tuning forks of frequency range 256 to 512 hertz, metre rule. Sonometer, length of steel of diameter about half millimeter, supporting hook and set of slotted five Newton weights, tuning folk, and micrometer screw gauge, Ripple tank.	Determine experimentally the velocity of sound in air using a resonance tube. Determine the frequency of a tuning fork using a sonometer. Demonstrate reflection, refraction, super position, interference and diffraction using a ripple tank.	Student should perform the experiment to determine experimentally the velocity of sound in air using a resonance tube. Student should determine by experiment the frequency of a tuning fork using a sonometer. The teacher should demonstrate reflection, refraction, super position, interference and diffraction using a ripple tank.	Derive the relationship between frequency of waves in a straight string, length and tension. Give examples of Doppler Effect in sound and light. .

	diffraction as they relate to waves. 9.9 State the conditions necessary for interference and diffraction to occur in waves. 9.10 Explain the term beat. 9.11 Determine beat frequency. 9.12 Explain the electromagnetic spectrum in relation to wave lengths and frequency. 9.13 Distinguish between emission and absorption of waves.					

SECOND SEMESTER COURSES
(YEAR 1 SEMESTER 2)

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course: Transport Phenomena I	**Code: PGP 121**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 2 Hour/Week
Year 1 Semester 2	**Pre-requisite: NIL**	**Practical hours: 0 Hours/Week**
Goal: This course is designed to enable student have general overview of transport processes and in particular the basics of fluid mechanics		

GENERAL OBJECTIVES	
On completion of this course, the students should be able to :	
1.0	Comprehend the concept of transport phenomena
2.0	Comprehend the fundamental principles of dimensional analysis
3.0	Appreciate the important fluid properties
4.0	Comprehend fluid pressure
5.0	Comprehend the principles of manometry
6.0	Comprehend the fundamentals of fluid flow.
7.0.	Comprehend fluid measurement and control.
8.0	Appreciate the fluid mechanics and their importance in petrochemicals and Gas processing
9.0	Comprehend the elements of particle mechanics.

PROGRAMME: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Transport Phenomena I			**COURSE CODE: PGP 121**		**CONTACT HOURS: 2 Hrs/Wk**	
Goal: This course is designed to enable student have general overview of transport processes and in particular the basics of fluid mechanics						
COURSE SPECIFICATION:THEORETICAL CONTENT			**PRACTICAL CONTENT**			
	General Objective 1.0: Comprehend the concept of transport phenomena					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Define the three transport processes. 1.2 State the application of transport phenomena 1.3 Explain the inter relationship between the three transport processes (momentum, heat and mass) 1.4 Explain the transport at macroscopic , microscopic, and molecular level 1.5 Analyse the three conservation equations.	Define transport phenomena. State the application of transport phenomena Explain activities in 1.3 to 1.5	Maker & whiteboard PC & projector Textbooks	-	-	State the application of transport phenomena

	General Objective 2.0: Comprehend the fundamental principles of dimensional analysis					
3	2.1 Define system and unit 2.2 Define dimensional analysis 2.3 Explain the system of units and the importance of dimensions 2.4 Explain how dimension can be used to help the formulation of relationships between large numbers of parameters	Define System of units Define dimensional analysis. Explain activities 2.3 to 2.4	Marker & whiteboard Ruler , weighing balance, thermometer etc	-	-	Explain how dimension can be used to help the formulation of relationships between large numbers of parameters
	General Objective 3.0: Appreciate the important fluid properties					
4	3.1 Define fluid 3.2 State the properties of fluid. 3.3 Explain the concept of fluid and particle mechanics 3.4 Explain the fluid viscosity, density, vapor pressure, surface tension and bulk modulus of elasticity.	Explain activities 3.1 to 3.4	Marker, whiteboard, PC and Projector. Some liquid substances like tooth paste , water ,paint etc	-	-	Explain the fluid viscosity, density, vapor pressure, surface tension and bulk modulus of elasticity.

General Objective 4.0: Comprehend the principles of manometry						
5	4.1 Explain the concept of pressure at a point 4.2 Develop the fundamental equations for pressure. 4.3 Describe the units and scales of pressure measurement	Demonstrate the concept of pressure by pressing a finger on someone's body. Explain activities in 4.1 to 4.3.	Marker & whiteboard , PC & Projector	-	-	Explain the concept of pressure at a point
	General Objective 5.0: Comprehend the principles of manometry					
6-7	5.1 Define manometer 5.2 State the uses of manometer. 5.3 Develop a general procedure for solving all manometry problems. 5.4 Apply the procedure in 5.3 above to single or multiple fluid, such as (a) simple u-tube manometer, (b) differential or micro manometer	Explain activities 5.1 to 5.4 Show the manometer to the students while describing it.	Marker & whiteboard Or PC & Projector. manometer	-	-	State the uses of manometer.
General Objective 6.0: Comprehend the fundamentals of fluid flow.						
8-9	6.1 Define system and control volume 6.2 Define streamlines	Use a small container and Water to illustrate	Marker & whiteboard Or PC &	-	-	Define streamlines and stream

	and stream tubes. 6.3 Develop the continuity and Euler's, Bernoulli's' energy and linear momentum equations for fluid flow. 6.4 Apply 6.3 above to simple steady flow, situations, siphon, impact of jets, force on fixed vanes, expansion losses, contraction losses and other head losses, etc.	the fundamentals of fluid flow. Explain activities in 6.1 to 6.4.	Projector. manometer			tubes
	General Objective 7.0: Comprehend fluid measurement and control.					
10-11	7.1 Explain the importance of flow measurements and control. 7.2 Distinguish between velocity and quantity measurement. 7.3 Explain pressure, force and optical measurements of flow. 7.4 Describe positive displacement	Explain activities in 7.1 to 7.6	Marker &whiteboard or PC & Projector A model, Flow meters and other flow measuring devices, viscometer, etc.	Identify flow measurement devices, e.g viscometer	Guide students to identify flow measurement devices. Guide students to use viscometer.	Distinguish between velocity and quantity measurement.

	meters, rate meter and Electromagnetic flow devices 7.5 Describe the measurement of viscosity. 7.6 Explain the principle of pressure and flow control.					
	General Objective 8.0: Appreciate the fluid mechanics and their importance in petrochemicals and Gas processing					
12-13	8.1 Explain the fundamental principles of fluid mechanics. 8.2 Explain the operation of pumps and blowers, turbines and compressors 8.3 Explain pump characteristics such as head capacity curves 8.4 Explain power, head, speed, capacity and efficiency relationships for pumps and compressors 8.5 Apply these relationships in 8.4 above to practical	Explain activities in 8.1 to 8.5.	Marker, whiteboard, PC and Projector. Video animation of fluid mechanics	-	-	Explain the operation of pumps and blowers, turbines and compressors

	situations.					
	General Objective 9.0: Comprehend the elements of particle mechanics.					
14-15	9.1 Explain Lagrangian and Eulerian concepts of relative motion between a particle and a fluid. 9.2 State Stoke's equation of motion of a single particle in a fluid 9.3 Explain the concept of drag coefficient 9.4 Describe 9.3 as a function of Reynolds number 9.5 Determine terminal settling velocity. 9.6 Apply the concepts in 9.1, 9.2, 9.3 and 9.4, above to relative motion between a fluid and a system of particles of different density and diameters.	Explain the activities in 9.1 to 9.5	Marker, whiteboard, PC and Projector.	Determine terminal settling velocity	Guide students to determine terminal settling velocity.	State Stoke's equation of motion of a single particle in a fluid

Programme: National Diploma in Petroleum and Gas Processing Technology		
Course Title: Separation Process I	**Code: PGP 122**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year: Semester:		**Practical : 0 hours/week**

Course main Goal: This course is designed to enable students acquire the fundamental knowledge on solid-liquid separations

General Objectives:

On the completion of the course, the student should be able to:

1.0 Comprehend the principles of liquid and solid mixing
2.0 Comprehend the principles of filtration
3.0 Appreciate the principles of Membrane Separation
4.0 Comprehend leaching and extraction processes
5.0 Appreciate the principles of evaporation

Programme: National Diploma in Petroleum and gas Processing Technology						
Course Title: Separation Process I			**Code: PGP 122**		**CH: 2**	**CU: 2**
General Objective 1.0 : Comprehend the principles of liquid and solid mixing						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define agitation 1.2 List various types of agitation equipment 1.3 Describe typical agitation equipment. 1.4 Explain the effects of baffles in agitation vessels. 1.5 Classify impellers into axial and radial flow types 1.6.Describe the following impellers: a. Propellers; b. Paddles; c. Turbines. 1.7 Explain the effect of viscosity on the selection of mixers. 1.8 Describe mixers for mixing thick pastes, e.g. kneeders, mixer extruders, etc.	Explain the typical agitation equipment Show how impellers are classified. Describe the action of propellers, paddles and turbines. Explain a typical mixer, and the other types based on duty	Marker, whiteboard, PC and Projector Recommended text.	-	-	Explain the effect of viscosity on the selection of mixers.

General Objectives 2.0 Comprehend the principles of filtration						
3-5	2.1 Define Filtration. 2.2Classify filters. 2.3State the reasons for filtration. 2.4 Explain the factors affecting the choice of filter media. 2.5Describe the use of filter aids. 2.6. Explain the principle of cake filtration. 2.6 Describe the essential features of filters.	State clearly the reasons for filtration, factors affecting filter media choice and use of filter aids. Solve numerical problems	Marker & whiteboard , PC & Projector Recommended text.	-	-	Explain the factors affecting the choice of filter media.
General Objectives 3.0 : Appreciate the principles of Membrane Separation						
6-7	3.1 Define membrane separation 3.2 Explain the classification of membrane processes 3.3 State types of membrane and its applications	Mention the classes of membrane processes Outline the nature of synthetic membrane Explain the principle of gas	Marker, whiteboard, PC and Projector Recommended text.	-	-	Explain the classification of membrane processes

		separation Solve some numerical examples.				
General Objectives 4.0 Comprehend leaching and extraction processes						
8-12	4.1 Define leaching and extraction processes. 4.2 Explain liquid-liquid and liquid-solid separations. 4.3 Explain liquid-liquid and liquid-solid equilibria. 4.4 Explain the need for feed pre-treatment and solvent recovery. 4.5 Differentiate between batch and continuous operations. 4.6 Explain the Shank's system of counter-current contacting. 4.7 Identify arrangements and equipment for continuous counter current contacting. 4.8 Classify liquid-liquid extraction equipment. 4.9 Apply the graphical diagrams for multi-stage calculations.	Explain liquid-liquid and solid – liquid equilibria State the need for feed pretreatment and differentiate between batch and continuous operations. Show step-by-step, the graphical solution methods for multi-stage calculation. Solve numerical problems.	Marker & whiteboard , PC & Projector Recommended text.	-	-	Differentiate between batch and continuous operations

General Objectives 5.0 Appreciate the principles of evaporation						
13-15	5.1 Define evaporation 5.2 Classify evaporators 5.3 Explain the mechanism of evaporation. 5.4 Describe single and multiple effect evaporators. 5.5 Explain the following terms: a. Forward feed; b. Backward feed; c. Parallel feed.	Explain the mechanism of evaporation, single and multiple effect evaporators. State the differences between forward, backward and parallel feeds.	Marker, whiteboard , PC and Projector Recommended text.	-	-	Describe single and multiple effect evaporators.

Programme: National Diploma in Petroleum and gas Processing Technology		
Course Title: Basic Notions of Utilities	**Code: 123**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year: 1 Semester: 2		**Practical : 0 hours/week**

Goal: The Course is designed to acquaint student with the principles and practice of water supply and consumption, this include water-treatment systems, boilers, and extensive piping networks.

General Objectives: On completion of this course the students should be able to:

1.0 Outline the quality requirements and uses of water/cooling water
2.0 Appreciate potable water treatment
3.0 Appreciate wastewater treatment
4.0 Appreciate demineralization of water
5.0 Outline the essence of steam generation in petroleum and gas Processing Plants.
6.0 Appreciate characteristic elements of steam generators.
7.0 Appreciate steam distribution system
8.0 Appreciate boilers/steam generators
9.0 Comprehend the air preheaters, deaerators and economizers

Programme: National Diploma in Petroleum and gas Processing Technology						
Course Title: Basic Notions of Utilities			**Code: PGP 123**		**CH: 2**	**CU: 2**
Theoretical Content			**Practical Content**			
Week	**General Objective: 1.0 Outline the quality requirements and uses of water/cooling water**					
1-3	1.1 List out the natural sources of water 1.2 Describe water cycle 1.3 Identify sources of industrial water 1.4 Enumerate uses of water in oil and gas industry 1.5 Explain the quality of water for each usage. 1.6 Classify the impurities present in natural water. 1.7 Identify the problems associated with each impurity in water for specific industrial utilization. 1.8 Enumerate the use of cooling water 1.9 Compare open and closed circuits 1.10 Itemize chemical additives in cooling water and their functions	• Explain what is meant by pure water. • Define an impurity in water with example. • State the effect of impure water to the environment • Explain the basic principles of heat exchangers	Whiteboards, computers, related software, PowerPoint projectors, Flip charts, interactive Boards.	-	-	• What are impurities as regards to water quality? • How does impure water affect the environment? • Why do industries need water?

General Objective 2.0: Appreciate potable water treatment						
4	2.1 State the quality requirements of potable water 2.2 State the treatment steps for potable water 2.3 Outline chemicals in water treatment and their functions 2.4 Explain water filtration process 2.5 State the purpose of water filtration 2.6 Enumerate the properties of filtered water 2.7Explain water clarification process 2.8 State the uses of chemicals in water clarification 2.9 Enumerate the properties of clarified water.	• Give the standard values for potable drinking water. • Explain how chemical additive affect water treatment. • Explain basic filtration process • Explain purpose of filtration • Explain the purpose of clarification	Recommended textbooks, lecture notes, etc.	-	-	• State the uses of chemical additives. • Give some examples of chemical additives. • What is the physical difference between filtered and unfiltered water • How do you tell if water is clarified
General Objective 3.0: Appreciate wastewater treatment						
5-6	3.1 Enumerate the sources wastewater. 3.2 Explain the dangers of untreated wastewater to receiving body of water.	• Explain why it is necessary to check the waste before disposing to the	Recommended textbooks, lecture notes, etc.	-	-	• Give some examples of waste. • What are some methods of

	3.3 Describe the following methods of treatment: • equalization • screening, • sedimentation • flotation, • neutralization, • sludge thickening, • Incineration. 3.4 Explain final check on quality of treated wastewater before disposal	environment . • Explain the process of wastewater treatment.				treating waste water.
General Objective 4.0: Appreciate demineralization of water						
7	4.1 Explain demineralized water and their industrial uses 4.2 Compare methods of water demineralization. 4.3 Describe the cation, anion exchanger, degasifier and polisher 4.4 List the quality requirements of boiler feed water 4.5 Describe the roles of chemical additives in	• Explain the need to demineralized water. • Explain the anion and cation exchangers.	Recommended textbooks, lecture notes, etc.	-	-	List the quality requirements of boiler feed water

	boiler.					
General Objective 5.0: Outline the essence of steam generation in petroleum and gas Processing Plants						
8	5.1Mention the uses of steam in petroleum and gas processing plants. 5.2 Explain the following energy conversion processes: • Chemical energy to heat (e.g chemical reactors and steam generators). • Heat energy to mechanical energy (e.g turbines). • Mechanical energy to electrical energy (e.g electric generators). 5.3 Distinguish between saturated and superheated steam. 5.4 State the advantages of superheated steam.	• Explain what steam is and it uses in process plants.	Recommended textbooks, lecture notes, etc.			At what temperature does water become steam? Distinguish between Saturated and superheated steam.
General Objective 6.0: Appreciate characteristic elements of steam generators.						
9	6.1 Define the following as applies to steam generators. • Capacity • Specific capacity • Operating	• Explain the relation between mass, temperature and specific	Recommended textbooks, lecture notes, etc.	-	-	• What is the relationship between heat, mass, specific heat capacity and

	pressure • Heating surface • Efficiency • Vaporization index 6.2 Describe efficiency of typical steam generator. 6.3 Calculate fuel requirements of steam generators making use of steam tables and heating values of fuels.	heat capacity of a substance. • Explain the efficiency of a steam engine and show how it can be calculated. • Show how to use the steam tables for calculations.				temperature of a substance?
General Objective 7: Appreciate steam distribution systems						
10-11	7.1 Relate steam utilization to steam pressure (low, medium and high). 7.2 Describe the operation of temperature. 7.3 Describe the operation of steam pressure reducing stations. 7.4 Describe steam distribution system in	• Explain steam pressure. • Explain how steam is passed through various units in a petro chemical plant.	Recommended textbooks, lecture notes, etc.	-	-	• What are the uses of steam in a petrochemical plant?

	refinery and petrochemical plants. 7.5 State the roles of waste heat boilers in steam generation and distribution					
General Objective 8: Appreciate boilers/steam generators						
12-13	8.1 List out the major parts of boilers/steam generators. 8.2 List the functions of major parts of boiler/steam generators. 8.3 Mention boiler auxiliaries and their functions. 8.4 Describe boiler operation. 8.5 Describe flow of water and steam through boiler. 8.6 Describe water drum and steam drum. 8.7 Describe water wall tubes, down comers, risers and blow down. 8.8 Describe superheaters. 8.9 Explain the role of	• Draw a boiler and explain how it works. • Mention and give the functions of the various parts of a boiler.	Recommended textbooks, lecture notes, etc.	-	-	• Sketch a boiler. • Explain the conditions at which a steam boiler operates

	chemical additives in boiler operation.					
General Objective 9: Comprehend air preheaters, deaerators and economizers						
14-15	9.1 Explain the influence of air pre heater on boiler thermal efficiency. 9.2 Explain types of air preheaters. 9.3 Describe the construction and operation of air preheaters. 9.4 Describe the boiler feed water system. 9.5 Describe the construction and operation of deaerator and economizers 9.7 Explain types of burners 9.8 Describe the construction and operation of gas burners, oil burners and combined burners.	• Explain what an air pre heater is, its types, their functions and how it is operated. • Explain the functions and operation of the deaerator and economizer. • Explain what a burner is, its operation, types and uses	Recommended textbooks, lecture notes, etc.	-	-	• List the types of air pre heaters. • Sketch a boiler and indicate the inlet and outlet streams. • Mention the types of burners you know.

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Basic Engineering Mathematics	**Code: PGP 124**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:-NIL	**Theoretical: 2 hours/week**
Year: 1 Semester: 2		**Practical : 0 hours/week**

Course main Goal: The course is designed to introduce students to the knowledge of differential calculus and develop the ability to use differential calculus to solve practical problems.

General Objectives:

On completion of the course, the student should be able to:
1.0 Comprehend the concept of limits
2.0 Comprehend the concept of continuity
3.0 Appreciate the techniques of differentiation
4.0 Recognize the various applications of derivations
5.0 Recognize integration as the reverse of differentiation

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Engineering Mathematics			**Code: PGP 211**		**CH:2**	**CU:2**
General Objective 1.0 : Comprehend the concept of limits						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define a limit with illustrated examples 1.2 State the basic theorems of limits 1.3 Prove the basic theorems of limits such as those relating to a sum, difference, product, quotient and composite of two functions. 1.4 Evaluate limits of given functions 1.5 Determine points at which a limit does not exist 1.6 Explain why limits do not exist in the above points in 1.5	• Explain concepts covered in 1.1 – 1.6 • Supervise student exercises and assess student work	Recommended textbooks, lecture notes, etc.	_	_	Define and give example on limits Prove the basic theorems on limits Evaluate limits of given functions

General Objectives 2.0 Comprehend the concept of continuity						
3-5	2.1 Define a continuous function 2.2 List examples of continuous functions using polynomials. 2.3 Distinguish between continuous function and discontinuous function. 2.4 Identify reasons for discontinuity. 2.5 Remove discontinuity whenever possible by redefining the function 2.6 State the basic theorems of continuity 2.7 Prove the basic theorems of continuity such as those relating to a sum, difference, product, quotient and composite of two functions 2.8 Identify	• Explain the concepts covered 2.1 – 2.8 • Supervise student exercises and assess student work	Recommended textbooks, lecture notes, etc.	-	-	Define Continuous functions and give polynomial examples Differentiate between continuous function and discontinuous function. State reasons for discontinuity of functions Prove theorems of continuity

	continuous functions using the basic theorems in 2.7 above.					
General Objectives 3.0 Appreciate the techniques of differentiation						
6-10	3.1 Explain how to carry out differentiation using first principle 3.2 State the basic theorems of differentiation 3.3 Prove the basic theorems of differentiation such as those relating to the derivatives of a sum, difference, product and quotient 3.4 Explain differentiation using the basic rules. 3.5 Differentiate a composite function using the chain rule. 3.6 Differentiate logarithmic,	• Explain the concepts covered in 3.1 – 3.9 • Supervise student exercises and assess student work	Recommended textbooks, lecture notes, etc.	-	-	Differentiate given function(s) State the basic theorems on differentiation. Prove the basic theorems on differentiation Carry out differentiation using the basic rules.

	exponential and trigonometric functions. 3.7 Explain successive differentiation using Leibnitz theorem. 3.8 Explain how to carry out implicit and partial differentiation					
General Objectives 4.0 Recognize the various applications of derivations						
11-12	4.1 Explain interpretation of derivative as a rate of change. 4.2 Solve problems on maxim and minima. 4.3 Determine errors using approximations. 4.4 Sketch curves applying the principles of derivatives.	• Explain the concepts covered 4.1 – 4.3 • Supervise student exercises and assess student work	Recommended textbooks, lecture notes, computers, etc.	-	-	Interpret derivatives as rates of change Solve problems on maxim and minima.
General Objectives 5.0 Recognize integration as the reverse of differentiation						
13-15	5.1 Define integration 5.2 Prove that	• Explain the concepts covered	Recommended textbooks,	-	-	Prove that integration is

	integration is the reverse of differentiation. 5.3 Solve definite and indefinite integrals using the first fundamental theorem of calculus 5.4 Explain with examples integration by substitution or change of variables. 5.5 Explain integration by parts and partial fractions.	5.1 – 5.5 • Supervise student exercises and assess student work	lecture notes, etc.			the reverse of differentiation. Solve definite and indefinite integrals using the first fundamental theorem of calculus Solve integration by substitution or change of variables. Solve problems involving integration by parts and partial fractions.

Programme: National Diploma in Petroleum and Gas Processing Technology		
Course Title: Petrochemical Process Chemistry	**Code: PGP 125**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year: 1 Semester: 2		**Practical : 0 hours/week**

Goal: This course is designed to acquaint students with the general physical and chemical characteristics of petroleum and its products.

General Objectives:

On the completion of the course, the student should be able to:

1.0 Comprehend the chemistry of primary raw materials of petroleum

2.0 Identify hydrocarbon intermediates

3.0 Appreciate crude oil processing and hydrocarbon intermediates

4.0 Identify non-hydrocarbon intermediates

5.0 Appreciate the chemical treatment of petroleum and its products

6.0 Recognize chemicals based on methane

7.0 Recognize Ethane and higher paraffins.

Programme : National Diploma in Petroleum and Gas Processing Technology						
Course Title: Petrochemical Process Chemistry			**Code: PGP 125**	**CH:2**	**CU:2**	
Theoretical Content			**Practical Content**			
General Objective 1.0 : Comprehend the chemistry of primary raw materials of petroleum						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1 - 2	1.1 Describe the geochemical origin of petroleum and gas. 1.2 State the elemental composition of crude oil and gas. 1.3 State the various classes of hydrocarbons present in crude oil. 1.4 Explain the effects of the preponderance of each of the classes in 1.3 above on the properties of petroleum and its products.	Explain the origin of petroleum and gas. State the various classes of hydrocarbons present in crude oil. Explain the effects of the presence of each of the compounds in 1.3 above on the properties of petroleum and its products.	Textbooks, lecture notes, etc. White board, Multimedia Projector, Laboratory manuals Textbooks	Determine the effects of the presence of each of the compounds a) Sulphur b) Nitrogen c) Oxygen on the properties of petroleum and its products. Identify the main indices of quality and stability of lubricating oils. Determine experimentally the indices in 1.5 above.	Guide students to determine the effect of each of the compounds Guide students to determine density, specific gravity, molecular weights, viscosity index and fractional composition of petroleum and its products. Guide students to determine the thermal properties of petroleum (e.g. Calorific value, Enthalpy, Latent heat etc.)	Explain the origin of petroleum and gas State the elemental composition of crude oil and gas.

	1.5 Explain the origin and structure of the following compounds in petroleum: (a) Sulphur. (b) Nitrogen (c) Oxygen. 1.6 Explain the effects of the presence of each of the compounds in 1.5 above on the properties of petroleum and its products. 1.7 Describe the determination of the density, specific gravity, molecular weights, viscosity index and fractional composition of petroleum and its products.	Describe the main indices of quality and stability of lubricating oils Explain cetane number of diesel fuels	Textbook, lecture notes, etc.		Guide students to determine experimentally the indices of quality and stability of lubricating oils	

	1.8 Carry out the tests in 1.7 above. 1.9 Explain the Chemical stability of various types of petroleum fuels. 1.10 Explain the thermal properties of petroleum (e.g. Calorific value, Enthalpy, Latent heat etc.) 1.11 Define cetane number of gasoline. 1.12 Explain the determination of octane number. 1.13Define "detonation" and detonation theories. 1.14 Define cetane			Explain the thermal properties of petroleum (e.g. Calorific value, Enthalpy, Latent heat etc.)		

	number of diesel fuels 1.15 Describe the main indices of quality and stability of lubricating oils.					
General Objectives 2.0 Recognize hydrocarbon intermediates.						
3 - 4	2.1 Describe paraffinic hydrocarbons. 2.2 Describe olefinic hydrocarbons 2.3 Explain Dienes 2.4 Describe aromatic hydrocarbons. 2.5 Explain the extraction of aromatics. 2.6 Describe liquid petroleum fractions and residues.	• Explain the paraffinic, olefinic and aromatic hydrocarbons. • Explain the extraction of aromatics. • Explain the petroleum fractions and residues as mixtures of different hydrocarbon classes.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Describe aromatic hydrocarbons

General Objectives 3.0 Appreciate chemistry of crude oil processing and hydrocarbon intermediates.						
5 - 6	3.1. Explain the chemistry concept of atmospheric distillation, vacuum distillation, absorption and adsorption with respect to petroleum processing. 3.2Explain thermal cracking in petroleum processing. 3.3 Explain the chemistry of hydro cracking. 3.4 Describe catalytic cracking in petroleum processing 3.5 State the difference between thermal cracking, hydro cracking	Distinguish between thermal and catalytic cracking. Explain the Chemical reactions of hydrocarbons during catalytic reforming Explain the chemistry of hydro cracking, the catalyst used and the nature of its products Explain the chemistry of isomerization , the catalyst used and the nature of its products	Textbook , lecture notes, etc.	-	-	Explain the chemistry of hydro cracking

	and fluid catalytic cracking. 3.6 Explain the use of catalysts in petroleum processing. 3.7 State types of catalysts used. 3.8 Explain the importance of activity, selectivity and service life of catalysts. 3.9 Describe the chemical reactions of hydrocarbons during catalytic reforming. 3.10 Explain the carboniumion concept of the mechanism of catalytic cracking.					

	3.11 Explain the chemistry of catalytic reforming, the catalyst used and the properties of it products 3.12. Explain the chemistry of Alkylation, the catalyst used and the nature of its products. 3.13 Explain the chemistry of isomerization, the catalyst used and the nature of its products					

General Objectives 4.0 Appreciate the non-hydrocarbon intermediate						
7 - 8	4.1 Describe hydrogen and Sulphur as non-hydrocarbon components of circle oil. 4.2 Explain the uses of sulphur. 4.3 Describe carbon black. 4.4 State the properties and uses of carbon black. 4.5 Describe synthesis gas. 4.6 Explain the uses of synthesis gas. 4.7 Describe naphthenic acids. 4.8 Enumerate the uses of naphthenic acids and their	• Describe sulphur and its functions. • Explain carbon black, its properties and functions. • Explain the synthesis gas, its properties and uses. • Explain Naphthenic acids and cresylic acids.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Enumerate the uses of naphthenic acids and their salts. State the uses of synthesis gas.

	salts. 4.9 Describe cresylic acids. 4.10 Enumerate the functions of cresylic acids.					
GeneralObjective:5.0 Appreciate the chemical treatment of petroleum and its products						
9 - 10	5.1 Describe desalting and dewatering of petroleum. 5.2 Explain reactions occurring during hydro treatment of petroleum for removal of sulphur, nitrogen and oxygen compounds. 5.1 Describe chemical methods of treatment for 5.2 above. 5.2 Describe the method of	Explain reactions occurring during hydro treatment of petroleum for removal of sulphur, nitrogen and oxygen compounds. Explain additives for petroleum fuels.	Textbook , lecture notes, etc.	-	-	Classify additives and state their uses. Explain additives for lubricating oils.

	removing hydrogen sulphide and mercaptans from the products. 5.3 Classify additives and state their uses. 5.4 Describe additives for petroleum fuels. 5.5 Describe additives for lubricating oils.	Explain additives for lubricating oils.				
General Objectives 6.0:Recognize chemicals based on methane						
11-12	6.1.Describe the chemicals based on direct methane reactions such as; • Carbon disulphide • Hydrogen cyanide. • Chloromethanes	• Explain the chemicals that can be produced from methane. • Explain synthesis gas and the chemicals obtained from	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	List chemicals produced from methane Explain Utility of synthesis gas

	6.2. Describe synthesis gas. 6.3. Describe chemicals based on synthesis gas such as; o Ammonia o Methyl alcohol. 6.4. Describe oxo aldehydes and alcohols. 6.5. Explain ethylene glycol.	it. • Explain oxoaldehydes and alcohols.				
General Objectives: 7. 0:Recognize Ethane and higher paraffins						
13-15	7.1. Describe ethane chemicals. 7.2. Describe propane chemicals. 7.3. Explain the oxidation of propane. 7.4. Describe the chlorination of propane. 7.5. Describe the dehydrogenation	• State ethane and propane chemicals. • Explain the oxidation and chlorination of propane. • Explain the dehydrogenation and	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Describe the isomerization of n-butane.

	of propane. 7.6. Describe the nitration of propane. 7.7. Describe n-butane chemicals. 7.8. Describe the oxidation of n-butane 7.9. Describe the isomerization of n-butane. 7.10. Describe iso-butane chemicals. 7.11. Describe naphtha based chemicals. 7.12. Explain chemicals from high molecular weight n-paraffins. 7.13. Describe oxidation of paraffins. 7.14. Describe chlorination of n-paraffins. 7.15. Describe the Sulphonation of n-	nitration of propane. • Explain n-butane chemicals. • Explain the oxidation of n-butane. • Explain iso-butane chemicals. • Explain naphtha based chemicals. • Explain the oxidation of paraffins. • Explain fermentation using n-paraffins.				

	paraffins. 7.16. Explain fermentation using n-Paraffins.					

Programme: National Diploma (ND) in Petroleum and Gas Processing Engineering Technology		
Course: Basic Chemical Laboratory Technology I	**Code: PGP 126**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 0 Hour/Week
Second Semester Year One	**Pre-requisite: NIL**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to acquaint students with the quality control procedures applicable to petroleum and its products		

GENERAL OBJECTIVES	
On completion of this course, the students should be able to :	
1.0	Appreciate the safety and fire prevention measures adopted in the laboratory when handling petroleum products.
2.0	Appreciate the determination of relative density and density.
3.0	Appreciate the test for API gravity of petroleum and its products.
4.0	Appreciate the determination of volume expansivity of petroleum products.
5.0	Comprehend the low temperature behavior of fuels.
6.0	Appreciate the kinematic and absolute viscosity measurements of petroleum products.
7.0.	Comprehend the determination of ash content of petroleum products.

PROGRAMME: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Basic Chemical Laboratory Technology I			**COURSE CODE: PGP 126**		**CONTACT HOURS: 0-0-2 Hrs/Wk**	
Goal: This course is designed to acquaint students with the quality control procedures applicable to petroleum and its products						
COURSE SPECIFICATION:THEORETICAL CONTENT			**PRACTICAL CONTENT**			
	General Objective 1.0: Appreciate the safety and fire prevention measures adopted in the laboratory when handling petroleum products.					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1 - 2	1.1 Explain types of different reagents found in the laboratory and their uses. 1.2 State the importance of current labeling of reagents. 1.3 Explain the significance of the fume chamber. 1.4 State the significance of safety wears. 1.5 Explain the operation of fire extinguishers.	Explain the activities in 1.1 to 1.7	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Identify different reagents in the laboratory and their uses. Demonstrate the fire prevention measures when using petroleum products.	Guide students in the identification of reagents. Guide students to light a gas burner. Guide students to demonstrate the fire prevention measures when using petroleum products	State the importance of safety wears

	1.6 Explain the current method of lighting a gas burner. 1.7 Explain the use of first aid boxes.					
	General Objective 2.0: Appreciate the determination of relative density and density					
3 - 4	2.1 Define relative density and density 2.2 Identify the apparatus for the test of relative density and density 2.3 Describe successive steps of the test procedure using the apparatus (pycnometer). 2.4 Show how to calculate relative density using appropriate formula. 2.5 State the significance of the test for density. 2.6 State the effect of temperature on the test for density. 2.7 Carry out the test for density in the laboratory	Explain activities in 2.1 to 2.7	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals. Pycnometer	Demonstrate how the relative density test is conducted	Guide students in the determine relative density	State the importance of relative density and density test.

	General Objective 3.0: Comprehend the test for API gravity of petroleum and its products.					
5 - 6	3.1 Define API gravity 3.2 Identify apparatus for the test for API gravity of petroleum and its products 3.3 Explain the difference between specific gravity and observed gravity values. 3.4 Describe the successive steps of the test for API gravity of petroleum procedures. 3.5 Explain methods of calculation of API gravity using appropriate formula. 3.6 State the significance of the API gravity test.	Explain the activities in 3.1 to 3.7	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Demonstrate the procedure of conducting API gravity test.	Guide students in the determination of API gravity of petroleum	Explain the difference between specific gravity and observed gravity values.

	General Objective 4.0: Appreciate the determination of volume expansivity of petroleum products.					
7 - 8	4.1 Define volume expansivity. 4.2 Identify the apparatus for the determination of volume expansivity of petroleum products 4.3 Explain the calculation method of volume expansivity using appropriate formula. 4.4 Describe the successive steps of the test of volume of expansivity procedures. 4.5 State the significance of the test especially choosing the correct method of storage.	Explain the activities in 4.1 to 4.5	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Demonstrate the procedure for conducting volume expansivity test.	Guide students in the determination of volume expansivity of petroleum products.	Explain the volume expansivity of petroleum products.

	General Objective 5.0: Comprehend the low temperature behavior of fuels.					
9 - 10	5.1 Define pour point. 5.2 Identify the apparatus for the pour point test. 5.3 Describe successive steps for the pour point test procedures. 5.4 State the precautionary measures involved in the pour point test. 5.5 Explain the difference between the upper and lower pour points. 5.6 State the significance of the pour point test.	Explain the activities in 5.1 to 5.6	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals. Pour point test apparatus	Demonstrate the procedure for pour point determination.	Guide students to conduct pour point test.	Discuss the importance of pour point.
	General Objective 6.0: Appreciate the kinematic and absolute viscosity measurements of petroleum products.					
11 - 12	6.1 Define kinematic viscosity 6.2 Identify the apparatus for the kinematic viscosity test 6.3 Describe successive	Explain the apparatus and importance of kinematic and absolute viscosity measurements of petroleum.	Whiteboard, Computer related software, PowerPoint projectors, recommended	Demonstrate the procedure for kinematic and absolute viscosity.	Guide students in the determination of kinematic and absolute viscosity measurements	Explain the kinematic viscosity of petroleum products.

	steps of the kinematic viscosity test procedure. 6.4 Explain calculation of carbon residue using appropriate formula. 6.5 State the precautionary measures involved in the kinematic viscosity test. 6.6 State the significance of the kinematic viscosity test and state other methods of determining carbon residue.		text books, flip charts, lecture notes, and related journals.		of petroleum products.	
	General Objective 7.0: Comprehend the determination of ash content of petroleum products					
13 - 15	7.1 Explain the meaning of ash content of petroleum 7.2 Identify the apparatus for the test of ash content 7.3 State the significance of the test in 7.2	Explain the activities in 7.1 to 7.6	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts,	Demonstrate the procedure for Ash Content determination.	Guide students in the procedures of ascertaining ash content.	State the importance of ash content.

	7.4 Describe the successive steps of the test of ash content procedure. 7.5 Explain the calculation of ash content using the appropriate formula.		lecture notes, and related journals.			

Programme: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING TECHNOLOGY		
Course Title: Technical Report Writing	**Code: PGP 127**	**Credit Hour: 1** **Credit Unit:1**
	Pre-requisite:	**Theoretical: 1 hour/week**
Year: 1 Semester: 2		**Practical:0 hour/week**

Goal: This course is designed to provide students with knowledge on technical reports, research writing and oral presentation

General Objectives:

On completion of the course, the student should be able to:

1.0 Apprehend the different types of technical reports
2.0 Apprehend the concept of scientific research
3.0 Apprehend formulation of problem statement
4.0 Apprehend guidelines required for project execution and report writing
5.0 Apply citation / referencing in literature review
6.0 Make oral presentation of technical report

Programme: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY						
Course Title: Technical Report Writing			**Code: PGP 127**		**CH:1**	**CU:1**
General Objective: 1.0 Apprehend the different types of technical report						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1 - 2	1.1 Define technical report writing 1.2 Explain types of technical report: Formal, Semi-formal and informal 1.3 Explain scientific integrity in research and publication: plagiarism and copyright.	Explain the types of technical report Explain research and students research project	Recommended textbook, lecture notes, journals, internet materials etc.	-	-	Differentiate different types of technical report.
General Objectives: 2.0 Apprehend the concept of scientific research						
3 - 5	2.1 Describe concept of research 2.2 Explain types of research: pure and applied 2.3 Classify research based on objectives, application, inquiry, etc. 2.4 Explain the characteristics of a good research in terms of objectivity, precision, design and	Explain research and research process.	Textbooks, journals, internet materials.	-	-	Explain the characteristics of a good research in terms of objectivity, precision, design and verifiability.

	verifiability. 2.5 Explain how to formulate research objectives 2.6 Explain research hypothesis 2.7 Explain how to write literature review					
General Objectives: 3.0 Apprehend basis for data collection and analysis						
6 - 7	3.1 Explain research design 3.2 Explain sampling procedure and sample size 3.3 Explain primary and secondary data 3.4 List methods of data collection such as experimental, observation, etc 3.5 Describe data processing and analysis.	Explain data collection and analysis.	Textbooks, journals, internet materials.	-	-	Explain primary and secondary data
General Objectives: 4.0 Apprehend guidelines required for project execution and report writing						
8 - 10	4.1 Review final year project execution guidelines 4.2 Explain the format for Introduction,	Explain data collection and analysis	Textbooks, journals, internet materials.	-	-	Explain the format for final year project writing

	literature review, methodology, results and discussion, conclusion and recommendation, abstract, references and appendices. 4.3 Describe how to present the following: Equations, figures, tables, numerical data and units. 4.4 Explain the format for the following: Typing, printing, cover page, title page, certification page, dedication, acknowledgement, table of contents and binding for final year project.					

General Objective: 5.0 Apply citation /referencing						
11 - 12	5.1 Explain citation styles in final year project writing in relation to different disciplines: In – text citation and text referencing 5.2 Explain types of reference styles in final year project writing 5.3 Differentiate between bibliography and list of references	Explain citation / referencing	Textbooks, journals, lecture notes, internet materials and etc.	-	-	Explain types of reference styles in final year project writing Differentiate between bibliography and list of references
General Objectives: 6.0 Make oral presentation of technical report						
13 - 15	6.1 Identify types of audience in project presentation 6.2 Explain modes of presentation such as Power point, Poster, etc 6.3 Explain the tips for good oral presentation.	Explain Oral presentation of technical report	Textbooks, journals, internet materials, lecture notes	-	-	Explain modes of presentation such as Power point, Poster, etc

THIRD SEMESTER COURSES
(YEAR 2 SEMESTER 1)

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Petroleum Processing Technology	**Code: PGP 211**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year: 2 Semester: 1		**Practical : 0 hours/week**

Goal: This course is designed to acquaint students with the fundamental principles of petroleum refining

General Objectives:

On the completion of the course, the student should be able to:
1.0 Comprehend the procedure of crude oil preparation for primary processing.
2.0 Comprehend primary processing
3.0 Appreciate secondary processing
4.0 Appreciate petroleum product treatment processes
5.0 Appreciate product blending techniques.
6.0 Comprehend auxiliary refining systems.
7.0 Comprehend oil movement and storage.

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Petroleum Processing Technology			**Code: PGP 211**		**CH:2**	**CU:2**
Theoretical Content			**Practical Content**			
General Objective 1.0: Comprehend the procedure of crude oil preparation for primary processing.						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define petroleum refinery 1.2 List out refinery products. 1.3 State roles of refinery in the petroleum industry. 1.4 Draw refinery overall block flow diagram. 1.5 Describe crude oil composition, physical properties, and classification. 1.6 Explain the following methods: i. Desalting/ Dewatering; ii. Caustic washing; iii. Pre-flashing; 1.7 State the relevance of the methods in 1.6 above. 1.8 Prepare samples of crude oil for	• Give a brief history of crude oil. • Classify methods by pointing out when which is desirable.	Recommended textbooks, lecture notes, etc.	Determine physical properties of crude oil like viscosity, flash point, metal content etc.	Guide, supervise students through the practicals.	What is petroleum Refining? Name the products of petroleum refining Classify crude oil according to; Composition, Physical Properties, etc. State the relevance of the following methods; Desalting/ Dewatering Caustic washing; Pre-flashing

	primary processing according to 1.6 above.					
General Objectives 2.0 Comprehend primary processing						
3-4	2.1 Explain the principles of distillation bearing in mind the following terms: 2.2 Explain the following • Ebullition; • Fractionation; • Refluxing • Reboiling. 2.3 State the functions of atmospheric and vacuum distillation. 2.4 Explain the principles of steam stripping. 2.5 Describe the atmospheric distillation unit (ADU) and enumerate the products. 2.6 Describe the vacuum distillation unit (VDU) and enumerate the products.	Make sketches to show differences between ADU and VDU Explain Ebullition; Fractionation; Refluxing and Reboiling	Recommended textbooks, lecture notes, etc.	Industrial visit to an oil refinery for acquaintance with ADU and VDU.	Guide, supervise students through the industrial visit.	Explain the following terms: Ebullition; Fractionation; Refluxing Reboiling. What are the differences between atmospheric and vacuum distillation in terms of Feed, process parameters, and products.
General Objectives 3.0 Appreciate secondary processing						
5-6	3.1 Compare the products of primary processing with final refinery	Explain the process of catalytic cracking giving its advantages	Recommended textbooks, lecture notes,	-	-	3.6 Compare the products of

	products. 3.2 List out the processing methods to upgrade, convert and purify primary products. 3.3 Define catalysis in secondary processing. 3.4 Explain the role of catalysis in secondary processing. 3.5 Describe the following secondary processes; Catalytic reforming, Catalytic cracking, Alkylation.		etc.			primary processing with final refinery products.
General Objectives 4.0 **Appreciate petroleum product treatment processes**						
7	4.1 Enumerate the purpose of treatment. 4.2 Describe the following treatment methods: i. Hydro treatments; ii. Merox sweetening; iii. Amine treatment.	Explain the meaning of sweetening and how it can be achieved	Recommended textbooks, lecture notes, etc.	-	-	Explain Hydro treatments, Merox sweetening, and amine treatment
General Objectives 5.0 **Appreciate product blending techniques.**						
8-9	5.1 State the purpose of product blending. 5.2 Compare tank blending and in-line blending. 5.3 Describe blending for gasoline and fuel oil.	Explain the meaning of blending. Explain (write on the board) obvious and non-obvious reasons for blending.	Recommended textbooks, lecture notes, etc.	-	-	Explain blending for gasoline and fuel oil.
Week	**General Objective: 5.0** Appreciate product blending techniques**.**					
10-11	5.4 State the purpose of	Explain the meaning	Recommended	-	-	What is the

	product blending. 5.5 Describe tank blending and in-line blending. 5.6 Describe blending for gasoline and fuel oil.	of blending. Explain (write on the board) obvious and non-obvious reasons for blending.	textbooks, lecture notes, etc.			importance product blending
Week	**General Objective: 6.0** Appreciate auxiliary refining systems.					
12-13	6.1 Explain sulphur recovery processes. 6.2 Explain control of noise in the refinery. 6.3 Explain control of atmospheric pollution. 6.4 Describe the refinery effluent treatment system.	Explain where sulphur is needed where it is not needed. Explain the effects of noise on the nervous system of human beings. Examples of some atmospheric pollutants should be given.	Recommended textbooks, lecture notes, etc.	-	-	Explain control of atmospheric pollution.
Week	**General Objective: 7.0** Appreciate oil movement and storage.					
14-15	7.1. Explain types of crude oil 7.2. Explain storage facilities and storage tanks 7.3. State advantages of each tank design 7.4 Describe types of products and products transfer equipment's	Explain crude oil types based on physical and chemical properties properties. Explain major design conditions for the storage facilities in refinery.	Recommended textbooks, lecture notes, etc.	-	-	Explain types of crude oil Describe types of products and products transfer equipment's (Pumps,

	(Pumps, valves, fittings etc) 7.5 Explain application of each in 7.4 above.	Explain petroleum products and relate it to movement within the refinery system.				valves, fittings etc)

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Basic Petrochemical Processing Technology	**Code: PGP 212**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year:2 Semester: 3		**Practical : 0 hours/week**

Goal: This course is designed to provide students with the basic knowledge of petrochemical feedstock and their derivatives

General Objectives:

On completion of the course, the student should be able to:

1.0 Appreciate the origin of petrochemicals from crude oil
2.0 Identify the essential petrochemical feedstock.
3.0 Appreciate the classification of petrochemical feedstock
4.0 Recognize the process technology for the production of important derivatives from methane
5.0 Appreciate the basic knowledge on the production of Synthesis gas and its derivatives

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Basic Petrochemical Processing Technology			**Code: PGP 212**		**CH: 2**	**CU: 2**
General Objective 1.0: Appreciate the origin of petrochemicals from crude oil						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Give the history of petrochemicals 1.2 State the composition of petroleum. 1.3 State essential chemicals from petroleum 1.4 State the composition of crude oil and natural gas as feedstock for petrochemicals production. 1.5 Highlight the processing routes for crude oil or natural gas into petrochemicals. 1.6 Identify the major primary petrochemical building blocks.	Explain how petrochemicals is derived from petroleum and the major components of petroleum Explain the properties of petroleum, its composition of crude oil and natural gas as feedstock for petrochemicals Explain the petrochemicals that can be produced from crude oil and natural gas List the primary petrochemical building blocks	Recommended textbooks, Internet services, etc. White Board, Multimedia projector Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	List major historical events in petrochemicals List chemicals derived from petrochemicals Mention the properties of crude oil and natural gas that makes their feedstock to petrochemicals
General Objectives 2.0 Identify the essential petrochemical feedstock						
4-8	2.1 State the classes of raw	Explain the classes of raw materials for the	Recommended textbooks,	-	-	Mention classes of

	materials from petroleum for the petrochemical industries 2.2 Identify the interrelationships between products in 2.1 and end uses. 2.3 Describe paraffin hydrocarbons and their petrochemical derivatives. 2.4 Describe Olefin hydrocarbons (ethylene, propylene, butylenes). 2.5 Describe Acetylene Hydrocarbons (Acetylene) 2.6 Describe Aromatic hydrocarbons (Benzene Toluene etc.). 2.7 Describe Schematic representation of "Petrochemical Tree"	petrochemical industries. Outline paraffin hydrocarbons and petrochemical derivatives Explain acetylene and the different types of aromatics (BTX) Depict the petrochemical tree	Internet services, etc. White Board, Multimedia projector			petrochemicals raw materials and provide examples With the aid of a diagram, highlight all the feedstock primary, tertiary and end-uses products of petrochemicals
General Objectives 3.0 Appreciate the classification of petrochemical feedstock						
9-10	3.1 Present in a chart form the secondary, tertiary	Explain the petrochemical	Recommended textbooks,	-	-	Identify the interrelationships

	and end products from each petrochemical building block (ethylene, propylene, butylene, benzene, toluene, xylene, methane, ammonia and methanol). 3.2 Identify the interrelationships between products in 3.1and end uses. 3.3 Prepare an overall petrochemical chart to highlight all the feedstock, primary, tertiary and end-use products and their interrelationships	building block of ethylene, propylene, butylene, benzene, toluene, xylene, methane, ammonia and methanol. Outline the end uses of the above petrochemicals. Illustrate on a diagram the link between feedstock, primary, tertiary and end-use products of petrochemicals assessment.	Internet services, etc. White Board, Multimedia projector			between petrochemical products and their feedstock.
General Objectives 4.0 Recognize the process technology for the production of important derivatives from methane						
11-12	4.1 List the important derivatives of methane 4.2 Enumerate the importance of chlorinated methane to the petrochemical industry 4.3 List out the various derivate from chlorinated methane 4.4 Explain the process technology for the	Explain with Illustration of a chart chemical products from chlorinated methane Describe with the aid of a process flow diagram for the manufacture of chlorinated methane	Recommended textbooks, internet materials, etc White board multimedia projector	-	-	Mention major derivatives of methane Mention various derivative of chlorinated methane Draw the block diagram for the manufacturing of

	manufacture of chlorinated methane by direct chlorination of methane, Methanol route 4.5 Explain the reactions, catalysts and process conditions involves in the manufacture of chlorinated methane 4.6 Describe the process technology for the production of Hydrogen cyanide 4.7 Describe the process technology for the production of Carbon disulphide 4.8 Define the process conditions for synthesis of Hydrogen cyanide and Carbon disulphide	Present the process operating parameters for manufacture of chlorinated methane Describe with the aid of a process flow diagram the synthesis of Hydrogen cyanide and Carbon disulphide from methane				chlorinated methane, hydrogen dioxide and carbon disulphide

General Objectives 5.0 Appreciate the basic knowledge on the production of Synthesis gas and its derivatives						
13-15	5.1 Define synthesis gas 5.2 Explain the relevance of synthesis gas to the petrochemical industry 5.3 Mention the feedstock for the production of synthesis gas 5.4 State the various technologies for synthesis gas production 5.5 Explain in detail steam reforming of natural gas to produce synthesis gas 5.6 State the various steps, reactions, process conditions and catalysts involve in the production of synthesis gas via steam reforming 5.7 Explain the process technology for the production of Ammonia via steam reforming	Explain with the aid of a chart, feedstock for the production of synthesis gas Explain with Illustration with the aid of process flow diagram the production of synthesis gas from Natural gas/Naphtha Explain with the aid of process flow diagram the production of synthesis gas from Fuel oil/Coal Explain with the aid of a chart the derivatives from ammonia Explain by Illustrating with the aid of process flow diagram the production of Ammonia Explain to Illustrate with the aid of process flow diagram the	Recommended textbooks, internet services, etc White board multimedia projector	-	-	State the importance of synthetic gas in industries Draw the block diagram for the production of synthesis gas ammonia

	5.8 List the various chemical feedstock derived from Ammonia 5.9 Explain the process technology for the production of ammonia via partial oxidation process 5.10 Describe the various technologies for the synthesis of Urea 5.11 Explain the steps and operating conditions for the synthesis of Urea from Ammonia	production Urea from Ammonia				

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Gas Processing Technology I	**Code: PGP 213**	**Credit Hour: 2** **Credit Unit:2**
	Pre-requisite:-NIL	**Theoretical: 2 hours/week**
Year: 2 Semester: 3		**Practical : 0 hours/week**

Goal: This course is designed to equip students with the basic theory and practice of Natural gas engineering operations**.**

General Objectives:

On the completion of the course, the student should be able to:
1.0 Outline the elementary introduction to gas technology
2.0 Appreciate the processing and principal products of natural gas.
3.0 Comprehend the principles of gas plant processing.
4.0 Use the field operations and inlet receiving of natural gas.
5.0 Apply the principles of natural gas compression

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Gas Processing Technology I				**Code: PGP 213**	**CH:2**	**CU:2**
Theoretical Content				**Practical Content**		
General Objective 1.0 : Outline the elementary introduction to gas technology						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Define the term natural gas. 1.2 Explain the development of natural gas. 1.3 Identify the sources of natural gas. 1.4 State the composition of natural gas. 1.5 Explain the Physical and Chemical properties of Natural Gas 1.6 Explain the classification of natural gas	Describe the processes involved in natural gas formation in a source rock. Enumerate the sources of natural gas. Explain the composition and classification of natural gas.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	State the composition of natural gas
General Objectives 2.0 Appreciate the processing and principal products of natural gas.						
4-5	2.1 Describe the processing of natural gas. 2.2 List the major products of natural gas such as o Methane. o Ethane o Propane o Butane 2.3 Explain the product specification of natural gas. a. Gaseous product b. Liquid product 2.4 Explain the combustion	Explain the processing of natural gas. Describe the combustion characteristics of natural gas.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Describe the combustion characteristics of natural gas.

	characteristics of natural gas. a. Heating value (HV) b. Wobbe Number					
General Objectives 3.0: Comprehend the principles of gas plant processing.						
6-7	3.1 Explain the roles of gas plants. 3.2 Explain plant processes. 3.3 Explain the important support components of gas plants. o Utilities o Process control 3.4 Explain contractual agreements of natural gas plants. o Fee based contracts. o Percentage of proceeds. o Wellhead purchase. o Fixed efficiency.	Explain plant processes, the support components of gas plants and describe the contractual agreements of natural gas plants.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Describe the contractual agreements of natural gas plants
General Objectives 4.0: Use the field operations and inlet receiving of natural gas.						
8-11	4.1 Explain the wellhead operations. 4.2 Explain the piping process. 4.3 Explain the operations of compression stations. 4.4 Explain pigging process. 4.5 Explain gas hydrates. 4.6 Explain hydrate inhibition. 4.7 Explain the separation	Explain the wellhead operations. Explain pigging process. Explain gas hydrates Explain the separator working principle.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture	-	-	Explain the separation principles of gas liquid separator.

	principles of. • Gas liquid separator. • Liquid- liquid separators. • Residence time for various separators. 4.8 Explain the slug catcher configurations.		notes, and related journals.			
General Objectives 5.0: Apply the principles of natural gas compression						
12-15	5.1 Explain the thermodynamics of compression. 5.2 Explain the multi-staging process. 5.3 Explain compressor efficiencies. 5.4 Describe compressor types. o Reciprocating compressors. o Oil free rotary screw compressors. o Centrifugal compressors. o Oil-injected rotary screw compressors. 5.5 Estimate the capacity of compressors. 5.6 Compute the power requirements of	• Explain the thermodynamics of compression. • Explain compressor efficiencies. • Explain compressor types. • Explain and Estimate the capacity of compressors. • Explain and compute the power requirements of compressors.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Compute the power requirements of a given compressor.

	compressors. 5.7 Compare reciprocating and centrifugal compressors					

PROGRAMME: NATIONAL DIPLOMA IN PETROCHEMICALS AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Basic Computer Applications in Process Engineering				**COURSE CODE: PGP 214**	**CONTACT HOURS: 1-0-1 Hrs/Wk**	
Goal: This course is designed to provide foundational knowledge on the Applications of Computer Packages and Programming skills in solving computational problems related to petrochemical and gas processes						
COURSE SPECIFICATION:THEORETICAL CONTENT				**PRACTICAL CONTENT**		
	General Objective 1.0: Familiarize with the components and basic operations of a computer					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Define a computer System 1.2 List the components of a computer system 1.3 Explain the major components of a computer system and their examples 1.4 Explain the concept of computer hardware and software 1.5 Distinguish between computer hardware and software 1.6 List out examples of computer hardware	Explain the major components of a computer system and their examples. Explain the concept of computer hardware and software Enumerate the differences between a computer hardware and software	Marker, Whiteboard, Duster, Computer System Projector etc. Computer Scrap, Projector etc.	Demonstrate the basic operations of a computer. System ` Show the basic Components of computer system	Guide Students on how to perform the basic operations on a computer system such as starting a computer, navigating through icons, identifying keyboard, creating and deleting a folder etc.	Identify the computer tools used in solving computational problems.

	1.7 Explain the concept of storage devices (media) 1.8 Distinguish between Primary and secondary storage 1.9 Describe computer Memory 1.10 Distinguish between RAM and ROM 1.11 Explain the basic operations of a computer system 1.12 Define software 1.13 Distinguish between operating system and application software 1.14 Give examples of operating systems 1.15 Give examples of application software use in Engineering fields 1.16 Enumerate computer tools used in solving	Explain the concept of storage devices (media) Elucidate the differences between Primary and secondary storage Describe computer Memory Enumerate the computer tools used in solving computational problems				

	computational problems					
General Objective 2.0: Comprehend the application of Microsoft Excel as a tool for solving computational problem						
4-9	2.1 Define an Excel Workbook 2.2 Explain the use of quick access tool bars, formula, ribbon and tabs bar, 2.3 Identify rows and columns in an excel worksheet. 2.4 Explain how to perform basic operations in an excel Worksheet (Spreadsheet) such as insert, delete, copy, move data and fill handle. 2.5 Identify arithmetic and logic operators 2.6 Identify syntax of	Explain activities in 2.1 - 2.6	Computer System, Projector etc.	Demonstrate how to use quick access tool bars, formula, ribbon and tabs bar Demonstrate how to perform basic operations in an excel Worksheet (Spreadsheet) such as insert, delete, copy, move data and fill handle. Show how to fix various errors in excel (#NAME?,#N/A, #NULL! etc.) Solve a of linear	Guide students to perform the activities.	Solve a of linear simultaneous equations in Excel using Goal Seek and Solver.

	various Excel functions (SUM, AVERAGE, MIN, MAX, COUNT etc.) 2.7 Identify the meaning various Error values in Excel (#NAME?, #N/A, #NULL! etc.) 2.8 Demonstrate how to perform basic mathematical operation using excel functions such as addition, subtraction and sigma average etc. 2.9 Explain Macros in Microsoft Excel			simultaneous equations in Excel Demonstrate how to use Goal Seek and Solver to solve mathematical Equations. Show how to represent excel values in charts (bar chart, pie chart and line graphs etc.) Demonstrate how to record macro, view macro and use relative reference in macro.		

General Objective 3.0: Recognize the fundamentals and application of visual basic programming						
10-11	3.1 Identify components of the VBA interface 3.2 Identify the commands on VBA control toolbar 3.3 Identify the features of a Code Window 3.4 State the purpose of Click() and Activate() Event Procedure 3.5 Explain Algorithm 3.6 Outline the structure of a VBA program 3.7 Explain the different data types in Visual Basic program 3.8 State the purpose and format of Variable declaration in VBA 3.9 Differentiate between 'Dim' 'Public' and 'Private' keywords 3.10 Explain formatting	Explain activities in 3.1 – 3.15	Marker, Whiteboard, Duster, Textbooks, Computer system, Projector etc. Computer System, Projector	Demonstrate how to use visual basic application interface Demonstrate how to use commands on VBA control toolbar Demonstrate steps involved in writing VBA program Demonstrate how to declare a variable and assign value in Visual Basic program Demonstrate how to format output of Visual Basic program Identify the differences	Demonstrate for the students to learn and guide them to perform the activities.	Write a VB program to solve a typical computational problem

	of output in Visual Basic program 3.11 Outline arithmetic and logic operators in VBA program 3.12 Differentiate between AND. OR and NOT logic operators 3.13 Describe Function used in VBA program 3.14 Describe Graphic User Interface (GUI) 3.15 Explain the conditional operators used in Visual Basic			between 'Dim' 'Public' and 'Private' keywords Identify the various functions used in VBA program Demonstrate how to write the syntax of 'Input Box' function Demonstrate how to write the syntax of 'Msg Box' function Write the format of If/Then/Else conditional structures Write the format of Select/Case conditional structures		

General Objectives 4.0: Apply Microsoft Excel to solve basic process engineering problems						
12-13	4.1 Perform the plotting and formatting of graphs, evaluation of slope and intercept. 4.2 Apply linear regression analysis in laboratory and field data processing 4.3 Perform statistical data analysis, summation, average variance etc 4.4 Solve material and energy balance in non-reacting system (e.g. distillation) systems 4.5 Apply simple Visual Basic programs in thermodynamics property calculation such as saturated vapor pressure, molar volume for ideal	Ensure students carry out class work and assignment using the Microsoft Excel and Visual Basic	Computers and projector	Perform plotting and formatting of graphs, evaluation of slope and intercept using computer	Guide students to perform plotting and formatting of graphs, evaluation of slope and intercept using computer	Solve material and energy balance in non-reacting system (e.g. distillation) systems

	and non-ideal gas 4.6 Perform the application of transport phenomena, heat and mass transfer using computer.					
General Objectives 5.0: Comprehend the use of Back-End programming language in Web-Based process Engineering Software applications						
14-15	5.1 Explain PHP Basic arithmetic operators and built –in function 5.2 State data types in PHP 5.3 Explain the Basic PHP Syntax 5.4 Explain Conditional Statement in PHP 5.5 Describe looping in PHP 5.6 Relate PHP on HTML 5.7 Describe PHP form Handling 5.8 Describe database management with PHP 5.9 Explain relational database management system.	Explain activities in 5.1 to 5.9	Computers and projector	-	-	State data types in PHP Describe database management with PHP

Programme: National Diploma (ND) in Petroleum and Gas Processing Engineering Technology		
Course: Transport Phenomena II	**Code: PGP 215**	**Total Hours: 2 Hours/Week**
		Theoretical hours: 2 Hour/Week
First Semester Year two	**Pre-requisite: PGP 121**	**Practical hours: 0 Hours/Week**
Goal: This course is designed to provide students with the fundamentals of mass and heat transfer mechanism		

GENERAL OBJECTIVES	
On completion of this course, the students should be able to :	
1.0	Appreciate the fundamentals of mass transfer operations.
2.0	Comprehend molecular diffusion in fluids.
3.0	Appreciate how to evaluate mass transfer coefficients.
4.0	Comprehend basic heat transfer phenomena.
5.0	Comprehend the analysis of heat conduction.
6.0	Appreciate the concepts of heat convection.
7.0.	Comprehend basic radioactive heat transfer

PROGRAMME: NATIONAL DIPLOMA IN PETRCHEMICALS AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Transport Phenomena II			**COURSE CODE: PGP 215**		**CONTACT HOURS: 2-0-0 Hrs/Wk**	
Goal: This course is designed to provide students with the fundamentals of mass and heat transfer mechanism						
COURSE SPECIFICATION:THEORETICAL CONTENT			**PRACTICAL CONTENT**			
	General Objective 1.0: Appreciate the fundamentals of mass transfer operations.					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1	1.1 Define mass transfer 1.2 Differentiate between transport and transfer processes. 1.3 Explain the meaning of a mass transfer operation. 1.4 Differentiate between direct and indirect phase contact operations. 1.5 Explain criteria for choice of specific mass transfer operation or solvent for specific purposes. 1.6 Explain steady state, unsteady state, Stage-wise, and continuous contact operation. 1.7 Explain design factors for mass transfer	Cite relevant processes in differentiating transport and transfer processes Explain steady state and unsteady state operation.	White board & Marker PC& Projector Textbooks	-	-	Differentiate between direct and indirect phase contact operations.

	equipment.					
General Objective 2.0: Comprehend molecular diffusion in fluids.						
2-4	2.1 Explain molar flux and molar average velocity relative to velocity of motion. 2.2 Explain stationary frame of reference for a system of components. 2.3 State the Fick's first law of diffusion for a binary system. 2.4 Develop the general expression for net molar flux for steady state diffusion in fluids at rest and in laminar flow. 2.5 Determine the net molar flux for steady state equimolar counter diffusion. 2.6 Determine the net flux for steady state diffusion through a stagnant medium. 2.7 Determine the diffusion coefficient for liquids and gases using empirical equation and formulae	Explain in detail and relate appropriately using simple illustrations activities 2.1 to 2.9	White board & Marker PC& Projector Textbooks Liquid diffusion coefficient apparatus	Determine the net molar flux for steady state equimolar counter diffusion. Determine the net flux for steady state diffusion through a stagnant medium. Determine the diffusion coefficient for liquids and gases using empirical equation and formulae	Guide students to determine the net molar flux for steady state equimolar counter diffusion. Guide students to determine the net flux for steady state diffusion through a stagnant medium. Guide students to determine the diffusion coefficient for liquids and gases using empirical equation and formulae	State the Fick's first law of diffusion for a binary system

	2.8 Develop, by using material balance, field equation for unsteady mass transfer. 2.9 Compare Fick's first law in mass transfer to Fourier's first law in heat transfer and to Newton's equation of fluid viscosity for momentum transfer. 2.10 Define molecular, thermal and momentum diffusivity.					
General Objective 3.0: Appreciate how to evaluate mass transfer coefficients.						
4-6	3.1 Define the mass transfer coefficient and relate it to net molar flux and concentration driving force 3.2 Differentiate between mass transfer coefficient defined with respect to mole faction, partial pressure and concentration in liquid and gas	Explain what mass transfer coefficient is and how its value affects molar flux and concentration drive	White board & Marker PC& Projector Textbooks	-	-	Differentiate between mass transfer coefficient for equimolar counter diffusion and diffusion in a stagnant medium

	phases. 3.3 Differentiate between mass transfer coefficient for equimolar counter diffusion and diffusion in a stagnant medium. 3.4 Show how to convert one mass transfer coefficient from one form to another. 3.5 Define Schmidt, Prandtl, Reynolds and Stanton numbers 3.6 Estimate mass transfer coefficients from empirical equations and formula for laminar and turbulent flows. 3.7 Calculate net molar flux using mass transfer coefficients for simple situation, e.g. wetted wall column, etc. 3.8 Define overall mass transfer	Explain the differences between mass transfer coefficient for equimolar counter diffusion and diffusion in a stagnant medium and show how to convert one mass transfer coefficient from one form to another. Explain Schmidt, Prandtl, Reynolds and Stanton numbers to estimate mass transfer coefficients from empirical equations and formula for laminar and turbulent flows.				

	coefficient. 3.9 Explain the terms: (i) gas film control; (ii) liquid film control.					
General Objective 4.0: Comprehend basic heat transfer phenomena						
7	4.1 Explain the importance of heat transfer science in Chemical Engineering. 4.2 Explain the phenomena and mechanism of heat transfer by conduction, convection, and radiation. 4.3 Explain the characteristic behaviour and properties of materials vis-à-vis heat conduction, convection and radiation	Explain the importance of heat transfer science in Chemical Engineering. Explain heat transfer by conduction, convection, and radiation. Explain the characteristic behaviour and properties of materials vis-à-vis heat conduction, convection and radiation	Whiteboard & Marker PC& Projector	-	-	Explain the phenomena and mechanism of heat transfer by conduction, convection, and radiation.
General Objective 5.0: Comprehend the analysis of heat conduction.						
8-10	5.1 Explain Fourier's first law. 5.2 Develop Fourier's field equation for heat conduction in an	Explain Fourier's first law and equation for heat conduction in an isotropic medium by an energy	Marker & white board , PC & projector	-	-	Explain thermal conductivity for isotropic and

	isotropic medium by an energy balance. 5.3 Develop the Poisson and Laplace equation from Fourier's field equation. 5.4 Explain thermal conductivity for isotropic and anisotropic media. 5.5 Calculate thermal conductivities for solids, liquids and gases from empirical equations and formulae 5.6 Apply one dimensional Laplace equation to heat conduction through single and composite flat plates and cylinders. 5.7 Apply Poisson equation to steady state heat transfer in a cylinder. 5.8 State the equation for heat transfer in a cylinder with internal heat generation.	balance and thermal conductivity for isotropic and anisotropic media.				anisotropic media

General Objective 6.0: Appreciate the concepts of heat convection.						
11-13	6.1 Define overall heat transfer coefficient 6.2 Explain natural and forced convection mechanisms of heat transfer. 6.3 Explain the dependence of heat transfer coefficient on the fluid flow regions. 6.4 Define overall heat transfer coefficient. 6.5 Describe heat exchange equipment. 6.6 Define temperature gradient, heat transfer resistance, effectiveness and NTU concepts. 6.7 Determine exchanger surface through simple performance and design calculations. 6.8 Explain exchange diagrams to co-current and counter-current heat exchangers. 6.9 Apply exchange	Explain overall heat transfer coefficient, natural and forced convection mechanisms of heat transfer, heat transfer coefficient, heat transfer coefficient on the fluid flow regions. Explain heat exchange equipment such as -Temperature gradient, -Heat transfer resistance, -Effectiveness and NTU concepts. Explain exchange diagrams to co-current and counter-current heat exchangers.	Marker & white board , PC & projector Video animation	-	- Explain overall heat transfer coefficient, natural and forced convection mechanisms of heat transfer, heat transfer coefficient	Define the heat transfer coefficient

	diagrams to simple heat exchange networks.					
General Objective 7.0: Comprehend basic radioactive heat transfer						
14-15	7.1 Explain ideal or black body radiation. 7.2 Define transmissivility, reflectivity, emissivity and absorptivity. 7.3 Differentiate between spectral and total values of intensity, emissive power and parameters in black body radiation. 7.4 Develop Lambert's Cosine law, Wien's displacement law Stefan-Boltsman law and Kirchoff's law. 7.5 Differentiate between black and grey surfaces. 7.6 Determine radiant heat exchange between ideal isothermal surfaces. 7.7 Explain view factors and direct radiant interchange areas.	Use drying rates of black white cloth for illustration of transmissibility, reflectivity, emissivity and absorptivity. Students should know which one dries quicker under identical conditions. Statement of each of the laws should be given to the class.	Whiteboard & Marker PC& Projector	Determine radiant heat exchange between ideal isothermal surfaces Determine view factors and radiant exchange between ideal rectangular surfaces in various configurations. Determine view factors in radiant exchange systems.	Guide students to determine radiant heat exchange between ideal isothermal surfaces Guide students to determine view factors and radiant exchange between ideal rectangular surfaces in various configurations. Guide students to determine view factors in radiant exchange systems.	Differentiate between black and grey surfaces

	7.8 Determine view factors and radiant exchange between ideal rectangular surfaces in various configurations. 7.9 Determine view factors in radiant exchange systems.					

Course: Basic Chemical Laboratory Technology II **First Semester Year two**	**Code: PGP 216** **Pre-requisite: PGP 126**	**Total Hours: 2 Hours/Week** **Theoretical hours: 0 Hour/Week** **Practical hours: 2 Hours/Week**
Goal: This course is designed to acquaint students with the quality control procedures applicable to petroleum and its products.		

GENERAL OBJECTIVES	
On completion of this course, the students should be able to :	
1.0	Appreciate the determination of color of petroleum products
2.0	Appreciate the determination of smoke point of fuels
3.0	Comprehend the determination of flash point of fuels
4.0	Comprehend distillation of petroleum products
5.0	Comprehend ring and bail softening point of bituminous materials
6.0	Appreciate the determination of aniline points by thin film method.
7.0.	Comprehend cone penetration test of lubricating grease and bituminous materials.
8.0	Comprehend the calibration of peristaltic pumps
9.0	Appreciate the determination of vapor pressure of petroleum products

PROGRAMME: NATIONAL DIPLOMA IN PETROCHEMICALS AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Basic Chemical Laboratory Technology II			**COURSE CODE: PGP 216**		**CONTACT HOURS: 2-0-0 Hrs/Wk**	
Goal: This course is designed to acquaint students with the quality control procedures applicable to petroleum and its products.						
COURSE SPECIFICATION: THEORETICAL CONTENT			**PRACTICAL CONTENT**			
	General Objective 1.0: Appreciate the determination of color of petroleum products					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-2	1.1 Define color 1.2 Identify comparator apparatus. 1.3 Describe successive steps of the test procedure. 1.4 Explain the significance of color test on petroleum products. 1.5 Explain the ASTM color test. 1.6 Carry out ASTM color test 1.7 Identify the lovibond Tintometer for color test. 1.8 Explain colour nomenclature in the lovibond system. 1.9 Describe successive steps of test	Explain the significance of color test on petroleum products, the ASTM color test. Identify the lovibond Tintometer for color test. Explain colour nomenclature in the lovibond system	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Carry out ASTM color test Identify the lovibond Tintometer for color test. Identify dull and bright samples. Carry out colour test using lovibo Tintometer.	Guide students to carry out ASTM color test Guide students to identify the lovibond Tintometer for color test. Guide students to identify dull and bright samples. Guide students to carry out colour test using lovibo Tintometer.	State the importance of color test of petroleum products.

	procedure 1.10 Identify dull and bright samples. 1.11 Carry out colour test using lovibo Tintometer.					
General Objective 2.0: Appreciate the determination of smoke point of fuels						
3	2.1 Define smoke of fuels 2.2 State the significance of smoke point 2.3 Identify and draw the smoke point lamp. 2.4 Identify and draw the smoke point lamp. 2.5 Describe successive steps of the test procedure. 2.6 Carry out smoke point determination of fuel.	Describe smoke of fuels and its significance. Identify and draw the smoke point lamp, smoke point lamp. Explain successive steps of the test procedure in smoke point determination of fuel.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Identify the smoke point lamp. Draw the smoke point lamp Carry out smoke point determination of fuel.	Guide students to identify and draw the smoke point lamp. Guide students to identify and draw the smoke point lamp Guide students to carry out smoke point determination of fuel.	Explain the importance of smoke point of petroleum products.
General Objective 3.0: Comprehend the determination of flash point of fuels						
4-5	3.1 Define flash point of fuels 3.2 State the significance of the test. 3.3 Identify the Pensky-Martens Flashpoint. 3.4 Describe steps of	Explain flash point of fuels, precautions to be taken during the test and flashpoint test of fuels.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books,	Identify the Pensky-Martens Flashpoint Carry out flashpoint test of fuels	Guide students to identify the Pensky-Martens Flashpoint Guide students to carry out flashpoint test of fuels	Explain the importance of flashpoint of petroleum products.

	the test procedure. 3.5 State the precautions to be taken during the test. 3.6 Carry out flashpoint test of fuels		flip charts, lecture notes, and related journals.			
General Objective 4.0: Comprehend distillation of petroleum products						
6	4.1 Define distillation 4.2 Identify a distillation unit. 4.3 Describe successive steps of the test procedure. 4.4 State the significance of distillation as volatility test of fuels.	Explain activities 4.1 to 4.5	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Identify a distillation unit. Draw a distillation unit Make a graphical presentation of result obtained in carrying out the test and interpret it.	Guide students to identify a distillation unit. Guide students to draw a distillation unit Guide students to make a graphical presentation of result obtained in carrying out the test and interpret it.	Explain the importance of the distillation of petroleum products.
	General Objective 5.0: Comprehend ring and bail softening point of bituminous materials					
7	5.1 Define softening point 5.2 Identify the apparatus for the determination of softening point 5.3 Explain the preparation of sample for the test. 5.4 Describe the	Discuss the softening point of bituminous materials and the apparatus involved.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes,	Identify the apparatus for the determination of softening point Carry out softening point of bituminous materials	Guide students to identify the apparatus for the determination of softening point Guide students to carry out softening point of bituminous materials	State the importance of the softening point of bituminous materials.

	successive test procedure. 5.5 State the significance of the test. 5.6 Carry out softening point of bituminous materials		and related journals.			
General Objective 6.0: Appreciate the determination of aniline points by thin film method.						
8-9	6.1 Define Aniline point 6.2 State the significance of the test. 6.3 Enumerate the apparatus for determination of aniline points by thin film method. 6.4 List the precautionary measures to be adopted during the test. 6.5 Describe successive test procedures.	Explain the Aniline point and the apparatus used in testing it.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Identify the apparatus for determination of aniline points Carry out aniline point test as measure of aromatic content of a fuel.	Guide students to identify the apparatus for determination of aniline points Guide students to carry out aniline point test as measure of aromatic content of a fuel.	Explain the importance of the Aniline point measurements.
General Objective 7.0: Comprehend cone penetration test of lubricating grease and bituminous materials.						
10-11	7.1 Define penetration test. 7.2 State the significance of penetration test. 7.3 Identify the	Explain activities in 7.1 to 7.6	Whiteboard, Computer related software, PowerPoint projectors,	Identify the apparatus for cone penetration test.	Guide students to identify the apparatus for cone penetration test. Guide students to	Explain the importance of the penetration test measurements.

	apparatus for cone penetration test. 7.4 Describe successive steps of each form penetration test. 7.5 State precautionary measures associated with test procedures. 7.6 Explain process of penetration test of lubricating grease and bituminous materials. 7.7 Present graphically the relationship between penetration and softening point of a bitumen material.		recommended textbooks, flip charts, lecture notes, and related journals.	Carry out penetration test of lubricating grease and bituminous materials. Present graphically the relationship between penetration and softening point of a bitumen material.	carry out penetration test of lubricating grease and bituminous materials. Guide students to present graphically the relationship between penetration and softening point of a bitumen material.	
General Objective 8.0: Comprehend the calibration of peristaltic pumps						
12-13	8.1 Describe a peristaltic pump 8.2 State the importance of peristaltic pump 8.3 Identify the peristaltic pump. 8.4 Describe the successive steps of calibrating pump before being used.	Explain activities in 8.1 to 8.8	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related	Identify the peristaltic pump Carry out tests using peristaltic pump.	Guide students to identify the peristaltic pump Guide students to carry out tests using peristaltic pump.	State the significance of calibrating a peristaltic pump.

	8.5 Carry out tests using peristaltic pump. 8.6 Interpret the graph drawn with tabulated result. 8.7 Differentiate between laminar and turbulent flow. 8.8 State the significance of calibrating a peristaltic pump.		journals.			
General Objective 9.0: Appreciate the determination of vapor pressure of petroleum products						
14-15	9.1 Explain vapour pressure of petroleum products. 9.2 Identify a vapour pressure Reid equipment. 9.3 Explain sample preparation for the vapor pressure test. 9.4 State the significance of the test. 9.5 Describe the successive test pressure procedure. 9.6 Explain the method of rectifying uncorrected vapor pressure read from	Explain vapour pressure of petroleum products, vapour pressure Reid equipment. Explain sample preparation for the vapor pressure test and the significance of the test.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Identify a vapour pressure Reid equipment. Carryout vapour pressure test on fuels.	Guide students to identify a vapour pressure Reid equipment Guide students to carryout vapour pressure test on fuels.	State the importance of the vapor pressure measurements.

	the gauge. 9.7 Explain weathering losses and the effects of vapour pressure on startup of a car engine. 9.8 Carryout vapour pressure test on fuels.					

PROGRAMME: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY		
Course Title: Industrial Safety	**Code: PGP 217**	**Credit Hour: 2** **Credit Unit:2**
	Pre-requisite: NIL	**Theoretical: 1hour/week**
Year: 2 Semester: 1		**Practical :1 hours/week**

Goal: This course is designed to acquaint students with the basic knowledge of process safety and occupational health and safety in the oil and gas industry

General Objectives:

On completion of the course, the student should be able to:

1.0 Appreciate the principles of health, safety and security at work.
2.0 Differentiate between process safety and occupational safety.
3.0 Appreciate basic safety in petroleum refining, petrochemical, and gas process plants.
4.0 Appreciate the importance and use of personal protective equipment.
5.0 Apprehend fire prevention, fighting, and control.
6.0 Appreciate the importance and use of 'permit to work system'.
7.0 Comprehend production accidents and professional diseases.
8.0 Appreciate first medical aid to accident victims
9.0 Appreciate the importance of ergonomics in workplace

Programme: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY						
Course Title: INDUSTRIAL SAFETY			**Code: PGP 217**		**CH:2**	**CU:2**
General Objective: 1.0 Apprehend the principles of health, safety and security at work.						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain health and safety culture. 1.2 Highlight the reasons for health, safety and security at work. 1.3 Identify the duties of employer and employee under health and safety at work act (HSWA). 1.4 Identify personal behavior, hygiene, discipline and security at workplace. 1.5 Recognize safe system of work	Explain health and safety culture and its importance at workplace. Explain the responsibilities of employee and employer under HSWA. Explain safe system of work.	Textbooks, journals, lecture notes, internet materials etc.	-	-	State reasons for health, safety and security at work
General Objective: 2.0 Differentiate between process safety and occupational safety.						
3	2.1 Explain process safety and occupational safety. 2.2 Describe process safety incidents. 2.3 Explain process safety	Explain the difference between process safety and occupational safety.	Textbooks, journals, lecture notes, internet materials, and etc	-	-	Describe process safety incidents

	management	Explain process safety management.				
General Objective: 3.0 Apprehend basic safety in petroleum refining, petrochemical, and gas process plants.						
4-5	3.1 Explain the types of processing units in petroleum refining and petrochemical plant. 3.2 Describe the various hazard associated with each unit. 3.3 Describe various hazard control. 3.4 Identify process safety critical equipment.	Explain the different units in the petroleum refining and petrochemical plant. Explain the various hazard associated with each unit and the different types of hazard control. Describe safety critical equipment	Textbooks, journals, lecture notes, internet materials and etc	-	-	Define hazard Describe process safety equipment.
General objective: 4.0 Appreciate the importance and use of personal protective equipment.						
6-7	4.1 Describe the protective equipment for ear, nose, eye, face, upper limbs and lower limbs. 4.2 State precautions against heat and	Explain the different types of personal protective equipment used in the oil and gas industry	Textbooks, journals, internet materials.	Identify the protective equipment for ear, nose, eye, face, upper limbs and lower limbs	Identify the protective equipment for ear, nose, eye, face, upper limbs and lower limbs	Mention protective equipment for ear, nose, eye and lower limbs

	radiation.					
General Objective: 5.0 Apprehend fire prevention, fighting, and control.						
8-9	5.1 Describe industrial fire and three elements of fire (fire Triangle) 5.2 State classes of fire and the methods of extinguishing. 5.3 List the various fire extinguishing agents and the class(es) of fire each is used on 5.4 Highlight the causes of industrial fire 5.5 List fire prevention rules	Explain fire, different classes of fire and the mode of extinguishing them. Explain the different types of fire extinguishing agents.	Textbooks, lecture notes, and internet materials.	-	-	State three classes of fire and the methods of extinguishing
General Objective: 6.0 Appreciate the importance and use of 'permit to work system'.						
10-11	6.1 Explain permit to work system. 6.2 Highlight the role and function of a permit to work. 6.3 Explain the different types of permit to work used in the oil and gas industry 6.4 Explain the information contained in a	Explain the role and function of a permit to work in the oil and gas industry. Explain the different types of permit to work and the information contained in it.	Textbooks, journals, lecture notes, internet materials and etc	-	-	State the functions of work permit

	permit to work.					
General objective: 7.0 Apprehend production accidents and professional diseases.						
12-13	7.1 Explain industrial accident 7.2 Highlight ways to prevent industrial accident 7.3 Distinguish between acute poisoning and chronic poisoning. 7.4 Differentiate occupational illness from accidents. 7.5 Describe the determination of accident frequency coefficient and accident seriousness coefficient	Explain the difference between acute poisoning and chronic poisoning. Explain the difference between professional diseases and accidents. Explain how to calculate accident frequency coefficient and accident seriousness coefficient.	Textbooks, journals, internet materials.	-	-	Differentiate between acute poisoning and chronic poisoning
General Objective:8.0 Appreciate first medical aid to accident victims						
14	8.1 Explain the concept of First Aid 8.2 Describe steps in First Aid treatment 8.3 Explain how to free victim from contact with electric current. 8.4 Describe the methods of applying artificial respiration.	Explain how to free victim from contact with electric current. Explain the methods of applying artificial respiration. Explain how to administer first aid	Textbooks, lecture notes, and internet materials.	-	-	Describe methods of applying artificial respiration

	8.5 Explain how to administer first aid to victims of poisoning.	to victim of poisoning.				
General Objective:9.0 Apprehend the importance of ergonomics in workplace						
15	9.1 Explain the importance of ergonomics in process industries 9.2 Highlight the ill-health effect associated with poor ergonomics design. 9.3 Explain how ergonomics improve health and safety at workplace.	Explain ergonomics and the ill-health associated with poor ergonomic design. Explain how ergonomics improve health and safety at workplace.	Textbooks, lecture notes, and internet materials.	-	-	Define ergonomics

PROGRAMME: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course: Process Equipment Fabrication	**Code: PGP 218**	**Total Hours: 3Hours/Week**
		Theoretical hours: 1 Hour/Week
Year 2 Semester: 1	**Pre-requisite: NIL**	**Practical hours: 2 Hours/Week**
Goal: This course is designed to acquaint students with knowledge and skills of basic tools and equipment in workshop equipment operations and welding processes, codes, standards, specification and safety precautions of process equipment.		

GENERAL OBJECTIVES

On completion of this course students should be able to :

1.0 Appreciate general Factory Acts, Safety Regulations and safety precautions
2.0 Use basic marking out, metal removal and filing tools
3.0 Use basic measuring and testing equipment
4.0 Comprehend welding processes
5.0 Appreciate various metal gas welding operations
6.0 Appreciate various metal arc welding operations
7.0 Comprehend principles of operations of modern welding processes
8.0 Inspect various welding joints
9.0 Perform basic operations on plastics

PROGRAMME: National Diploma in Petroleum and Gas Processing Engineering Technology						
COURSE: Process Equipment Fabrication			**CODE: PGP 218**		**CONTACT HOURS: 1 - 0 - 2 HOURS PER WEEK**	
General Objective 1.0: Appreciate general factory acts, safety Regulations and safety precautions						
COURSE SPECIFICATION: **THEORETICAL CONTENT**				**COURSE SPECIFICATION**: **PRACTICAL CONTENT**		
Week	**Specific Learning Objectives**	**Teacher's Activities**	**Learning Resources**	**Specific Learning Objective**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Interpret 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 List Personal Protective Equipment (PPE) such as safety boots, goggles, coverall, hand gloves, etc.	Provide list of safety precautions in the workshop State 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	Guide students to perform the activities. Use safety equipment and Personal Protection Equipment. Practice safety procedures and precautionary measures.	State the safety and precautionary measures against accidents in the workshop
	General Objective 2.0: Use basic marking-out, metal removal and filing tools					
3-4	2.1 List types of marking-out tools. 2.2 Explain the use of 2.1 2.2 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	Work bench vice, Hammers, Set of drills Steel rule Scribers Scribing blocks, Inside and	Use marking-out tools on the bench correctly. Produce simple objects using bench/hand tools such as files, chisels, scrapers,	• 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	Explain the role of the following tools in the mechanical workshop: Scribers Inside and outside caliper

		condition	outside calipers Surface plate Dividers Centre punches, Files, Scrapers, etc	saws etc. Maintain files, dividers, saws, gauges try squares, bevel edge square etc.	practical exercises. a. Guide students to identify this bench cutting tools b. Guide students to write process sheet or operation layout for the component to be produced.	Centre Files, Scrapers, File card.
	General Objective 3.0: Use basic measuring and testing equipment					
5-6	3.1 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 3. 2 Explain the principle of construction of a dial indicator, their types and their accuracy 3.3 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	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	Demonstrate to the students to learn and guide them to perform the activities listed: 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. 3.4 Inspect jobs using simple comparators	State the differences and similarities between measuring and testing equipment in mechanical workshop with regards to: i. principle of operation ii. construction iii Use

			gauge straight edge vernier protractor.	protractor and sine bars. 3.4 Inspect jobs using simple comparators		
General Objective 4.0: Understand welding processes						
7--8	4.1 Explain the principle of welding 4.2 Classify welding terminologies, welding symbols, types of joints, types of welds 4.3 Mention the advantages of welding 4.4 Mention the limitations of welding 4.5 State the industrial applications of welding 4.6 Explain welding positions, techniques and symbols 4.7 State general safety precautions in welding 4.8 State codes, standards, specifications and welding qualifications 4.9 Describe requirements for Welding Procedure Specifications (WPS)	Explain activities 4.1 to 4.9 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, presentation materials, PPEs (Leather apron, safety gloves, Safety goggles, welding helmet, safety shoes, ear plug, safety belt, fume mask etc)	Identify different welding positions. Utilize different welding positions during welding. Use Personal Protective Equipment (PPE)	Guide students to perform all the practical activities listed below to: Identify different welding positions. Utilize different welding positions during welding. Use Personal Protective Equipment (PPE).	Explain the welding principles, types, procedures, codes and standards.

General Objective 5.0: Appreciate various metal gas welding operations						
9	5.1 Explain the principle of gas welding. 5.2 List the types of gas welding flames and their applications	Explain activities 5.1 and 5.2 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, Safety welding goggles, Gas welding equipment set, Chipping hammer, Wire brush, Flame cutting blow pipe (nozzle), Gas welding set	5.1 Assemble OXY-acetylene welding plant 5.2 Select various welding regulators, clips, blow pipe and nozzles. 5.3 Perform gas welding using various welding techniques.	Demonstrate to the students to learn and guide them to carry out all the activities.	Explain gas welding procedures.
General Objective 6.0: Appreciate various metal arc welding operations						
10	6.1 Explain the principle of arc welding 6.2 Explain the principle of shielded metal arc welding 6.3 Describe the principle of submerged arc welding 6.4 Explain the classification of Electrodes, compositions and specific applications	Explain activities 6.1 to 6.4 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, presentation tools Electric arc welding	Regulate current and determine polarity for metal arc welding. Determine polarity and select current. Demonstrate how	Demonstrate to the students to learn and guide them to carry out all the activities.	Explain arc welding procedures.

			Machine, Welding table, Welding chipping hammer, Wire brush, Hand grinder, Pedestal grinding machine, electrode oven, jigs and fixtures, lights, exhaust fans, fire blankets, fire extinguishers, first aid box, PPEs	to adjust the following SAW welding parameters and their effects on weld: - Voltage - Amperes - Travel speed - Type of Polarity 6.4 Prepare metal edges for various thickness and technique welding 6..5 Demonstrate requirement of a workplace for SMAW welding of specific job: 3.6 Demonstrate preparation of welding machine. 3.7 Show how to adjust SMAW welding parameters and their effects on SMAW welding 3.8 Demonstrate post weld cleaning. - Removal of slag - Removal of jigs		

				and fixtures		
General Objective 7.0: Comprehend principles of operations of modern welding processes						
11-12	7.1 Define the principle of resistance welding (i.e. spot, seam, projection and percussion welding) 7.2 Explain the principle of thermite, electro slag, electron beam, ultrasonic, laser beam, and robotic welding 7.3 Explain the principle of underwater (hyperbaric) welding 74 Explain the principle of Tungsten inert gas (TIG) and metal inert gas (MIG) welding	Explain activities 7.1 to 7.4 with diagrams where necessary and detailed notes	Recommended textbooks, charts, lecture notes, presentation tools GMAW Welding machine and gas cylinders (CO2, Argon) with accessories, , fire blankets, fire extinguishers, first aid box, PPE	7.1 Identify the equipment of MIG process 7.2 Illustrate workplace for MIG welding specific jobs MIG Welding machines, Consumables and accessories 7.3 Practice the use of MIG welding machine. 7.4 Identify the equipment of TIG process.	Demonstrate to the students to learn and guide them to carry out all the activities.	Explain the different modern welding processes. Explain TIG and MIG welding procedures.
General Objective 8.0: Inspect various welding joints						
13-14	8.1 Explain the types of welding distortions. 8.2 Explain the types of welding defects 8.3 Identify ways of controlling welding defects 8.4 Ascertain how welded joints are inspected	Explain activities 8.1 to 8.4 with diagrams where necessary and detailed notes	Electric arc welding Machine OXY-acetylene welding plant	Apply correctly the stop back and skip method of controlling distortion. Apply pre and post heating	Demonstrate to the students to learn and guide them to carry out all the activities.	Explain the process of inspection and verification of the quality of welding jobs.

				technique. Identify welding distortions and defects		
General Objective 9.0: Perform basic operations on plastics						
15	9.1 Differentiate between thermo-setting and thermo-plastics. 9.2 Describe the use of conventional metal cutting tools to perform operations on plastics.	Explain the need for care in the use of the tools and machines for tapping operations Explain the methods of maintenance of the tools and	Set of drill Wood turning lathe HSS cutting tools Evostic glue Thermo-setting and thermo-plastic	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. Explain the result of using conventional metal cutting tools for operation on thermo-setting and thermo-setting plastic. Guide students to join the thermo-setting and thermo-plastic.	Describe the three processes of joining plastics together

FOURTH SEMESTER COURSES
(YEAR 2 SEMESTER 2)

Programme: National Diploma in Petrochemical and Gas Processing Engineering Technology		
Course Title: Gas Processing Technology II	**Code: PGP 221**	**Contact Hour: 3** **Credit Unit: 2**
	Pre-requisite: PGP 213	**Theoretical: 2 hours/week**
Year: 2 Semester: 2		**Practical : 1 hours/week**

Goal: This course is designed to equip students with the basic theory and practice of Natural gas engineering operations

General Objectives:

On the completion of the course, the student should be able to:

1.0 Outline basic principles of gas treating.

2.0 Comprehend the basic principles of Gas Dehydration

3.0 Comprehend the basis of hydrocarbon recovery.

4.0 Comprehend the basis of Nitrogen Rejection

5.0 Comprehend trace component recovery

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
Course Title: Gas Processing Technology II				**Code: PGP 221**	**CH: 3**	**CU: 2**
Theoretical Content				**Practical Content**		
General Objective 1.0: Outline basic principles of gas treating.						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Explain Acid gas concentrations in Natural Gas. 1.2 Identify the purification levels of natural gas 1.3 Explain acid gas disposal. 1.4 Describe the purification process of natural gas 1.5 Identify solvent in absorption process. 1.6 Explain amines. 1.7 Explain physical absorption. • Solvent properties. • Representative process conditions. • Hybrid processes. 1.7 Explain the adsorption process.	• Explain the purification levels and natural gas • Explain the solvent absorption process. • Explain cryogenic systems. • Explain the physical absorption. • Explain the adsorption process of natural gas • Explain the cryogenic fractionation. • Explain membranes fundamentals.	Whiteboard, Computer related software, PowerPoint projectors, recommended textbooks, flip charts, lecture notes, and related journals.	-	-	Describe the purification process of natural gas

	1.8 Explain the cryogenic fractionation. 1.9 Explain membranes fundamentals. 1.10 Explain carbon dioxide removal from natural gas. 1.11 Outline the merits and limitations of membranes. 1.12 Explain Non-regenerable hydrogen sulfide scavengers. 1.13 Outline biological processes.					
General Objectives 2.0 Comprehend the basic principles of Gas Dehydration						
4-7	2.1 Explain the water contents of hydrocarbons. 2.2 Explain the Absorption Process. 2.3 Explain the Representative Operating Conditions for TEG Absorbers. 2.4 Outline other factors that affect glycol dehydrator performance. 2.5 Explain the Properties of Industrial Adsorbents for Dehydration. 2.6 Explain the Adsorption Process. 2.7 Explain Other Factors	• Explain Absorption Process. • State the Representative Operating Conditions for TEG Absorbers. • Describe the Adsorption Process. • Describe the membrane processes.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Outline other factors that affect glycol dehydrator performance

	That Affect the Adsorption Process. 2.8 Explain desiccant processes. 2.9 Explain the membrane processes. 2.10 Compare hydration and dehydration processes.					
General Objectives 3.0 Comprehend the basis of hydrocarbon recovery.						
8-10	3.1 Describe retrograde condensation. 3.2 Explain the concept of external refrigeration such as: • Basic Propane Refrigeration Process. • Alternate Process Configurations. • Effect of Operating Variables on Refrigeration Performance. 3.3 Describe turbo-expansion. 3.4 Describe heat exchange. • Plate-Fin Exchangers. • Printed Circuit Heat Exchangers. 3.5 Explain fractionation.	• Explain the external refrigeration. • Explain retrograde condensation. • Explain heat exchange and fractionation. • Explain low and high ethane recovery. • Assess the students.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	Determine low ethane recovery: -Cooling by Expansion or External Refrigeration. -Lean Oil Absorption.	Guide students to conduct the practical activities	Explain low and high ethane recovery.

	3.6 Describe the recovery processes. • Dew point control and fuel conditioning. 3.7 Determine low ethane recovery. • Cooling by Expansion or External Refrigeration. • Lean Oil Absorption. 3.8 Describe high ethane recovery.					
General Objectives 4.0 Comprehend the basis of Nitrogen Rejection						
11-12	4.1 Explain Nitrogen Rejection for Gas Upgrading. 4.2 Explain Cryogenic Distillation. 4.3 Explain Membrane separation. 4.4 Explain Pressure Swing Adsorption.	• Explain the cryogenic distillation procedure. • Explain Pressure Swing Adsorption.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	State the cryogenic distillation procedure

General Objectives 5.0: Comprehend trace component recovery						
13-15	5.1 Explain the recovery of the following substances: • hydrogen. • oxygen. • Radon. • Arsenic. • helium • mercury.	• Explain the recovery of hydrogen, oxygen, radon and arsenic. • Explain the recovery techniques of helium.	Whiteboard, Computer related software, PowerPoint projectors, recommended text books, flip charts, lecture notes, and related journals.	-	-	Explain the recovery of hydrogen, oxygen, radon and arsenic

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course Title: Kinetics and Catalysis of Chemical Processes	**Code: PGP 222**	**Contact Hour: 3** **Credit Unit:2**
	Pre-requisite: NIL	**Theoretical: 2 hours/week**
Year: 2 Semester: 2		**Practical : 1 hours/week**

Goal: This course is designed to enable students to understand the underlying principles of reactor design and catalytic phenomena.

General Objectives:

On the completion of the course, the student should be able to:

1.0 Outline the importance of chemical reactor in petroleum and gas process engineering

2.0 Appreciate the rate mechanism and utilization of kinetic data

3.0 Comprehend the basic design of single homogenous ideal reactors

4.0 Appreciate the fundamental principles of catalysis, catalyst and catalytic reaction

5.0 Appreciate catalytic materials and their properties

6.0 Appreciate the methods of catalysts preparation and characterization

Programme: National Diploma in Petroleum and Gas Processing Technology						
Course Title: Kinetics and Catalysis of Chemical Processes		**Code: PGP 222**		**CH:3**		**CU:2**
Theoretical Content		**Practical Content**				
General Objective 1.0: Outline the importance of chemical reactor in petroleum and gas process engineering						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Define chemical reactor in process engineering 1.2 Explain chemical reaction engineering 1.3 Explain the importance of reactors in petroleum and gas processing 1.4 Explain the engineering subjects relevant to reactor design such as: a. chemical kinetics; b. thermodynamics; c. material science d. heat transfer; e. mass transfer; f. corrosion engineering; g. economics h. mathematics and i. computer science, etc. 1.5 State the factors to be considered in reactor design. 1.6 Classify types of reactions 1.7 Define rate of reaction	• Explain chemical reaction and factors affecting rates of reaction • Explain the effects of a poorly designed reactor on finished products. • State the factors to be considered in reactor design • Explain with a process flow diagram a typical petroleum and gas process plant and show the reactors	Recommended textbooks, Internet services, etc. White Board, Multimedia projector Process Flow Diagram	-	-	Explain chemical reaction engineering Classify reactors and reactions

	1.8 Explain variables affecting rates of reaction					
General Objective 2.0: Appreciaterate the rate mechanism and utilization of kinetic data						
3-5	2.1 Explain the kinetics of homogenous reactions: Elementary and non-elementary reactions, 2.2 Define molecularity, reaction order and rate constant 2.3 Explain the temperature dependency theories and activation energy 2.4 Explain rate expressions from postulated mechanisms 2.5 Interpret batch reaction kinetic data from constant volume batch reactor: Introducing integral and differential methods of data analyses	• Explain molecularity, reaction order and rate constant for elementary reactions • Explain collision theory and transition state theory • Sketch a reaction coordinate demonstrating activation energy • Interpret batch reaction kinetic data from constant volume batch reactor: • Explain reversible, irreversible reactions series, parallel and autocatalytic reactions	Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	Differentiate between elementary and non-elementary reactions Determine molecularity, reaction order and rate constant

General Objective 3.0: Comprehend the basic design of single homogenous ideal reactors						
6	3.1 Explain single ideal batch, mixed and plug flow reactors	• Show the design ideal batch reactor • Show the design of ideal mixed reactor • Show the design of ideal plug reactor	Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	Basic calculation of volume of reactor and resident time
General Objective 4.0 : Appreciate the fundamental principles of catalysis, catalyst and catalytic reaction						
7-9	4.1 Define catalyst 4.2 Explain the concept of catalysis. 4.3 Give a brief history of catalyst technology 4.4 Describe the development of industrial catalyst. 4.5 Enumerate the importance of catalysis and catalytic technology 4.6 List petrochemical catalyst producers and their products 4.7 Explain the effect of catalyst on activation energy of a reaction 4.8 Describe the structure of a catalyst	• Explain the concept of catalysis • Explain the relevance of catalytic technology to modern life • Illustrate with a diagram the activation energy of a catalyzed and un-catalyzed reaction • Illustrate the with a diagram the steps involve in a heterogeneous catalytic reaction	Recommended textbooks, Internet services, etc. White Board, Multimedia projector			Differentiate between homogenous and interogenous catalytic reactions

	4.9 Describe the steps involve in a heterogeneous catalytic reaction 4.10 Describe Adsorption and Desorption 4.11 Explain the application of Isotherm 4.12 Explain homogeneous and heterogeneous catalyst.	• Show a schematic illustration of adsorption on a surface				
General Objective 5.0: Comprehend catalytic materials and their properties						
10-12	5.1 Identify the components of a typical heterogeneous catalyst. 5.2 Give examples of Active Phases, Supports, and Promoters 5.3 Enumerate properties of heterogeneous catalyst 5.4 Describe the difference between bulk catalyst and supported catalyst 5.5 Explain the effects of support on catalytic activity and selectivity 5.6 Outline desirable	• Explain the make-up of heterogeneous catalyst • Describe Active phases, Carriers and Promoters • List the physical, mechanical and chemical properties of catalyst • Display period table indicating elements finding application as	Recommended textbooks, Internet services, etc. White Board, Multimedia projector			List examples of Active Phases, Supports, and Promoters Identify various zeolites used in petrochemical industry

	characteristics of a catalyst support 5.7 Explain molecular sieves and zeolites 5.8 Explain the composition and structure of molecular sieves and zeolite 5.9 Explain exchangeability, active sites, acidity, and thermal stability of molecular sieves 5.10 Explain different shape selectivity associated with zeolites 5.11 Enumerate the general applications of zeolites 5.12 Lists some important commercial catalytic processes utilizing zeolites 5.13 Calculate the following physical properties: (a) bed or bulk porosity, (b) pellet density, (c) specific pore volume, (d) pellet porosity, (e) specific	catalytic phases, carriers, or promoters • Outline the uses of molecular sieves and zeolites • List Common Zeolites and state their makeup • Depict the formation of zeolites from primary SiO4 and A1O4 tetrahedral units • Depict the different dimensionalities of common zeolite • Illustrate reactant selectivity for cracking of a straight-chain versus branched hydrocarbons • Show a schematic of Lewis and Brosnsted acid	Chemicals for catalyst preparation and clay Oven, furnace, weighing balance filtration unit, glassware			

	macropore volume, (f) macro and mesoporosity 5.14 Define Brønstate and Lewis Acidity	sites on an alumina silicate surface.				
General Objective 6.0: Identifymethods of catalysts preparation and characterisation						
13-15	6.1 Explain Impregnation method of depositing active component onto a support 6.2 Describe Adsorption/ion exchange. 6.3 Explain catalyst precipitation 6.4 Explain Gelation and flocculation 6.5 Describe hydrothermal transformation 6.6 Explaindecantation, filtration, centrifugation and washing 6.7 Describe drying of catalyst 6.8 Explain calcination process 6.9 Describe catalyst reduction	• Show a scheme typical routes for catalyst preparation and forming • Show a schematic of supported catalysts preparation by incipient wetness impregnation method • Explain unit operations involve in preparation of catalyst • State the importance of forming operation • State conditions in catalyst drying and	XRF, XRD, FTR, SEM and VV-VIS	-	-	Identify various techniques for catalyst preparation State the importance of forming operation

	6.10 State the importance of forming operation 6.11 Outline various catalyst forming methods 6.12 Outline common techniques used in catalyst characterization (AAS, BET, EDX, FTIR, IR, NMR, SEM, TEM, TGA, TPD, TPR, UV-VIS, XRD, XRF, etc.)	calcination processes • List common techniques used in characterization of catalyst				

Programme: National Diploma in Petroleum and Gas Processing Engineering		
Course Title: Basic Petrochemical Plant Design	**Code: PGP 223**	**Credit Hour: 2** **Credit Unit: 2**
	Pre-requisite:	**Theoretical: 2 hours/week**
Year:2 Semester: 1		**Practical : 0 hours/week**

Course main Goal: This course is designed to equip students with fundamentals of petrochemical plant design

General Objectives:

On completion of the course, the student should be able to:

1.0 Appreciate how to make literature survey

2.0 Identify the types of designs and the design constraints.

3.0 Recognize the plant design cycle.

4.0 Prepare flow sheet for a petrochemical plant.

5.0 Estimate material and energy balances of a petrochemical process

6.0 Apply the economic analysis of the design process

Programme: National Diploma in Petroleum and Gas Processing Engineering						
Course Title: Basic Petrochemical Plant Design			**Code: `PGP 223**		**CH: 2**	**CU: 2**
Theoretical Content			**Practical Content**			
General Objective 1.0: Appreciate how to make literature survey.						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Describe a typical petro chemical process. 1.2 Describe the units operations involved in a typical petrochemical process. 1.3 Describe a typical gas base process	• Explain the processes involved in a typical petro chemical plant. • Explain the process involve in atypical gas process plant	Recommended textbooks, lecture notes, etc.	-	-	Explain the process flow diagram of petrochemical and gas processes
General Objectives 2.0 **Identify the types of designs and the design constraints**						
3-4	2.1 Explain the different types of designs: • Preliminary or quick estimate design. • Detailed estimate design. • Firm process design. 2.2 Describe Internal and external design constraints.	• Explain the various types of designs giving examples. • Explain the design constraints and illustrate using a diagram.	Recommended textbooks, lecture notes, etc.	-	-	Explain types of design and design constrain

General Objectives 3.0 **Recognize the plant design cycle**						
5-6	3.1 Explain the steps involved in plant design. Steps such as; • Feasibility study. • Process design. • Feed. • Pre commissioning. • Stable operation. • Trouble shooting and revamp.	• Show the stages involved in a petrochemical plant design. • Illustrate the stages using diagrams and tables for better understanding.	Recommended textbooks, lecture notes, etc.		-	Describe the steps involve in plant design
General Objectives 4.0 **Prepare flow sheet for a petrochemical plant.**						
7-10	4.1 Draw a flow diagram showing all equipment and process involved in a petrochemical plant. 4.2 Indicate major control loops and instrumentation of the process. 4.3 State the importance of flow sheeting. 4.4 List the various flow sheet symbols, line and symbol designation and equipment designation and numbering. 4.5 Identify the various	• Illustrate a simple process, showing all equipments and process pipe work involved. • Identify the control loops in the processes. • Describe a simple petrochemical process in form of block diagram, the in form of a process flow diagram.	Recommended textbooks, lecture notes, etc.	-	-	Describe flow sheets, PFD and control loops

	flow sheet presentations and their uses: • Block flow diagram • Process flow diagram. • Piping and instrumentation diagram.					
General Objectives 5.0 **Estimate material and energy balances of a petrochemical process**						
11	5.1 Define material and energy balance 5.2 Calculate material and energy balance of simple petrochemical process. 5.3 Estimate material and energy balance of the units involved in a petrochemical plant. 5.4 Describe the importance of material and energy balances.	• Solve typical examples involving material and energy balances in a petrochemical plant. • Highlight the importance of doing material and energy balance of a process.	Recommended textbooks, lecture notes, etc.	-	-	Define material and Energy Balance Calculate material and Energy Balance

General Objectives: 6.0 **Apply equipment sizing and selection of material**.						
12-13	6.1 Calculate reactor volumes and dimensions for the various types of reactors. 6.2 Make initial selection of the reactor conditions to give the desired conversion & yield. 6.3 Select a suitable material of construction for the equipment. 6.4 Make a preliminary mechanical design for the reactor and other equipment.	Calculate volume and dimensions of different reactors.	Recommended textbooks, lecture notes, etc.	-	-	Describe reactor design
General Objective 7.0 **Appreciate the economic analysis of the design process**						
14-15	7.1 Explain the economic viability of the process. 7.2 Estimate the capital cost, expected profit, annual product cost.	Calculate the capital cost, expected profit and annual product cost of the design process.	Recommended textbooks, lecture notes, etc.	-	-	Make economic viability analysis

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology		
Course: Separation Process II	**Code: PGP 224**	**Total Hours: 2Hours/Week**
		Theoretical hours: 2 Hour/Week
Year 2 Semester 2	**Pre-requisite: PGP 122**	**Practical hours: 0 Hours/Week**
Goal: This course is designed to enable students acquire the basic knowledge on solid-liquid-gas separation techniques		

GENERAL OBJECTIVES

On completion of this course, the students should be able to :

1.0 Appreciate separation by distillation
2.0 Comprehend the principles of gas absorption operations
3.0 Appreciate the Principles of adsorption
4.0 Appreciate the principles of humidification and drying
5.0 Comprehend the principles of crystallization operation

PROGRAMME: NATIONAL DIPLOMA IN PETROCHEMICALS AND GAS PROCESSING ENGINEERING TECHNOLOGY						
COURSE: Separation Process II			**COURSE CODE: PGP 224**		**CH: 2**	**CU: 2**
Goal: This course is designed to enable students acquire the basic knowledge on solid-liquid-gas separation techniques						
COURSE SPECIFICATION: THEORETICAL CONTENT			**PRACTICAL CONTENT**			
	General Objective 1.0: Appreciate separation by distillation					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1-3	1.1 Define distillation. 1.2 Define relative volatility 1.3 Explain phase diagram and Calculate vapour – liquid equilibrium data for ideal binary systems. 1.4 Calculate the material balance for simple batch distillation. 1.5 Explain batch distillation with rectification 1.6 Apply calculation procedures for batch rectification at: a. constant reflux;	Explain how to calculate vapour-liquid equilibrium data, and material balance for a simple batch distillation. Describe different types of batch distillation Use numerical examples to • Explain the application of • Calculate procedures for batch rectification.	Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	Explain batch distillation with rectification

	b. Constant overhead composition. 4.13 Explain the operating and control parameters for batch distillation					
	General Objective 2.0: Comprehend the principles of gas absorption operations					
4-6	2.1 Define solubility of gases. 2.2 Define absorption and stripping 2.3 Explain the properties and types of tower packing. 2.4 Describe gas absorption tower construction. 2.5 Explain the factors affecting the selection of solvents in gas absorption operations.	Explain clearly solubility of gases, absorption and stripping, tower packings and towers construction. Explain the factors affecting solvent selection. Solve numerical examples	Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	Explain the properties and types of tower packing Explain absorption Distinguish between absorption and adsorption
	General Objective 3.0: Appreciate the Principles of adsorption					
7-9	3.1 Define adsorption 3.2 Define adsorption energy 3.3 List commercially available adsorbent and their application 3.4 Explain adsorption equilibria	Explain the principles of adsorption Differentiate between physisorption and chemisorption State examples of adsorbent	Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	List commercially available adsorbent and their application

		State characteristics of adsorbent and applications. Explain the following: i. Isotherm ii. Isobar iii. Isostere				
	General Objective 4.0: Appreciate the principles of humidification and drying					
10-12	4.1 Define the following terms: drying; humidification and dehumidification. 4.2 Explain humidification and dehumidification. 4.3 Distinguish between wet bulb and adiabatic saturation temperatures. 4.4 Determine humidity, dew point, etc, using psychometric charts. 4.5 Explain the principles and operation of a cooling tower. 4.6 Explain the mechanism of drying operations. 4.7 Define the following terms: bond and un-	Explain the difference between humidification and dehumidification, and wet bulb and adiabatic saturation temperatures. Explain clearly the principles and operation of cooling towers. Define the various technical terms clearly. Solve numerical problems.	Recommended textbooks, Internet services, etc. White Board, Multimedia projector psychometric charts	Determine humidity, dew point, etc, using psychometric charts	Guide students to determine humidity, dew point, etc, using psychometric charts	Distinguish between wet bulb and adiabatic saturation temperatures.

	bond moisture, free moisture, critical moisture content and equilibrium moisture content. 4.8 Give examples of equipment used for batch and continuous drying.					
	General Objective 5.0: Comprehend the principles of crystallization operation					
13-15	5.1 Define crystallization. 5.2 Explain the mechanism of crystallization. 5.3 Explain the effects of temperatures and impurities on crystallization. 5.4 State examples of batch and continuous crystallizers	Describe crystallization in detail showing its mechanism and the effect of temperature and impurities. Give examples of batch and continuous crystallization Solve numerical problem	Recommended textbooks, Internet services, etc. White Board, Multimedia projector	-	-	Explain the effects of temperatures and impurities on crystallisation.

Programme: National Diploma in Petroleum and Gas Processing Engineering		
Course Title: Petrochemical Processing Technology	**Code: PGP 225**	**Contact Hour: 2** **Credit Unit:2**
	Pre-requisite: PGP 212	**Theoretical: 2 hours/week**
Year2: Semester: 2		**Practical : 0 hours/week**

Course main Goal: This course is designed to acquaint student with the knowledge on process technology for the production of major petrochemical derivatives

General Objectives:

On the completion of the course, the student should be able to:

1.0 Appreciate the process technology for the production of methanol and its derivatives

2.0 Appreciate the process technology for the production of Formaldehyde (HCHO) and its derivatives

3.0 Appreciate the process technology for the production of Acetic acid and its derivatives

4.0 Appreciate the process technology for the production of Acetylene and its derivatives

5.0 Appreciate the process technology for the synthesis of ethane and higher paraffinic derived chemicals

Programme: National Diploma in Petrochemical and Gas Processing Engineering						
Course Title: Petrochemical Processing Technology			**Code: PGP 225**		**CH: 2**	**CU: 2**
Theoretical Content			**Practical Content**			
General Objective 1.0 : Appreciate the process technology for the production of methanol and its derivatives						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-3	1.1 Explain the importance of CO in the Petrochemical industry 1.2 Describe Fischer-Tropsch technology for the production of syngas (H_2 and CO) 1.3 List the various products obtainable from CO 1.4 Explain the relevance of methanol to the petrochemical industry 1.5 List the various products derived from methanol 1.6 Describe the various technologies for the production of methanol 1.7 Describe BASF technology or other technologies for the production of methanol	• Explain Fischer-Tropsch technology for the production of syngas with the aid of process flow diagram • Depict with the aid of a chart the various products derived from methanol • Describe with the aid of a process flow diagram for the production of methanol from Natural gas/Naphtha • Present the process operating parameters for	Recommended textbooks, internet services etc White board Multimedia projector	-	-	State the application of methanol Draw the block diagram for the production of methanol

	1.8 State the catalyst and process conditions employed in BASF technology or other technologies 1.9 List the various steps in the production of methanol from partial oxidation of fuel oil	methanol				
General Objectives 2.0 Appreciate the process technology for the production of Formaldehyde (HCHO) and its derivatives						
4-5	2.1 Explain the relevance of formaldehyde to the petrochemical industry 2.2 List the various products obtainable from formaldehyde 2.3 Describe the process technology for the production of formaldehyde from methanol by: (a) Silver catalyst process (BASF) (b) Iron-Molybdenum oxide catalyst process 2.4 State the catalyst and process conditions	• Illustrate with chart chemical products from acetic acid • Depict with the aid of a chart the various routes for the manufacture formaldehyde • Distinguish with the aid of a process flow diagram between Silver and Iron-Molybdenum based process for the production of formaldehyde	Recommended textbooks, internet services etc White board Multimedia projector	-	-	Mention various products obtained from formaldehyde Draw the block diagram for the production of formaldehyde from methanol

	involve in the production of formaldehyde	• Present the process operating parameters for formaldehyde production				
General Objectives 3.0 Appreciate the process technology for the production of Acetic acid and its derivatives						
6-7	3.1 Explain the relevance of Acetic acid to the petrochemical industry 3.2 List out the various products derivates from Acetic acid 3.3 Describe the process technology for the production of acetic acid by: (a) Oxidation of Acetaldehyde (b) Oxidation of n-butane (c) Methanol carbonylation 3.4 State the catalyst and process conditions involve in the production of acetic acid	• Illustrate with chart chemical products from acetic acid • Depict with the aid of a chart the various routes for the manufacture acetic acid • Describe with the aid of a process flow diagram for the production of acetic acid by Oxidation of Acetaldehyde • Present the process operating parameters for acetic acid production.	Recommended textbooks, internet services etc White board Multimedia projector	-	-	State application of acetic acid With the aid of a block diagram describe the process of production of acetic acid

General Objectives 4.0 Appreciate the process technology for the production of Acetylene and derivatives						
8-9	4.1 Explain the relevance of Acetylene to the petrochemical industry 4.2 List out the various products derivates from Acetylene 4.3 Explain the process technology for the manufacture of Acetylene via Calcium carbide route 4.4 State the reactions, catalyst and process conditions involve in the manufacture of Acetylene	• Illustrate with the aid of chart chemical products derived from Acetylene • Describe with the aid of a process flow diagram for the synthesis of Acetylene • Present the process operating parameters for synthesis of Acetylene	Recommended textbooks, internet services etc White board Multimedia projector	-	-	What are the utilities of acetylene in industry Draw the block diagram for the manufacture of acetylene from calcium cadride
General Objectives 5.0 Appreciate the process technology for the synthesis of ethane and higher paraffinic derived chemicals						
10-15	5.1 Describe steam cracking of ethane for ethylene production 5.2 State the major applications ethylene 5.3 Describe Transcat or other technologies process for producing vinyl chloride from ethane 5.4 State the process	• List out the chemical products derived from ethane • Describe with the aid of a process flow diagram the steam cracking of ethane	Recommended textbooks, internet services etc White board Multimedia projector	-	-	List major application of ethylene Describe with the aid of a process flow diagram the steam cracking of ethane

	condition for Transcat process 5.5 State the major applications of vinyl chloride 5.6 Explain the oxidation of propane to aldehydes and alcohols 5.7 Explain the chlorination of propane 5.8 Explain Lummus-Crest or other technologies dehydrogenation of propane to propene 5.9 Explain the process for the nitration of propane 5.10 Explain the production of n-butane and its derivatives 5.11 Explain DuPont or other technologies process technology for partial oxidation of butane to maleic anhydride 5.12 List out naphtha based chemicals derivates 5.13 Explain oxidation of paraffins. 5.14 Explain the chlorination of n-paraffins	• Describe with the aid of a process flow diagram the synthesis of vinyl chloride via Transcat process • Describe with the aid of a process flow diagram the oxidation of propane • Describe with the aid of a flow diagram Lummus-Crestdehydrogenation process • Describe with the aid of a process flow diagram nitration of propane • Describe with the aid of a process flow diagram the production of n-butane and its derivatives				

	5.15 Explain the Sulphonation of n-paraffins 5.16 Explain fermentation using n-paraffins.	• Describe with the aid of a flow diagram DuPont process technology				

Programme: National Diploma) Petrochemical and Gas Processing		
Course Title: Polymer Science and Technology	**Code: PGP 226**	**Contact Hour: 2** **Credit Unit:**
	Pre-requisite:-NIL	**Theoretical: 2 hours/week**
Year:2 Semester: 2		**Practical : 0 hours/week**

Course main Goal: This course is designed to enable student have understanding of fundamentals polymer processing technology

General Objectives:

On completion of the course, the student should be able to:

1.0 Appreciate the development of Polymer
2.0 Appreciate the classes of polymers and draw material sources
3.0 Appreciate the classes of polymers and draw material sources.
4.0 Outline principles of polymer manufacture
5.0 Comprehend polymer materials production (synthetic and natural).
6.0 Outline the various methods of processing polymers.

Programme: National Diploma) Petrochemical and Gas Processing						
Course Title: Polymer Science and Technology			**Code: PGP 226**		**CH:2**	**CU:2**
Theoretical Content			**Practical Content**			
General Objective 1.0 : Appreciate the development of Polymer						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1	1.1 Give the historical development of polymer 1.2 Give examples of polymers applications and date of discovery 1.3 Define the following terms : Monomers Polymer Pendants groups	• Explain the historical development of polymers • Define polymers	Laptop, Multimedia Projector, Marker and Recommended text	-	-	Define the following terms : Monomers, Polymer , Pendants groups,
General Objectives 2.0 Appreciate the classes of polymers and draw material sources						
2-4	2.1 Classify polymers 2.2 Identify sources of polymeric raw materials 2.3 Explain Natural gas and Crude oil as sources polymeric raw materials	Explain the ways through which polymers are classified Explain natural and synthetic sources of polymer	Laptop, Multimedia Projector, Marker and Recommended text	-	-	State the natural and synthetic sources of polymer

General Objectives 3.0 Appreciate the classes of polymers and draw material sources.						
5-7	3.1 Explain addition polymerization, condensation polymerization and co-polymerization reactions. 3.2 Explain the mechanisms of the reactions in 3.1 above.	Explain Condensation and Addition Polymerization reactions.	Laptop, Multimedia Projector, Marker and Recommended text	-	-	Explain Condensation and Addition Polymerization reactions.
General Objectives 4.0 Outline principles of polymer manufacture						
8-10	4.1 Explain the various classes of polymerization processes including solution polymerization, suspension polymerization, emulsion polymerization, vulcanization, compounding and reinforcement. 4.2 Explain the effect of heat and mass transfer on the various processes in 4.1 above. 4.3 Explain the basic principles of designing of Polymer reactors.	Explain activities in 4.1 to 4.3	Laptop, Multimedia Projector, Marker and Recommended text	-	-	State the basic principles of designing of Polymer reactors.

General Objectives 5.0 Comprehend polymer materials production (synthetic and natural).						
11-13	5.1 Explain the process of manufacture of natural resin e.g. latex. 5.2 Explain the production of thermoplastics, polyvinyl, nylons, acrylic and phenoxy resins. 5.3 Explain the production of thermosetting polymers of phenol formaldehyde, polyester, amino and epoxy resins.	Describe the steps involve in the production of polymer raw materials from natural and synthetic source	Laptop, Multimedia Projector, Marker and Recommended text	-	-	Explain the production of thermoplastics, polyvinyl, nylons, acrylic and phenoxy resins.
General Objectives: 6.0 Outline the various methods of processing polymers						
14-15	6.1 Describe mastication, mixing, extrusion, calendaring, moulding, thermo-forming and sintering processes. 6.2 Explain the purposes of the various processing methods in 6.1above.	Explain activities in 6.1 to 6.2	Laptop, Multimedia Projector, Marker and Recommended text			

PROGRAMME: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY		
Course Title: Oil Movement, Jetty and Depot Operations	**Code: PGP 227**	**Contact Hour: 2** **Credit Unit:2**
	Pre-requisite: NIL	**Theoretical: 2hours/week**
Year: 2 Semester: 2		**Practical : 0 hours/week**

Goal:

This course is designed to acquaint students with the fundamental principles of the movement of oil (in general, all kinds of fluids).

General Objectives:

On completion of the course, the students should be able to:

1.0 Appreciate the raw materials, finished and unfinished products from processing of crude oil
2.0 Apprehend roles of additives to petroleum products
3.0 Appreciate storage facilities for different types of petroleum products.
4.0 Appreciate fiscalization of petroleum products
5.0 Apprehend the product transportation, distribution of products and Jetty/Depot operation
6.0 Comprehend basic scheduling and dispatching process
7.0 Appreciate the importance of metering systems and quality control of petroleum products
8.0 Apprehend the roles of government agencies in jetty and depot operations.

Programme: NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING TECHNOLOGY						
Course Title: Oil Movement, Jetty and Depot Operations			**Code: PGP 227**		**CH:2 CU:2**	
General Objective 1.0: Appreciate the raw materials, finished and unfinished products from processing of crude oil						
Week	**Specific Learning Outcomes**	**Teacher's Activities**	**Resources**	**Specific Learning Outcomes**	**Teacher's Activities**	**Evaluation**
1-2	1.1 Define hydrocarbon fluids. 1.2 Explain the major functions of the Oil Movement Department. 1.3 Explain the different types of crude oil and their composition. 1.4 Differentiate between raw materials, finished and unfinished products 1.5 Define specific gravity, density, vapour density and API gravity. 1.6 Explain the different types of viscosity 1.7 Explain the latent heat, specific heat, distillation, boiling point in relation to	Explain hydrocarbon fluids. Explain major functions of an "Oil Movement Department in a Petroleum Refinery Describe crude oil and explain its composition Explain the four main types of crude oil according to their hydrocarbon percentages and sulphur content. Explain with simple scheme processes involved from crude oil to various unfinished and finished products. Explain the concepts of : ● Raw materials ● Unfinished products ● Finished products.	Textbooks, journals, lecture notes, internet materials, etc.	Demonstrate expressions and symbols for 1.5 - 1.7 Provide symbols and expressions for different types of viscosities	Demonstrate with simple calculations for determination of 1.5-1.7 Solve representative calculations of viscosity	Differentiate between raw materials, finished and unfinished products

	petroleum products.	Explain density and its relationship to finished products: ● Specific Gravity ● API Gravity ● Vapour Density Explain dynamic viscosity in relationship to Newtonian/Non Newtonian fluids Explain the property, "Kinematic Viscosity". Explain Specific Heat in relation to petroleum products Explain latent heat in relation to petroleum products. Explain Distillation process giving emphasis to initial and final boiling points of petroleum Products Explain Vapor Pressure and Saturation Vapor Pressure Explain Flash point and Pour point		Define IBP and FBP of various liquid petroleum products		

		State the significance of the properties in 1.5 – 1.7 to petroleum products				
General Objective 2.0: Apprehend roles of additives in petroleum products						
3	2.1 Define additives in petroleum products 2.2 Explain the role of additives in petroleum products.	Explain some intermediate products, e.g. ● Fuel gas ● LPG/Naphtha ● Kerosene ● Atmospheric and vacuum residues, ● Light and Heavy vacuum gas oils Describe white and coloured products Explain how Blending of petroleum products is done. Explain how Gasoline blending affects the following: • Starting of the	Textbooks, lecture notes, internet materials, etc.	-	-	Define additives and provide a list of common ones.

		Engine (RVP) ● Knocking properties ● Gasoline Sensitivity to load ● Delta R.				
General Objective 3.0: Appreciate storage facilities for different types of petroleum products.						
4	3.1 List storage facilities for different types of products. 3.2 Group materials into raw materials, intermediate, blending and finished products tanks. 3.3 Differentiate between fixed roof and floating roof tanks. 3.4 Explain accessories in tanks.	State type of storage tanks for different types of products. Classify storage materials into raw materials, intermediate, blending and finished products tanks. Distinguish between fixed roof and floating roof tanks. Identify and explain tank accessories	Textbooks, lecture notes, internet materials.	Identify physical configuration of each type of storage tank Draw various storage tanks used both in refineries and depot.	Guide students to conduct the practical activities.	State the forms of storage facilities for different types of products Explain the relevance of storage facilities on product distributions

General Objective 4.0: Appreciate fiscalization of petroleum products						
5-6	4.1 Explain tank measurement and its importance. 4.2 Identify the various types of tank measurement. 4.3 Calculate volumes of floating roof tanks. 4.4 State various measuring devices. 4.5 Calculate volumes and weights. 4.6 Explain verified tank.	Explain tank measurement and its importance as regards the different products stored in different vessels during crude oil processing Explain Outage Measurement Explain Innage (Full load) measurement Water load (Content) measurement Explain stadia and probe measurements Explain Hatch And Dipstick operation Explain control measurement Explain the following; ● Fiscal Assessment: ● Inventory Assessment. ● Temperature Reading	Textbooks, lecture notes, internet materials and etc.	Solve some simple storage tank measurement calculations Identify different measuring devices. Use different measuring devices.	Guide students to solve some simple storage tank measurement calculations Guide students to identify different types measuring devices. Guide students to use different measuring devices.	State the various measuring devices Explain the relevance of routine measurements in oil and gas operations Describe human attitudes and cultural behaviour.

		• Pressure Reading Explain Floating Roof tank measurements and readings Explain Pressure tanks measurements and readings. Describe the following measurement devices used for measurement: • Nanometers including • Bourdon Tube Nanometers • U-Tube Nanometers with liquid column • Viscometers Explain classes as measuring devices Explain a general concept of calculations process, e.g. on the Quantity of oil products in verified tank. Explain calculate volume on the contents of a verified tank				

		Explain weight calculations on the content of a verified tank.				
General Objectives 5.0: Apprehend the product transportation, distribution of products and Jetty/Depot operation						
7-8	5.1 Explain different means of transporting petroleum products. 5.2 Choose a suitable means of transporting petroleum product 5.3 Give the history of pipelines in petroleum products transportation 5.4 State the different types of pipelines.	Explain the distribution/transportation of petroleum products via ● Road ● Rail ● Sea ● Pipelines Give the history of the pipelines industry State different types of pipelines.	Textbooks, lecture notes, internet materials.	Demonstrate, using pictures and sketches, different types of pipeline	Guide students to demonstrate, using pictures and sketches, different types of pipeline.	Explain the significance of transportation and depot operation in product distribution.
General Objectives 6.0: Comprehend basic scheduling and dispatching process						
9-10	6.1 Differentiate between scheduling and dispatching 6.2 Explain the generation and growth of interface in a multi-product pipeline. 6.3 State factors that affect interface growth. 6.4 Explain the movement and displacement of	Explain the following scheduling and dispatching: ● Crude Oil Scheduling ● Crude Oil ● Dispatching ● Product Scheduling ● Product Dispatching Explain a basic scheduling process with the aid of block diagram Explain with diagram a	Textbooks, journals, lecture notes, internet materials.	-	-	Explain movement and displacement of products in pipeline

	product in a pipeline 6.5 Explain the causes of pressure drop in a pipeline and the method of calculation.	typical cycle of pipeline schedule Explain the growth and nature of interface as distance increases graphically Explain factors that enhance interface generation or growth. Explain with diagram product sequence and interface generation in one cycle				
General Objectives 7.0: Appreciate the importance of metering systems and quality control of petroleum products						
11	7.1 Differentiate between a metering system and a proving system. 7.2 Explain the different types of meters. 7.3 Calculate meter factors and flow rate. 7.4 Explain the installation of meter in pipeline and storage facilities. 7.5 Explain the use of meter prover.	Explain metering and proving systems and factors governing their accuracy Describe types of meters with particular reference to the following: • Venturimetors • Orifice • Positive Displacement (PD) meters • Turbine meters • Flow straighteners • Totalizers	Textbooks, journals, lecture notes, internet materials and etc.	-	-	Explain the different types of meters. Explain the importance of metering systems in product transport

	7.6 Explain the contamination of tanks, pipelines and products by microorganisms. 7.7 Explain the remedies to microbial contamination. 7.8 Differentiate between tank and line sampling. 7.9 Practice safety rules and precautions during sampling.	Explain the following turbine characteristics: • Meter prover loop (Mechanical displacement) • Calculations for meter factors and flow rates. Explain the installation of meter. With the aid of allied/graphic symbols diagram, explain a meter proving system Explain the contamination of tanks, pipelines and products by Fungus, Bacterium and Yeast. Explain tests for aviation fuels with reference to: • Control check • Full test • Short test Explain the following: • Tank sampling • Line sampling				

		Explain methods of sampling to: • "All levels" sample • "Composite" sample State precautions taken during sampling. State safety rules in sampling				
General Objective 8.0: Apprehend the roles of government agencies in jetty and depot operations.						
12-15	8.1 Describe the role of government regulation of jetty and depot operations.	Explain the role of Nigeria Midstream and Downstream Petroleum Regulatory Authority (NMDPRA) in; Technical and Commercial regulation of jetty and depot operations.	Textbooks, journals, lecture notes, internet materials, etc.	-	-	Explain the importance of regulating jetty and depot operations

Course: Process Instrumentation and Control	Code: PGP 228	Total Hours: 2 Hours/Week
		Theoretical hours: 2 Hour/Week
Year: 2 Semester: 2	Pre-requisite: NIL	Practical hours: 0 Hours/Week
Goal: This course is designed to enable student have general overview of processes instrumentation and control.		

GENERAL OBJECTIVES

On completion of this course, the students should be able to :

1.0 Comprehend static and dynamic characteristics of measurement systems
2.0 Appreciate the methods of pressure measurement
3.0 Comprehend the relationship between level height and volume.
4.0 Appreciate the principles of volumetric flow meter
5.0 Appreciate the primary elements of differential pressure devices
6.0 Appreciate the principles of variable area constant head devices
7.0 Comprehend the methods of temperature measurement
8.0 Comprehend basic plant control concepts
9.0 Appreciate modes of control and their applications
10.0 Outline the construction and operation of practical controllers
11.0 Appreciate the use of Programmable Logic Controllers (PLC)
12.0 Appreciate the use of Micro Controllers in Process Industries

Programme: National Diploma in Petroleum and Gas Processing Engineering Technology						
COURSE: Process Instrumentation and Control				**COURSE CODE: PGP 228**	**CONTACT HOURS: 2-0-0 Hrs/Wk**	
Goal: This course is designed to enable student have general overview of processes instrumentation and control.						
COURSE SPECIFICATION:THEORETICAL CONTENT				**PRACTICAL CONTENT**		
	General Objective 1.0: Comprehend static and dynamic characteristics of measurement systems					
Week	**Specific Learning Outcomes**	**Teachers Activities**	**Resources**	**Specific Learning Outcomes**	**Teachers Activities**	**Evaluation**
1	1.1 Explain the following static characteristics: accuracy, sensitivity, linearity, resolution, threshold, hysteresis, drift, stability, dead bard, readability and range. 1.2 Explain the following dynamic characteristics: system response and frequency response 1.3 Explain the criteria for selecting instruments for a particular measurement	Explain activities in 1.1 to 1.3	Maker & whiteboard, PC & projector, Textbooks	-	-	State the criteria for selecting instruments for a particular measurement
	General Objective 2.0: Appreciate the methods of pressure measurement					
2-3	2.1 Explain the working principle and the application of the	Sketch the manometer, bourdon tube gauge,	Marker & whiteboard, ruler, weighing balance,	-	-	Explain the principle and application of pressure

	manometer. 2.2 Explain the principle and application of the bourdon tube gauge 2.3 Explain the principle and application of the diaphragm bellow type gauge 2.4 Explain the principle and application of pressure recorders. 2.5 Describe the calibration of the pressure measuring devices. 2.6 Explain the principle and application of differential pressure measuring devices. 2.7 Explain the principle and application of pressure regulators. 2.8 Describe the installation of the pressure recording systems to include; recorders, indicators,	bellow type gauge and show their differences. Show how pressure measuring devices work	thermometer, etc..			regulators.

	drain regulator and air drying chamber					
	General Objective 3.0: Comprehend the relationship between level, height and volume.					
4	3.1 Define level in terms of height, weight and volume. 3.2 Describe the use of pressure devices as level measuring devices. 3.3 Describe the operation and use of buoyancy type gauges. 3.4 Describe the operation and use of float-operated gauges. 3.5 Describe the operation and use of differential pressure transmitter system for measuring the following conditions: open tank; closed tank (dry leg); closed tank (wet leg); and closed tank (purged dip-pipe system). 3.6 Describe the operation and use of purged dip	Explain activities in 3.1 to 3.8	Marker & whiteboard, PC & Projector	-	-	Define level in terms of height, weight and volume.

	pipe systems. 3.7 Describe the operation and use of electrical level measuring devices. 3.8 Explain the design and application of sight glasses.					
General Objectives 4.0: Appreciate the principles of volumetric flow meter						
5	4.1 Describe the Construction and operation of liquid and gas flow meters such as: (a) reciprocating piston; (b)oscillating piston; (c) oval gear; (d) bellows; (e)liquid sealed drum; (f)rotating impeller; (g) deflecting vane; (h)rotating vane; and (i)turbine	Explain activities in 4.1.	Marker & whiteboard , PC & Projector	-	-	Explain the working of a volumetric flow meter
General Objectives 5.0: Appreciate the primary elements of differential pressure devices						
6	5.1 Describe the calibration and use of the following primary elements for measuring fluid flow rate: (a) venture meter; (b)	Explain activities in 5.1	Marker & whiteboard Or PC & Projector. manometer	-	-	Explain the differential pressure devices.

	nozzle; (c) pitot tube; (d) orifice plate and (e) pitot- static tube					
General Objectives 6.0: Appreciate the principles of variable area constant head devices						
7	6.1 Describe the operation and calibration of: (a) Float and tapered tube meter. (b) Orifice meter	Explain activities in 6.1	Marker & whiteboard, PC & Projector.	-	-	Explain tapered tube meter and orifice meter.
General Objectives 7.0: Comprehend the methods of temperature measurement						
8-9	7.1 Explain the principle and application of bi-metallic thermometers and thermostats. 7.2 Explain the principle and application of liquid-in-glass thermometers 7.3 Explain the principle and application of gas-filled thermometers 7.4 Explain the principle and application of vapour pressure thermometers 7.5 Explain the principle and application of thermocouple	Explain the activities in 7.1 to 7.8	Marker &whiteboard, PC & Projector	-	-	Explain the working principle of thermometers and thermostats Distinguish between the various types thermometers and thermostats

	thermometers 7.6 Explain the principle and application of radiation and optical pyrometer. 7.7 Describe the calibration of temperature measuring instruments to known standards 7.8 Describe the installation of temperature measuring devices.					
General Objectives 8.0: Comprehend basic plant control concepts.						
10-11	8.1 Explain the objectives of the control systems 8.2 Describe the purpose of each element in a control system 8.3 Define open and closed loop systems and distinguish between their separate characteristics 8.4 Explain the improvement of output linearity by the	Explain activities in 8.1 to 8.7	Marker &whiteboard, PC & Projector. Video animation of fluid machinery	-	-	Describe inherent regulation as a plant characteristic.

	application of negative feedback 8.5 Describe inherent regulation as a plant characteristic. 8.6 Distinguish between distance velocity and transfer lags. 8.7 Identify where and why lags occur in a system.					
General Objectives 9.0: Appreciate modes of control and their applications						
12	9.1 Describe the behavior of the following control actions: step, proportional, integral, derivative,	List examples of step, proportional, integral and derivative control actions.	Marker & whiteboard, PC & Projector.	-	-	Describe the behavior of the following control actions: step, proportional, integral, derivative
General Objectives 10.0: Outline the construction and operation of practical controllers.						
13	10.1Explain the principles of the following: (a) pneumatic controllers, (b) electronic controllers,	Explain activities in 10.1 to 10.2	Marker & whiteboard, PC & Projector. -	-	-	Describe the construction and operation of butterfly valves.

	(c) transducers. 10.2 Describe the operation of the following: Diaphragm control valves, Butterfly valves, Dampers, Power cylinders					
General Objectives 11.0: Appreciate the use of Programmable Logic Controllers (PLC)						
14	11.1 Explain the working principle of PLC. 11.2State the common programming languages use for PLC. 11.3State the application of PLC in the process equipment. 11.4State the advantages and limitations of PLC.	Explain activities 11.1 to 11.4	Marker &whiteboard, PC & Projector.	-	-	State the advantages of PLC in process equipment.
General Objectives 12.0: Appreciate the use of Micro Controllers in Process Industries						
15	12.1 Explain the working principle of Micro Controllers. 12.2 State the common programming	Explain activities 12.1 to 12.5	Marker & whiteboard, PC & Projector.	-	-	State the application of Micro Controllers in process industries.

	languages use for Micro Controllers. 12.3 State the application of Micro Controllers in process industries. 12.4 State the advantages and limitation of Micro Controllers. 12.5 Compare PLC and Micro Controllers,.					

LIST OF PHYSICAL FACILITIES REQUIRED TO MOUNT NATIONAL DIPLOMA & HIGHER NATIONAL DIPLOMA IN PETROLEUM AND GAS PROCESSING ENGINEERING (PETROL CHEMICALS AND GAS PROCESSING OPTION)

S/N	LABORATORIES	WORKSHOPS	STUDIOS
1	Fluid/Hydraulic Laboratory	Process Plant Simulator Workshop	Drawing Studio
2	Strength of Materials Laboratory	Unit Operation Workshop	Computer Studio
3	Gas/Petroleum Processing Laboratory	Welding and Fabrication Workshop	
4	Petrochemical Laboratory	Safety Workshop	
5	Instrumental Analysis Laboratory		
6	Thermodynamics Laboratory		

LIST OF EQUIPMENT/TOOLS FOR LABORITORIES AND WORKSHOPS/STUDIOS REQUIRED FOR NATIONAL DIPLOMA PETROLEUM AND GAS PROCESSING ENGINEERING PROGRAMME

(A) LABORATORIES (ND/HND)

1) Fluid/Hydraulic Laboratory (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Laminar Flow Equipment with Accessories	1
2.	Flow through an Orifice with Accessories	1
3.	Pipe Friction with Accessories	1
4.	Free and Forced Vertices with Accessories	1

2) Strength of Materials Laboratory (Mechanical Engineering Department) (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Polygon of Force Apparatus	1
2.	Young's Modulus Apparatus	1
3.	Shearing Force Apparatus	1
4.	Bending Moments Apparatus	1
5.	Gyroscope Apparatus	1
6.	Centrifugal Force Apparatus	1

3) Gas/Petroleum Processing Laboratory (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Absolute Viscosity Bath Lovibond color Comparator	1
2.	Carbon Residue Apparatus	1
3.	Pour Point Apparatus	1
4.	Table Top Distribution Apparatus	1

5.	Refractometer	2
6.	Smoke Point Lamp	1
7.	Penetrometer Point Testing Apparatus	1
8.	Aniline Point Testing Apparatus	1
9.	Kinematic Viscosity Tester	1
10.	ASM Colour Comparator	
11.	Constant Temperature Bath	2
12.	Vapour Pressure Apparatus	1
13.	Oven Dryer	1
14.	Weighing Balance (Analytical)	2
15.	Air Compressor	1
16.	Orsat Gas Analyser	2
17.	Softening Point of Bitumen Apparatus	1
18.	Melting Point Apparatus (Digital and Non-Digital)	1
19.	Peristaltic Pump	1
20.	Ice Making Machine	1
21.	Distilled Water Making Equipment	1
22.	Centrifuge Machine with Accessories	2
23.	Sulphur Determination Apparatus with Accessories	1
24.	Salts in Crude Analyzer, 240V, 50.60hz	1
	FOR HND ONLY	
1	Wheel Bearing Grease Tester	1
2	Baths for Oxidation stability of gasoline test, 230v, 60v	1

3	Freezing point testing apparatus for aviation reciprocating engine and turbine engine fuels	1
4	Cobalt bromide test apparatus for testing dryness of commercial propane and propane HDS	1
5	Smoke point lamp	1
6	Softening point apparatus for Bituminous materials	1

4) Petrochemical Laboratory (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Oven Dryer	2
2.	Tetrameter Apparatus	4
3.	Variosata	1
4.	Vacuum Pump	4
5.	Rotary Viscometer with Accessories	1
6.	Rotary Evaporator with Accessories	2
7.	Electronic Weighing Balance	5
8.	Pilot Plant Distillation Unit	1
9.	Heating Mantle (3 + 250ml Capacity)	2
10.	Micro Burettes	100 pieces
11.	Crucible Pots	100
12.	Round Bottom Flasks (250, 500, 100ml)	50 each
13.	Respiratory Bottles	100
14.	Beakers (Graduated 250, 500, 100ml)	50 each
15.	Tripod Stands	**30**
16.	Bunsen Burner	**20**
17.	Retort Stand	20
18.	Manometer	1
19.	Thermometer	10

5) Instrumental Analysis Laboratory (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Spectronic 21	1
2.	Flexible Optic Tintometer	1
3.	HPLC	1
4.	TLC	2
5.	Densitometer	1
6.	Turbidimeter	1
7.	Analytical Balance	2
8.	pH Meter (Digital)	2
9.	Polarimeter	1
10.	Titrimeter	2
11.	Magnetic Stirrer	2
12.	Refractometer	1
13.	Compressor	1
14.	Vacuum Pump	1
15.	Oxygen Electrode	1
	FOR HND ONLY	
1	Auto bomb calorimeter with accessories	1
2	Gas chromatograph	1
3	Flame photometer	1
4	Atomic Absorption Spectrophotometer	1

6) Thermodynamics Laboratory (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Thermodynamic Converter for Demonstrating Second Law of Thermodynamics	1
2.	Cp/Cv Apparatus with Accessories for Specific Heat Capacity of Gases Determination	1
3.	Boyle's Law Apparatus	5
4.	Charles's Law Apparatus	5
5.	Heat of Combustion Apparatus	1

6.	Rotary Viscometer with Accessories	1
7.	Strobe cope	1
8.	Tachometer	1
9.	Mechanical Equivalent of Heat Apparatus	2
10.	Water Heater/Strirrer Unit with Bath	2
11.	Orsat Gas Analyzer	1
12.	Stirling Heat Pump	1
13.	Steam Boiler Plant	1
14.	Electronic Anemometer	1
15.	Falling Viscometer	1
16.	Energy Conversion Kit	2

(B) WORKSHOPS (ND/HND)

1) Process Plant Simulator Workshop (ND/HND)

S/NO.	DESCRIPTION OF EQUIPMENT	QUANTITY REQUIRED
1.	Control Console Unit	1
2.	Plant Module Unit	1
3.	Utilities – Air Compressor, Overhead Water Tank, Water Heater, Boiler	1 each

2) Unit Operations Workshop (ND/HND)

S/NO.	**DESCRIPTION OF EQUIPMENT**	**QUANTITY REQUIRED**
1	Liquid-liquid-extraction unit	1
2	Solid-liquid-extraction unit	1
3	Liquid diffusion coefficient apparatus	1
4	Gaseous diffusion coefficient apparatus	1
5	Gas absorption column	1
6	Single-effect climbing film evaporator	1
7	Crude oil fractionation column	1

8	Universal pump test rig	1
9	Reformer	1
10	Boiler	1
11	Compressor	1
12	Heat of conduction study bench	1
13	Sedimentation studies apparatus	1

3) Welding and Fabrication Shop

S/N	Description of Equipment	Quantity Required
1.	Universal welding machine (ProMIG-315DCMMA/TIG/MIG/MAG) with accessories	3
2.	Oxygen cylinder	5
3.	Acetylene cylinder	5
4.	Argon cylinders	2
5.	CO_2 cylinders	2
6.	Oxy acetylene welding manifold (regulator)	2
7.	Weld joint teaching aids (diagrams)	2
8.	Apron (leather)	15
9.	Hand gloves	15
10.	Welding head shield	15
11.	Welding booth/cubicle	3
12.	Working benches, for each welding machine	3
13.	Safety charts	Assorted
14.	Safety boots	6
15.	Fire Extinguisher/sand buckets	1 each

4) Safety **Workshop**

S/No.	Description of Equipment	Quantity Required
1.	Eye protection spectacles: - general purpose	40NO

	- grade 2 impact	15no.
2	Eye protection goggles: - grade 2 impact - chemical, type C - dust, type D - gas, type G - molten metal, type M	15no.each
3	Face shields: -grade 2 impact, C resistance - grade 2 impact, C and M resistance -grade 1 impact, C and M resistance -Ultraviolet	5 each
4	Eye wash assembly	2
5	Fire extinguishers - BCF dry powder - BCF	3each
6	First aid kit (up to 30 persons)	3
7	Resuscitator (Brook airway)	5
8	Lifting manikin model	1
9	Safety hand gloves: - sterile types - non-sterile types Heat/cold resistance type	Assorted (1strream of 40students)
10	Hazard warning labels: - Chemical (corrosive, flammable, irritant, toxic) - general (laser beam, radiation, radioactive, toxic)	1no symbol each
11	Protective coats: - flame retardant - chemical resistant	(1steam of 40 students)
12	Dust/mist/fumes masks	5 each

13	Respirators: - dust/mist type - mercury vapour type - nuisance odor - organic vapour - acid gas	2pack 3 3 3 2
14	Safety caps (Hard hats)	30
15	Leather aprons	15
16	Fire buckets	5

(3) STUDIO

1) Computer Studio

S/No.	Description of Equipment	Quantity Required
1.	Computer (PC)	40
2.	Printer	2
3.	Scanner	2
4.	UPS	40
5.	Software	Assorted

2) Drawing Studio-: Drawing Studio (At least 40Nos Adjustable Drawing Tables and Stools)

LIST OF PARTICIPANTS AT THE DEVELOPMENT OF ND/HND PETROCHEMICAL AND GAS PROCESSING CURRICULUM HELD AT NBTE CONSULT N0. 9 KAJURU CLOSE U/RIMI GRA, KADUNA FROM 6TH TO 11TH JANUARY, 2022

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