NATIONAL UNIVERSITIES COMMISSION

BENCHMARK MINIMUM ACADEMIC STANDARDS FOR UNDERGRADUATE PROGRAMMES IN NIGERIAN UNIVERSITIES

ENGINEERING & TECHNOLOGY

APRIL, 2007

PREFACE

Decree (Act) No. 16 of 1985 as contained in the National Universities Commission amended Decree (Act) No. 48 of 1988 empowers the Commission to lay down minimum standards for all programmes taught in Nigerian universities. Consequently, the Commission in collaboration with the universities and their staff developed minimum academic standards for all the programmes taught in Nigerian universities in 1989. The Federal Government subsequently approved the documents in 1989.

After more than a decade of using the Minimum Academic Standard (MAS) documents as a major instrument of accreditation, the Commission in 2001 initiated a process to revise the documents. The curriculum review was necessitated by the fact that the frontier of knowledge in all academic disciplines had been advancing with new information generated as a result of research. The impact of Information and Communication Technologies on teaching and learning and the competitiveness engendered by globalization were also compelling reason for the curriculum review.

Other compelling reasons included the need to update the standard and relevance of university education in the country as well as to integrate entrepreneurial studies and peace and conflict studies as essential new platforms that will guarantee all graduates from Nigerian universities the knowledge of appropriate skills, competences and dispositions that will make them globally competitive and capable of contributing meaningfully to Nigeria's socio-economic development.

Congnisant that the content-based MAS documents were rather prescriptive, a decision was taken to develop outcome-based benchmark statements for all the programmes in line with contemporary global practice. To actualize this, the Commission organized a stakeholders' statements were developed for each programme in all the disciplines taught in Nigerian universities. Subsequent to this exercise, it was discovered that the benchmarch-style statements were too sketchy to meaningfully guide the development of curricula and were also inadequate for the purpose of accreditation.

Given this scenario, the Commission therefore considered the merger of the Benchmark Style Statements and the revised Minimum Academic standards into new documents to be called Benchmark Minimum Academic Standards (BMAS) as an amalgam that crisply enunciates the learning outcomes and competences expected of graduates of each academic programme without being overly prescriptive while at the same time, providing the requisite flexibility and innovativeness consistent with a milieu of increased institutional autonomy.

Following this decision, the Commission initiated the process to produce the documents. The first, in the series, was the conduct of Needs Assessment Survey of Labour Market for Nigerian graduates. This was carried out for all the disciplines taught in Nigerian universities. The exercise involved major stakeholders particularly employers of Nigerian graduates. The objectives of the need assessment survey included identification of expected knowledge, attitudes and skills for graduates and their ability to fit into the requirements of the new national and global economy. Secondly, a workshop was held at which academic experts across Nigerian universities including vice-chancellors participated with the objective of effecting the merger.

At the end of the workshop, draft BMAS documents were produced for the thirteen disciplines and the General Studies programme taught in Nigerian Universities. The documents were later sent to the Universities offering relevant disciplines for comments and input. Following the return of the inputs and comments from the universities to the Commission, a one-day workshop was held at which invited academic experts studied and incorporated the comments and inputs into the draft document.

To ensure that the documents were free from technical errors, the documents were sent to another set of academic experts for editing who also attended a one-day workshop to finally harmonize the BMAS documents.

Following the aforementioned processes, BMAS documents were produced for the underlisted academic disciplines:

i) Administration; Management and Management Technology;
ii) Agriculture, Forestry, Fisheries and Home Economics;
iii) Arts;
iv) Basic Medical and Health Science
v) Education;
vi) Engineering and Technology;
vii) Environmental Sciences;
viii) Law;
ix) Pharmaceutical Sciences
x) Medicine and Dentistry;
xi) Science;
xii) Social Sciences;
xii) Veterinary Medicine.

The process has been a rather long and tortuous one but it is gratifying to note that the BMAS documents will for long be an enduring academic covenant between the universities and the students that will be enrolled to study in their different programmes.

On behalf of the National Universities Commission, I wish to express my sincere gratitude to all Nigerian universities and their staff for their cooperation and immense contribution towards the development of the BMAS documents.

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1.0 GENERAL

These Benchmark Minimum Academic Standards are for the training of undergraduate students wishing to obtain first degrees in the different areas of Engineering and Technology. The benchmark statements give the minimum academic standards required to meet these needs and to produce graduates in Engineering and Technology with sufficient academic background and practical experience who would be able to rise to the challenges of a developing economy.

1.1 List of Programme(s) and Degree(s) in View

Programme	Degree in View
1. Agricultural Engineering	B.Eng/B.Tech/B.Sc.
2. Automotive Engineering	B.Eng/B.Tech/B.Sc.
3. Ceramic Engineering	B.Eng/B.Tech/B.Sc.
4. Chemical Engineering	B.Eng/B.Tech/B.Sc.
5. Civil Engineering	B.Eng/B.Tech/B.Sc.
6. Computer Engineering	B.Eng/B.Tech/B.Sc.
7. Electrical Engineering	B.Eng/B.Tech/B.Sc.
8. Electrical and Electronics Engineering	B.Eng/B.Tech/B.Sc.
9. Electronics Engineering	B.Eng/B.Tech/B.Sc.
10. Food Science and Technology	B.Eng/B.Tech/B.Sc.
11. Industrial and Production Engineering	B.Eng/B.Tech/B.Sc.
12. Information and Communication Technology	B.Eng/B.Tech/B.Sc.
13. Marine Engineering	B.Eng/B.Tech/B.Sc.
14. Materials and Metallurgical Engineering	B.Eng/B.Tech/B.Sc.
15. Mechanical Engineering	B.Eng/B.Tech/B.Sc.
16. Metallurgical Engineering	B.Eng/B.Tech/B.Sc.
17. Mining Engineering	B.Eng/B.Tech/B.Sc.
18. Operations Research	B.Eng/B.Tech/B.Sc.
19. Petrochemical Technology	B.Eng/B.Tech/B.Sc.
20. Petroleum Engineering	B.Eng/B.Tech/B.Sc.
21. Petroleum and Gas Engineering	B.Eng/B.Tech/B.Sc.
22. Polymer Engineering	B.Eng/B.Tech/B.Sc.
23. Polymer and Textile Engineering	B.Eng/B.Tech/B.Sc.
24. Public Health Engineering	B.Eng/B.Tech/B.Sc.
25. Refrigeration & Airconditioning Engrg	B.Eng/B.Tech/B.Sc.
26. Structural Engineering	B.Eng/B.Tech/B.Sc.
27. Systems Engineering	B.Eng/B.Tech/B.Sc.
28. Telecommunications Engineering	B.Eng/B.Tech/B.Sc.
29. Water Resources Engineering	B.Eng/B.Tech/B.Sc.
30. Wood Products Engineering	B.Eng/B.Tech/B.Sc.

1.2 Philosophy and Objectives of the Discipline

1.2.1 Philosophy

To achieve the goals and objectives of the National Policy on Industrialisation and Self-Reliance, the Engineering and Technology education should be geared towards:

(i) The development of a thorough practice in engineering and technology training

(ii) Broad–based training in general Engineering and Technology at the early stages of the programme

(iii) Practical application of Engineering, Technology and Manufacturing Processes.

(iv) Adequate training in human and organisational behaviour and management

(v) Introduction to entrepreneurial education and training

(vi) Close association of the programme with industries in the country.

The general philosophy therefore is to produce graduates with high academic standard and adequate practical background for self employment as well as being of immediate value to industry and the community in general.

1.2.2 Goals and Objectives

The general goals and objectives of Engineering and Technology training should be in consonance with the realisation of national needs and aspirations vis-à-vis industrial development and technological emancipation. The graduates must therefore be resourceful, creative, knowledgeable and able to perform the following functions:

(a) **Graduates in Engineering**

(i) To design engineering projects and supervise their implementation.

(ii) To design and implement components, machines, equipment and systems.

(iii) To design and develop new products and production techniques in industries.

(iv) To install and maintain complex engineering systems so that they can perform optimally in our environment.

(v) To adapt and adopt exogenous technology in order to solve local engineering problems.

(vi) To be able to exercise original thought, have good professional judgment and be able to take responsibility for the direction of important tasks.

(vii) To be able to manage people, fund, materials and equipment.

(viii) To improve on indigenous technology to enhance local problems solving capability

(b) **Graduates in Technology**

(i) To be conversant with all the materials, components, machines, equipment, production techniques and systems in his/her area of specialisation.

(ii) To man and maintain the specific production equipment in his /her area of specialisation.

(iii) To plan, manage and be responsible for quality control of the products and processes in the plant/factory.

(iv) To adapt and adopt exogenous technology in order to solve local technical problems.

(v) To be able to manage people, fund, materials and equipment.

(vi) To improve on indigenous technology to enhance local problems solving capability

1.3 Basic Admission Requirements and Expected Duration of the Programmes

The basic admission requirements for Engineering and Technology disciplines shall be;

1.3.1 Admission Requirements for UME

The minimum admission requirement for Engineering and Technology disciplines should be passes at credit level in the Senior Secondary School final year examination or GCE 'O' Level in five subjects including Mathematics, English Language, Physics and Chemistry. Candidates are also required to have acceptable pass in UME. It is also desirable for candidates to have Further Mathematics and Technical Drawing at credit levels. Such candidates shall have added advantage.

1.3.2 Admission Requirements for Direct Entry

For Direct Entry, candidates must have passes in Mathematics, Physics and Chemistry at GCE 'A' level or equivalent. Holders of OND and HND at minimum of upper credit level are eligible for consideration for admission into 200 and 300 levels respectively.

1.3.3 Minimum Duration

The minimum duration of Engineering and Technology programmes is five academic sessions for candidates who enter with Senior Secondary School Certificate or GCE 'O' Level qualifications. Candidates with relevant passes in Mathematics, Physics and Chemistry at GCE 'A' Level or equivalent will spend a minimum of four academic sessions provided that they satisfy all the other University requirements.

1.4 Graduation Requirements

1.4.1 Degree Classifications

The determination of the class of degree shall be based on the Cumulative Grade Point Average earned at the end of the programme. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The CGPA shall be used in the determination of the class of degree as summarized in Table 1.1.

Table 1.1: Degree Classification

CUMULATIVE GRADE POINT AVERAGE (CGPA)	CLASS OF DEGREE
4.50 – 5.00	First Class (Hons)
3.50 – 4.49	2nd Class Upper (Hons)
2.40 – 3.49	2nd Class Lower (Hons)
1.50 – 2.39	3rd Class (Hons)

The maximum length of time allowed to obtain a degree in the Faculty shall be fourteen semesters for the 5-year degree programme and twelve semesters for students admitted directly into the 200 level. For extension beyond the maximum period, a special permission of Senate shall be required on the recommendation of the Faculty Board.

1.4.2 Probation

A student whose Cumulative Grade Point Average is below 1.50 at the end of a particular year of study, earns a period of probation for one academic session. A student on probation is allowed to register for courses at the next higher level in addition to his/her probation level courses provided that: The maximum of 18 credit units per semester is not exceeded.

(a) the regulation in respect of student work-load is complied with; and

(b) the pre-requisite courses for the higher level courses have been passed.

(c) Universities are enjoined to run comparable syllabi to enable students who transfer from one university to another transfer their credits wholly.

Students who transfer from other universities shall be credited with only those courses, deemed relevant to the programmes, which they have already passed prior to their transfer. Such students shall however be required to pass the minimum number of units specified for graduation for the number of sessions he/she has spent in the Faculty; provided that no student shall spend less than two sessions (4 semesters) in order to earn a degree. Students who transfer for any approved reason shall be credited with those units passed that are within the curriculum. Appropriate decisions on transfer cases shall be subjected to the approval of Senate on the recommendation of the Faculty.

1.4.3 Withdrawal

A candidate whose Cumulative Grade Point Average is below 1.50 at the end of a particular year of probation should be required to withdraw from the University. However in order to minimise waste of human resources, consideration should be given to withdrawal from programme of study and possible transfer to other programmes within the same University.

1.4.4 Course Credit System

All Engineering and Technology programmes shall be run on a modularised system, commonly referred to as Course Unit System. All courses should therefore be sub-divided into more or less self-sufficient and logically consistent packages that are taught within a semester and examined at the end of that particular semester. Credit weights should be attached to each course. One credit is equivalent to one hour per week per semester of 15 weeks of lectures or 2 hours of tutorials or 3 hours per week of laboratory/studio work per semester of 15 weeks.

1.4.5 Grade Point Average and Cumulative Grade Point Average

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point Equivalents (GPE). For the purpose of determining a student's standing at the end of every semester, the Grade Point Average (GPA) system shall be used. The GPA is computed by dividing the total number of credit points (TCP) by the total number of units (TNU) for all the courses taken in the semester. The credit point for a course is computed by multiplying the number of units for the course by the Grade Point Equivalent of the marks scored in the course. Each course shall be graded out of maximum of 100 marks and assigned appropriate Grade Point Equivalent as in Table 1.2.

Table 1.2: Grade Point Equivalent

(i) Credit Units	(ii) Percentage Scores	(iii) Letter Grades	(iv) Grade Points (GP)	(v) Grade Point Average (GPA)	(vi) Cummulative Grade Point Average (CGPA)	(vii) Class of Degree

Vary according to contact hours assigned to each course per week per semester, and according to load carried by students	70 – 100	A	5	Derived by multiplying I and IV and dividing by Total Credit Units	4.50 – 5.00	First Class
	60 – 69	B	4		3.50 – 4.49	2nd Class Upper
	50 – 59	C	3		2.40 – 3.49	2nd Class Lower
	45 – 49	D	2		1.50 – 2.39	3rd Class
	0 – 44	F	0			

1.5 Evaluation

1.5.1 Techniques of Student Assessment

(a) **Practicals**

By the nature of the disciplines in Engineering and Technology, laboratory practicals are very important in the training of the graduates. To reflect this importance of practical work, a minimum of 9 hours per week (3 credits) should be spent on students' laboratory practicals. Furthermore, it is very important to determine performance of the student in the practical component of the programme. To achieve this, all the laboratory practicals have been lumped together to form a course which the student must pass. It is expected that the weighting given in the various courses is reflected in number and nature in the design of the experiments. These practicals must follow the trend in the current development of the programmes.

(b) **Tutorials**

There should be one hour of tutorial for every four hours of lecture. Thus a course of one credit unit should comprise 12 hours of lecture and three hours of tutorials.

(c) Continuous Assessments

Continuous assessment shall be done through essays, tests, and practical exercises.

(i) Scores from continuous assessment shall normally constitute 30 per cent of the final marks for courses which are primarily theoretical.

(ii) For courses which are partly practical and partly theoretical, scores from continuous assessment shall constitute 50% of the final marks.

(iii) For courses that are entirely practical, continuous assessment shall be based on a student's practical work or reports and shall constitute 100 percent of the final marks.

(d) **Examinations**

In addition to continuous assessment, final examinations should normally be given for every course at the end of each semester. The final grade should be based on the following breakdown, subject to section 1.5.1 (c) of this document:

Final Examination: 60% - 70%

Continuous assessment (Quizzes, Tutorials, Homework, Tests): 30% - 40%

(i) Each course shall normally be completed and examined at the end of the semester in which it is offered.

(ii) A written examination shall normally last a minimum of one hour for one unit course.

1.5.2 External Examiners' System

The external examiner system should continue. This system should be used only in the final year of the undergraduate programme to assess final year courses and projects, and to certify the overall performance of the graduating students, as well as the quality of facilities and teaching. However, the existing practice of using different External Examiners for major subject areas in professional programmes should be continued.

1.5.3 SIWES Rating and Assessment

In Engineering education, industrial attachment is very crucial. The minimum duration of this attachment should be 34 weeks (one semester and 2 long vacations) and should be broken into the following modules: Students Work Experience Programme (10 weeks – long vacation); Students Industrial Work Experience Scheme (24 weeks, one semester plus long vacation).

To make the training effective, it is important that the students learn how to operate some of the ordinary machines and tools they will encounter in the industry before they go for the attachment. Therefore they should start with Student Work Experience Programme, which is conducted in the Faculty Workshops, under strict industrial conditions. On successful completion of Students Work Experience Programme, the Students Industrial Work Experience Schemes can be done in industries under strict industrial conditions and supervision.

Normally, industrial attachment should be graded and no student should graduate without passing all the modules of the attachment and this should be used in degree classification. There should be a Faculty Industrial Training Unit with full complement of staff and facilities to function.

1.5.4 Students' Evaluation of Courses

There should be an established avenue put in place offering opportunity to students to evaluate courses delivered to them at the end of each semester. This should be an

integral component of the course credit system; serving as feedback mechanism for achieving the following:

i) Improvement in the effectiveness of course delivery.

ii) Continual update of lecture materials to incorporate emerging new concepts.

iii) Effective usage of teaching aids and tools to maximize impact of knowledge on students.

iv) Improvement in students' performance through effective delivery of tutorials, timely in presentation of continuous assessment and high quality examination.

In order to achieve effective learning, all students should normally be permitted to evaluate those courses registered at the end of each semester, preferably before the final semester examinations. It is very important that students' evaluation of courses be administered fairly and transparently through the use of well designed questionnaires, maintain confidentiality demanded by such exercise and apply their scientifically processed outcome to improving effective course delivery in all ramifications.

1.5.5 Maintenance of Curricular Relevance

Using the benchmark as guide, the curriculum in each discipline shall be reviewed from time to time to determine the continued relevance and fitness of purpose.

The NUC, in its role as the national quality assurance agency on university programmes, shall subject the benchmark statements for review periodically.

It is recommended that universities review their programme, at least once in five years, using the current quality assurance benchmark statements.

Unless otherwise essential for particular programmes all engineering and technology programmes in a university should be reviewed at the same time. Indeed, because even engineering and technology students normally take their 100 and 200 level courses in science, and their special electives in the humanities, it would be expedient if all courses in the University are reviewed at the same time.

Each curriculum review shall be done by a committee of staff senior enough and competent to carry out an effective review. The review shall include an assessment as to whether the goals and objectives of the programme as formulated are still relevant in dynamic professional and social contexts.

Reviews shall endeavour to incorporate the opinions of relevant stakeholders such as students, staff, external examiners, employers, professional bodies, policy makers etc.

Each curriculum so revised shall be subjected to consideration and approval at the levels of Department, Faculty/Colleges, and Senate in the University. Specifically, a good review should examine the curriculum and resources in accordance with the following criteria:

(i) Re-assessment/re-formulation of goals and objectives of the programme in relation to the needs of the learners and the market requirements taking into account the broader aspects of the discipline.

(ii) The market demands of the graduates now and in the future, in terms of skills needed to function as competitive professionals in the current labour market on a global scale.

(iii) Relevance of the current content in terms of knowledge, skills and attitudes being taught/developed and how these meet the needs of the present and future requirements of the clientele.

(iv) How the teaching and learning methods meet or fall short of current and future standards of comparable programmes.

(v) The quality of teaching and learning material used.

(vi) Outcomes of learning in terms of success, experience of learners (pass rate, knowledge and skills acquisition, professional capability and integrity) as contributed by the programme.

(vii) The views of employers and community members on the quality and relevance of the curriculum.

1.5.6 Performance Evaluation Criteria

a) Definition of Accreditation

The accreditation of the Engineering and Technology degree programme means a system of recognising educational institutions (universities and programmes offered by them) for a level of performance, integrity and quality which entitles them to the confidence of the educational and professional community, the public they serve, and employers of labour.

The objectives of the accreditation exercise are to:

(i) Ensure that at least the provisions of the minimum academic benchmark statements are attained, maintained and enhanced.

(ii) Assure employers and other members of the community that graduates of these institutions have attained an acceptable level of competence in their areas of specialisation.

(iii) Certify to the international community that the programmes offered in these universities are of high standards and that their graduates are adequate for employment and for further studies.

b) Performance Indices

In an accreditation exercise, the main aim should be to assess the extent to which the benchmark statements are being achieved. In this respect, the following performance indices should be examined:

(i) Philosophy and objectives of the programme
(ii) Curriculum
(iii) Teaching staff quantity and quality
(iv) Students' admission, retention and graduation
(v) Standards of degree examinations
(vi) Physical facilities
(vii) Financial Support

(viii) Employer's rating of graduates
(ix) Quantity and quality of technical support staff
(x) Administration of the department/programme.

1.6 Resource Requirement

1.6.1 Personnel

a) Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience. With a minimum load of 18 credits per semester for students and a minimum of six fulltime equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.

In employing staff, the following criteria are suggested:

(i) **Graduate Assistant**
Candidate must have honours degree with at least second class upper.

(ii) **Assistant Lecturer**
Candidate must have Master's degree or 1st Class Honour Degree at undergraduate level.

(iii) **Lecturer II**
Candidate should normally have Ph.D. degree or spent at least three years as an Assistant Lecturer or equivalent industrial experience and some potential for research may be considered.

(iv) **Lecturer I**
Candidates should normally have Ph.D. degree with at least one year of teaching or industrial experience plus some publications. A candidate, who does not possess a Ph.D., but possesses a Masters degree with sufficient industrial experience acceptable for COREN registration, can also be considered. Such a candidate should also show evidence of research potential. Also, a Lecturer II plus a minimum of three years as Lecturer II or equivalent industrial experience can be considered.

(v) **Senior Lecturer**
Candidate should possess Ph.D. degree and/or research experience and/or industrial experience. Such candidate should also possess a good number of referred journal publications. Also, a Lecturer I plus a minimum of three years or equivalent industrial experience can be considered provided the candidate possesses Ph.D.

(vi) **Associate Professor/Reader**

Candidate should possess Ph.D. degree with teaching and research experience. Also, a Senior Lecturer plus three years as Senior Lecturer or equivalent industrial experience can be considered.
In addition to possessing the ability of providing academic leadership, such a candidate should also have a considerable number of referred journal publications which must be assessed externally.

(vii) **Professor**
Candidate should possess Ph.D. degree with teaching and research experience. Associate Professors/Readers may be promoted to the rank of Professors after at least three years as Associate Professors/Readers. Such a candidate should possess an ability to provide a strong academic leadership in addition to a considerable number of referred journal publications. Furthermore, the publications of such candidate should be externally assessed.
Each Professor in the Faculty of Engineering and Technology should be given a Secretary, as this is essential for efficient performance of his internal and external duties

b) Non-Academic Staff
The services of support staff, which are indispensable in the proper running of laboratories, workshop/studios as well as for administration are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. The minimum of academic staff to technical staff ratio of 1:4 should be maintained. Universities should pay attention to optimum proportioning of the non-academic staff to avoid redundancy and overstaffing.

1.6.2 **Physical Facilities**

a) Spaces
The NUC recommends the following physical space requirement:

		m^2
Professor's Office	-	18.50
Head of Department's Office	-	18.50
Tutorial Teaching Staff's Office	-	13.50
Other Teaching Staff Space	-	7.00
Technical Staff Space	-	7.00
Secretarial Space	-	7.00
Science Staff Research Laboratory	-	16.50
Engineering Staff Research Laboratory	-	14.50
Seminar Space/per student	-	1.85
Drawing Office Space (A.O. Board) (Per Student)	-	4.60
Drawing Office Space (A.I. Board) (Per Student)	-	3.70
Laboratory Space	-	7.50

b) Equipment
To achieve the benchmark statements for any programme, there should be:

(i) A minimum number of identifiable laboratories for each discipline which should be in accordance with the NUC recommended space requirements and, in addition, be reasonably equipped.
(ii) At least one large and reasonably equipped central workshop for teaching and research.
(iii) Drawing and design studios, which should be well equipped and in accordance with the NUC recommended space requirements.

It is important that equipment should be acquired in sufficient number to enable adequate implementation of the benchmark statements as they relate to Mathematics, Science, Design, Information and Communications Technology, Business and Professional Practice.

1.6.3 Library and Information Resources

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications etc. in sufficient numbers.

1.7 General Studies

Goal

To produce a well rounded morally and intellectually capable graduates with vision and entrepreneurial skills in an environment of peace and social cohesiveness.

Objectives

The objectives of the General Studies programme consist of the following:

a) Acquisition, development and inculcation of the proper value-orientation for the survival of the individual and society.
b) The development of intellectual capacities of individuals to understand, appreciate and promote peaceful co-existence.
c) Producing graduates with broad knowledge of the Nigerian Nation and people with a view to inculcating in them mutual understanding and patriotism.
d) Exposing graduates of Nigerian Universities to the rudiments of ICT for computer literacy and ability to live usefully in this ICT age.
e) Preparing students for a post university life with opportunities for job creation and entrepreneurial skills.
f) Production of graduates capable of communicating effectively (both oral and written).

GST 111: **Communication in English I** **(2 Units)**

Effective communication and writing in English, Language skills, Writing of essay answers, Comprehension, Sentence construction, Outlines and paragraphs, Collection and organisation of materials and logical presentation, Punctuation.

GST 112: **Logic, Philosophy and Human Existence (2 Units)**
A brief survey of the main branches of Philosophy Symbolic Logic Special symbols in symbolic Logic-conjunction, negation, affirmation, disjunction, equivalent and conditional statements law of tort. The method of deduction using rules of inference and bi-conditionals qualification theory. Types of discourse, Nature of arguments, Validity and soundness; Techniques for evaluating arguments, Distinction between inductive and deductive inferences, etc. (Illustrations will be taken from familiar texts, Including literature materials, Novels, Law reports and newspaper publications).

GST 113: **Nigerian Peoples and Culture (2 Units)**
Study of Nigerian history, culture and arts in pre-colonial times, Nigerian's perception of his world, Culture areas of Nigeria and their characteristics, Evolution of Nigeria as a political unit, Indigene/settler phenomenon, Concepts of trade, Economic self-reliance, Social justice, Individual and national development, Norms and values, Negative attitudes and conducts (cultism and related vices), Re-orientation of moral and national values, Moral obligations of citizens, Environmental problems.

GST 121: **Use Of Library, Study Skills and Information Communication Technology (ICT) (2 Units)**
Brief history of libraries, Library and education, University libraries and other types of Libraries, Study skills (reference services), Types of library materials, using library resources including e-learning, e-materials, etc, Understanding library catalogues (card, OPAC, etc) and classification, Copyright and its implications, Database resources, Bibliographic citations and referencing.
Development of modern ICT, Hardware technology, Software technology, Input devices, Storage devices, Output devices, Communication and internet services, Word processing skills (typing, etc).

GST 122: **Communication in English II (2 Units)**
Logical presentation of papers, Phonetics, Instruction on lexis, Art of public speaking and oral communication, Figures of speech, Précis, Report writing.

GST 123: **Communication in French (2 Units)**
Introduction to French, Alphabets and numeracy for effective communication (written and oral), Conjugation and simple sentence construction based on communication approach, Sentence construction, Comprehension and reading of simple texts.

OR

GST 123: **Communication in Arabic (2 Units)**
Introduction to Arabic alphabets and writing systems, Elementary conversational drills, Basic reading skills, Sentence construction in Arabic.

GST 221: **History and Philosophy of Science (2 Units)**

Man – his origin and nature, Man and his cosmic environment, Scientific methodology, Science and technology in the society and service of man, Renewable and non-renewable resources – man and his energy resources, Environmental effects of chemical plastics, Textiles, Wastes and other material, Chemical and radiochemical hazards, Introduction to the various areas of science and technology. Elements of environmental studies.

GST 222: **Peace Studies and Conflict Resolution (2 Units)**
Basic Concepts in peace studies and conflict resolution, Peace as vehicle of unity and development, Conflict issues, Types of conflicts, e.g. Ethnic/religious/political/economic conflicts, Root causes of conflicts and violence in Africa, Indigene/settler phenomenon, Peace – building, Management of conflict and security. Elements of peace studies and conflict resolution, Developing a culture of peace, Peace mediation and peace-keeping, Alternative Dispute Resolution (ADR), Dialogue/arbitration in conflict resolution, Role of international organisations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

ESP 223: **Introduction to Entrepreneurial Skills (2 Units)**
Introduction to entrepreneurship and new venture creation; Entrepreneurship in theory and practice; The opportunity, Forms of business, Staffing, Marketing and the new venture; Determining capital requirements, Raising capital; Financial planning and management; Starting a new business, Feasibility studies; Innovation; Legal Issues; Insurance and environmental considerations. Possible business opportunities in Nigeria.

ESP 311: **Introduction to Entrepreneurship Studies (2 Units)**
Some of the ventures to be focused upon include the following:

1. Soap/Detergent, Tooth brushes and Tooth paste making
2. Photography
3. Brick, nails, screws making
4. Dyeing/Textile blocks paste making
5. Rope making
6. Plumbing
7. Vulcanising
8. Brewing
9. Glassware production/Ceramic, production
10. Paper production
11. Water treatment/Conditioning/Packaging
12. Food processing/packaging/preservation
13. Metal working/Fabrication – Steel and aluminum door and windows
14. Training industry
15. Vegetable oil/and Salt extractions
16. Fisheries/Aquaculture

17. Refrigeration/Air conditioning
18. Plastic making
19. Farming (crop)
20. Domestic Electrical wiring
21. Radio/TV repairs
22. Carving
23. Weaving
24. Brick laying/making
25. Bakery
26. Tailoring
27. Iron welding
28. Building drawing
29. Carpentry
30. Leather tanning
31. Interior decoration
32. Printing
33. Animal husbandry (Poultry, Piggery, Goat etc)
34. Metal Craft – Blacksmith, Tinsmith etc
35. Sanitary wares
36. Vehicle maintenance
37. Bookkeeping

1.8 Definition of Terms

Core/Compulsory Course
A course which every student must compulsorily take and pass in any particular programme at a particular level of study.

Required Course
A course that you take at a level of study and must be passed before graduation.

Elective Course
A course that students take within or outside the faculty. Students may graduate without passing the course provided the minimum credit unit for the course had been attained.

Optional Course
A course which students can take based on interest and may count towards the minimum credit unit required for graduation.

Pre-requisite Course
A course which student must take and pass before taking a particular course at a higher level.

Minimum Credit Load Per Semester
The Minimum credit load per semester is 15.

Course Credit Unit System
This should be understood to mean a 'quantitative system of organization of the curriculum in which subject areas are broken down into unit courses which are examinable and for which students earn credit(s) if passed'. The courses are arranged in progressive order of difficulty or in levels of academic progress, e.g. Level or year 1 courses are 100, 101 etc. and Level II or Year II courses are 200, 202 etc. The second aspect of the system is that courses are assigned weights allied Credit Units.

Grade Point Average (GPA)
Performance in any semester is reported in Grade Point Average. This is the average of weighted grade points earned in the courses taken during the semester. The Grade Point Average is obtained by multiplying the Grade Point average in each course by the number of Credit Units assigned to that course, and then summing these up and dividing by the total number of Credit Units taken for the semester.

Cumulative Grade Point Average (CGPA)
This is the up-to-date mean of the Grade Points earned by the student in a programme of study. It is an indication of the student's overall performance at any point in the training programme. To compute the Cumulative Grade Point Average, the total of Grade Points multiplied by the respective Credit Units for all the semesters are added and then divided by the total number of Credit Units for all courses registered by the student.

2.0 DEGREE PROGRAMMES

Common Engineering Courses

In the first two years, all students in Engineering Faculties should, as much as possible, take the following common courses:

100 Level

Course Title	Lecture/Lab. Units
Mathematics	12
Physics*	10
Chemistry*	8
General Studies	8
Total	38

*Include laboratory practicals

The 100 level courses are mainly basic science subjects which are necessary for a full understanding of Engineering.

In the second year, the following courses shall be taken:

200 Level

Course Title		Lecture/Lab. Units
Engineering Mathematics	-	6
Computers & Computing	-	3
IT in Engineering	-	2
Engineering Drawing	-	2
Applied Mechanics	-	3
Strength of Materials	-	2
Thermodynamics	-	2
Material Science	-	2
Fluid Mechanics	-	2
Basic Electrical Engineering	-	3
Manufacturing Tech./Workshop Practice	-	2
Engineer – in – Society	-	1
Laboratory Practicals	-	6
Programme elective	-	3
General Studies		8
Total		**46**

The 200 level courses are foundation engineering courses designed to expose students to the fundamentals of the engineering discipline in a broad sense. Students can take 3 credits as electives from their programme of study.

It is believed that exposing engineering students to the various aspects of the discipline in the first two years of their study, equips them with enough knowledge to determine their inclinations in terms of specialisation at a later stage.

This view is further strengthened by the fact that an appreciable number of engineering students have rural backgrounds which limit their perception of engineering and the sub-disciplines therein. It is believed that after the second year, the wide engineering horizon would have been sufficiently illuminated for such students, who are now better placed, to make a choice. In addition, a broad-based programme at these foundation levels becomes an asset to its beneficiaries in the future when they are invariably required to play managerial, supervisory and/or executive roles in engineering areas that may not be strictly their areas of specialisation.

100 and 200 Levels Common to All Engineering Programmes
Course Synopses

100 Level

Elementary Mathematics I: (3 Credit Units)

(Algebra and Trigonometry)

Elementary set theory, subsets, union, intersection, complements, venn diagrams. Real numbers: integers, rational and irrational numbers, mathematical induction, real sequences and series, theory of quadratic equations, binomial theorem.

Complex numbers: algebra of complex numbers, the Argand Diagram, De Moivre's theorem, nth roots of unity. Circular measure, trigonometric functions of angles of any magnitude, addition and factor formulae.

Elementary Mathematics II: (3 Credit units)

(Vectors, Geometry and Dynamics)

Geometric representation of vectors in 1 – 3 dimensions, components, direction cosines. Addition, Scalar, multiplication of vectors, linear independence. Scalar and vector products of two vectors. Differentiation and integration of vectors with respect to a scalar variable. Two-dimensional co-ordinate geometry.

Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals, Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles, resisted vertical motion. Angular momentum. Simple harmonic motion, elastic string, simple pendulum, impulse. Impact of two smooth sphere and of a sphere on a smooth surface.

Mathematics III and IV: (6 Credit units)

General Physics I: (3 Credit units)

(Mechanics)

Space and Time, frames of reference, Units and dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; Galilean invariance; Universal gravitation; work and energy; rotational dynamics and angular momentum; conservation laws.

General Physics II: **(3 Credit Units)**
(Electricity and Magnetism)
Electrostatics; conductors and currents; dielectrics; magnetic fields and induction; Maxwell's equations; electromagnetic oscillations and waves; Applications.

General Physics III: **(2 Credit Units)**
Molecular treatment of properties of matter, elasticity; Hooke's law, Young's shear and bulk moduli. Hydrostatics; Pressure, buoyancy. Archimedes' Principles. Hydro-dynamics; Stream-lines, Bernoulli and continuity equations, turbulence, Reynold's number; viscosity; laminar flow, Poiseuille's equation. Surface tension, adhesion, cohesion, capillarity, drops and bubbles. Temperature; the zeroth law of thermodynamics; heat: gas laws; laws of thermodynamics; Kinetic theory of gases. Applications.

General Chemistry I: **(4 Credit Units)**
Atoms, molecules and chemical reaction; Chemical equations and stoichiometry, Atomic structure and Periodicity; Modern electronic theory of atoms; Radioactivity; Chemical bonding; Properties of gases; Equilibria and Thermodynamics; Chemical Kinetics; Electrochemistry.

General Chemistry II: **(4 Credit Units)**
Historical survey of the development and importance of Organic Chemistry; nomenclature and classes of organic compounds; homologous series; functional groups; isolation and Purification of organic compound; Qualitative and quantitative Organic Chemistry; stereochemistry; determination of structure of organic compounds; electronic theory in Organic Chemistry; Saturated hydrocarbons; unsaturated hydro-carbons, Periodic table and periodic properties; Valence forces; Structure of solids. The Chemistry of selected metals and non-metals and qualitative analysis.

Laboratory Practicals: **(4 Credit Units)**

General Physics Laboratory: **(2 Credit Units)**
This introductory course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques will be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc covered in General Physics I, II and III.

General Chemistry Laboratory: **(2 Credit Units)**
Topic in different areas of General Chemistry to be treated.

200 Level
Engineering Mathematics **(6 Credits)**

Complex analysis – Elements of complex algebra, trigonometric, exponential and logarithmic functions. Real number, sequences and series.

(i) Vectors – Elements, differentiation and integration.
(ii) Elements of linear algebra.
(iii) Calculus – Elementary differentiation. Relevant theorems.
(iv) Differential equations – Exact Equations. Methods for second order equations. Partial differential equation. Simple cases – Applications.
(v) Numerical Analysis – linear equations, non-linear equations. Finite difference operators: Introduction to linear programming.

Computers & Computing (2 Credits)

Program design using pseudo-code/flowchart. Extensive examples and exercises in solving engineering problems using pseudo-code/flowchart. **Computer programming using structure BASIC such as QBASIC**: symbols, keywords, identifiers, datatypes, operators, statements, flow of control, arrays, and functions. Extensive examples and exercises in solving engineering problems using QBASIC. **Use of Visual programming such as Visual BASIC** in solving engineering problems.

15hrs (Teaching & Demonstrations), 30hrs (Practicals)

IT in Engineering (2 Credits)

Identification of PC parts and peripheral devices: functions, applications, and how to use them. Safety precautions and preventive maintenance of PC. **Filing system**: directory, sub-directory, file, path, and how to locate them. **Word processing**: principle of operation, applications, demonstrations, and practical hand-on exercises in word processing using a popular word processing package. **Internet**: available services, principle of operation, applications, demonstrations, and hand-on exercises in e-mail, and www. **Spreadsheet**: principle of operation, applications, demonstration, and practical hands-on exercises in use of spreadsheets to solve problems. **Database Management package**: principle of operation, applications, demonstrations and practical hands-on exercises in use of DBMS package in solving problems. **Report Presentation Software Packages**: principle of operation, applications, demonstrations, and practical hands-on exercises in use of a popular report presentation package (such as PowerPoint). **Mini-project** to test proficiency in use of software packages.

15hrs (Teaching & Demonstrations), 30hrs (Practicals)

Engineering Drawing (2 Credits)

(i) Use of draughting instruments, lettering, dimensioning, layout.
(ii) Engineering graphics – Geometrical figures, comics, etc. Graphical calculus and Applications. Development, intersection of curves and solids.
(iii) Projections – lines, planes and simple solids. Orthographic and projections, simple examples Threaded fastness.
(iv) Pictoral/Freehand Sketching.

(v) Conventional practices.
(vi) Introduction to Computer Aided Drafting: Electronic draughting packages: principle and use in engineering design. Simulation packages: principle and use in engineering.

Applied Mechanics **3 Credits** Statics Laws of statics, system of forces and their properties, Simple problems, Friction.

(i) Particle dynamics – Kinematics of plane motion. Newton's laws – Kinetics of particles, momentum and energy methods.
(ii) Kinematics of rigid body – velocity and acceleration diagrams for simple problems.
(iii) Kinetics of rigid bodies – Two dimensional motion of rigid bodies, energy and momentum, Mass, Moment of inertia, Simple problems.
(iv) Simple harmonic motions.

Strength of Materials **2 Credits**

(i) Force equilibrium – free body diagrams.
(ii) Concept of stress, strain; Tensile test. Young's moduli and other strength factors.
(iii) Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems. Hoop stresses in cylinders and rings.
(iv) Bending moment, shear force and axial force diagrams for simple cases, Simple torsion and application.

Thermodynamics **2 Credits**

(i) Basic concepts, definitions and laws.
(ii) The ideal gas, Heat and Work.
(iii) The first Law of thermodynamics, applications to open and closed systems.
(iv) The steady State flow equation (Bernoulli's Equation) and applications.
(v) Second law of thermodynamics and Heat Cycles.

Materials Science **2 Credits**

Atomic and molecular structure, crystals, Metallic states, Defects in crystals, conductors, semi-conductors and insulators.

(i) Alloy theory – Application to industrial alloys – steel in particular.
(ii) Engineering Properties – Their control, Hot and cold working, heat treatment, etc. Creep, fatigue and fracture. Corrosion and corrosion control.
(iii) Non-metallic materials – glass, rubber, concrete, plastics, wood and ceramics.
(iv) Elastic and plastic deformations: Defects in metals.

Fluid Mechanics **2 Credits**

(i) Elements of fluid statics; density; pressure, surface tension, viscosity, compressibility etc.

(ii) Hydrostatic forces on submerged surfaces due to incompressible fluid.
(iii) Introduction to fluid dynamics – conservation laws.
(iv) Introduction to viscous flow.

Chemistry **2 Credits**

Thermo-chemistry, electro-chemistry, kinetic theory, gas laws, transition metals, introductory organic and inorganic chemistry.

Basic Electrical Engineering **3 Credits**

(i) Circuits – elements, DC and AC circuits, Basic circuit laws and theorems. Resonance, power, power factors, 3-phase circuits.
(ii) Introduction to machines and machine designs.
(iii) Physics of devices – Discharge devices, semi-conductors, diode and transistors.
(iv) Transistor characteristics, devices and circuits
(v) Electrical and electrical power measurements.

Manufacturing Technology/Workshop Practice 2 Credits

Elementary introduction to types and organisation of engineering Workshop, covering jobbing, batch, mass production.

(i) Engineering materials: their uses and properties.
(ii) Safety in workshop and general principles of working. Bench work and fitting: Hand tools, instruments.
(iii) Carpentry: Hand tools and working principles. Joints and fastenings: bolt, rivet, welding, brazing, soldering. Measurement and marking: for uniformity, circulatory, concentricity, etc.

(iv) Blacksmith: Hand tools and working principles. Joints and fastenings: Bolt, rivet, welding, brazing, soldering, measurement and marking: for uniformity, circulatory, concentricity, etc.
(v) Standard measuring tools used in workshop: Welding, brazing and soldering: Principles, classification, power source.
(vi) General principles of working of standard metal cutting machine tools.
(viii) Invited lectures from Professionals

Engineer-In-Society **1Credit** Philosophy of Science

(i) History of Engineering and Technology
(ii) Safety in Engineering and Introduction to Risk Analysis
(iii) The Role of Engineers in Nation Building
(iv) Invited Lectures from Professionals.

Laboratory Practicals **6 Credits**

All courses share the laboratory schedules to suit; sometimes alternate weeks.

2.1 AGRICULTURAL ENGINEERING

2.1.1 Philosophy, Aims and Objectives of the Degree Programme

Philosophy

To achieve the national goals and objectives of industrialisation and self reliance, the Engineering and Technology education should be geared towards:

(i) The development of a thorough practice in training

(ii) Early broad – based training in general Engineering and Technology

(iii) Practical application of Engineering, Technology and Manufacturing Processes.

(iv) Adequate training in human and organisational behaviour

(v) Introduction to entrepreneurial education and training

(vi) Close association of the programme with industries in the country.

The general philosophy therefore is to produce graduates with high academic standard and adequate practical background for self employment as well as being of immediate value to industry and the community in general.

Aims and Objectives

The general aims and objectives of Engineering and Technology training should be in consonance with the realisation of national needs and aspirations vis-à-vis industrial development and technological emancipation. The benchmark statements give the minimum academic standards required to meet these needs and to produce graduates in Engineering and Technology with sufficient academic background and practical experience who would be able to rise to the challenges of a developing economy. Such graduates must therefore be resourceful, creative, knowledgeable and able to perform the following functions:

Graduates in Engineering

(i) To design engineering projects and supervise their construction.

(ii) To design and make components, machines, equipment and systems.

(iii) To design and develop new products and production techniques in industries.

(iv) To install and maintain complex engineering systems so that they can perform optimally in our environment.

(v) To adapt and adopt exogenous technology in order to solve local engineering problems.

(vi) To be able to exercise original thought, have good professional judgment and be able to take responsibility for the direction of important tasks.

(vii) To be able to manage people, fund, materials and equipment.

(viii) To improve on indigenous technology to enhance local problems solving capability

Graduates in Technology

(i) To be conversant with all the materials, components, machines, equipment, production techniques and systems in his/her area of specialisation.
(ii) To man and maintain the specific production equipment in his /her area of specialisation.
(iii) To plan, manage and be responsible for quality control of the products and processes in the plant/factory.
(iv) To adapt and adopt exogenous technology in order to solve local technical problems.
(v) To be able to manage people, fund, materials and equipment.
(vi) To improve on indigenous technology to enhance local problems solving capability

2.1.2 Admission and Graduation Requirements

Admission Requirement

The minimum admission requirement for Engineering and Technology disciplines should be passes at credit level in the Senior Secondary School final year examination or GCE 'O' Level in five subjects including Mathematics, English Language, Physics and Chemistry. Candidates are also required to have an acceptable pass in UME. It is also desirable for candidates to have Further Mathematics and Technical Drawing at credit levels. Such candidates shall have added advantage.

For Direct Entry, candidates must have passes in Mathematics, Physics and Chemistry at GCE 'A' level or equivalent. Holders of OND and HND at minimum of upper credit level are eligible for consideration for admission into 200 and 300 levels respectively.

Graduation Requirement

To satisfy the requirements for graduation, a student must take and pass the minimum units specified in the programme before he/she can qualify for the award of a degree in Engineering or Technology. This includes passing all compulsory General Studies Courses and the Industrial Training courses.

2.1.3 Learning Outcome

a) Regime of Subject Knowledge
Fundamental Emphasis

The programmes in engineering and technology shall be designed with full recognition that:
Mathematics and Science are the basic intellectual tools which graduate engineers use to understand and harness the forces of nature to the benefit of mankind. Students need to develop a

good understanding of science in general and study the specific sciences in their chosen disciplines to a greater depth.

Engineering and Technology are professionally directed toward the skilled application of distinctive knowledge based primarily on mathematics and science integrated with business and management in developing, providing and maintaining infrastructure, goods and services for industry and the community.

Criteria for content of degree programmes

These are viewed in the context of the understanding and development of skills in mathematics, science, design, information technology, business know-how and professional practice.

Mathematics Content

Appropriate mathematical methods shall be ensured in the programme. The knowledge level should include ability to select and apply appropriate mathematical modeling and analysing engineering problems. It should also include development of transferable skills in terms of manipulation and sorting of data, presentation of data in a variety of ways. The mathematics content of each engineering curriculum should provide opportunities for understanding of significant number of mathematical methods in the particular discipline including an appreciation of their limitation and ways of applicability.

Science Content

The science level selected shall be as deemed appropriate to the specific discipline. It should be capable of imparting knowledge, understanding intellectual abilities and practical skills to use relevant scientific principles in the development of engineering solution to practical problems; use of scientific principles in modeling and analysis of engineering systems, processes and products.

Design Content

Adequate design training shall be ensured. This includes assurance of understanding of general principles of design and design techniques specific to particular products and processes; development of intellectual capabilities in analysis of systems, processes and components requiring engineering solutions; Creation of new processes or products through synthesis of ideas from a wide range of sources; and assurance of knowledge and understanding of the characteristics of engineering materials and components.

Information Technology

Knowledge, understanding and intellectual abilities shall be assured in principles and application of information technology in general and also specific to the discipline. These shall include ability to select and apply appropriate computer based methods designed for modeling and analysing engineering problems.

Business Content

Each programme shall include adequate knowledge, understanding and intellectual capabilities in management and business practices, including finance, law, marketing, engineering economics, etc

Professional Practice

Adequate elements of activities in the practice of engineering and technology shall be ensured. These include applicable codes of practice, safety requirements, manufacturing, operational practice, project management, technical risk evaluation, environmental impact assessment and environmental auditing. Strong attachment of students to industry should be ensured.

b) **Competencies and Skills**

Each curriculum should provide opportunities to develop in the student competencies and skills in the various components of the regime of knowledge. These include the following:

(i) Ability to manipulate data in alternative forms to create deeper understanding.
(ii) Use of relevant test and measurement equipment including assemblage and use of experimental laboratory/workshop activities; ability to estimate errors/accuracy of measurements.
(iii) Research for information to develop ideas further and working with limited or contradictory information.
(iv) Use of information technology tools, including programming languages and a broad understanding of common information technology tools.
(v) Ability to apply engineering techniques taking into account, industrial and commercial constraints, to learn independently and understand new concepts in the discipline.
(vi) Competence in teamwork and leadership.

c) **Behavioural Attributes**

Graduating engineering and technology students must have an understanding of their professional and ethical responsibilities. Therefore, the broad education necessary to understand these and the impact of their work in a global and societal context (including awareness of relevant contemporary issues) should be ensured.

2.1.4 **Attainment Levels**

In the Engineering and Technology programmes, assessment of students' achievements should be based on:

(i) Examinations
(ii) Laboratory reports
(iii) Planning, conduct and reporting of project work
(iv) Oral presentations and problem solving exercises
(v) Assignment
(vi) Group project work
(vii) Reports of Industrial Training programme.

Continuous assessment shall be done through assignments, tests and practical exercises.

(a) Scores from continuous assessment shall normally constitute 30% of the final marks for courses which are primarily theoretical.
(b) For courses which are partly practical and partly theoretical, scores from continuous assessment shall constitute 50% of the final marks.
(c) For courses that are entirely practical, continuous assessment shall be based on a student's practical work or reports and shall constitute 100% of the final marks.

Although all students graduating with a Bachelor's degree in Engineering and Technology are expected to demonstrate that they have acquired knowledge, abilities and skills in the areas identified by the benchmark statements, it is accepted that there will be significant differences in their level of attainment. The following criteria are suggested as indicators of the different levels of attainment:

First Class

a. Knowledge base is extensive and extends well beyond the work covered in the programme. Conceptual understanding is outstanding.
b. Problems of a familiar and unfamiliar nature are solved with efficiency and accuracy: problem-solving procedures are adjusted to the nature of the problem.
c. Experimental skills are exemplary and show a thorough analysis and appraisal of experimental results with appropriate suggestions for improvements.

Second Class (Upper) Division:

a. Knowledge base covers all essential aspects of subject matter dealt with in the programme and shows some evidence of enquiry beyond this. Conceptual understanding is good.
b. Problems of a familiar and unfamiliar nature are solved in a logical manner: solutions are generally correct or acceptable
c. Experimental work is carried out in a reliable and efficient manner.
d. Performance in transferable skills is sound and shows not significant deficiencies.

Second Class (Lower) Division:

a. Knowledge base is sound, but is largely confined to the content of the programme. Level of conceptual understanding is generally sound.
b. Problem-solving ability is sound in relation to problems of a familiar type or those that can be tackled through the straightforward application of standard procedures and/or algorithms.
c. Experimental work is generally satisfactory and reliable
d. Performance in transferable skills is largely sound.

Third Class

a. Knowledge and understanding of the content covered in the course are basic.
b. Problems of a routine nature are generally adequately solved.
C. Standard laboratory experiments are usually carried out with reasonable success though significance and limitations of experimental data and/or observations may not be fully recognised.

Pass

Engineering and Technology degrees shall normally not be awarded at pass level.

2.1.5 Resource Requirement for Teaching and Learning

a) Academic Staff and Non-Academic Staff

Academic Staff

The NUC guidelines on staff/student ratio of 1:15 for Engineering and Technology departments shall apply. However, there should be a minimum of six full-time equivalent of Staff in the department. There is need to have a reasonable number of Staff with doctoral degrees as well as sufficient industrial experience.
With a minimum load of 18 credits per semester for students and a minimum of six fulltime equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practicals and supervision of projects.
In employing staff, the following criteria are suggested:

(i) **Graduate Assistant**
Candidate must have honours degree with at least second class upper.

(ii) **Assistant Lecturer**
Candidate must have Master's degree or 1st Class Honour Degree at undergraduate level.

(iii) **Lecturer II**
Candidate should normally have Ph.D. degree or spent at least three years as an Assistant Lecturer or equivalent industrial experience and some potential for research may be considered.

(iv) **Lecturer I**
Candidates should normally have Ph.D. degree with at least one year of teaching or industrial experience plus some publications. A candidate, who does not possess a Ph.D., but possesses a Masters degree with sufficient industrial experience acceptable for COREN registration, can also be considered. Such a candidate should also show evidence of research potential. Also, a Lecturer II plus a minimum of three years as Lecturer II or equivalent industrial experience can be considered.

(v) **Senior Lecturer**
Candidate should possess Ph.D. degree and/or research experience and/or industrial experience. Such candidate should also possess a good number of referred journal publications. Also, a Lecturer I plus a minimum of three years or equivalent industrial experience can be considered provided the candidate possesses Ph.D.

(vi) **Associate Professor/Reader**
Candidate should possess Ph.D. degree with teaching and research experience. Also, a Senior Lecturer plus three years as Senior Lecturer or equivalent industrial experience can be considered.
In addition to possessing the ability of providing academic leadership, such a candidate should also have a considerable number of referred journal publications which must be assessed externally.

(vii) **Professor**
Candidate should possess Ph.D. degree with teaching and research experience. Associate Professors/Readers may be promoted to the rank of Professors after at least three years as Associate Professors/Readers. Such a candidate should possess an ability to provide a

strong academic leadership in addition to a considerable number of referred journal publications. Furthermore, the publications of such candidate should be externally assessed.

Each Professor in the Faculty of Engineering and Technology should be given a Secretary, as this is essential for efficient performance of his internal and external duties

Non-Academic Staff

The services of support staff, which are indispensable in the proper running of laboratories, workshop/studios as well as for administration are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. The minimum of academic staff to technical staff ratio of 1:4 should be maintained. Universities should pay attention to optimum proportioning of the non-academic staff to avoid redundancy and overstaffing.

b) Academic and Non-Academic Spaces

Academic

The NUC recommends the following physical space requirement:

		m^2
Professor's Office	-	18.50
Head of Department's Office	-	18.50
Tutorial Teaching Staff's Office	-	13.50
Other Teaching Staff Space	-	7.00
Technical Staff Space	-	7.00
Science Staff Research Laboratory	-	16.50
Engineering Staff Research Laboratory	-	14.50
Seminar Space/per student	-	1.85

Drawing Office Space (A.O. Board) (Per Student) - 4.60 Drawing Office Space (A.I. Board) (Per Student) - 3.70 Laboratory Space - 7.50 **Non-Academic**

The NUC recommends the following physical space requirement:

		m^2
Secretarial Space	-	7.00

c) Academic and Administrative Equipment

To achieve the benchmark statements for any programme, there should be:

(a) A minimum number of identifiable laboratories for each discipline which should be in accordance with the NUC recommended space requirements and, in addition, be reasonably equipped.

(b) At least one large and reasonably equipped central workshop for teaching and research.

(c) Drawing and design studios, which should be well equipped and in accordance with the NUC recommended space requirements.

It is important that equipment should be acquired in sufficient number to enable adequate implementation of the benchmark statements as they relates to

Mathematics, Science, Design, Information and Communications Technology, Business and Professional Practice.

d) Library and Information Resources

There must be adequate library facilities to cater for the interest of all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications etc. in sufficient numbers.

2.1.6 Course Contents and Descriptions

Agricultural And Bio-Resources Engineering

Course Summary

Course Title		Lecture/Lab. Units
(i)	**General Studies**	16
(ii)	**Basic Sciences**	
	Mathematics	12
	Physics	10
	Chemistry	8
(iii)	**Entrepreneurial Studies**	4
	Sub-Total	**50**
(iv)	**Management and Humanities**	
	Economics	2
	Principles of Management	3
	Farm Management, Rural Sociology and Agric. Extension	2
	Technical Communication	2
	Engineer-in-Society	1
	Sub-Total	**10**
(v)	**Basic Agriculture**	
	Animal Production	3
	Crop Production	3
	Soil Science	2
	Sub-Total	8
(vi)	**Engineering Mathematics & Statistics, Computers & Computing**	
	Engineering Mathematics & Statistics	9
	Computers & Computing	2
	Information Technology in Engineering	2
	Sub-Total	**13**

(vii) **Basic Engineering**

Basic Electrical Engineering	3
Applied Mechanics	3
Engineering Drawing	2
Machine Drawing and Design	2
Fluid Mechanics	2
Hydraulics	2
Hydrology	3
Geology for Engineers	2
Metallurgy	2
Strength of Materials	2
Materials Science	2
Manufacturing Tech/Workshop Practice	2
Thermodynamics	2
Laboratory Practicals	6
Sub-Total	**35**

Core Courses

(viii) **Agricultural and Bio-Resources Engineering**

Basic Agric. & Bio-Res. Engineering	2
Farm Power and Machinery	3
Irrigation and Drainage	3
Properties, Handling, Processing and Storage of Agricultural Materials	2
Land Surveying	3
Land Clearing and Development	2
Soil and Water Conservation	3
Farm Electrification	3
Farm Structures and Environmental Control	3
Agric. Mechanisation	2
Workshop Practice	2
Laboratory Practicals	7
Final Year Project	6
Sub-Total	**41**

(ix) **Specialisation and Electives** **Lecture/Lab. Units**

(Up to 20 Credits selected from any of the three options)

Crop Processing and Storage Option:

Advanced Thermodynamics	3
Engineering Properties and Handling of Agric. Materials	3
Processing and Storage of Agric.	

Materials	3
Solar Energy Applications to Processing and Storage	2
Agric. Machinery	3
Mechanics of Deformable Bodies	2
Design of Agric. Machines	3
Food Engineering	2
Farm Transportation	2
Automotive Service and Maintenance	2
Industrial Studies	3
Sub-Total	28

Farm Power and Machinery Option:

Agric. Power	3
Agric. Machinery	3
Mechanics of Deformable Bodies	2
Design of Agric. Machines	3
Operations and Management of Farm Power and Machinery Systems	2
Farm Transportation	2
Engineering Properties and Handling of Agric. Materials	3
Processing and Storage of Agric. Materials	3
Food Engineering	2
Automotive Service and Maintenance	2
Industrial Studies	3
Sub - Total	**28**

Soil and Water Engineering Option:

Irrigation	3
Agricultural Land Drainage	2
Advanced Hydraulics	3
Rural Water Supply and Sanitation	2
Design of Irrigation and Soil Conservation Structures	3
Environmental Engineering	3
Foundation Engineering	3
Farm Transportation	2
Automotive Service and Maintenance	2
Industrial Studies	3
Sub – Total	26

Grand Total	**174 to 177**

Break-down of Courses into Levels of Study:

300 Level

Course Title	Lecture/Lab. Units
Engineering Mathematics	6
Basic Agric. & Bio-Res. Engineering	2
Land Surveying	3
Hydrology	3
Geology for Engineers	2
Machine Drawing and Design	2
Hydraulics	2
Metallurgy	2
Mechanics of Machines	2
Soil Mechanics	2
Soil Science	2
Animal Production	3
Crop Production	3
Technical Communication	2
Foundation Courses in Entrepreneural Studies	2
Laboratory Practicals	3
Sub-Total	41

400 Level

Course Title	Lecture/Lab. Units
Engineering Mathematics & Statistics	3
Farm Power and Machinery	3
Irrigation and Drainage	3
Farm Structures and Environmental Control	3
Properties, Handling, Processing and Storage of Agric. Materials	3
Farm Management, Rural Sociology and Agric. Extension	2
Economics	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**21**

500 Level

Principles of Management	3
Farm Electrification	3
Soil and Water Conservation	3
Land Clearing and Development	2
Agric. Mechanisation	2

Final Year Project	6
Sub-Total	19
Specialisation and Electives from any of the three options	17 to 20
Sub-Total	36 to 39

Engineering Mathematics Course Synopses for Agricultural & Bio-Resources Engineering and Technology-Based Disciplines

300 Level

Engineering Mathematics 6 Credits

1. Linear Algebra – Elements of Matrices, determinants, Inverse of matrix. Theory of linear equations, Eigen-Values and Eigen Vectors.
2. Analytic geometry – Co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates.
3. Elements of functions of several variables.
4. Numerical differentiation, solution of ordinary differential equations, Curve fitting, Simple linear programming.
5. Fourier series – Euler coefficients, even and odd functions, sine and cosine functions, simple applications. Gama, Beta and probability functions.
6. Differential equation of second order – series solutions. Legendre and Bessel functions and their properties.
7. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient Line, surface and volume integrals and related theorems.

400 Level

Engineering Mathematics 3 Credits

1. Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems:
2. Laplace and Fourier transform - Applications
3. Introduction to non-linear differential equations – stability and Applications.
4. Probability – Elements of probability, density and distribtion functions, moments, standard distribution, etc.
5. Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

Agricultural And Bio-Resources Engineering Course Synopses

(i) **Basic Agric. & Bio-Resources Engineering 2 Credits**

Introduction to Agricultural & Bio-Resources engineering profession. Agricultural and Bio-Resources. Identification of various tractors. Identification of other farm power sources. Types of farm implements.

Tractor driving and test. Use of tractor for various field operations.

(ii) **Land Surveying** **3 Credits**

Definitions. Measurement of distances. Use of minor instruments, Random errors. Chain surveying. Bearing of lines. Levelling. Topographic surveys. Traversing. Theodolite traversing. Plane table surveying. Triangulation. Land shaping and earthwork.

(iii) **Hydrology** **3 Credits**

Hydrologic cycle. Solar and earth radiation. Precipitation. Evapotranspiration, Infiltration. Rainfall-runoff over agricultural land. Stream gauging. Hydrographs. Streamflow routing. Groundwater hydraulics. Watershed management. Flood control.

(iv) **Geology for Engineers** **2 Credits**

The earth. Geological processes. Engineering properties of rocks. Stratigraphy. Geotechnics. Geomorphology. Mineralogy and Petrology. Geology of Nigeria.

(v) **Machine Drawing and Design** **2 Credits**

Part assembly. Detailed drawing of machine components. Sketching and use of standards: design features, symbols, screws, fasteners, couplings, clutches, gears. Machine component design. Presentation of design portfolio.

(vi) **Hydraulics** **2 Credits**

Fluid properties. Fluid statics. Fluid motion: continuity, Bernoulli, energy, momentum equations. Reynolds number. Laminar and turbulent flows. Pipe flow. Open channel flow. Weirs, flumes, pumps, turbines, outlets, gates, valves.

(vii) **Metallurgy** **2 Credits**

Metals and alloys, their production and use. Nature, origin and control of structure in metallic systems and their relation to mechanical properties. Diffusion, deformation, hardening, transformation. Heat treatment. Metallographic laboratory practice.

(viii) **Mechanics of Machines** **2 Credits**

Force and motion relationships in constrained mechanisms. Analysis of car, gear, linkage, belt drive and chain drive systems for motion and power transmission. Vehicular mechanics: brake and clutch systems. Kinetics of rotating and reciprocating masses. Elements of vibratory systems.

(ix) **Soil Science** **2 Credits**

Origin and formation of soils. Physical properties of soils. Soil colloids; soil reaction; soil mineralogy. Soil organic matter. Soil survey and classification. Water movement in soils.

(x) **Soil Mechanics** **2 Credits**

Phase relationships, shear strength, consolidation, settlement, compaction. Machinery-soil-relationships, site investigations.

(xi) **Animal Production 3 Credits**
Types of livestock (for eggs, milk, meat, wool, etc)
Distribution of livestock in Nigeria. Animal feeding and nutrition. Forage crops and their preservation. Artificial insemination. Livestock housing. Livestock processing equipment.

(xii) **Crop Production 3 Credits**
Classification and ecology of crops in Nigeria. Nutrient requirements and mineral nutrition of plants. Manures and fertilizers. Plant growth and development. Growth stages. Tillage and weed control. Other cultural practice. Cropping sequences and rotation. Farming systems. Production practices for specified crops.

(xiii) **Technical Communication 2 Credits**
Principles of effective communication. Professional use of the English language. Principles of technical writing. Oral presentation of technical ideas.

(xiv) **Farm Power and Machinery 3 Credits**
Farm power sources. Selection and management of farm tractors and equipment. Force analysis and power measurement on tillage tools. Field performance evaluation of crop production equipment. Adjustment, maintenance, and repair of farm tractors and equipment.

(xv) **Irrigation and Drainage 3 Credits**
Water requirements in an irrigation system. Methods of irrigation. Frequency and amount of irrigation. Irrigation water scheduling. Evaluating irrigation systems and practices. Design of furrow, basin and sprinkler irrigation. Effect of poor drainage on plants and soils. Drainage requirements of crops, surface drainage. Sub-surface drainage.

(xvi) **Farm Structures and Environmental Control 3 Credits**
Environmental and structural requirements of crops and livestock, Planning of plant and livestock houses, storage and stores. Design of structural members. Water supply and sewage disposal. Specifications and selection of farm building materials. Environmental control for plants and livestock. Use of psychrometric charts. Farmstead planning and layout.

(xvii) **Properties, Handling, Processing and Storage of Agric. Materials 3 Credits**
Properties and characteristics of agric. Materials. Cleaning, sorting and grading. Handling methods. Processing techniques. Crop drying. Crop storage.

(xviii) **Farm Management, Rural Sociology and Agric. Extension 2 Credits**

Application of basic sociological concepts to rural life. Management decision making. Functions of Management planning, organisation, staffing, directing and controlling. Financial management. Principles of Extension: diffusion, adoption and rejection of innovations. Communication and leadership in agricultural extension.

(xix) **Economics** **2 Credits**

Basic concepts. Factors of production. Supply and demand. Price, Elasticity analysis. Household behaviour theories, Business organisation, Production, the market. Income, Employment – classical, non-classical and keynessian approaches. Money, Expenditure, Taxation, Budget, International trade.

(xx) **Principles of Management** **3 Credits**

Principles of Management. Industrial group and organisational behaviour. Motivation, Industrial Law, legislation on wages, trade marks and patents. Law of contract and sale of goods. Liability for industrial injuries. Industrial relations. Trade unions, employer associations, wage bargaining and the role of the state.

(xxi) **Farm Electrification** **3 Credits**

Electrical codes, tariffs and regulations. Generation and transmission of electricity, Farmstead distribution systems. Testing procedure. Power factor correction. Selection and use of electric motors. Transformers. Energy conversion. Application of electricity to handling, processing and storage of agricultural products. Basic electronic applications to farm electrical processes.

(xxii) **Soil and Water Conservation** **3 Credits**

Types of erosion, Soil erosion by water, Universal soil loss equation. Control of soil erosion by water. Wind erosion and its control, Desertification and control measures. Earth dams and farm ponds.

(xxiii) **Land Clearing and Development** **2 Credits**

Land resources and Land Use Act in relation to Nigerian agriculture. Objectives, methods and equipment for land clearing and development. Machinery selection, mechanics of operation and vegetation types. Land reclamation. Earthmoving machinery and earthmoving mechanics.

(xxiv) **Agricultural Mechanisation** **2 Credits**

Nature and objectives of agricultural mechanisation. Factors affecting agricultural mechanisation in the tropics. Analysis of production systems. Agricultural mechanisation as a strategy for rural development. Impact on food production and on infrastructural development. Linkages with rural industrialisation. Case studies of selected farms.

(xxv) **Final Year Project** **6 Credits**

Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report.

(xxvi) **Agricultural Power** **3 Credits**

Farm power sources. Farm tractor; selection, use, maintenance. Other power sources; selection, use, maintenance. Hitches and hitch systems, design considerations of single-axle, two-wheel drive, four-wheel drive and crawler tractors. Tractor mechanics. Power Measurement. Fluid controls. Ergonomics. Tractor testing and test codes.

(xxvii) **Agricultural Machinery** **3 Credits**

Force analysis and design consideration of various farm machinery. Hitching methods. Power requirement for operating farm equipment and machines. Operation and maintenance of various farm machinery. Field evaluation. Criteria for replacement. Cost analysis of the use of agricultural machines.

(xxviii) **Mechanics of Deformable Bodies** **2 Credits**

Three dimensional stress and strain. Theories of failure. Stress concentration. Moments and products of inertia and area. Mohr's strain and inertia circles. Unsymmetrical bending, shear center. Curved beams.

(xxix) **Design of Agricultural Machines** **2 Credits**

Machine design processes and procedures. Materials of construction: selection, strength properties, stress analysis, costing. Design of machine elements. Machine fabrication. Typical designs of low cost agricultural machinery. Problems and prospects of agricultural machinery development and commercial manufacture in Nigeria.

(xxx) **Operation and Management of Farm Power and Machinery Systems** **2 Credits**

Integrated approach to machinery usage and agricultural production sequence. Equipment selection, scheduling of operation, seasonality factor. Machinery management. Machinery ownership and financing. Gross margin analysis. Optimisation of machinery – input combinations. Management of farm enterprise. Case studies.

(xxxi) **Irrigation** **3 Credits**

Design of open channels. Water flow measurement. Pumping power requirements. Design of irrigation systems: border, sprinkler, drip, etc. Salinity and quality of irrigation water. Reclamation of saline and alkali soils. Seepage from canals and canal lining. Design of an irrigation project. Evaluating irrigation systems and practices. Irrigation water management.

(xxxii) **Agricultural Land Drainage** **2 Credits**

Surface drainage. Subsurface drainage. Design of drainage systems. Envelope materials and their design. Loads on conduits. Drainage pumping. Construction and installation of drains. Maintenance of drains.

(xxxiii) **Advanced Hydraulics** **3 Credits**

Pipe flow, Pipes in parallel and in series. Branched pipes. Simple pipe network. Water hammer. Hardy Cross method of water distribution. Open channel flow. Channel transition and control. Hydraulic jump. Backwater curves. Dimensional analysis and similitude. Reservoir hydraulics and planning. High pressure outlets, gates, valves.

(xxxiv) **Rural Water Supply and Sanitation** **2 Credits**

Water requirements. Water quality standards. Water borne diseases. Biochemical oxygen demand. Potable water impurities. Sources and treatment methods of water for rural homes. Water lifting devices. Transportation and distribution systems. Pipe sizes. Waste disposal in rural communities. Collection, conveyance, treatment and disposal of sewage from rural homes. Septic tanks, digestion ponds and family privies.

(xxxv) **Design of Irrigation and Soil Conservation Structures** **2 Credits**

Factors affecting efficient farm water management. Review of relevant hydraulic theories. Design of irrigation structures. Design of soil conservation structures.

(xxxvi) **Environmental Engineering** **3 Credits**

Design of unit operations and processes in water and wastewater treatment. Sedimentation. Chemical coagulation. Ion exchange. Filtration. Disinfection. Water supply treatment and distribution. Water quality. Wastewater handling, treatment and disposal. Solid waste disposal. Air pollution and control.

(xxxvii) **Foundation Engineering** **3 Credits**

Stress in soils. Consolidation, compaction, CBR and soil improvement, stability of slopes. Earth pressure analysis. Bearing capacity and settlement analysis of shallow and deep foundations. Design of footings, foundations, retaining walls. Analysis and control of groundwater.

(xxxviii) **Advanced Thermodynamics** **3 Credits**

Thermodynamics of gases, vapours and reactive and non-reactive mixtures. Process relations. Concepts of equilibrium, reversibility.

(xxxix) **Engineering Properties and Handling of Agricultural Materials** **3 Credits**

Physical, mechanical, rheological and thermal properties of agricultural materials. Newtonian and Non-Newtonian fluids. Handling methods. Design and construction of appropriate material handling equipment for tropical products. Economics of material handling.

(xl) **Processing and Storage of Agricultural Products**

3 Credits

Cleaning, sorting, grading and separation: Principles, techniques and machine, communication, Particle size analysis. Heat treatment. Dehydration and drying. Psychrometry, Storage types and environment. Deterioration of produce in storage. Containerisation. Design of grain storage structures. Environmental control in storage.

(xli) **Solar Energy Applications to Processing and Storage**

2 Credits

Fundamentals of solar radiation. Solar heating and cooling, Heat transfer, solar energy conversion efficiency. Principles of solar collectors. Solar heat storage and storage systems for tropical crops.

(xlii) **Food Engineering** **2 Credits**

Definition, Heat and mass transfer, Insulation, Heat exchangers-design and applications. Heat and cold preservation of foods. Food packaging, Food quality control. Principles and design of food equipment.

(xliii) **Farm Transportation** **2 Credits**

Farm roads. Farm transportation system. Development and construction of farm transport equipment. Farm transport system – standards and specifications. Ergonomics.

(xliv) **Automotive Service and Maintenance** **2 Credits**

Service and maintenance of all the components of an automobile.

(xlv) **Industrial Studies** **2 Credits**

Organisational structure of manufacturing organisation. Market survey, Feasibility studies, Project and contract documents. Specification, Planning schedule, Quality control. Safety and safety procedures.

2.2 AUTOMOTIVE ENGINEERING

2.2.1 Philosophy, Aims and Objectives of the Degree Programme

As in Section 2.1.1

2.2.2 Admission and Graduation Requirements

As in Section 2.1.2

2.2.3 Learning outcome

As in Section 2.1.3

2.2.4 Attainment Levels

As in Section 2.1.4

2.2.5 Resource Requirement for Teaching and Learning

As in Section 2.1.5

2.2.6 Course Contents and Descriptions

Course Summary

	Course Title	Lecture/Lab. Units
(i)	**Core Courses**	
	Theory of Machines	6
	Workshop Practice (including Automobile Workshop)	2
	Engineering Drawing	4
	Manufacturing Technology	2
	Thermodynamics	8
	Fluid Mechanics	8
	Mechanical Design	7
	Science and Engineering of Materials and Metallurgy	6
	IC Engines and Fuels	6
	Automobile Systems & Vehicle Dynamics	6
	Automobile Systems Design	4
	Engineering Materials Selection and Economics	3
	Engineer-in-Society	1
	Technology Policy & Development	2
	Automobile Maintenance and Testing	3
	Engineering Communications	2
	Advanced CAD/CAM	2
	Project	6
	Total	**80**

(ii)	**Other Courses**	
	Electrical & Electronic Engineering	10
	Law and Management	3
	Basic Civil Engineering	2
	Total	**15**
(iii)	**Basic Science Courses**	
	Mathematics	20
	Chemistry	10
	Physics	10
	Computer & Computing	6
	Total	**46**
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	8
	Total	**24**
	GRAND TOTAL	**182**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Engineering Mathematics	6
Computers & Computing	2
Theory of Machines I	3
Manufacturing Technology	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing	2
Workshop Practice	2
Engineering Metallurgy I	2
Engineer-in-Society	1
Automobile Maintenance and Testing	3
Electrical & Electronic Engineering	4
IC Engines and Fuels	2
Auto Systems & Vehicles Dynamics	3
Control Systems	3
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**39**

400 Level	3
Theory of Machines II	2
Thermodynamics	2
Fluid Mechanics	3
Mechanical Engineering Design	2
IC Engines and Fuels	2
Automobile System Design	2
Technology Policy & Development	2
Engineering Communications	2
Engineering Statistics	2
Introduction to Entrepreneurship Studies	3
Laboratory Practicals	**25**
Total	

500 Level	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy II	2
Automobile Systems Design	3
Automobile Systems & Vehicle Dynamics	3
Automobile Maintenance and Testing	
Engineering Materials:	3
Selections and Economics	2
IC Engines and Fuels	6
Project	3
Law and Management	8
Electives	3
Advanced CAD/CAM	3
Laboratory Practicals	**42**
Total	

Core Course Synopses Common to 300, 400, And 500 Levels

(i) **Thermodynamics** **6 Credits**

Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(ii) **Theory of Machines** **2 Credits**

Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton's Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(iii) **Fluid Mechanics** **6 Credits**

Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) **Science and Engineering of Materials and Metallurgy**
3 Credits

Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) **Engineering Drawing** **2 Credits**

Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) **Mechanical Engineering Design** **7 Credits**

Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production metching; Optimisation in design.

(vii) **Manufacturing Technology** **2 Credits**

Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) **Workshop Practice** **2 Credits**

Workshop setting; Types of workshop equipment, machines and materials; Use of instruments and tools, Machine operation practice; Safety procedures in workshops.

(ix) **Control Systems** **3 Credits**

Control Engineering concepts; Transfer function; Differential Equation of control Systems; Tranducers; Automatic control methods.

(x) **Engineering Statistics** **2 Credits**

Probability- elements of Probability, density and distribution functions, moments, standard distributions etc.

Statistics – Regression and correlation, Large sampling theory. Test hypothesis and quality control. Introduction to Statistical Analysis Software packages.

(xi) I.C. Engines And Fuels 8 Credits
(300, 400 & 500 Levels)
Fundamentals of I.C. Engines; SI and IC Engines;
Fuels and Lubricants; IC Engine, Cycles and their analysis.

(xii) **Auto Systems And Vehicle Dynamics 2 Credits**
(300 & 500 Levels)
Friction forces in Automobile systems; Drag and propelling forces; Effect of body shape on vehicles.

(xiii) **Automobile System Design 4 Credits**
(400 & 500 Levels)
Auto Engine design; Design of steering systems; Design of transmission systems.

(xiv) Automobile Workshop Practice, Maintenance And Testing 5 Credits
(300, 400 And 500 Level)
Practical works on Engines and other auto systems;
Bodywork techniques; Wheelbalancing and alignment;
Routine maintenance; Fault finding techniques and rectification procedures; Test and Performance analysis of auto parts and systems.

2.3 CERAMIC ENGINEERING PROGRAMME

2.3.1 Philosophy, Aims and Objectives of the Degree Programme

As in Section 2.1.1

2.3.2 Admission and Graduation Requirements

As in Section 2.1.2

2.3.3 Learning outcome

As in Section 2.1.3

2.3.4 Attainment Levels

As in Section 2.1.4

2.3.5 Resource Requirement for Teaching and Learning

As in Section 2.1.5

2.3.6 Course Contents and Descriptions

COURSE SUMMARY

	Course Title	LECTURE/LAB. UNITS
(i)	**CORE COURSES**	
	Science and Engineering of Materials and Metallurgy	6
	Engineering Drawing	6
	Mechanics of Machines	5
	Workshop Practice	2
	Manufacturing Technology	5
	Thermodynamics	5
	Fluid Mechanics	5
	Ceramic Engineering Process Design	6
	Thermodynamics & Kinetics of Materials	2
	Properties of Ceramic Materials	5
	Physical Ceramics	6
	Glass Technology	5
	Ceramic Processing	5
	Solid State Ceramics	2
	Ceramics Coatings	4
	Foundry Technology	6
	Heat and Mass Transfer	3
	Nuclear and Special Materials	2
	Heat Treatment of ceramic Materials	3
	Engineering Material Selection and Economics	3

	Engineer-in-Society	1
	Project	6
	Technology Policy & Development	6
	Total	**102**
(ii)	**Other Courses**	
	Electronic and Electrical Engineering Courses	10
	Basic Chemical Engineering	5
	Law and Management	4
(iii)	**Basic Science Courses**	
	Mathematics	24
	Physics	10
	Chemistry	10
	Computers & Computing	3
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	0
	Total	**86**
	GRAND TOTAL	**188**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Engineering Mathematics	6
Computers & Computing	2
Manufacturing Technology	2
Engineering Drawing & Computer Aided Graphics	2
Workshop Practice	2
Electrical & Electronic Engineering Courses	5
Basic Chemical Engineering Courses	5
Thermodynamics	2
Fluid Mechanics	2
Metallurgy	2
Engineer-in-Society	1
Properties of Ceramic Materials	2
Foundry Technology	3
Fuels, Refractories & Furnace Technology	2
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**43**

400 Level

Thermodynamics & Kinetics of Materials	2
Properties of Ceramic Materials	2
Ceramic Processing	2
Physical Ceramics	3
Foundry Technology	3
Glass Technology	2
Solid State Ceramics	2
Technology Policy & Development	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	6
Total	**28**

500 Level

Ceramic Processing	2
Physical Ceramics	3
Glass Technology	2
Ceramic Engineering Process Design	6
Heat and Mass Transfer	3
Heat Treatment of Ceramic Materials	3
Engineering Metallurgy	2
Nuclear and Special Material	2
Ceramic Coatings	2
Engineering Materials Selection & Economics	3
Project	6
Law and Management	4
Laboratory Practicals	4
Total	**42**

Course Synopses Common To 300, 400, And 500 Levels

(i) Thermodynamics 6 Credits

Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(ii) Theory of Machines 2 Credits

Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton's Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(iii) **Fluid Mechanics 6 Credits**

Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) **Science and Engineering of Materials and Metallurgy**
3 Credits

Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) **Engineering Drawing** **2 Credits**

Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) **Mechanical Engineering Design** **7 Credits**

Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production metching; Optimisation in design.

(vii) **Manufacturing Technology** **2 Credits**

Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) **Workshop Practice** **2 Credits**

Workshop setting; Types of workshop equipment, machines and materials; Use of instruments and tools, Machine operation practice; Safety procedures in workshops.

(ix) **Control Systems** **3 Credits**

Control Engineering concepts; Transfer function; Differential Equation of control Systems; Tranducers; Automatic control methods.

(x) **Engineering Statistics** **2 Credits**

Probability- elements of Probability, density and distribution functions, moments, standard distributions etc.

Statistics – Regression and correlation, Large sampling theory. Test hypothesis and quality control. Introduction to Statistical Analysis Software packages.

2.4 CHEMICAL ENGINEERING PROGRAMME

2.4.1 Philosophy, Aims and Objectives of the Degree Programme

As in Section 2.1.1

2.4.2 Admission and Graduation Requirements

As in Section 2.1.2

2.4.3 Learning outcome

As in Section 2.1.3

2.4.4 Attainment Levels

As in Section 2.1.4

2.4.5 Resource Requirement for Teaching and Learning

As in Section 2.1.5

2.4.6 Course Contents and Descriptions

Course Summary

Course Title	Lecture/Lab. Units
General Studies	16
Sub-Total	16
Basic Sciences	
Mathematics	20
Physics	10
Chemistry	17
Sub-Total	**47**
Entrepreneurial Studies	4
Sub Total	4
Core Engineering Courses	
(Chemical Engrg. Courses)	
Introduction to Chemical Engineering	3
Chemical Engineering Process Analysis	3
Transport Phenomena	10
Chemical Engineering Thermodynamics	7
Separation Processes	10
Kinetics & Reaction Engineering	7
Control and Optimisation	7
Plant Design	7
Chemical EngineeringLaboratory	8
Chemical Engineering Project	4
Sub-Total	**66**

Other Engineering Courses	
Technical/Engineering Drawing	2
Workshop Practice	2
Applied Electricity	4
Biochemical Engineering	4
Strength of Materials	4
Science of Materials	3
Polymer Engineering/Science	3
Computers & Computing	2
Other Engineering electives	3
Sub-Total	**27**
Specialisation	12
Components of Chemical Engineering	
General Studies	16
Basic Sciences	47
Entrepreneurial Studies	4
Major Engineering Courses	66
Other Engineering Courses	27
Specialisation	12
Total	**172**

Theory/Laboratory Ratio (contact hours) 62.5/37.5

Break-Down of Courses into Levels of Study

300 Level

Engineering Mathematics	5
Transport Phenomena I	4
Chemical Engineering Thermodynamics	3
Separation Processes I	3
Chemical Kinetics	3
Biochemical Engineering	4
Science of Materials	3
Polymer Process Engineering	3
Technical Communications	2
Chemical Engineering Laboratory	4
Humanities Electives	2
Engineering Elective	1
Foundation Course in Entrepreneurial Studies	2
Chemical Engineering Laboratory	4
Sub-Total	**39**

400 Level

Economics for Engineers	2
Transport Phenomena II	4
Chemical Engineering Thermodynamics	2
Separation Processes	4
Plant Design	2
Introduction to Entrepreneurship Studies	2
Chemical Engineering Laboratory	2
Engineering Electives	2
Sub-Total	**20**

500 Level

Separation Processes	3
Reaction Engineering	4
Process Control	4
Process Optimisation	3
Plant Design	5
Chemical Engineering Laboratory	1
Project	4
Specialisation	12
Sub-Total	**36**

Course Synopses

300 Level

i) **Transport Phenomena I** **4Credits**

Compressible flow: Normal shock waves. Non-Newtonian fluids. Radiation: Mechanism of radiative heat transfer. Heat exchange between radiating surfaces. Unsteady state conduction. Free and forced convective heat transfer. Determination of heat transfer coefficients. Application to design of heat exchanges. Diffusion of vapors. Diffusion in liquids and solids.

(ii) **Engineering Mathematics** **5 Credits**

Linear Algebra – Elements of Matrices, determinants, Inverse of Matrix. Theory of linear equations, Eigen-values and Eigen-vectors. Analytic geometry – co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates. Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equation, curve fitting. Simple linear programming. Fourier series – Euler coefficients, even and odd functions, Sine and Cosine, functions, simple applications. Gamma, Beta and probability functions. Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product divergence, curl and Del operators. Gradient. Line, surface and volume integrals and related theorems.

(iii) **Technical Communications** **2 Credits**

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills- extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing.

(iv) **Process Instrumentation 2 Credits**

Measuring instruments for level, pressure, flow, temperature and physical properties. Chemical composition analysers. Measurement. Gas chromatograph. Mass Spectrometer. Sampling systems.

(v) **Separation Processes I 3 Credits**

Stage-wise and continuous contact equipment. Isothermal gas absorption. Binary distillation. Leading. Hydrodynamics of packed and plate columns.

(vi) **Chemical Engineering Thermodynamics II 3 Credits**

The second law. Thermodynamics properties of pure fluids and mixtures. Isothermal isentropic and polytropic expansion. Carnot cycle. Thermodynamic cycles.Refrigeration. Steam and gas turbines.

(vii) **Chemical Reaction Kinetics 3 Credits**

Measurement and analysis of wreathing reaction. Homogeneous reactions. Catalysis. Chain reactions. Kinetics of heterogeneous and catalytic reactions. Photochemistry. Absorption of gases on solids. Application to gas chromatography.

(viii) **Biochemical Engineering 4 Credits**

Introduction microbiology and biochemistry. Classification and growth characteristics of micro-organisms. Enzymes in engineering. Microbial culture processes in manufacturing industries.

(ix) **Chemical Engineering Laboratory I 2 Credits**

Laboratory experiments in transport phenomena. Kinetics and separation process.

(x) **Chemical Engineering Laboratory II 2 Credits**

Further laboratory experiments in transport phenomena, kinetics and separation processes.

400 Level

(i) **Chemical Engineering Analysis (Electives) 2 Credits**

Applied ordinary and partial differential equations. Chemical engineering operations and their numerical solutions. Statistics: types of observation. Analysis of variance. Tests of significance. Regression analysis. Design of experiments.

(ii) **Transport Phenomena II 4 Credits**

Boundary layer theory and turbulence. Navier-Stokes equations. Universal velocity profile. Condensation and boiling. Eddy diffusion. Theories of mass transfer. Mass transfer with chemical reaction. Inter- phase mass transfer.

(iii) **Chemical Engineering Thermodynamics III 2 Credits**

The Euler equation, Gibbs-Duhem equation. Phase equilibria. Partial molar quantities. Chemical equilibria – Multicomponent systems. Non- ideal systems.

(iv) **Separation Processes II 4 Credits**

Drying of solids. Multiple-effects evaporators. Crystallisation. Ion- exchange. Reverse osmosis, humidification and water cooling.

(v) **Particle Technology (Electives) 2 Credits**

Properties of particles. Motion of particles in a fluid, Stoke's and Newton's Laws. Flow through packed beds. Fluidization. Sedimentation and flocculation. Filtration. Screening, Classification and grinding.

(vi) **Chemical Engineering Laboratory II 2 Credits**

Laboratory experiments in transport phenomena. Separation processes and thermodynamics.

(vii) **Economics for Engineers 2 Credits**

Introduction to economics. Economic analysis. Capital cost and manufacturing cost estimation Financial analysis. Discounted cash flow analysis. Accounting and depreciation. Sensitivity analysis. Break-even analysis.

(viii) **Engineering Mathematics 2 Credits**

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier transforms – Applications. Probability – Elements of probability, density and distribution functions, moments, standard distribution, etc. Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

500 LEVEL

(i) **Process Control 4 Credits**

Process dynamics. Transfer functions. Frequency response analysis. Discrete events. Control system design. Cascade control. Feed forward and feedback control. Introduction to multi-variable control. The control valve.

(ii) **Process Optimisation 3 Credits**

Maxima of functions through the use of calculus. Unconstrained peak seeking methods. Single and multi-variable search techniques. Constrained optimisation techniques. Linear programming. Numerical optimisation techniques. Discrete events.

(iii) **Principles of Chemical Engineering Plant 2 Credits**

Sources of design data. Process charts and flowsheets. Equipment selection, specification and design. Mechanical design of process vessels and piping. Environmental considerations. Site considerations. Process services.

(iv) **Loss Prevention in Process Industries 2 Credits**

Hazards in chemical process industries. Safety in plants. Causes of accidents in process plants. Prevention of accidents. Hazop technique. Maintenance of plant to minimise losses. Waste disposal and efficient treatment. Pollution control. Legal implications of various losses.

(v) **Separation Processes III 3 Credits**

Solvent extraction. Extractive and azeotropic distillation. Multicomponent gas absorption. Distillation of multi-component mixtures. Novel separation process.

(vi) **Law for Engineers 2 Credits**

Function of law, Basic principles of Nigerian Law. Introduction to the law of contracts. Law of Business associations. Industrial and Labour Law. Maritime Law. Environmental Law.

(vii) **Industrial Management 2 Credits**

Functions and responsibilities of management. Organising for efficiency. Training, recruitment and compensation of staff. Staff appraisal. Budget and cost control. Effective communication. General Management, Planning.

(viii) **Chemical Reaction Engineering 4 Credits**

Classification and types of reactions. Methods of operation and design equations for single and multiple reactions. Temperature and pressure effects. Fluid mixing and residence time distribution. Fixed and fludised bed reactor design. Catalyst deactivation. Choice of reactors.

(ix) **Chemical Engineering Research Project 4 Credits**

Individual research projects under the supervision of an academic staff. Projects should focus on national and state industrial problems.

(x) **Design Project 5 Credits**

A design problem involving the study of a process. Preparation of flowsheet, preparation of heat and mass balances and detailed design of some plant items. Economics and safety considerations must be stressed.

(xi) **Reservoir Engineering (Electives) 3 Credits**

Petroleum geology. Petroleum exploration. Crude oil production. Pollution control. Natural gas production.

(xii) **Coal Processing Technology (Electives) 3 Credits**

Introduction to coal formation. Physical and chemical properties of coal. Carbonisation of coal. Combustion of coal. Gasification of coal. Liquefaction of coal. Environmental aspects of coal utilisation.

(xiii) **Sugar Technology (Electives) 3 Credits**
Description of the equipments and considerations of the process and operations involve in the manufacture of refined sugar from cane. Utilisation of the by-products of the refining operation. Safety, economic and environmental considerations. Energy recovery.

(xiv) **Detergent Technology (Electives) 3 Credits**
Historical outline. Types of detergents. Mechanism of detergency. Oil and fats, manufacture of soap base by direct saponification of oils and fats. Manufacture of fatty acids. Production of solid soap, soap powders. Manufacture of non-soap detergents

(xv) F**ermentation Technology (Electives) 3 Credits**
Introductory microbiology and biochemistry. Substrates. The fermentation process. Batch and continuous fermentation. Malting and brewing. Wine making Enzymes in fermentation.

(xvi) **Pulp and Paper Technology (Electives) 3 Credits**
Properties of the raw materials. Preparation of pulpwood. Pulping processes. Energy recovery. Bleaching of pulps and stock preparation. Utilisation of by-products. Economics and ecological aspects of paper manufacture

(xvi) **Polymer Science and Technology (Electives) 3 Credits**
Introduction to polymer and their characteristics. Source of monomers. Structure and physical properties of polymers: rheology, solubility and molecular weights. Plasticity and elasticity. The William Landel Ferry Equation, Polymerisation reactions and manufacturing methods; Ziegler Natta catalysis. Processing and Technology of Polymers.

(xvii) **Technology of Fossil Fuel Processing (Electives) 3 Credits**
Source, availability and characterisation of fossil fuel (Petroleum, Natural gas, tar sands, coal). Modern processing technology: Choice of product lines and products: Alternative product lines and products and product specification to be emphasized.

(xviii) **Other Electives should be made up of the Following:**
Petrochemicals, Dyes and Dyestuff, Fertilizers, Chlor-Alkali Industries, Industrial Gases, Cement and Lime, Adhesives, Activated Carbon and Clay etc.

2.5 CIVIL ENGINEERING

2.5.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.5.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.5.3 **Learning outcome**
As in Section 2.1.3

2.5.4 **Attainment Levels**
As in Section 2.1.4

2.5.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.5.6 **Course Contents and Descriptions**

	Course Title			Lecture/Lab. Units
(a)	**Course Summary**			
	(i) **Core Courses**			
	Engineering Mathematics/Analysis			15
	Engineering/Construction Drawing			7
	(ii) **Structural Engineering**			
	Structural Analysis	(7)	}	
	Design of Structures	(7)	}	
	Civil Eng. Materials	(3)	}	22
	Strength of Materials	(3)	}	
	(iii) **Geotechnical Engineering**			

	Soil Mechanics	(5)	}	16
	Foundation Engineering	(4)	}	
	Geology	(3)	}	
	Highways Engineering	(2)		
	Transportation Engineering	(2)		
(iv)	**Water Resources & Environmental Eng.**			
	Fluid Mechanics		}	13
	Hydraulics		}	
	Hydrology		}	
	Public Health		}	
	Geodetic Eng. & Photogrammetry			6
	Civil Engineering Practice			2
	Engineer-in-Society			1
	Project			6
(v)	**Laboratory/Design Practicals**			21
(vi)	**Auxiliary Courses**			
	Thermodynamics			2
	Applied Mechanics			3
	Materials Science			2
	Manufacturing Technology			2
	Electrical Engineering			4
	Management and Economics			6
	Computers & Computing			3
	Technical Communications			2
(vii)	**Basic Science Courses**			
	Mathematics			12
	Physics			10
	Chemistry			8
(viii)	**General Studies**			
	General Studies			16
(ix)	**Entrepreneurial Studies**			4
(x)	**Optional/Electives**			6
	Compulsory Options/Electives from:			
	Advanced Structural Analysis			
	Geotechnical Engineering			
	Water Resources & Environmental Eng.			
	Highways & Transportation Engineering			
	Building/Construction Engineering			
	Total			**193**

(b) **Break-Down of Courses Into Levels of Study**

300 Level

Engineering Mathematics	
Fluid Mechanics	6
Strength of Materials	3
Engineering Geology	3
Elements of Architecture	3
Civil Engineering Materials	3
Soil Mechanics	3
Design of Structures	3
Structural Mechanics	3
	3
Engineering Surveying & Photogrammetry	3
Foundation Course in Entrepreneurial Studies	2
Hydrology	2
Hydraulics	2
Laboratory Practicals/Design Studies	6
Sub-Total	**45**

400 LEVEL

Engineering Mathematics	3
Civil Engineering Practice	2
Structural Analysis I	2
Design of Structures II	2
Soil Mechanics	2
Engineering Surveying & Photogrammetry	3
Highway Engineering	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals/Design Studio	3
Sub-Total	**23**

500 Level

Management and Economics	6
Structural Analysis II	2
Design Structures III	2
Geotechnical Engineering	3
Water Resources & Environmental Engineering	4
Highway Engineering	2
Transportation Engineering	2
Laboratory/Design	6
Safety Engineering	2
Project	6

One Optional Course (See below)	6
Optional Courses	
Advanced Structural Analysis	
Highway & Transportation Engineering	
Water Resources & Environmental Engineering	
Construction Engineering	
Geotechnical Engineering	
Drainage and Irrigation Engineering	2
Total	**40**

Course Synopses

(a) **300 Level**

(i) **Mathematics** **6 Credits**

Linear Algebra – Elements of matrices, determinants, Inverse of matrix. Theory of linear equations, eigen-values and eigen-vectors.Analytic geometry – co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates. Elements of functions of several variables.Numerical differentiation, solution of ordinary differential equations. Curve fitting. Simple linear programming. Fourier series – Euler coefficients, even and odd functions, Sine and Cosine, functions, simple applications, Gamma, Beta and probability functions. Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient. Line, Surface and volume integrals and related theorems.

(ii) **Fluid Mechanics** **3 Credits**

Fluid statics: Floatation and stability.

Dynamics of fluid flow-conservation equation of mass and momentum: Euler and Bernoulli equations. Introduction to incompressible viscous flow. Reynold's Number. Dimensional analysis – Philosophy, Similitude, Buckingham PI theorems. Applications. Hydraulic model. Flow measurements. Flow meters, errors in measurement.

(iii) **Strength of Materials** **3 Credits**

Advanced topics in Bending moment and shear force in beams.Theory of bending of beams. Deflection of beams. Unsymmetrical bending andshear center. Applications. Strain energy. Biaxial and triaxial state of stress.Transformation of stresses. Mohrs circle. Failure theories. Springs.Creep, fatigue,Fracture and stress concentration.

(iv) **Engineering Geology** **3 Credits**

Geological structures and mapping. Rocks and minerals. Stratigraphy – time scale– fossils and their importance: special reference to Nigeria. Introduction to

geology of Nigeria. Engineering Applications – Water supply, site investigation – Dams, Dykes, etc.

(v) **Elements of Architecture** **2 Credits**

Introduction – Dimensional awareness, Graphic communication, relation to environments. Free hand drawing – form in terms of shades, light and shadow. Orthographics; dimetrics, perspective projections: Applications. Common curves. Elementary Designs. Computer Aided Design and Drawing (CADD)

(vi) **Civil Engineering Materials** **3 Credits**

Concrete Technology – Types of cements, aggregates – properties, Concrete mix. Design, Properties and their determination. Steel Technology – Production, fabrication and properties: corrosion and its prevention. tests on steel and quality control. Timber Technology – Types of wood, propertie, defects. Stress grading, Preservation and fire protection. Timber products. Rubber, plastics; Asphalt, tar, glass, lime, bricks, etc. Applications to buildings, Roads and Bridges.

(vii) **Soil Mechanics** **3 Credits**

Formation of soils. Soil in water relationship – void ratio, porosity, specific gravity and other factors. Soil classification: Atterberg limits – particle size distribution. Flow in soils – seepage and permeability. Laboratory work.

(viii) **Design of Structures I** **3 Credits**

Fundamentals of design process, materials selection, building regulations and codes of practice. Design philosophy, Elastic design: Limit State design. Design of structural elements in Reinforced concrete. Further work in Computer Aided Design

(ix) **Structural Mechanics** **3 Credits**

Analysis of determinate structures, Beams, Trusses; Structure Theorems.
Graphical methods: Aplication to simple determinate trusses. Williot
Mohr diagram. Deflection of statistically determinate structures. Unit load, moment area methods. Strain Energy Methods. Introduction to statistically indeterminate structures.

(x) **Engineering Surveying & Photogrammetry 3 Credits**

Chain Surveying. Compass surveying – Methods; Contours and their uses. Traversing – methods and applications.
Levelling – Geodetic leveling – errors and their adjustment
Applications. Tacheometry – Methods; Substance heighting, self adjusting and electromagnetic methods. Introduction to Photogrammetry.

(xi) **Hydraulics** **2 Credits**

Simulation of complex flow fields using sources, sinks uniform flows and doublets and combinations of vortices. Steady and unsteady flows in open channels. Dimension analysis and similitude. Hydraulic modeling techniques, Pipe network analysis, Design of reticulation systems. Unsteady flows in pipes with special emphasis on water hammer and the use of surge tanks.

(xii) **Hydrology** **2 Credits**

The hydrologic cycle. Precipitation, infiltration, evaporation, groundwater, surface run-off, floods and droughts. Physical and statistical analysis related to hydrologic processes. Flood routing techniques. Hydrologic systems analysis. Hydrography analysis. Unit hydrograph theory. Occurrence and distribution of water in nature. Hydrogeology, Fundamentals of flows in porous media. Equations governing flows in aquifer. Exact and approximate solutions. Flows in layered aquifer systems.

(xiii) **Laboratory Practicals** **6 Credits**

All courses share the laboratory schedules to suit; sometimes in alternate weeks.

400 LEVEL

(i) **Engineering Mathematics** **3 Credits**

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier transforms – Applications.

Introduction to non-linear differential equations – stability and Applications. Probability – elements of probability, density and distribution functions, moments, standard distribution, etc. Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(ii) **Drainage and Irrigation Engineering** **2 Credits**

Analysis and design of surface and combined drainage systems, collectors, storages and pumps. Methods of overflow protection of large areas. Analysis and design of irrigation systems. Soil-plan-water relationships. Water supplies, water delivery systems and water distribution systems.

(iii) **Civil Engineering Practice** **2 Credits**

Civil Engineering Work Standards and measurements. Contracts and sub-contracts. Works construction and supervision. Job planning and control – Programme Charts – Bar charts. Critical path methods, etc. Construction machinery and equipment. Applications/Case study-dams, foundations, bridges, highways, industrial buildings, sewage works.

(iv) **Structural Analysis I** **3 Credits**

Indeterminate structural analysis: Energy and Virtual work Methods, Slope deflection and Moment distribution methods.Elastic Instability. Simple plastic theory of bending. Collapse loads. Stress-Grading of Timber, visual mechanical and electronic stress grading of Timber.

(v) **Design of Structures II** **2 Credits**

Limit state philosophy and Design in steel: Elastic and Plastic moment Designs. Design of Structural Elements in steel and connections and Joints. Limit state philosophy and design in Timber. Elastic methods and Design in Timber. Design of structural elements in Timber and Timber connectors. Laboratory Tests on Structural elements in Concrete, Timber and Steel. Computer Aided Design of structures

(vi) **Soil Mechanics** **2 Credits**

Mineralogy of Soils. Soil Structures. Compaction and Soil stabilisation. Site Investigations. Laboratory and Coursework.

(vii) **Engineering Surveying & Photogrammetry 3 Credits**

Further work on contours and contouring: Methods of contouring, contour interpolation and uses of contour plans and maps. Areas and Volumes. Setting out of Engineering Works. Elementary topographical surveying: Elements of photogrammetry, Photogrammetry equipment and Errors of Measurement.

(viii) **Highway Engineering** **2 Credits**

Soil Engineering Aspects of Highways. Railways and Airfields.Highway Geometrics. Pavement Structure and Design. Pavement materials and Laboratory Tests.

(ix) **Technical Communications** **2 Credits**

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills-extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing. Project report
presentation.
15 hrs (Teaching & demonstrations), 30hrs (Practicals).

(x) **Laboratory/Design Practicals** **3 Credits**

All courses share the Laboratory schedules to suit; sometimes in alternate weeks.

500 Level

(i) **Management and Economics** **4 Credits**

The Management of Environment: Formation of a company, sources of finance, money and credit. Insurance. National policies. GNP growth rate and prediction. Organisational Management: Principles and elements of organisation. Organisation charts. Functions. Types. Principles of Management. Schools of thought. Office and production management. Management by Objectives. Financial Management: Accounting methods. Financial statement. Elements of costing. Cost planning

and control. Budget and Budgeting control. Cost reduction programmes. Depreciation accounting, valuation of assets. Personnel Management: Selection, recruitment and training. Job evaluation. Merit rating. Incentive schemes. Industrial Committees and joint Consultations. Trade Unions and collective bargaining. Industrial Psychology: Individual and Group Behaviour. The learning process. Motivation and Morale. Influence of the Industrial Environment. Resources Management. Materials Management: Purchasing methods. Contracts. Interest formula. Rate of return. Methods of economic evaluation. Selection between alternatives. Tendering evaluation and contract administration. Planning and Decision Making: Forecasting Planning, Scheduling. Production control Gantt Chart. C.P.M. and PERT. Optimisation. Linear programming as an aid to decision making policies under risk and uncertainties. Transport and Materials Handling: Selection of transport media for finished goods, raw materials and equipment. Faculty layout and location.
Work Study and Production Processes: Basic principles of work study.
Principles of motion economy. Ergonomics in the design of equipment and process.

(ii) **Structural Analysis II** **2 Credits**

Plastic Methods of Structural analysis. Matrix Methods of Structural analysis. Elastic Instability. Continuum of plane strain, elastic flat plates and torsion, solution by series, finite difference, finite element. Yield line Analysis and Strip methods for slabs.

(iii) **Design of Structures III** **2 Credits**

Composite Design and construction in Steel and Reinforced Concrete. Design of Structural Foundations. Pre-stressed concrete Design. Modern Structural form. Tall Buildings, Lift shafts and shear walls, system buildings. Design projects.

(iv) **Geotechnical Engineering 4 Credits**

Stresses in Soils. Consolidation and settlement. Shear Strength of Soils. Earth Pressures. Bearing Capacity of Soils. Foundations: Normal and Deep Foundations. Slope Stability. Site Investigations.

(v) **Water Resources and Environmental Engineering 4 Credits**

Water Resources **2 Credits**

The Hydraulics of open channels and Wells .Drainage. Hydrograph Analysis. Reservoir and Flood-routing. Hydrological forecasting Hydraulic Structures, i.e. Dams, Dykes/Levees, Weirs, Docks and Harbours, Spillways, Stilling basins, Man Holes and Coastal Hydraulic Structures, etc. Engineering Economy in Water Resources Planning

Environmental Engineering **2 Credits**

The work of the Sanitary Engineer. Water Supply, Treatment and Design. Waste Water Collection, Treatment, Disposal and Design. Solid waste Collection, treatment, disposal and design of systems.
Air Pollution and Control.

(vi) **Highway Engineering** **2 Credits**

Highway Planning and Traffic Surveys. Pavement Design. Construction and maintenance. Administration and Finance of Highways.

(vii) **Transportation Engineering** **2 Credits**

Coordination of all Transportation Media. Transportation Planning and Economics. Traffic Management and Design of Traffic Signals. Parking. Geometric Design. Construction Methods. Construction. Materials and Laboratory Tests.

(viii) **Laboratory/Design** **6 Credits**

Courses (ii) – (vii) should carry Laboratory/Design works while (i) carry case Study/Feasibility Report assignments.

(ix) **Project** **6 Credits**

For proper guidance of the students, Projects will depend on the available academic staff expertise and interest but the projects should be preferably of investigatory nature. Preferably, students should be advised to choose projects in the same area as their. Optional course. (See below)

(x) **Optional Course** **6 Credits**

The Option Course is to be taken from the following:-
Advanced Structural Engineering. Highway and Transportation Engineering. Water Resources and Environmental Engineering. Building/Construction Technology. Geotechnical Engineering. The Options should aim at standards normally higher than the Bachelor's degree but below Master's degree expectations and calling for an in-depth study in the above areas.

2.6 COMPUTER ENGINEERING

2.6.1 Philosophy, Aims and Objectives of the Degree Programme

As in Section 2.1.1

2.6.2 Admission and Graduation Requirements

As in Section 2.1.2

2.6.3 Learning outcome

As in Section 2.1.3

2.6.4 Attainment Levels

As in Section 2.1.4

2.6.5 Resource Requirement for Teaching and Learning

As in Section 2.1.5

2.6.6 Course Contents and Descriptions

		Lecture/Lab. Units
(a)	**Course Summary**	
(i)	**Humanities**	
	General Studies	16
(ii)	**Basic Sciences**	
	Mathematics	12
	Physics	10
	Chemistry	8
	Total	**46**
(iii)	**Entrepreneurial Studies**	4
(iv)	**Basic Engineering Courses**	
	Engineering Mathematics	6
	Computers & Computing	3
	Engineering Drawing	4
	Applied Mechanics	4
	Strength of Materials	2
	Material Science	3
	Thermodynamics	2
	Fluid Mechanics	2

Basic Electrical Engineering	6
Manufacturing Techniques/Workshop Practice	2
Engineer-in-Society	1
Total	**36**

(v) **Core Courses**

Engineering Mathematics	12
Embedded system design	3
Analogue Electronic Circuits	3
Digital Electronic Circuits	3
Measurements and Instrumentation	3
Circuit Theory	6
Digital System design with VHDL	3
Control System	3
Communication Principles	3
Electrical Machines	3
Software Engineering	3
Computer Programming	2
Assembly Language Programming	3
Software Development Techniques	3
Microprocessor system & Interfacing	3
Laboratory Practicals	9
Artificial Neural Network	3
Computer Graphics & Animations	3
Computer Organisation & Architecture	3
Cyberpreneuship & Cyberlaw	2
Computer Security Techniques	3
Data Communication & Network	3
Prototyping Techniques	2
Digital Signal Processing	3
Reliability & Maintainability	3
Project	6
Electives	4
Total	**98**

Course Title

(b) **Break-Down Of Courses Into Levels Of Study:**

Core Courses 300 Level

Engineering Mathematics	6
Electromagnetic Fields & waves	3
Computer Organisation & Architecture	3
Entrepreneurial Studies	4
Circuit Theory	3
Analogue Electronic Circuit	3
Digital Electronic Circuit	3
Communication Principles	3

Measurement & Instrumentation	3
Electrical Machines	3
Laboratory Courses	3
Software Development Techniques	3
Total	**40**

CORE COURSES 400 LEVEL	
Technical Communications	2
Microprocessor System & Interfacing	3
Control System	3
Data Communication & Network	3
Assembly Language Programming	3
Object Oriented Design & Programming	3
Laboratory Course	2
Prototyping Techniques	2
SIWES (Industrial Training)	6
	27

CORE COURSES 500 LEVEL	
Reliability and Maintainability	3
Embedded system design	3
Software Engineering	3
Digital Signal Processing	3
Digital System design with VHDL	3
Artificial Neural Network	3
Cyberpreneurship & Cyberlaw	2
Computer Graphics & Animation	3
Computer Security Techniques	3
Project	6
Electives (2):	
Robotic & automation	2
Digital Image Processing	2
Digital Speech Processing	2
Fuzzy logic & Programming	2
Cryptography Principles & Applications	2
Total	**34**

Course Synopses

300 Level

Computer Organisation and Architecture **3 Units**

Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored program concept. Von-Neuman architecture. Havard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. Computer

Arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types), Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Overview of I/O, programmed and interrupt-driven I/Os, DMA, I/O channel and I/O processor. Control Unit: Micro-operations, control of the CPU, hardwired implementation, control unit operation, micro-instruction sequencing and execution, micro-programmed control. Use INTEL family, and MOTOROLA family as case study of a CISC computer system. Instruction Set and Register: Machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, register organization, instruction pipelining. High performance computer systems: Techniques to achieve high performance, pipelining, storage hierarchy, units with function dedicated for I/O. RISC, introduction to superscalar processor, parallel processor. Use popular RISC processor (e.g. i960, Motorola PowerPC) as case study. Operating System: Overview of operating system, dimension and type of operating system, high level scheduling, short-term scheduling, I/O scheduling, memory management, virtual memory, UNIX/LINUX operating system: architecture, commands, programming; window based operating systems (MS windows, X-window).

Software Development Techniques **3 Units**

Software development life cycle. Top-Down design. Program, design using pseudo-code, flowchart. Flowchart ANSI symbols and usage. Extensive examples, and exercises using pseudo-code/flowchart to solve practical problems in engineering. Debugging and documentation techniques. Programming using a structural language such as C: Symbols, keywords, identifiers, data types, operators, various statements, operator precedence, type conversion, conditional and control structures, function, recursive functions. Arrays: 1-D, and multi-dimensional arrays, passing elements or whole array to a function. Simple sorting and searching on arrays, pointers, strings, dynamic memory allocation. Structures and Unions: Structure declaration and definition, accessing structures, array of structures, pointers and structures, union declaration, enumerated variables. File Handling: Concept of a file, files and streams, standard file handling functions, binary files, random access files. Advanced Topics: Command line parameters, pointers to functions, creation of header files, stacks, linked lists, bitwise manipulation. Software development in C in MS Windows, UNIX/LINUX environments, header file, preprocessor directives, make, makefile. Static and dynamic linking libraries. Extensive examples, and exercises programming in C to solve practical problems in engineering. Exercises are to be done in the Computer Laboratory.

Analogue Electronic Circuit (3)

See Electrical and Electronics Engineering (Sec 2.8.6)

Digital Electronic Circuit (3)

See Electrical and Electronics Engineering (Sec 2.8.6)

Communication Principles 3

See Electrical and Electronics Engineering (Sec 2.8.6)

Electrical Machine 3

See Electrical and Electronics Engineering (Sec 2.8.6)

Electromagnetic Field & Waves

See Electrical and Electronics Engineering (Sec 2.8.6)

400 Level

Control System **3 Units**

Introduction: definition, examples of control systems. Open-loop and closed-loop control systems. Review of Laplace and inverse Laplace transforms. System modelling: Signal flow graph, block diagram. Transfer function. Poles and zeros. Block diagram reduction using signal flow graph and block diagram reduction techniques. Mechanical, electrical and electromechanical systems. First and second order models, higher order models. Definitions of transient response parameters. Analysis of second-order system as prototype. Routh-Hurwitz stability criterion. Classification of systems based on steady-state characteristics, steady-state error coefficient. Definition of Root locus, Properties of root locus, sketching of root locus plots. Effect of open-loop zeros and poles. Root locus design concepts. Frequency response analysis and design: Bode diagram, Polar plot, Nichols plot. Nyquist stability criterion: non-mathematical description of Nyquist criterion, interpretation of stability. Relative stability - Gain and phase margins. Closed-loop frequency response analysis - M and N contours, Nichols chart. Compensation techniques: lag, lead and lag-lead compensation, PD, PI and PID controllers. Cascade compensation based on root-locus method. Introduction to Feedback compensation. Computer-aided design and analysis of control system.

Data Communication and Network **3 Units**

Introduction to Data communications: the Development of Data Communications; types and sources of data, simple communications network, transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronization, character synchronization, character synchronization, synchronous transmission, asynchronous transmission, efficiency of transmission, error detection methods and data compression. Protocols: Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding and dynamic Huffman coding. Local Area Networks: medium access control techniques – Ethernet, token bus and token ring; LAN standards; fibre distributed data interface, metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface independence, platform independence, transaction processing, connectivity, reliability, backup and recovery mechanisms. Information Network Software; Features and benefits of major recovery mechanisms. Information Network Software: features and benefits of major Network Operating Systems. Network OS: (e.g. Novell NetWare, UNIX/LINUX, OS/2 & WindowsNT). TCP/IP and Network OS. INTERNET: Definition, architecture, services, Internet addressing. Internet protocol, IPv4, IPv6. Internet programming, Intranet. System administration, and security issues.

Prototyping Techniques **2 Units**

Introduction: Grounding, ground plane, digital ground, analogue ground, power decoupling, inductance and capacitive effects, feedthrough capacitors. Soldering techniques for pass-through and surface mount components, desoldering. Breadboarding, veroboarding. Wire wrapping techniques. Radio Frequency design and implementation techniques. Printed Circuit Board techniques, and production of PCB. Use of PCB CAD packages. Construction exercises using different prototyping techniques.

Microprocessor System and Interfacing 3Units

A basic microprocessor system: the CPU, memory, I/O, and buses subsystems, basic operation of a microprocessor system: fetch and execute cycle, the architecture of some typical 8-bit, 16-bit microprocessors (INTEL, MOTOROLA) and their features. Programming model in real mode: registers, memory, addressing modes. Organisation of the interrupt system, interrupt vectors, and external interrupts, implementation of single and multiple interrupts in real mode. Programming model in protected mode: registers, memory management and address translation, descriptor and page tables, system control instructions, multitasking and memory protection, addressing modes, and interrupt system. Memory interfacing and address decoding. I/O interfacing: memory mapped i/o, isolated i/o, bus timing, i/o instructions. Peripheral devices interfacing: 8255 PPI/6821 PIA, 8251 USART/6821 UART, DMA, Timer/Counter chips, etc. Instruction set. Assembly language Programming of INTEL and MOTOROLA microprocessors. Discussion of a typical system e.g. IBM PC, Apple Macintosh.

Assembly Language Programming 3 Units

Introduction: Language level of abstraction and effect on machine, characteristics of machine code, advantages , justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: Programming model as resources available to programmer, addressing modes, instruction format, instruction set- arithmetic, logical, string, branching, program control, machine control, input/output , etc; assembler directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service routine. Interfacing of assembly language to C . Intel 80x87 floating point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

500 Level

Cyberpreneurship & Media Law 2 Units

Introduction: Definition of creativity, innovation, examples of creativity leading to innovation, commercialization of creative and innovative ideas. Trends in technology development. Entrepreneurship management and ownership. Characteristics of entrepreneur, starting a new business, business planning, strategic planning & management, site selection and layout. Establishing new venture, risk management. Business Plan Development: definition, need, preparation of business plan. Forecasting developments and charting an action plan . Identifying the product/service, market research and feasibility study. Financing business. Sources of debt financing. Creating the marketing plan, pricing, creative advertising and promotion. Entrepreneurship case studies: Overview and analysis of successful entrepreneurs such as Bill Gates, Michael Dell, David Filo and Jerry Yang of Yahoo, etc. Nigerian Entrepreneurship: Discussion of Nigerian business environment, and illustrated with successful Nigerian entrepreneurs. Overview of the Nigerian Legal System: Civil and criminal. Basic concepts of law. Contract Law. . Current issues: digital signatures, Intellectual property and copyright. Speech Law: Defamation, Sedition, Printing Press Act. Speech on the Internet. Advertising Code: Made in Nigeria rules and guidelines, Advertising Standards. Media and Licensing law in Nigeria: Developing an in-depth understanding of the nature and function of Nigerian media law. Public and Private licensing. Intellectual and moralrights. Music royalties, synchronization rights, performance rights. Role of music publishers. Broadcast rights, merchandising. Detailed

analysis of Communications and Multimedia Act. Ethic and Etiquette: New codes of social behaviour: the right to privacy.

Digital System Design with VHDL **3 Units**

Finite State Machine: definition, mealy and moore models, state diagram, state table, transition table. Sequential circuits design using flip-flops, asynchronous, and synchronous circuit design. Algorithm State Machine. Design examples and exercises. Structured Design: Design constructs, Design Levels, Geometry-based interchange formats, Computer aided electronic system design tools, Schematic circuit capture, Hardware description languages, Design process (simulation, synthesis), Structural design decomposition. Introduction to VHDL: VHDL language abstractions, Design hierarchies, VHDL component, Lexical description, VHDL source file, Data types, Data objects, Language statements, Concurrent VHDL, Sequential VHDL, Advanced features of VHDL (library, package and subprograms). Structural level modeling, Register-Transfer level modeling, FSM with datapath level modeling, Algorithmic level modeling. Introduction of ASIC, Types of ASIC, ASIC design process, Standard cell ASIC synthesis, FPGA Design Paradigm, FPGA synthesis, FPGA/CPLD Architectures. VHDL Design: Top-down design flow, Verification, simulation alternatives, simulation speed, Formal verification, Recommendations for verification, Writing RTL VHDL code for synthesis, top-down design with FPGA. VHDL synthesis, optimization and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives. Computer-aided design of logic circuits.

Digital Signal Processing **3 Units**

Introduction: Advantages of digital over analogue signal processing, problems of digitization, overview of application of DSP, basic elements of DSP system. Digital Processing of analogue signals: Sampling of analogue signals, sampling theorem, aliasing, quantization, noise, and coding, types and selection of ADC/DAC, Sigma-delta ADC. Analytical tools: z-transform, properties, transfer function, inverse z-transform, z-plane poles and zeros, analysis of linear time-invariant in z-domain, system stability. Discrete Fourier Analysis: Discrete Fourier Transform and properties, inverse DFT, truncated fourier transform, windowing, FFT algorithms. Discrete Time Signals & systems: Discrete time sequences (signals), classification and determination of discrete time system, discrete time i/o description (difference equation), solution of difference equations, convolution, correlation, impulse response. Digital Filters: Definition and types. FIR filters: Transfer function, characteristics, applications, design methods, Gibb's effect and elimination, fir filter realisation. IIR filter: Transfer function, characteristics, applications, overview of analogue filter design techniques, design methods-conversion from analogue to digital filter design techniques, IIR filter realization. Structure of Discrete Time System: Block diagram representation of constant coefficient difference equations, IIR and FIR systems and their basic structures, stability of discrete time systems. Software implementation of dsp algorithms. DSP Microprocessors: Architecture, fixed point vs floating point DSP, Finite word length effects. DSP chips: interfacing and programming. Practical application of DSP in audio, and video.

Reliability and Maintainability **3 Units**

Introduction to reliability, maintainability, reliability specification and metrics. Application to computer hardware system, communication equipment, power systems, electronic components. Basic maintenance types, and procedures of computer and digital communication system. Fault

troubleshooting techniques. QoS and time of availability of data communication. Quality control techniques. Design for higher reliability, fault tolerance. Software Reliability: software reliability specification, software reliability Metrics, fault avoidance, fault tolerance, programming for reliability, software safety and hazard analysis. Comparison of hardware and software realiability. Software Quality and Assurance: definition of software quality, software quality factors, quality control, cost of quality, quality assurance. SQA activities, formal technical reviews, software quality metrics, statistical quality assurance. ISO 9000 Requirements and Certification, ISO 9000-3 for software quality process, process documentation, quality audit. Capability Maturity Model: Software Engineering Institute, levels of maturity, key process areas, Comparison between ISO 9000 Standards and CMM. Ensuring Quality and Reliability: verification and validation, measurement tracking and feedback mechanism, total quality management, risk management.

Embedded System Design **3 Units**

Introduction to embedded system, components, characteristics, applications. Intel 8051/8031 Micro-controller: Features of the 8051/8031 family, block diagram and definitions of the pin of the 8051, I/O port structure, memory organisation: general purpose RAM, bit addressable RAM, register bank, special function registers, external memory, memory space mapping and decoding, bus control signals timing, a typical 8051 micro-controller based system. Instruction Set and Assembly Language Programming: Addressing modes, the 8051 instruction set and typical examples, assembler operation, assembly language format, assembler directives, operation of assemblers and linkers, programming examples. On-chip Peripheral Devices: I/O ports, operations and uses of port 0, port 1, port 2, port 3, timers: their operations, programming, and applications, serial port: operations and programming, typical applications, serial port interrupt. Interfacing to external memory, keypad, seven-segment LED display, ADC and DAC chips, and input / output port expansion, description and uses of hardware development tools. MOTOROLA M6811 Micro-controller: Features of the M6811 family, block diagram and definitions of the pin of the M6811, I/O port structure, memory organisation: general purpose RAM, bit addressable RAM, register bank, special function registers, external memory, memory space mapping and decoding, bus control signals timing. Instruction Set and Assembly Language Programming. On-chip peripheral devices and I/O interfacing. Introduction to PIC microcontroller: general architecture, applications and selection of microcontroller, advantages, low-end, and high performance PIC. Specific PIC microcontrollers: Features, architecture, block diagram, pin configuration, on-chip memory, and peripheral. Instruction set and Assembly language programming. Serial I/O interfacing: I2C, and SPI interfacing and programming. Memory interfacing: external memory interfacing, EEPROM and Flash memory interfacing. Design exercises using development system.

Neural Network & Programming **2 Units**

Neural Network: Definition of artificial neural network. Similarities of neural network with human brain. Classification of ANN. Terminologies: input/output sets, weights, bias or threshold, supervised learning, network training, Convergence process, single layer vs. multilayer perception, Forward and Backward propagation, gradient descent rule. Back-propagation neural network, Variable term used in back propagation neural network: learning rate, momentum, hidden nodes, sigmoid activation function. Back propagation algorithm of ANN. Design of ANN model, training sets for ANN, test sets for ANN, network testing and performance. Engineering applications. ANN programming.

Computer Security Techniques **2 Units**

Introduction: Overview of computer security, attacks and services, control of hardware software. Usage. Intruders, Viruses and Worms: Intrusion techniques. Nontechnical attacks. Password protection and its vulnerability. Intrusion detection. Nature of viruses. Malicious programs. Types of viruses. Antivirus approaches. Worm propagation and countermeasures: access control, intrusion detection and firewalls. Disaster Recovery: Recovery requirements, policy, strategy, technical team. Execution of recovery plans. Documentation and backup system. Loss estimation. Developing Secure Computer System: External Security Measures, Issue, Security Models [Specification and Verification, Bell and LaPadulla Model, Clark-Wilson Model, Goguen-Meseguer, TCSEC], Discretionary Access Requirements, Mandatory Access Requirements, User Authentication, Access and Information Flow Control, Auditing and Intrusion Detection, Damage Control and Assessment, Microcomputer Security. Entropy, perfect secrecy, unicity distance, complexity theory, NP completeness, number theory. Cryptographic System, Public Key Systems, digital signatures. Network and Telecommunication Security: Fundamentals, Issue, Objective and Threats, Security Services, Distributed System Security, The Trusted Network Interpretation, TNI Security Services, AIS Interconnection Issues, Firewalls [Gateways, Application, Cost and Effectiveness .Database Security: Security Requirements to Databases, Designing the Security, Methods of Protection, Security of Multilevel Database .

Digital Image Processing **2 Units**

Introduction: definition, problems, and applications of digital image processing. Digital image acquisition devices. Digital image formats. Edge detection techniques, segmentation methods. Image Morphology. Image enhancement. Image restoration techniques. Morphology. Fourier transform and Wavelet transform in image processing. Image registration techniques. Shape analysis. Image understanding. Artificial neural network and image understanding. Colour representation standards, equations, processing, quantization, and dithering. Case study: practical application of image processing to face recognition, fingerprint, iris, etc. Introduction to image compression techniques.

Fuzzy Logic & Programming **2 Units**

Introduction: fuzzy set theory, knowledge base problem, objective and subjective knowledge, crisp sets, fuzzy sets, linguistic variables, membership functions. Set theoretic operations, comparison between crisp sets and fuzzy sets. Law of Contradiction and Law of Excluded Middle, fuzzy intersection, union and complement, and other fuzzy operators. Fuzzy relations and compositions on the same and different product spaces. Max-Min composition, Max-Product composition, fuzzy relational matrix, sup-star composition. Hedges or modifiers of linguistic variables, fuzzy logic vs. probability. Fuzzy reasoning and implication, the fuzzy truth tables, traditional propositional logic and the rule of inference, the Modus Ponens and Modus Tollens, fuzzy modeling with causal IF-THEN statements. Fuzzy Models, fuzzy logic systems, combination of fuzzy basis functions, universal approximator, fuzzy neural network, fuzzy associate memory matrix, self-learning fuzzy systems. Fuzzy logic system applications. Fuzzy programming.

Robotic & Automation **2 Units**

Robot classification and manipulation. Technology and history of development of robots. Applications. Direct and inverse kinematics: arm equation. Workspace analysis and trajectory

planning. Differential motion and statics. Manipulator dynamics. End-of arm tooling. Automation sensors. Robot vision. Work-cell support systems. Robot and system integration. Safety. Human interface. Robot control system. Circuit and system configuration. Task oriented control. Robot control programming. Fuzzy logic and AI based robot control. Fundamentals of automation. Strategies and economic consideration. Integration of systems. Impact to the production factory. Evaluation of conventional processes. Analysis of automated flow lines. Assembly systems and line balancing. Automated assembly systems. Numerical control and adaptive control. Robot applications. Automated materials handling and storage systems. Automation in inspection and testing. Linear feedback control system. Optimal control. Computer process control. Computer integrated manufacturing systems. Future automated factory.

Cryptography Principles & Applications 2 Units

History of cryptographic System, Public Key Systems, Digital Signatures. Information Theory: Entropy, Perfect Secrecy, Unicity Distance, Complexity Theory, NP Completeness, Number Theory. Data Encryption Methods : Transposition Ciphers, Substitution Ciphers, Product Ciphers, Exponentiation Ciphers, Knapsack Ciphers, Breakable NP-Complete Knapsack, Encryption Standards DES, RSA, Elliptic Curves. Cryptographic Techniques: Block and Stream Ciphers, Autokey, Endpoints of Encryption, One-way Ciphers, Password and Authentication, Secret Keys and Public Keys, Threshold Scheme. Video scrambling techniques. Digital video encryption techniques: principle, IRDETO, Viaaccess, Videoguard, etc. Security and Legality Issues: Copyrights, Patents, Trade Secret, Ownership of Products, Computer Crimes, Ethical Issue in Computer Security.

Design & Installation of Electrical & ICT services 3 Units

Electrical Installation: Induction to Health and safety at work act in Nigeria. Electrical safety. First aid. Electricity supply regulations. Lighting and Illumination: Luminous intensity and flux. Maintenance factor. Coefficient of utilization. Types of light sources. Calculation of lighting requirements. Glare. Stroboscopic effect. Installation Materials, cables, junction box, terminations, joints. Conduits and conduiting. Truck and trucking. Electrical Installation design in domestic, commercial and industry. Alarm and emergency systems. Earthling and Protection. Purposes of earthing. Faraday cage. Rod electrodes. Earth electrode resistance. Earthing system. Earth fault loop impedance. ICT services: NCC and FCC codes of practice and standards. Telecommunication design and installation: Satellite, VSAT, etc. Telephone design and installation. Computer networking design and installation. Wireless LAN design and installation. Preparation of Bill of Engineering Measurement Evaluation. Contract bidding. Consultancy.

Computer Security Techniques 2 Units

History of cryptographic System, Public Key Systems, Digital Signature. Information Theory: Entropy, Perfect Secrecy, Unicity Distance, Complexity Theory, NP Completeness, Number Theory. Data Encryption Method Ciphers, Knaspsack Ciphers, Breakable NP-Complete Knapsack, Encryption Standards DES, RSA, Elliptic Curves. Cryptographic Techniques: Block and Stream Ciphers, Autokey, Endpoints of Encryption, One-Way Ciphers, Password and Authentication, Secret Keys and Public Keys, Threshold Scheme. Video Scrambling techniques. Digital video encryption techniques: principle, IRDETO, Viaaccess, Videoguard, etc. Security and Legality Issues: Copyrights, Patents, Trade Secret, Ownership of Products, Computer Crimes, Ethnical Issue in Computer Security.

Computer Graphics & Animations (3Units)

Overview of 3D animation and its application and types. Coordinate system, vertex, faces and object. Concept of wireframe, surface and solid modeling. Construction planes and differences between object space and world space. Principles of making characters alive. Polygonal Modeling techniques: the Box, using Edit Mesh, Smoothing Techniques, Sudivision Surfaces. Nurbs Modelling techniques: Utilizing NURBS toolbox, surface points and CVs. Importing and attaching NURBS surfaces, rebuilding surfaces, curve and surface approximation. Graphic animation process: Camera & Animation Camera, Set & Background (Image Plane), Light Linking. Animation Techniques: Walk Cycle and Facial Expression using Blend Shape. Dynamics animation: Rigid Bodies, Soft Bodies, constraint, Particles. Tips and tricks on rendering. Concept of Rendering in 3D modeling. Render options and file output. Same as CSP 421.

Cyberpreneurship & Media Law (2 Units)

Introduction: Definition of creativity, innovation, examples of creativity leading to innovation, commercialization of creative and innovative ideas. Trends in technology development. Entrepreneurship management and ownership. Characteristics of entrepreneur, starting a new business, business planning, strategic planning & management, site selection and layout. Establishing new venture, risk management. Business Plan Development: definition, need, preparation of business plan. Forecasting developments and charting an action plan . Identifying the product/service, market research and feasibility study. Financing business. Sources of debt financing. Creating the marketing plan, pricing, creative advertising and promotion. Entrepreneurship case studies: Overview and analysis of successful entrepreneurs such as Bill Gates, Michael Dell, David Filo and Jerry Yang of Yahoo, etc. Nigerian Entrepreneurship: Discussion of Nigerian business environment, and illustrated with successful Nigerian entrepreneurs. Overview of the Nigerian Legal System: Civil and criminal. Basic concepts of law. Contract Law. . Current issues: digital signatures, Intellectual property and copyright. Speech Law: Defamation, Sedition, Printing Press Act. Speech on the Internet. Advertising Code: Made in Nigeria rules and guidelines, Advertising Standards. Media and Licensing law in Nigeria: Developing an in-depth understanding of the nature and function of Nigerian media law. Public and Private licensing. Intellectual and moralrights. Music royalties, synchronization rights, performance rights. Role of music publishers. Broadcast rights, merchandising. Detailed analysis of Communications and Multimedia Act. Ethic and Etiquette: New codes of social behaviour: the right to privacy.

2.7 ELECTRICAL ENGINEERING

2.7.1 Philosophy, Aims and Objectives of the Degree Programme

As in Section 2.1.1

2.7.2 Admission and Graduation Requirements

As in Section 2.1.2

2.7.3 Learning outcome

As in Section 2.1.3

2.7.4 Attainment Levels

As in Section 2.1.4

2.7.5 Resource Requirement for Teaching and Learning

As in Section 2.1.5

2.7.6 Course Contents and Descriptions

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Humanities**	
		General Studies	16
	(ii)	**Basic Sciences**	
		Mathematics	12
		Physics	10
		Chemistry	10
		Sub-Total	**48**
	(i)	**Entrepreneurial Studies**	4
	(ii)	**Basic Engineering Courses**	6
		Engineering Mathematics	4
		Computers & Computing	4
		Engineering Drawing	4
		Applied Mechanics	2
		Strength of Materials	3
		Material Science	2
		Thermodynamics	2
		Fluid Mechanics	
		Basic Electrical Engineering	6
		Manufacturing Technology/Workshop	2
		Engineer-in-Society	1
			36

(iii) **Core Courses**

Engineering Mathematics	4
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Analogue Electronic Circuits	3
Digital Electronic Circuits	3
Physical Electronics	3
Measurements and Instrumentation	3
Control Theory	3
Communication Principles	3
Electrical Machines	4
Electric Power Principles	3
Laboratory Practicals	9
Reliability Engineering	2
Electromechanical Devices Design	2
Electrical Services Design	2
Advanced Computer Programming	3
Advanced Circuit Techniques	2
Power Electronics and Devices	3
Control Engineering	3
Electric & Magnetic Field Theory	2
Power Systems Engineering (Systems } Analysis) Planning and Protection	3
Power Systems Communication & Control	2
Switch Gear and High Voltage Engineering	2
Technical Communications	2
Project	6
Electives	6
Total	**93**

b) **Break-Down Of Courses Into Levels Of Study**

300 Level (2 Semesters) And 400 Level (1 Semester): (3 Semesters)

Engineering Mathematics	4
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Analogue Electronic Circuits	3
Digital Electronic Circuits	3
Physical Electronics	3
Measurements and Instrumentation	3
Control Theory	3
Communication Principles	3
Electric Power Principles	3

Electrical Machines	4
Laboratory Practicals	9
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Total	**58**

Core Courses (500 Level: 2 Semesters):

Reliability Engineering	2
Electromechanical Devices Design	2
Electrical Services Design	2
Advanced Computer programme & Statistics	3
Advanced Circuit Technique	2
Power Electronics and Devices	2
Control Engineering	3
Electric and Magnetic Field Theory	3
Power Systems Engineering (Systems Analysis)	2
Planning and Protection	3
Power Systems Communication and Control	2
Switch Gear and High Voltage Engineering	2
Project	4
Electives	6
Total	**36**

Course Synopses

(i) **Core Courses 300 Level: 2 Semesters and 400 Level 1 Semester: 3 Semesters:**
All courses are the same as for 300 and 400 levels of Sec 2.8.6

(ii) **Core Courses (500 Level: 2 Semesters)**

(iii) **Reliability Engineering:**
See Sec 2.8.6

(iv) **Electromechanical Devices Design**
See course OPT. 1 of Sec 2.8.6

(v) **Electrical Services Design**
See course OPT. 2 of Sec 2.8.6

(vi) **Advanced Computer Programming**
See Section 2.8.6

(vii) **Advanced Circuit Techniques**
See Section 2.8.6

(viii) **Power Electronics and Devices**
See course OPT. 3 of Section 2.8.6

(ix) **Control Engineering**
See Section 2.8.6

(x) **Electric And Magnetic Field Theory**

(xi) Electric, magnetic field problems, solutions, electric fields of electrode configurations. Field distribution in air-gap Schwar problems, Christoffed

transformation, numerical analysis, Simulation Quasi-stationary magnetic fields, eddy currents, braking power.

(xii) **Power Systems Engineering**
See course OPT. 4 of Sec 2.8.6

(xiii) **Power Systems Communication and Control**
See course OPT. 5 of Sec 2.8.6

(xiv) **Switchgear and High Voltage Engineering**
See Sec 2.8.6

(xv) **Project**
See Sec 2.8.6

(xvi) **Electives**
See Sec 2.8.6

2.8 ELECTRICAL AND ELECTRONICS ENGINEERING

2.8.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.8.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.8.3 **Learning outcome**
As in Section 2.1.3

2.8.4 **Attainment Levels**
As in Section 2.1.4

2.8.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.8.6 **Course Contents and Descriptions**

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Humanities**	
		General Studies	16
	(ii)	**Basic Sciences**	
		Mathematics	12
		Physics	10
		Chemistry	8
		Sub-Total	**36**
	(iii)	**Entrepreneurial Studies**	4
	(iv)	**Basic Engineering Courses**	
		Engineering Mathematics	12
		Computers & Computing	3
		Engineering Drawing	4
		Applied Mechanics	4
		Strength of Materials	2
		Material Science	3
		Thermodynamics	2
		Fluid Mechanics	2
		Basic Electrical Engineering	6

Manufacturing Technology/Workshop Practice	2
Engineer-in-Society	1
Sub-Total	**41**

(v) **Core Courses**

Engineering Mathematics	4
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Analogue Electronic Circuit	3
Digital Electronic Circuit	3
Physical Electronics	3
Measurements and Instrumentation	3
Communication Principles	3
Electric Power Principles	3
Electromechanical Devices & Machines	4
Practicals	9
Reliability Engineering	2
Advanced Computer Programming & Statistics	3
Control Engineering	2
Advanced Circuit Techniques	2
Final Year Project	4
Electives	6
Total	**73**

(vi) **Options**

A choice of 20 Credits from any of the following courses	2
Electromechanical Devices Design	2
Electrical Services Design	
Power Electronics and Drives	3
Power Systems Engineering (Systems Analysis, Planning and Protection)	2
Power Systems Communication and Control	2
Switchgear and High Voltage Engineering	2
Industrial Electronics Design	
Micro-Computer Hardware and Software Techniques	3
Communications Systems	3
Telecommunication Engineering	2
Analogue and Digital Computer	2
Solid State Electronics	2
Digital Signal Processing	2
Telecommunication Services Design	2
Digital communication systems	2
Special topics in Engineering Technology in	

Electrical Engineering	
Total	**174**

(b) **Break-Down Of Courses Into Levels Of Study**
Core Courses 300 Level
(2 Semesters) And 400 Level (1 Semester): (3 Semesters)

	Lecture/Lab. Units
Engineering Mathematics	6
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Electronic Circuit (Analogue & Digital)	6
Physical Electronics	3
Measurements and Instrumentation	3
Control Theory	3
Communication Principles	3
Electric Power Principles	3
Electromechnical Devices and Machines	4
Laboratory Practicals	9
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**60**

500 Level

Reliability & Maintainability of Electrical & Electronic Components and Systems	2
Advanced Computer Programming and Statistics	3
Control Engineering	3
Advanced Circuit Techniques	2
Project	4
Electives	6
Total	**20**

Options

A choice of 16 Credits from any of the following courses	
Electromechanical Devices Design	2
Electrical Services Design	2
Power Electronics and Drives	3
Power Systems Engineering (Systems Analysis, Planning and Protection)	3
Power Systems Communication & Control	2
Switchgear and High Voltage Engineering	2
Industrial Electronic Design	2

Micro-Computer Hardware and Software Techniques	3
Communications Systems	3
Telecommunication Engineering	2
Analogue and Digital Computer	2
Solid State Electronics	2
Digital Signal Processing	2
Digital communications system	2
Special Topics	2
Telecommunication Services Design	2

Course Synopses

Core Courses 300 Level (2 Semesters) And 400 Level (1 Semester): 3 Semesters

(i) **Engineering Mathematics** **4 Credits**

Introduction to Partial differential equations. Fundamental equations of mathematical physics. Classification of quasilinear differential equations of the second order. Properly posed initial and boundary value problems for linear differential equations of the second order. Correctness of properly posed problems of mathematical physics. Problems in heat transfer (parabolic equation); wave propagation (hyperbolic equations); steady-state (elliptic equation). Problems in different co-ordinate systems, boundary value problems.

(ii) **Numerical Methods** **4 Credits**

Polynomials and their zeros – methods of bisection, Newton, Bairstow, synthetic division and Lehmer; Direct methods for the solution of linear equations; Iterative process, its application to the solution of simultaneous linear equations; convergence; interpolation and differentiation method in Numerical integration – Newton Coates formulae and finite difference methods; The eigen system problem Solution of ordinary differential equations – methods of Taylor, Euler, Predictor – Corrector and Runge-Kutta. Use of appropriate soft ware packages (e.g mathlab) should be encouraged.

(iii) **Electromagnetic Fields And Waves** **6 Credits**

Review of electromagnetic laws in integral form, Gauss's Law, Ampere's and Faraday's Laws; Electrostatic fields due to distribution of charge, magnetic fields in and around current carrying conductors, time-varying magnetic and electric fields; conduction and displacement current; Maxwell's equation (in rectangular co-ordinates and vector-calculus notation): Derivation of Maxwell's equations; electromagnetic potential and waves; Poynting vector; Boundary conditions; wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media, Fundamentals of transmission lines, wave-guides and antennae.

(iv) **Circuit Theory** **6 Credits**

Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer's methods of Synthesis, 2-port network synthesis,

active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.

(v) **Analogue Electronic Circuit** **3 Credits**

Review of single-stage transistor amplifiers using BJTS and EETs Equivalent circuit and calculation of current gain, voltage gain, power gain, in put and out put impedance. Operational Amplifiers: Parameters and applications. Feedback, Broadband and narrowed band amplifies. Power amplifiers. Voltage and current stabilizing circuit. Voltage amplifiers, multi storage amplifier. Using BJTs and FETs.

(vi) **Digital Electronics Circuit** **3 Credits**

Number Systems and Codes. Logic Gate Simplification of Logic expressions using Boolean Algebra. Simplification of Logic expressions using Karnaugh Method. Design combinational circuit. Flip-Flops. Application of Flip-Flops in the design of counters, registers and timers. Switching and Waves shipping circuit. Generation of non sinusoidal signal (multi vibrators). Introduction to ADC and DAC. Design of Logic Gates (Diode, DTL, TTL, ECL etc)

(vii) **Physical Electronics** **3 Credits**

Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

(viii) **Measurements And Instrumentation** **3 Credits**

General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal impendance bridge; Electronic instruments for the measurement of voltage, current resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic multimeter, digital volumeters; oscilloscope: vertical deflection system, horizontal deflection system, probes, sampling CRO, Instruments for generating and analyzing waveforms; square-wave and pulse generator, signal generators, function generators, wave analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(ix) **Control Theory** **3 Credits**

Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria.

Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

(x) **Communication principles** **3 Credits**

Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, clipers and limiters. Amplitude modulated signal reception; discrimination, frequency tracking loop, phase locked loop and noise performance. Commercial radio systems. Transmission media; attenuation in open space, air, cable and fibre channels; construction of cables and fibres, sampling theorem, pulse amplitude modulation, pulse width modulation, multiplexing, quantization systems and pulse code modulation, delta modulation, courses and correction of errors in PCM and DM.

(xi) **Electric Power Principles** **3 Credits**

Introduction to power systems and sources of electric energy, structure of electric system, load characteristics, electric energy transmission and distribution, line impendance, representation and per unit systems, relationship between currents and voltage; regulation of voltage, transmitted power and losses; construction of overhead lines and underground cables; power system equipment: standard and safety.

(xii) **Electrical Machines** **3 Credits**

Review of electromechanical energy conversion, rotating magnetic fields, performance and methods of speed control of DC machines, induction motors, linear induction motors, circle diagrams, power transformers, parallel operation of 3-phase transformers.

Performance of synchronous machines, parallel operation of synchronous generators, fractional horse-power motors, single-phase induction motors, universal motors. Reluctance motors, hysteresis motors. Faults on machines, methods of starting and protection of machines.

(xiii) **Practicals** **9 Credits**

Electrical Machines Laboratory:

A laboratory work on electrical machines designed to illustrate topics covered in Electromechanical Devices and Machines.

Telecommunication Laboratory

A laboratory work on telecommunication designed to illustrate topics covered in Communication Principles as well as topics such as passive filters, turned circuits and active analogue filters.

Digital Electronics Laboratory

A laboratory work on digital electronics designed to illustrate topics covered in Electronic circuits.

Electronic Circuits Laboratory
A laboratory work on electronic circuits designed to illustrate topics covered in Electronic Circuits.

(xiv) **Engineering Mathematics** **2 Credits**

Linear Algebra – Elements of Matrices, determinants, Inverse of matrix, Theory of linear equations, eigenvalues and eigenvectors. Analytic geometry – co-ordinate transformation – solid geometry polar, cylindrical and spherical co-ordinates. Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equation, Curve fitting. Simple linear programming, Fourier series – Euler coefficients, even and odd functions, Sine and cosine functions, Simple Applications. Gamma, Beta and probability functions.

Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient. Line, surface and volume integrals and related theorems.

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Rieman equations: Related theorems:

Laplace and Fourier transforms – Applications

Introduction to non-linear differential equations – stability and Applications.

Probability – Elements of probability, density and distribution functions, moments, standard distribution, etc.

Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(b) **500 LEVEL**

Reliability Engineering **2 Credits**

(i) Introduction to Reliability, maintainability, availability, Elementary reliability theory. Application to power systems and electronic components. Test characteristics of electrical and electronic components. Types of fault. Designing for higher reliability. Packaging, Mounting, Ventilation. Protection from humidity, dust.

(ii) **Advanced Computer Programming And Statistics** **3 Credits**

Elements statistics: Distribution and experiements: Law of large number; Numerical iteration procedures, Revision of FORTRAN and BASIC in Engineering. Application programme in computer aided design of Electrical and Electronic systems.

(iii) **Control Engineering** **3 Credits**

State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realisation of systems having specified transfer function, applications to circuit synthesis and signal processing.

(iv) **Advanced Circuit Techniques** **3 Credits**

Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops, Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate packages e.g PSPICE, Electronic workbench, Visio technical etc should be encouraged.

(v) **Project** **6 Credits**

This course lasts for one academic session. Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars.

(vi) **Electives** **16 Credits**

These will be chosen by students with the Co-ordinators approval. The courses can be chosen from other programmes such as Mechanical Engineering, Physics and Mathematics/Computer Science.

The courses chosen should provide some breadth to the students chosen area of specialisation.

OPT 1 Electromechanical Devices Design **2 Credits**

Design of transformers, principles of AC and DC machine design, introduction to parks equations. .

OPT 2 Electrical Services Design **2 Credits**

Lighting installation, power installation, energy supply and distribution, choice of cables and conductors, wiring systems and accessories, outdoor low voltage lines and cables, protection of low voltage installation, and characteristics of low voltage equipment, Earthing and testing of electrical installation, illumination.

OPT 3 Power Electronics And Devices **3 Credits**

Switching characteristics of diodes, transistors, thyristors etc. analysis of diode circuit with reactive loades, analysis of circuits using transistors as switches, power control circuits, ACDC converters, characteristics of switching transformers, power semi-conductor device protection, examples of power electronic circuits, solar devices.

OPT 4 Power Systems Engineering **3 Credits**

Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical

components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

OPT 5 Power System Communication And Control 2 Credits

Review of transmission line theory. High frequency communication on power lines carrier systems and power line carrier applications. Multiplexing, Telementering, Signal processing and data transmission. Control of power generation, voltage control, system stability, automatic voltage regulators, regulating transformers.

OPT 6 Switchgear And High Voltage Engineering 2 Credits

Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightining protection, Electric cables and condensers.

OPT 7 Industrial Electronics Design 2 Credits

Characteristics and industrial applications of thyristors and other SCR devices. Transducers and their applications in sensing light, voltage pressure, motion, current temperature, etc. Mechanical relays, solid state relays and stepping motors. Real time control and remote control concepts in instrumentation. Micro-processor and micro-computer based systems.
Fire alarms, burglar alarms and general home and industrial instrumentation.

OPT 8 Micro-Computer Hardware And Software Techniques 3 Credits

Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes. Micro-processors, system architecture, bus control, instruction execution and addressing modes. Machine codes, assembly language and high-level language programming, Micro-processors as state machines. Microprocessor interfacing: Input/output. Technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters. System development tools: simulators, EPROM programming, assemblers and loaders, overview of a available microprocessor application.

OPT 9 Communications Systems 3 Credits

Microwave frequencies and uses; microwave tansmission in transmission lines and wave guides, microwave circuits; impendance transformation and matching, microwave circuits; passive microwave devices, resonant and filter circuits, active microwave devices; Klystron and magnetron tubes and semiconductor devices for microwave generation. Antennae: definitions of elementary parameters related to radiation patterns; dipole and operture antennae and the releated design parameters; introduction to antennae arrays. Radiowave propagation: propagation in the ionosphere, troposphere and in stratified media; principles of scatter

propagation; applications in general broadcast, television and satellite communication systems. Radar systems nature of radar and radar equations; composition of a radar system; application of different types of radars.

OPT 10 Telecommunication Engineering 2 Credits

Cable telegraphy and telephony characteristics, cross talk, equation, Poleliness, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

OPT 11 Analogue And Digital Computer 2 Credits

Analogue computation, electrical analogue of mechanical, electromechanical systems and servomechanisms. Analogue computer elements: potentiometers, operational amplifiers, function generators, simulation of system transfer functions. Digital computer structure and elements, CPU, storage, peripherals Arithmetic processes, Hybrid computer systems.

OPT 12 Solid State Electronics 2 Credits

Physics and property of semi-conductors including high field effects, carrier injection and semi-conductor surface phenomena, devices technology, bulk and eptitaxical material growth and impurity control, metal-semi-conductor interface properties, stability and methods of characterisation: controlled and surface-controlled devices.

OPT 13 Digital Signal Processing 2 Credits

Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and software. Basic image processing concepts.

OPT 14 Digital Communications System 2 Credits

Block Diagram of digital communication system sampling theorem, Shannm theorem and applications in digital communication system. Advantages of digital signals . Noise in digital system. Filtering and equalisation. Digital modulation techniques: FSK, ASK, QPSK, M-PSK, QAM, etc. Error detection and correction techniques. Encoders/Decoders. Applications of digital communication system: Satellite communication, telephoning microwave, wireless communication, optical communication, Broadband. Communication. Internet Technology.

OPT 15 Special Topics 2 Credits

Topics in emerging technology in Electrical Energy – should be taught by one or more lecturers.

OPT 16 Telecommunication Services Design 2 Credits

Telephone installations, PABX installations choice of cables and accessories, computer networking: choice of cables , installations, accessories, optic fibre installations and accessories. Lighting protection techniques. Earthing techniques. Bill if Engineering material and Evaluation and billing of telecommunication installations

2.9 ELECTRONICS ENGINEERING

2.9.1 Philosophy, Aims and Objectives of the Degree Programme

As in Section 2.1.1

2.9.2 Admission and Graduation Requirements

As in Section 2.1.2

2.9.3 Learning outcome

As in Section 2.1.3

2.9.4 Attainment Levels

As in Section 2.1.4

2.9.5 Resource Requirement for Teaching and Learning

As in Section 2.1.5

2.9.6 Course Contents and Descriptions

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Humanities**	
		General Studies	16
	(ii)	**Basic Sciences**	
		Mathematics	12
		Physics	10
		Chemistry	8
			46
	(iii)	**Entrepreneurial Studies**	4
	(iv)	**Basic Engineering Courses**	
		Engineering Mathematics	6
		Computers & Computing	3
		Engineering Drawing	4
		Applied Mechanics	4
		Strength of Materials	2
		Material Science	3
		Thermodynamics	2
		Fluid Mechanics	2
		Basic Electrical Engineering	6
		Manufacturing Technology/Workshop	2

Engineer-in-Society	1
Total	**36**

(v) **Core Courses**

Engineering Mathematics	12
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Analogue Electronic Circuits	3
Digital Electronic Circuits	3
Physical Electronics	3
Measurements and Instrumentation	3
Control Theory	3
Communication Principles	3
Electrical Power Principles	3
Electrical Machines	4
Communication Systems	3
Laboratory Practicals	9
Reliability Engineering	2
Industrial Electronics Design	2
Advanced Computer Programming	3
Microcomputer Hardware & Software Techniques	3
Control Engineering	3
Telecommunications Engineering	2
Analogue and Digital Computers	2
Advanced Circuit Techniques	2
Solid State Electronics	2
Digital Signal Processing	2
Project	4
Electives	6
Total	**98**

(b) **Break-Down Of Courses Into Levels of Study**

Core Courses 300 Level (2 Semesters) And 400 Level (1 Semester): 3 Semesters

Engineering Mathematics	4
Numerical Methods	4
Electromagnetic Fields and Waves	6
Circuit Theory	6
Analogue Electronic Circuits	3
Digital Electronic Circuits	3
Physical Electronics	3
Measurement and Instrumentation	3
Control Theory	3
Communication Principles	3

Electrical Power Principles	3
Electromechanical Devices and Electrical Machines	4
Laboratory Practicals	9
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Total	**58**

Core Courses 500 Level: 2 Semesters	
Reliability Engineering	2
Industrial Electronics Design	2
Advanced Computer Programming	3
Microcomputer Hardware & Software Techniques	3
Control Engineering	3
Communications Systems	3
Telecommunications Engineering	2
Analogue and Digital Computers	2
Advanced Circuit Techniques	2
Solid State Electronics	2
Digital Signal Processing	2
Project	4
Electives	6
Total	**36**

Course Synopses

(i) **Core Courses 300 Level: 2 SemestersAnd 400 Level 1 Semester: 3 Semesters:**
All courses are the same as for 300 and 400 levels of Section 2.8.6

(ii) **Core Courses 500 Level: (2 Semesters)**

(iii) **Reliability Engineering:**
See Section 2.8.6

(iv) **Industrial Electronics Design**
See course OPT. 6 of Sec 2.8.6

(v) **Advanced Computer Programming**
See course OPT. 5.2 of Sec 2.8.6

(vi) **Microcomputer Hardware & Software Techniques**
See Sec 2.8.6

(vii) **Control Engineering**
See course 5.3 of 2.8.6

(viii) **Communication Systems**
See course OPT.9 of Sec 2.8.6

(ix) **Telecommunications Engineering**
See Sec 2.8.6

(x) **Analogue And Digital Computer**
See course OPT 11 of Sec 2.8.6

(xi) **Advanced Circuit Techniques**
See course OPT. 5.4 of Sec 2.8.6

(xii) **Solid State Electronics**
See course OPT.12 of Sec 2.8.6

(xiii) **Digital Signal Processing**
See Sec 2.8.6

(xiv) **Project**
See Sec 2.8.6

(xv) **Electives**
See Sec 2.8.6

2.10 FOOD SCIENCE AND TECHNOLOGY PROGRAMME

2.10.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.10.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.10.3 **Learning outcome**
As in Section 2.1.3

2.10.4 **Attainment Levels**
As in Section 2.1.4

2.10.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.10.6 **Course Contents and Descriptions**

(i) Food Processing Technology
(ii) Food Technology
(iii) Food Science and Technology
(iv) Brewing Science and technology
(v) Food Engineering

	Course Summary	**Lecture/Lab. Units**
(i)	**General Studies**	16
(ii)	**Preliminary Sciences**	
	Mathematics	6
	Physics	10
	Chemistry	10
(iii)	**Entrepreneurial Studies**	4
	Sub-Total	**46**
Management		
	Economics	
	Principles of Management	2
	Technical Communications	3
	Sub-Total	2
		7
Agriculture		
Animal Science or Crop Science		3

Basic Sciences	
Mathematics	
Computers & Computing	8
Chemistry	3
Biochemistry	6
Basic Microbiology	2
Sub-Total	3
	22
Basic Engineering	
Applied Electricity	4
Fluid Mechanics	2
Thermodynamics	2
Engineering Drawing	3
Workshop Practice	2
Practicals	1
Sub-Total	**14**
Core Courses	
(i) **Food Technology**	
Introduction to Food Technology	2
Food Chemistry	3
Food Microbiology	3
Principles of Nutrition	3
Food Analysis	3
Food Machinery	3
Fundamentals of Food Processing	4
Food Process Engineering	4
Food Process Plant Design	4
Post Harvest Physiology }	
and Storage Technology }	3
Food Packaging	3
Cereals Technology	3
Fruits and Vegetable Processing	3
Meat Technology	3
Milk and Dairy Technology	3
Food Standards and Quality Control	3
Processing of Misc. Food Commodities	3
Laboratory Practicals	13
Final Year Project	6
Sub-Total	**72**
Electives	9
Grand Total	**166**

Break-Down Of Courses Into Levels Of Study:

300 Level

Mathematics	2
Animal or Crop Science	3
Basic Microbiology	3
Introduction to Food Technology	2
Food Microbiology	3
Food Chemistry	3
Foundation course in Entrepreneurial Studies	2

CORE COURSES

Fundamentals of Food Processing	4
Food Analysis	3
Principles of Nutrition	3
Food Machinery	3
Post Harvest Physiology and Storage Technology	3
Laboratory Practicals	4
Sub-Total	**38**

400 LEVEL

Principles of Management	3
Technical Communication	1
Food Process Engineering	4
Food Process Plant Design	4
Cereals Technology	3
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	2
Sub Total	**19**

500 Level

Food Packaging	3
Fruits and Vegetables Processing	3
Meat Technology	3
Milk and Dairy Technology	3
Processing of Misc. Food Commodities	3
Food Standard and Quality Control	3
Final Year Project	6
Laboratory Practicals	4
Electives/Emphasis	9
Sub-Total	**37**

Course Synopses

(i) **Introduction to Food Technology** **2 Credits**

Review of global food situation with emphasis on Nigeria. Introduction to the microfloral of foods. Physical, chemical and biological principles of food processing and preservation. Engineering units and dimensions applicable to the food industry.

(ii) **Food Microbiology** **3 Credits**

The microfloral of foods and its relation to food preservation and spoilage. Microbiological examination of foods. Food infection and poisoning. Public health and sanitation.

(iii) **Food Chemistry** **3 Credits**

Naturally occurring constituents of foods. Their structure, chemical and physical properties and significance. Food activities. Chemical, physical and biochemical changes that occur in food during handling, processing and Storage.

(iv) **Fundamentals of Food Processing** **4 Credits**

Basic methods of food processing and preservation. Preservation: thermal, low temperature, dehydration, concentration, Fermentation irradiation.

(v) Food Analysis **3 Credits**

The principles and application of analytical methods such as photometry, colorimentry, gravimentry, refractomentry. Physical and chemical analysis of water and other major food components. For colours, additives, trace metals, contaminants.

(vi) Food Machinery **3 Credits**

Design features and functions of equipment used in the food Industry e.g. equipment for clearing, sorting, grading, size reduction, mixing, homogenisation, filtration, distillation, centrifugation etc. Electric Motors.

(vii) **Milk and Dairy Technology** **3 Credits**

Technology of milk and milk products: condensed and dehydrated milk, filled milk, ice-cream, cheese, cultured milk, butter, Machine milking. Milk processing, Dairy waste management and Processing. Dairy plant sanitation.

(viii) **Cereals Technology** **3 Credits**

Technology and chemistry of the principal cereals. Conventional milling processes, use of products and by-products. Baking, Protein-enriched cereal products. Nutritional considerations.

(ix) **Fruit and Vegetable Processing** **3 Credits**

Preservation of fruits and vegetables. Harvesting and pre-processing operations. Use of chemicals to control enzymatic and non-enzymatic changes in processed fruits.

(x) **Meat Technology** **3 Credits**

Processing meat, fish, sea foods, poultry, eggs. Ageing, tenderizing, curing of meat . Manufacture of sausages and other table-meats. Smoking, freezing, canning, irradiating, dehydration.

(xi) **Food Process Engineering** **4 Credits**

Thermodynamics properties of food materials. Basic concepts of fluid flow. Power requirements for pumping fluids in the food industry. Pipe-line design. Application of the theory of heat, mass, momentum transfer in the food industry. Fuel utilisation in the food industry.

(xii) **Food Standards and Quality Control** **3 Credits**

The importance of food standards and legislation. Coded Alimentarius. The food standards and legislation of Nigeria. Principles and methods of food quality control.

(xiii) **Post-Harvest Physiology and Storage Technology**
3 Credits

Post-Harvest physiology of horticultural commodities. Control of post-harvest losses. Refrigeration and cooling systems. Handling and Storage of cereal grains and legumes. Measurement of temperature, relative humidity, moisture in stored foods. Buildings and other structures for food storage.

(xiv) **Processing of Miscellaneous Food Commodities 3 Credits**

Processing of cocoa, tea, coffee, sugar, confectionery, soft drinks.

(xv) **Food Process Plant Design** **4 Credits**

Plant lay-out in the food industry. Economics of process design and optimisation techniques. Optimum design of food processing plants.

(xvi) **Principles of Human Nutrition** **3 Credits**

Situation of nutrition in Nigeria Protein-Calorie malnutrition. Metabolism of carbohydrates, proteins, lipids, Basal metabolism. Important mineral and vitamin deficiencies, their aetiology and control. Anti-nutritional factors in food. Food balance sheets. Food composition tables and recommended dietary allowance. National problems of affluence,

(xvii) **Food Packaging** **3 Credits**

Characteristics of packaging materials. Testing for structural quality and performance. Packaging requirements for fresh and processed foods for local and foreign markets.

(xiii) **Introduction to Tropical Crops** **3 Credits**

Kinds of tropical crops; cereals, grasses, root and tuber crops, fibre crops, legumes (grain and forage), horticultural crops, including tree crops (cocoa, oil palm, coconut palm, rubber, coffee, citrus).

(xix) **Animal Husbandry and Production 3 Credits**
A broad treatment of the-breed types, world distribution, management, feeding and disease problems of farm live-stock.

2.11 INDUSTRIAL AND PRODUCTION ENGINEERING

2.11.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.11.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.11.3 **Learning outcome**
As in Section 2.1.3

2.11.4 **Attainment Levels**
As in Section 2.1.4

2.11.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.11.6 Course Contents and Descriptions

(a) **Course Summary**

	Lecture/Lab Units
(i) **Core Courses**	
Science & Eng. Of Materials and Metallurgy	10
Operations Research	5
Production Technology	6
Mechanics of Machines	8
Fluid Mechanics	5
Industrial Engineering Statistics	4
Thermodynamics	5
Engineering Economics	4
Engineering Drawing	6
Workshop Practice including } Automobile workshop } Manufacturing Techniques/ } Workshop Practice }	2
HFE and Factory Layout	5
Machine Tools	5
Project Planning and Control	6
Mechanical Engineering Design	4
Metrology	4
Control systems	3
Tool Design	3
Industrial Computers and Applications	2
Production Planning and Control	5
Engineering Materials, Selection } and Economics }	3
Engineer-in-Society	1
Technology Policy & Development	2
Project	6
Total	**104**
(ii) **Other Courses**	
Industrial Engineering	5
Electronic & Electrical Engineering	10
Law and Management	4
Industrial Law	2

(iii)	**Basic Science Courses**	
	Mathematics	24
	Physics	10
	Chemistry	10
	Computers & Computing	3
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	12
	Sub-Total	**100**
	Grand Total	**204**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Engineering Mathematics	6
Computers & Computing	3
Theory of Machines	2
Operations Research	2
Manufacturing Technology	3
Thermodynamics	2
Fluid Mechanics	2
Industrial Engineering Statistics	2
Engineering Drawing	2
Workshop Practice	2
Metallurgy	2
HFE and factory Layout	1
Electrical & Electronic Engineering	4
Industrial Engineering	4
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Total	**43**

400 Level	
Operations Research	2
Engineering Economics	2
Project Planning and Control	2
Work Study and Systems Design	2
Industrial Process Design	2
Machine Tools	2
HFE and Factory Layout	2

Tool Design	2
Laboratory Practicals	1
Production Technology	2
Metrology	2
Introduction to Entrepreneurship Studies	2
Technical Communications	2
Total	25

500 Level	
Industrial Computers and Applications	5
Engineering Metallurgy	2
Project Planning and Control	2
Mechanical Engineering Design	4
Works Study and Systems Design	2
Engineering Materials, Selection and }	
Economics }	3
Industrial Engineering Statistics	2
Machine Tools	3
Production and Inventory Design	2
Manufacturing Technology	5
Production Planning and Control	2
Project	6
Law and Management	4
Electives	6
Laboratory Practicals	6
Technology Policy & Entrepreneurship	2
Control Systems	3
Total	**59**

Course Synopses

(i) See Sec 2.15.6. for Core Courses Synopses Common to all levels

(ii) **Machine Tools**

Basic principles of machine tools Elements of machine tools
Rigidity of machine tools. Kinematics of machine tolls. Jigs and Tool Design. Hydraulic and electrical transmissions in machines

(iii) **Meterology**

Meterology Laboratory setting. Various metrological experimental techniques. Applications of metrology. Control of metrology Labs

(iv) **Production Technology**

Production process: Machining, Metal forming, Metal casting

Metal joining processes: welding, bracing, soldering, mechanical joining, adhesive joining, heat treatment and surface finishing processes

(vi) **Tool Designs**

Design of machine constructional elements. Tooling Design for Numerically controlled machines. Economics of machine tool design. Installation and Testing of machine tools. Machine tool maintenance. Design applications of jigs and fixtures

(vii) **Operations Research**

Planning and progressing in the manufacturing industry, Linear programming techniques; Model formulations; maintainability and reliability procedures; Transportation and trans-shipment problems; Non-linear programming models.

(vii) **Engineering Economics**

Economics of business settings: Costing of production systems;
objectives of cost analysis and cost control.

(viii) **Project Planning and Control**

Production planning; production control; Corporate Strategy and long range planning; project cost analysis and control.

(ix) **Work Study and Systems Design**

Method study and work measurement; work Study; time study; System design and optimisation.

(x) **Industrial Process Design**

Process capability; process reliability measurement; process
selection and design.

(xi) **Human Factors Engineering and Factory Layout**

Factory layout models; Labour and time analysis; job evaluation; Workforce management and control; Training and incentives.

(xii) **Technical Communications**

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills-extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing. 15 hrs (Teaching & demonstrations), 30hrs (Practicals)

2.12 INFORMATION & COMMUNICATION TECHNOLOGY

2.12.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.12.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.12.3 **Learning outcome**
As in Section 2.1.3

2.12.4 **Attainment Levels**
As in Section 2.1.4

2.12.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.12.6 **Course Contents and Descriptions**

Course Title	**Lectures/Lab (Units)**
300 Level	
Engineering Mathematics	3
Electromagnetic Fields & waves	3
Data-Base Design & Management	2
Computer Organisation & Architecture	3
Operating Systems	3
Entrepreneurial Studies	4
Circuit Theory	3
Analogue Electronic Circuit	3
Digital Electronic Circuit	3
Communication Principles	3
Electrical Machines	3
Software Development Techniques	3
Sub-Total	36
400 Level	
Technical Communications	2
Satellite Communication	3
Control System	3
Digital Signal Processing	3
Data Communication System & Network	3
Internet Technology & Programming	3
SIWES (Industrial Training)	6
Sub-Total	**23**

500 Level

Design & Installation of Electrical & ICT Services	3
Mobile Communication and Network	3
Java Technology & Programming	3
Telecommunication Software Development	3
Artificial Neural Network	3
Reliability and Maintenance	3
Cyberpreneurship & Cyberlaw	2
Antenna & Propagation	2
Computer Graphics & Animation	2
Computer Security Techniques	2
Project	6
Electives (2):	
Information Systems Analysis & Design	2
Project Management	2
Communication Electronics	2
Multimedia Technology & Programming	2
Random Process & Queue Theory	2
Data Structure & Algorithms	2
Sub-Total	**34**

Course Descriptions

300 Level

Electromagnetic Fields & Waves (3 Units)

Review of Vector Algebra & Calculus: Scalar product and vector product, coordinate systems, gradient, curl, divergence operations. Gauss's, Stokes, Hemholtz and Green's integral theorems, integral of scalar and vector fields.Electrostatics: Charge and charge density. Coulomb's Law. Concept of fields. Electric flux density and electric field intensity. Gauss's Theorem and applications. Voltage and electric potential. Conductor, dielectrics. Polarization, susceptibility, permittivity. Electrostatic boundary condition. Capacitance calculation and electric energy. Magnestostatics: Current and current density. Magnetic dipoles and current loops. Magnetic flux density and magnetic field intensity. Biot-Savart Law and Ampere's Law, Faraday's Law. Magnetostatic boundary condition. Self and mutual induction. Inductance calculation and magnetic energy. Magnetic Circuits: B and H, Magnetic materials: diamagnetic material, paramagnetic material, ferromagnetic material. Saturation and hysterisis, Hysterisis loss and eddy current loss, reluctance and permeance, Analysis of linear magnetic circuits (with air-gap problems). Maxwell's Equations: Time Varying fields : Faraday's Law of Induction, the conservation of charge and the incompleteness of Ampere's Law. Maxwell's equations and Lorentz force law. Uniform plane waves and wave equation. Time harmonic fields. Polarization of waves. Poynting's Theorem and the conservation of energy, the field definitions of impedance, admittance. Phase and group velocities. Waves in media: lossy media, dispersive media.Wave Propagation and Transmission Theory: Boundary conditions. Reflection and refraction at plane interface (normal and oblique angles), transmission line analogy. Transmission line theory: differential equations for a general transmission line, low loss and lossless lines, impedance characteristics of lines with various terminations, simple mismatch problems and the use of Smith Chart. Waveguides and Cavity Resonators: Review of Maxwell's equations. Properties of waves in

rectangular waveguides, modes of propagation, phase and group velocities in waveguide, wave impedance. Dielectric waveguides. Cavity resonators and field distribution. Applications in microwave .

Database Design & Management (2Units)

Overview of Database systems: model, schema, instance. Database system vs. File systems. Data abstraction levels, database languages, system architecture. Classification of DBMS. Data modeling: Entity-Relationship (ER) Model, Entities and Entity types, Relationship and Relationship type, Constraints, Weak Entity Types, ER, Diagrams. Semantic object model. Process of database design: requirement analysis, conceptual database design, database schema design. Database design using entity-relationship and semantic object models, database application design. Terminology in Relational Data model, Integrity Constraints, Primitive Operations on Relations, Relational Algebra (RA), Relational Algebra Operations, Relational Completeness, Additional Operations on Relations. Foundations of relational implementation. Structured Query Language (SQL): DML Features in SQL, DDL in SQL, updates in SQL, Views in SQL, Embedded SQL, Query-by-Example (QBE). Concurrency, recovery and security issues. Armstrong's inference rules and minimum covers, normal forms. Current trends in database systems: Client-Server database systems, Open Database connectivity (ODBC) standard, knowledge-Based Systems, Object-Based Systems, data warehousing and data mining concepts, Web databases.

Operating Systems (3 Units)

Early System, Simple Batch Systems, Multiprogrammed and Batched Systems, Time-Sharing Systems, Personal-Computer Systems, Parallel Systems, Distributed Systems, Real-Time Systems. Computer-System Structures: Computer-System Operation, I/O Structure, Storage Structure, Storage Hierarchy, Hardware Protection, General-System Architecture. Operating System Structures: System Components, Operating-System Services, System Calls, System programs, System Structure, Virtual Machines, System Design and Implementation, system Generation. Processes, Threads, Interprocess Communication. CPU Scheduling: Basic Concepts, Scheduling Criteria, Scheduling Algorithms, Multiple-Processor Scheduling, Real-time Scheduling, algorithm Evaluation. Deadlocks: System Model, Deadlock Characterization, methods for handling Deadlocks, Prevention, Avoidance, Detection, Recovery, Combined Approach. Memory Management: Address space, Swapping, Contiguous Allocation, Paging, Segmentation, Paged Segmentation. Virtual memory: Demand paging, page replacement, page-replacement, page-replacement alrothmes, frame allocation, thrashing. File systems: File concept, Access Method, Directory Structure, Protection, File-System Structure, Allocation methods, Free-Space Management, Directory Implementation, Efficiency and Performance, Recovery. MS Windows and UNIX/LINUX architecture, applications, and programming.

Information System Analysis & Design (2Units)

System Development Life Circle: Strategy and planning system analysis, logical design, physical design, implementation maintenance. System Development Techniques and methodologies: by Process modeling, function decomposition diagramming, Entity-Relationship diagramming, data flow diagramming, and procedure modeling. Design and Layout of forms, screens, dialoques, and report. Integrated CASE tool e.g. Oracle Designer to be used for the system development life circle. RAD tools e.g power Builder, Power Objects, visual Basic, IntraBuilder, or C++ Builder for concepts and techniques visualization.

Electric Circuit Theory

Electric quantities: charge, voltage, current, power, energy. Voltage and current sources, resistor, inductor and capacitor. Ohm's Law. Kirchoff's current and voltage Laws. Thevenin and Norton equivalents, superposition, reciprocity, maximum power transfer theorem. Signal waveforms: d.c.,

step, impulse, square pulse, sinusoidal, triangular, exponential. General description of signals: time constant, rms valus, duty cycle, crest factor, form factor. Effective alternating current. A.c. behaviour in R, L and C elements. Phasor analysis with complex algebra. Two terminal networks – impedance, admittance and their real and imaginary parts. Resonance: series and parallel reasonance, half power points, bandwidth, Q-factors. Power: instantaneous, average, power factor,active, reactive, complex, apparent. Analysis of first order LR and RC circuits subjected to excitation of d.c., square pulse, sinusoidal sources and exponential sources. Interpretation of complementary function and particular integral. Elementary network topology, network constraints, network equilibrium equations. Nodal and mesh network analysis. L-attenuator, Image Parameter Design, T-attenuator, Pi-attenuator, Cascaded attenuator networks. Impedance transformations, constant impedance inverters, Norton's network transformation, Bartett bisection theorem.

Software Development Techniques **2 Units**

Software development life cycle. Top-Down design. Program, design using pseudo-code, flowchart. Flowchart ANSI symbols and usage. Extensive examples, and exercises using pseudo-code/flowchart to solve practical problems in engineering. Debugging and documentation techniques. Programming using a structural language such as C: Symbols, keywords, identifiers, data types, operators, various statements, operator precedence, type conversion, conditional and control structures, function, recursive functions. Arrays: 1-D, and multi-dimensional arrays, passing elements or whole array to a function. Simple sorting and searching on arrays, pointers, strings, dynamic memory allocation. Structures and Unions: Structure declaration and definition, accessing structures, array of structures, pointers and structures, union declaration, enumerated variables. File Handling: Concept of a file, files and streams, standard file handling functions, binary files, random access files. Advanced Topics: Command line parameters, pointers to functions, creation of header files, stacks, linked lists, bitwise manipulation. Software development in C in MS Windows, UNIX/LINUX environments, header file, preprocessor directives, make, makefile. Static and dynamic linking libraries. Extensive examples, and exercises programming in C to solve practical problems in engineering. Exercises are to be done in the Computer Laboratory.

Analogue Electronic Circuit **3 Units**

See Electrical and Electronics Engineering (Sec 2.8.6)

Digital Electronic Circuit **3 Units**

See Electrical and Electronics Engineering (Sec 2.8.6)

Communication Principles **3 Units**

See Electrical and Electronics Engineering (Sec 2.8.6)

Electrical Machine **3 Units**

See Electrical and Electronics Engineering (Sec 2.8.6)

400 LEVEL

Data Communication and Network Applications **(3 Units)**

Introduction to Data communications: the Development of Data Communications; types and sources of data, simple communications network, transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronization, character synchronization, character synchronization, synchronous transmission, asynchronous transmission, efficiency of transmission, error detection methods and data compression. Protocols: Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control

and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding and dynamic Huffman coding. Local Area Networks: medium access control techniques – Ethernet, token bus and token ring; LAN standards; fibre distributed data interface, metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface independence, platform independence, transaction processing, connectivity, reliability, backup and recovery mechanisms. Information Network Software; Features and benefits of major recovery mechanisms. Information Network Software: features and benefits of major Network Operating Systems. Network OS: (e.g. Novell NetWare, UNIX/LINUX, OS/2 & Windows NT). TCP/IP and Network OS. INTERNET: Definition, architecture, services, Internet addressing. Internet protocol, IPv4, IPv6. Internet programming, Intranet. System administration, and security issues.

Satellite Communication (3 Units)

Satellite frequency bands, services, transmission and multiplexing schemes, trans-multiplexing, multiple access schemes. Satellite orbit, satellite motion, paths, geostationary satellites, non-geostationary constellations, satellite subsystems, and satellite lauching. Antennas: types, gain, pointing loss, G/T, EIRP; high power amplifiers; low noise amplifiers; BUC/LNB : conversion process, polarization hopping, redundancy configurations; earth station monitoring and control. Basic link analysis, attenuation, sources of interference, carrier to noise and interference ratio, system availability, frequency reuse, link budget, link design. Multiple access techniques: companded FDM-FM-FDMA, SSB-AM-FDMA, amplitude and phase nonlinearities, optimized carrier to noise and intermodulation ratio; TDMA : frame structure, burst structure, frame efficiency, super-frame structure, frame acquisition and synchronization, satellite position determination, TDMA equipment, advanced TDMA satellite systems; CDMA : direct sequence CDMA (DS-CDMA), sequence synchronous and sequence asynchronous DS-CDMA, random access DS-CDMA, link analysis, FH-SS systems, FH-CDMA, acquisition and synchronization. Demand assignment multiple access (DAMA): types of demand assignments, DAMA characteristics, real time frame reconfiguration, DAMA interfaces, SCPC DAMA, SPADE, digital speech interpolation. Message transmission by FDMA: M/G/1 queue, message transmission by TDMA : pure ALOHA- satellite packet switching, slotted ALOHA, packet reservation, tree algorithm. Advantages and disadvantages of multibeam satellites, interconnection by transponder hopping, interconnection by on-board switching (SS/TDMA), interconnection by beam scanning, ISL : GEO-LEO, GEO-GEO, LEO-LEO, RF and optical links. VSAT networks: VSAT technologies, network configurations, multi-access and networking, network error control, polling VSAT networks.

Computer Organisation and Architecture 3

See Electrical and Electronics programme (Sec 2.8.6)

Control System 3

See Electrical Electronics Engineering (Sec 2.8.6)

Communication Electronics 2

See Electrical Electronics Engineering (Sec 2.8.6)

Internet Technology and Programming 3

See Electrical Electronics Engineering (Sec 2.8.6)

Digital Signal Processing 3

See Electrical and Electronics Engineering (Sec 2.8.6)

500 LEVEL

Design & Installation of Electrical & ICT services 3 Units

Electrical Installation: Induction to Health and safety at work act in Nigeria. Electrical safety. First aid. Electricity supply regulations. Lighting and Illumination: Luminous intensity and flux. Maintenance factor. Coefficient of utilization. Types of light sources. Calculation of lighting requirements. Glare. Stroboscopic effect. Installation Materials, cables, junction box, terminations, joints. Conduits and conduiting. Truck and trucking. Electrical Installation design in domestic, commercial and industry. Alarm and emergency systems. Earthling and Protection. Purposes of earthing. Faraday cage. Rod electrodes. Earth electrode resistance. Earthing system. Earth fault loop impedance. ICT services: NCC and FCC codes of practice and standards. Telecommunication design and installation: Satellite, VSAT, etc. Telephone design and installation. Computer networking design and installation. Wireless LAN design and installation. Preparation of Bill of Engineering Measurement Evaluation. Contract bidding. Consultancy.

Mobile Communication & Network 3 Units

Evolution of mobile radio communications. Examples of mobile radio systems: radio paging, cordless telephones, cellular radio. Trends in cellular radio and personal communications. A basic cellular system, Frequency reuse, Roaming, Hand-off strategies, Co-channel interference, Traffic and Grade of service, System capacity, Improving capacity of cellular system. Propagation path loss, multi-path propagation problem, Raleigh fading, Rician distribution. Doppler effect. Field strength prediction models, co-channel interference and reduction, adjacent channel interference, near-far problem. Standards and overview of analogue and digital cellular systems: AMPS, TACS, GSM, CT2, PCN, DECT, PHS. Frequency management and channel assignment, speech coding, channel coding, bandwidth consideration, equalization, modulation techniques, multiple access techniques. GSM: Architecture, elements, and standard interfaces; FDMA/TDMA structure; Speech and channel coding; time slots and bursts; signaling; hand-offs; DCS 1800; GPRS; data services over gsm. Third Generation Wireless Standard: convergence; UMTS; IMT-2000; CDMA2000; WCDMA; UWC-136; Network layer standards. Paging services and technologies; Short Message Services. Call Processing: Signalling; Roaming and mobility management; Route optimization; Wireless Intelligent Networking; Databases; Protocols; Security and billing issues. Global Positioning System: principles, and applications.

Computer Security Techniques 2 Units

History of cryptographic System, Public Key Systems, Digital Signature. Information Theory: Entropy, Perfect Secrecy, Unicity Distance, Complexity Theory, NP Completeness, Number Theory. Data Encryption Method Ciphers, Knaspsack Ciphers, Breakable NP-Complete Knapsack, Encryption Standards DES, RSA, Elliptic Curves. Cryptographic Techniques: Block and Stream Ciphers, Autokey, Endpoints of Encryption, One-Way Ciphers, Password and Authentication, Secret Keys and Public Keys, Threshold Scheme. Video Scrambling techniques. Digital video encryption techniques: principle, IRDETO, Viaaccess, Videoguard, etc. Security and Legality Issues: Copyrights, Patents, Trade Secret, Ownership of Products, Computer Crimes, Ethnical Issue in Computer Security.

Artificial Neural Network 2 Units

Neural Network: Definition of artificial neutral network. Similarities of neural network with human brain. Classification of ANN. Terminologies: input/output sets, weights, bias or threshold, supervised learning, network training, Convergence process, single layer vs. multilayer perception, forward and Backward propagation, gradient descent rule. Back-propagation neural network, Variable term used in back propagation neural network: learning rate, momentum, hidden nodes, sigmoid activation function. Back propagation algorithm of ANN. Design of ANN model, training

sets for ANN, test sets for ANN, network testing and performance. Engineering applications. ANN programming.

JAVA Technology & Programming 2 Units

Java programming: Java basics, Java Applets and Applications, decisions and repetitions, arrays and strings, methods and parameters. Objects and classes, encapsulation and data hiding, data abstraction and abstract data types (ADTs), inheritance, polymorphism, abstract classes and design principles, java.awt and java.awt. event packages, buttons, labels, lists, text fields and panels, mouse events and keyboard events, scrollbars and layout managers. Basics of Java exception handling, try blocks, throwing an exception, tatching an exception, throws clause, constructors, finalisers and exception handling, exceptions and inheritance, finally block. Thread methods, thread states, thread priorities and thread scheduling, thread synchronization, daemon threads, runnable interface, thread groups. Multimedia Applications: Loading, Displaying and Scaling Images, Introduction to Animation, Graphics Double Buffering, Media Tracker, Loading and Playing audio Clips, Customizing Applets, Image Maps. Network programming: Introduction, Manipulating URLS, Establishing a Simple Server, Establishing a Simple Client, Client/Server Interactions, Security and the Network.

Computer Graphics & Animations (3 Units)

Overview of 3D animation and its application and types. Coordinate system, vertex, faces and object. Concept of wireframe, surface and solid modeling. Construction planes and differences between object space and world space. Principles of making characters alive. Polygonal Modeling techniques: the Box, using Edit Mesh, Smoothing Techniques, Sudivision Surfaces. Nurbs Modelling techniques: Utilizing NURBS toolbox, surface points and CVs. Importing and attaching NURBS surfaces, rebuilding surfaces, curve and surface approximation. Graphic animation process: Camera & Animation Camera, Set & Background (Image Plane), Light Linking. Animation Techniques: Walk Cycle and Facial Expression using Blend Shape. Dynamics animation: Rigid Bodies, Soft Bodies, constraint, Particles. Tips and tricks on rendering. Concept of Rendering in 3D modeling. Render options and file output. Same as CSP 421.

Cyberpreneurship & Media Law (2 Units)

Introduction: Definition of creativity, innovation, examples of creativity leading to innovation, commercialization of creative and innovative ideas. Trends in technology development. Entrepreneurship management and ownership. Characteristics of entrepreneur, starting a new business, business planning, strategic planning & management, site selection and layout. Establishing new venture, risk management. Business Plan Development: definition, need, preparation of business plan. Forecasting developments and charting an action plan . Identifying the product/service, market research and feasibility study. Financing business. Sources of debt financing. Creating the marketing plan, pricing, creative advertising and promotion. Entrepreneurship case studies: Overview and analysis of successful entrepreneurs such as Bill Gates, Michael Dell, David Filo and Jerry Yang of Yahoo, etc. Nigerian Entrepreneurship: Discussion of Nigerian business environment, and illustrated with successful Nigerian entrepreneurs. Overview of the Nigerian Legal System: Civil and criminal. Basic concepts of law. Contract Law. . Current issues: digital signatures, Intellectual property and copyright. Speech Law: Defamation, Sedition, Printing Press Act. Speech on the Internet. Advertising Code: Made in Nigeria rules and guidelines, Advertising Standards. Media and Licensing law in Nigeria: Developing an in-depth understanding of the nature and function of Nigerian media law. Public and Private licensing. Intellectual and moral rights. Music royalties, synchronization rights, performance rights. Role of music publishers. Broadcast rights, merchandising. Detailed analysis

of Communications and Multimedia Act. Ethic and Etiquette: New codes of social behaviour: the right to privacy.

Antenna & Propagation (3 Units)

Antenna Systems:Review of Maxwell's equations. Polarization, polar diagrams, antenna gain, directivity, radiation resistance, impedance matching, effective length and capture area. Radiation by dynamic currents and charges, retarded potentials, the isotrope. Hetzian dipole, short and loop antenna, folded dipole antenna. Vertical and horizontal antennas, rhombic antenna, log-periodic antenna. Centre-fed linear antenna, linear arrays, radiation from diffraction gratings, Yagi-Uda arrays, integrated antennas. Microwave antenna, horn, parabolic reflectors, slot, lenses. Field analysis of antennas. Transmitting-receiving system, reciprocity relations. Equivalent circuit of receiving antenna. Radar Systems: Principles of pulse radar and Doppler radar. Radar equation and system parameters. Components of radar systems. Study of a practical radar system. Radar signal detection. Synthetic aperture radar, tracking and scanning radar, HF (OTR) radar. Radio Wave Propagation:Electromagnetic waves, wavefront, characteristic impedance of free space, reflection, refraction and diffraction. Ground waves and sky waves. The ionospheric layers, refractive index, virtual height, critical frequency and angle, maximum usable frequency, skip zone, skip distance, fading. VHF line of sight transmission. Tropospheric scattering communications. Relationship between transmitter power, antenna gains and received signal to noise in a free space radio link. VHF and microwave point-to-point link.

Multimedia Technology & Programming (2 Units)

Introduction: Multimedia state-of-the art, impact of multimedia, technology, and applications. Multimedia Components: Text, data, audio, image, video. Text: Text compression and decompression. Text coding and decoding. Multi-languages. Unicode. Data: Framing of data. Segmentation of data frames. Data formats, data encryption, data recovery, data representation and manipulation. Audio: Audio creation and encoding. Audio recording format, mono and stereo. Audio compression. Real-time audio. Audio streaming technique. Voice recognition. Image: Image formats, image color scheme, image enhancement, image processing techniques, image compression, scale of compression, multiple images, animation. Video: Video recording formats and standards, resolution, compression, video streaming techniques.Multimedia Systems: Integration, storing and presentation of multimedia. Comparison of analogue and digital recording. System integration and coordination. Real-time recording and transmission. Error recovery. Video conferencing systems: configuration, functions, transmission, technology.Multimedia over the networks: Hypertext: concepts. Hypertext Markup Language (HTML). HTML programming and multimedia document design. An introduction to XML. Uniform Resource Locators (URL). Protocols: HTTP, FTP, SMTP. Common Gateway Interface (CGI) processing. MIME specification. Script language. Platform independent language, bytecode and interpreter. Multimedia application over the Intranet and the Internet.

Mobile Communication & Network (3 Units)

Evolution of mobile radio communications. Examples of mobile radio systems: radio paging, cordless telephones, cellular radio. Trends in cellular radio and personal communications. A basic cellular system, Frequency reuse, Roaming, Hand-off strategies, Co-channel interference, Traffic and Grade of service, System capacity, Improving capacity of cellular system. Propagation path loss, multipath propagation problem, Raleigh fading, Rician distribution. Doppler effect. Field strength prediction models, co-channel interference and reduction, adjacent channel interference, near-far problem. Standards and overview of analogue and digital cellular systems: AMPS, TACS, GSM, CT2, PCN, DECT, PHS. Frequency management and channel assignment, speech coding, channel coding, bandwidth consideration, equalization, modulation techniques, multiple access

techniques. GSM: Architecture, elements, and standard interfaces; FDMA/TDMA structure; Speech and channel coding ; time slots and bursts; signaling; hand-offs; DCS 1800; GPRS; data services over gsm. Third Generation Wireless Standard: convergence; UMTS; IMT-2000; CDMA2000; W-CDMA; UWC-136; Network layer standards. Paging services and technologies; Short Message Services. Call Processing: Signaling; Roaming and mobility management; Route optimization; Wireless Intelligent Networking; Databases; Protocols; Security and billing issues. Global Positioning System: principles, and applications.

Project Management (2 Units)

Management Concepts. Project organization, teams, methods and tools for project management. Organization constraints on development. Project Planning Objectives, Resources, Project Estimation, Cost Factors, Decomposition Techniques, Estimation Models. Risk Strategies, Risk Identification, Risk Projection, Risk Monitoring and Management. Work Breakdown Structure, Task Allocation/Effort Distribution. Network Diagrams, PERT and Critical Path Method, Gantt Chart. Scheduling Strategies. Project Tracking, Controlling Progress. Quality measurement. Linear Programming and PERT/CPM applications. System Engineering, Software Development Process, Software Life Cycle, Software Metrics and Measurement.

Data Structures & Algorithm (2 Units)

Data Types and ADT: Data types, Arrays & Pointers, Data structures, ADTs & implementation, objects, classes. Programming language support for ADTs. Data Structures: stacks: implementation & linked stacks. Recursion: Backtracking & Look-Ahead. Queues: circular, linked. Polynomial arithmetic. List & strings. Searching and Sorting: "Big O" notation. Sequential search, binary search, comparison trees, Insertion sorts, election sort, shell sort, quicksort, mergesort, Radix sort & Heapsort. Hashing. Analysis of these searching and sorting techniques. Trees: Binary trees. Traversal of binary tree. Binary search trees: Insertion and deletion & building binary trees. Height balance. Multiway trees. Polish Notation. Graph ADT, Graph traversal, depth-first & breadth-first algorithms. Shortest Paths, best-first, uniform-cost traversals.

Random Processes & Queue Theory (2 Units)

Review of probability: Basic concepts. Conditional and total probability. Distribution and density functions. Random variables: single and multiple variables. Mean variance and moments. Basic concepts , definition, and classification of random processes. Stationary process and independence property. Autocorrelation and correlation functions. Ergodicity. Power density spectrum. Linear systems. Hilbert Transforms. Noise modelling. Linear system response to random signal. Narrowband, bandlimited and bandpass processes. Optimum linear systems: matched filter for white noise and coloured noise, Wiener filters, minimum mean-squared error. Optimization by parameter selection.Poisson points and renewals. Queueing theory. Shot noise. Markov processes. Applications of random signal theory in communications: AM system and noise performance, FM system and noise performance, noise in a phase-locked loop, radar detection: false alarm probability and threshold detection probability.

Telecommunication Software Development 3

See Electrical and Electronics Engineering (Sec 2.8.6)

Reliability and Maintenance 3

See Electrical and Electronics Engineering (Sec 2.8.6)

Electromagnetic Interference 2

See Electrical and Electronics Engineering (Sec 2.8.6)

2.13 MARINE ENGINEERING

2.13.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.13.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.13.3 **Learning outcome**
As in Section 2.1.3

2.13.4 **Attainment Levels**
As in Section 2.1.4

2.13.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.13.6 **Course Contents and Descriptions**

(a) **Course Summary**

		Lecture/Lab. Units
(i)	**Core Courses**	
	Fluid Mechanics	8
	Thermodynamics	8
	Theory of Machines	6
	Science and Engineering of Materials and Metallurgy	6
	Corrosion Engineering	2
	Engineering Drawing	4
	Mechanical Design	7
	Workshop Practice	4
	Engineer-in-Society	1

	Manufacturing Technology	2
	Naval Architecture and Ship Building	3
	Marine Operations	4
	Control Systems	3
	Ship Propulsion	3
	Engineering Materials Selection }	
	and Economics }	3
	Meteorology and Navigation	4
	Technology Policy & Development	2
	Engineering Communications	2
	Advanced CAD/CAM	2
	Project	6
	Total	**96**
(ii)	**Other Courses**	
	Electrical & Electronic Engineering	10
	Civil (Coastal) Engineering	4
	Law and Management	3
	Total	**18**
(iii)	**Basic Science Courses**	
	Mathematics	20
	Physics	10
	Chemistry	10
	Computers & Computing	3
	Total	**43**
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	0
	Total	**16**
	Grand Total	**181**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

Engineering Mathematics	6
Computer & Computing	2
Manufacturing Technology	2
Theory of Machines I	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy I	2

Engineering Drawing	2
Workshop Practice	2
Engineer-in-Society	1
Electrical & Electronic Engineering Courses	4
Civil (Coastal) Engineering	4
Meteorology and Navigation	2
Control Systems	3
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**41**

400 Level	2
Theory of Machines II	2
Thermodynamics	2
Corrosion Engineering	2
Fluid Mechanics	3
Mechanical Engineering Design	2
Marine Operations	2
Technology Policy & Development	2
Engineering Communications	2
Engineering Statistics	2
Introduction to Entrepreneurship Studies	3
Laboratory Practicals	**24**
Total	

500 Level	4
Mechanical Engineering Design	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy II	3
Naval Architecture & Ship Building	2
Marine Operations	3
Ship Propulsion	2
Meteorology and Navigation	3
Engineering Materials Selection and Economics	6
Project	3
Law and Management	3
Electives	3
Advanced CAD/CAM	4
Laboratory Practicals	**42**
Total	

Course Synopses

(i) See Sec 2.15.6 for core Courses' Synopses Common to all Levels

(ii) **Marine Operation** **4 Credits**
(400 & 500 Levels)
Fuel, Lubricants and water on ship; Ship automation; Heating, humidification, ventilation and air-condition on ships; Refrigerated cargo hold and freezers.

(iii) **Naval Architecture and Ship Building** **3 Credits**
(500 Level)
Functions of a ship; Layout of a ship; Structural components of a ship; Theoretical Naval Architecture; Ship Building Technology; Ship-yard.

(iv) **Ship Propulsion** **3 Credits**
(500 Level)
Ship engines and power plants; ship equipment; Ship strength; Marine Diesel engines, steam boilers, steam turbines and auxiliary machines

(v) **Meteorology and Navigation** **4 Credits**
(300 & 500 Levels)
Weather and its impact; Atmospheric thermo-dynamics; Basic climatology; Meteorological instrumentation; Marine ecology and the weather; Numerical weather prediction; Meteorological applications in Navigation.

2.14 MATERIALS AND METALLURGICAL ENGINEERING

2.14.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.14.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.14.3 **Learning outcome**
As in Section 2.1.3

2.14.4 **Attainment Levels**
As in Section 2.1.4

2.14.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.14.6 **Course Contents and Descriptions**

(a) **Course Summary**

	Lecture/Lab. Units
(i) Core Courses	
Science and Engineering of Materials	5
Fluid Mechanics	5
Mechanics of Machines	5
Engineering Drawing	6
Workshop Practice (including Automobile Workshop)	2
Thermodynamics	5
Metallurgical Thermodynamics and Kinetics	2
Manufacturing Technology	5
Mechanical Processing of Materials	2
Chemical Processing of Materials	2
Mineral Processing and Technology	5
Production Metallurgy	4
Fuels, Refractories and Furnace Technology	2
Extraction and refining of materials	4
Metallurgical and Materials Process Design	9
Non-Metals Technology	4
Foundry Technology	6
Heat and Mass Transfer	3
Thermal Treatment Materials	3
Corrosion Engineering	2
Powder Technology	2

	Physical Metallurgy	2
	Engineer-in-Society	2
	Technology Policy and Development	2
	Project	6
	Engineering Materials Selections }	
	and Economics }	3
	Other Materials & Metallurgy Laboratories	6
	Total	**104**
(ii)	**Other Courses**	
	Electronic & Electrical Engineering Courses	10
	Basic Chemical Engineering	5
	Law and Management	4
(iii)	**Basic Science Courses**	
	Mathematics	24
	Physics	10
	Chemistry	10
	Computers & Computing	3
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	8
	Total	**94**
	Grand Total	**198**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

Engineering Mathematics	
Computers & Computing	6
Manufacturing Technology	2
Metallurgical Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing & Computer Aided Graphics	2
Workshop Practice	2
Engineer-in-Society	2
Foundry Technology	1
Materials Electives (Non-Metals)	2
Minerals Processing and Technology	4
Fuels, Refractories & Furnace Technology	3
Electrical and Electronics Engineering Courses	2
Basic Chemical Engineering Courses	3

Introduction to Deformation Processes	2
Laboratory Practicals	2
Foundation Course in Entrepreneurial Studies	3
Total	2
	42

400 Level

Extraction and Refining of Materials	2
Mechanical Processing of Materials	2
Chemical Processing of Materials	2
Production Metallurgy I	2
Materials & Metallurgical Laboratories	2
Metallurgical & Materials Process Design	3
Foundry Technology	3
Corrosion Engineering	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Total	**25**

500 Level

Mineral Processing and Technology	2
Metallurgical Thermodynamics & Kinetics	2
Powder Technology	2
Production Metallurgy II	2
Extraction and Refining of Materials	2
Metallurgical & Materials Process Design	4
Heat and Mass Transfer	3
Thermal Treatment of Materials	3
Physical Metallurgy	2
Project	6
Law	2
Engineering Materials Selection & Economics	3
Other Materials & Metallurgical Laboratories	4
Technology Policy and Development	2
Production & Financial Management	2
Materials Electives (Non Metals)	2
Laboratory Practicals	3
Total	**44**

Electives

- Wood Product Engineering
- Polymer Science Technology
- Ceramics & Glass Technology
- Composite Materials
- Plastic Engineering

Course Synopses

(i) See Sec 2.15.6 for Core Course Synopses Common to all Levels.

(ii) **Process Technology And Design** **9 Credits**
(400 & 500 Levels)
Mineral Processing and Technology, Extraction and Refining of materials; Non-metals; Foundry, Fuels, Refractions and Furnaces; Thermal Treatment of materials; Metallurgical and Materials process design.

(iii) **Heat And Mass Transfer** **2 Credits**
(500 Level)
Analogue between convective heat and mass transfer; Secondary surfaces; Heat transfer with phase change.

(iv) **Corrosion Engineering** **2 Credits**
(400 Level)
Aqueous corrosion; Environmental aspects of corrosion; Oxidation and metals. Corrosion control.

(vi) **Instrumentation** **9 Credits**
Instrumentation methods of analysis; Dynamics of process and equipment; Controllers and their applications; Computer methods.

2.15 MECHANICAL ENGINEERING

2.15.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.15.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.15.3 **Learning outcome**
As in Section 2.1.3

2.15.4 **Attainment Levels**
As in Section 2.1.4

2.15.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.15.6 **Course Contents and Descriptions**

		Lecture/Lab. Units
Course Summary		
(i) **Core Courses**		
Theory of Machines		6
Workshop Practice		6
Auto Workshop		3
Engineering Drawing		4
Thermodynamics		8
Fluid Mechanics		8
Mechanical Design		7
Science and Engineering of Materials and Metallurgy	}	6
Control Systems		3
Manufacturing Technology		2
Engineering Materials, Selection and Economics	}	3
Engineer-in-Society		1
Technology Policy and Development		2
Technical Communications		2
Advanced CAD/CAM		3
Project		6
Sub-Total:		67
(ii) **Other Courses**		
Electrical and Electronics Engineering		10
Basic Civil Engineering		2

	Law and Management Courses	3
	Sub-Total	**15**
(iii)	**Basic Science Courses**	
	Mathematics	20
	Chemistry	10
	Physics	10
	Computers & Computing	6
	Sub-Total	**46**
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives	12
	Sub-Total	**28**
	Ground Total	**161**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Engineering Mathematics	6
Computers & Computing	2
Theory of Machines I	3
Manufacturing Technology	2
Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing	2
Workshop Practice	2
Engineering Metallurgy I	2
Engineer-in-Society	1
Elect. & Electronics Engineering	4
Civil Engineering	2
Control Systems	3
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Total	**41**
400 Level	
Theory of Machines II	3
Auto Workshop Practice	2
Thermodynamics	2
Fluid Mechanics	2
Mechanical Engineering Design I	3

Engineering Communication	2
Technology Policy and Development	2
Engineering Statistics	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Total	**23**

500 Level	
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy II	2
Mechanical Engineering Design II	4
Engineering Materials Selection, and Economics	3
Project	6
Law and Management	3
Electives	12
Advanced CAD/CAM	3
Laboratory Practicals	3
Total	**40**

Core Course Synopses Common to 300, 400 and 500 Levels

(iv) **Thermodynamics** **6 Credits**

Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(v) **Theory of Machines** **2 Credits**

Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton's Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(vi) **Fluid Mechanics** **6 Credits**

Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) **Science and Engineering of Materials and Metallurgy**
3 Credits

Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of

materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) **Engineering Drawing** **2 Credits**

Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) **Mechanical Engineering Design** **7 Credits**

Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production metching; Optimisation in design.

(vii) **Manufacturing Technology** **2 Credits**

Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) **Workshop Practice** **2 Credits**

Workshop setting; Types of workshop equipment, machines and materials; Use of instruments and tools, Machine operation practice; Safety procedures in workshops.

(ix) **Control Systems** **3 Credits**

Control Engineering concepts; Transfer function; Differential Equation of control Systems; Transducers; Automatic control methods.

(x) **Engineering Statistics** **2 Credits**

Probability- elements of Probability, density and distribution functions, moments, standard distributions etc.

Statistics – Regression and correlation, Large sampling theory. Test hypothesis and quality control. Introduction to Statistical Analysis Software packages.

2.16 METALLURGICAL ENGINEERING

2.16.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.16.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.16.3 **Learning outcome**
As in Section 2.1.3

2.16.4 **Attainment Levels**
As in Section 2.1.4

2.16.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.16.6 **Course Contents and Descriptions**

		Lecture/Lab. Units
(i)	**Core Courses**	
	Science & Engineering of Materials	5
	Fluid Mechanics	4
	Engineering Drawing	4
	Workshop Practice (including automobile } Workshop }	2
	Thermodynamics	4
	Manufacturing Technology	4
	Metallurgical Thermodynamics and Kinetics	2
	Mechanics of Machines	5
	Process Metallurgy	4
	Minerals Processing and Technology	5
	Production Metallurgy	4
	Extraction Metallurgy	4
	Physical Metallurgy	2
	Metallurgical and Material Process Design	9
	Fuels, Refractories and Furnace Technology	2
	Foundry Technology	6
	Corrosion Engineering	2
	Heat and Mass Transfer	5
	Heat Treatment of Materials	0
	Instrumentation	3

	Engineering Materials Selection and Economics	} }	3
	Engineer-in-Society		1
	Technology Policy & Development		2
	Project		6
	Other Materials & Metallurgy Laboratory		6
	Total		**94**
(ii)	**Other Courses**		
	Electrical & Electronic Engineering Courses		
	Basic Chemical Engineering		10
	Law and Management		5
			4
(iii)	**Basic Science Courses**		
	Mathematics		24
	Physics		10
	Chemistry		10
	Computers & Computing		3
(iv)	**Entrepreneurial Studies**		4
(v)	**Humanities**		
	General Studies		16
	Electives		0
	Total		**86**
	Grant Total		**186**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

Engineering Mathematics	6
Computers & Computing	2
Manufacturing Technology	2
Metallurgical Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing & computer Aided Graphics	2
Workshop Practice	2
Engineer-in-Society	1
Foundry Technology	3
Fuels, Refractories and Furnace Technology	2
Minerals Processing and Technology	3
Electrical & Electronics Engineering Courses	3
Basic Chemical Engineering	3
Introduction to Deformation Processes	2

Physical Metallurgy	2
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**42**

400 level

Extraction Metallurgy	2
Process Metallurgy	2
Production Metallurgy I	2
Instrumentation	2
Materials & Metallurgical Laboratory	2
Materials & Metallurgical Process Design	3
Foundry Technology	3
Corrosion Engineering	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Total	**25**

500 Level

Minerals Processing and Technology	2
Metallurgical Thermodynamics & Kinetics	2
Extraction Metallurgy	2
Process Metallurgy	2
Production Metallurgy II	2
Metallurgical & Materials Process Design	6
Heat and Mass Transfer	3
Thermal Treatment of Materials	3
Technology Policy & Development	2
Law and Management	3
Engineering Materials Selection & Economics	3
Project	6
Other Materials & Metallurgy Laboratory	3
Laboratory Practicals	3
Total	**42**

Course Synopses

(i) See Sec 2.15.6 for Core Courses Synopses Common to all Levels

(ii) **Production Metallurgy** **4 Credits**
(400 & 500 Levels)
Metal casting; Metal working and fabrication technology;
Rolling; Extrusion; Forging; Wire drawing; other metal forming methods.

(iii) **Process Metallurgy** **4 Credits**
(400 & 500 Levels)

Fundamental principles of metal processing plants;
Selection of process and equipment; Process efficiency calculations; Management and cost effectiveness of various processing system.

(iv) **Extraction Metallurgy** **4 Credits**
(400 & 500 Levels)
Ore preparations; Pyro-metallurgy methods; Hydro-metallurgy; Electro-metallurgy; Other extraction methods.

(v) **Physical Metallurgy** **2 Credits**
(500 Level)
Atomic bonding, Metallurgraphy; Miscroscope;
Diffraction methods.

2.17 MINING ENGINEERING

2.17.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.17.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.17.3 **Learning outcome**
As in Section 2.1.3

2.17.4 **Attainment Levels**
As in Section 2.1.4

2.17.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.17.6 **Course Contents and Descriptions**

(a) **Course Summary**

		Lecture/Lab. Units
(i) **Core Courses**		
Mechanics of Machines		5
Thermodynamics		4
Fluid Mechanics		4
Engineering Drawing		4
Workshop Practice		2
Science and Engineering of Materials	}	
And Metallurgy	}	10
Manufacturing Technology		5
Geology		6
Mineral Processing and Technology		5
Mine Surveying		6
Mining Process Design		4
Mining Systems		9
Rock Mechanics		3
Explosive		3
Mine Ventilation		4
Mine Health and Safety		2
Plant Technology		3
Engineering Materials Selection	}	
And Economics	}	3
Project		6
Technology Policy and Development		2
Engineer-in-Society		1
Total		**91**

(ii)	**Other Courses**	
	Electrical/Petroleum/Civil Engineering	
	Law and Management	20
		4
(iii)	**Basic Science Courses**	
	Mathematics	
	Physics	24
	Chemistry	10
	Computers & Computing	10
		3
(iv)	**Entrepreneurial Studies**	
		4
(v)	**Humanities**	
	General Studies	16
	Electives	0
	Total	**93**
	Grand Total	**188**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Engineering Mathematics	6
Computers & Computing	3
Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy	2
Engineering Drawing	2
Workshop Practice	2
Engineer-in-Society	1
Manufacturing Technology	2
Electrical & Electronic Engineering	3
Civil Engineering Courses	3
Mine Surveying	3
Mining Systems	3
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**38**
400 Level	
Geology	3
Mining Systems	3
Mine Surveying	3
Drilling and Blasting	3
Mining Process Design	2
Plant Technology	3
Engineering Communications	2

Laboratory Practicals	6
Total	**25**

500 Level	
Geology	3
Mining System	3
Petroleum Engineering	3
Mining Process Design	2
Mine Ventilation	3
Mine Health and Safety	2
Rock Mechanics	3
Engineering Metallurgy	2
Mineral Processing Technology	3
Engineering Materials, Selection and Economics	3
Project	6
Technology Policy & Development	2
Law and Management	3
Laboratory Practicals	3
Total	**41**

Course Synopses

(i) See Sec 2.15.6 for Core courses Synopses Common to all Levels

(ii) **Geology** **6 Credits**

(400 & 500 Levels)

Elements of physical geology; Structural geology; Paleontology and Stratigraph; Mineralogy; Petrology; Geochemistry; Sedimentology; Geophysical prospecting methods, Photogeology; Hydro geology

Structure and history of the earth and the solar system. Rocks and minerals: origin, distribution, diagnostic features and classification. Energy and water resources. Introduction to geophysical prospecting methods. Interpretation of geophysical data. Characteristics of the earth's atmosphere. Atmospheric variables and methods of measurement. weather systems and forecasting. Climate and climatic change. Development of mining technology. States in the life of a mine. Unit operations in mining. Mining and its consequences. Government influence and regulations.

(iii) **Mineral Processing and Technology** **3 Credits**

(500 Level)

Properties of single particles and particle systems; Transport properties; Mass and momentum transfer; Cost analysis and control in mineral processing; Applications of operational research techniques. Structures and textures of Mineral and their significance in Mineral genesis and treatment. Ore analysis: Qualitative and quantitative assaying and Mineralogical analysis. Basic comminution theory, comminution and liberation. Particle sizing: sizing by screening, sizing by classification, particle size analysis. Mineral concentration techniques e.g: Heavy

medium separation, magnetic and other separation techniques including the physical and mechanical processes of agglomeration. Preparation of Metallurgical mass balance: recovery and metallurgical losses.

Dewatering: flocculation and dispersion, theory and practice of thickening, filtration and drying. Ore sampling techniques. Communition theory. Criteria for selection of grinding and screening equipment for mineral concentration techniques. Selection of mineral concentration techniques. Selection of mineral concentration equipment. Design, testing and evaluation of mineral beneficiation flow sheets for copper, tin, lead, zinc, iron, gold and other ores of local importance. Materials handling methods. Tailings disposal.

(iv) **Mine Surveying** **6 Credits**

(300 & 400 Levels)

Basic land surveying theory and practice; Mine Surveying; Applications; Setting out and typical calculations.

Mining theodolite. Unique difference between mining theodolite and land surveying theodolite. Surveying in open cast mines – building and construction of an open cast deposit, calculation for drilling, blasting, excavation, transport operations and drainage. Mine survey control in support and stability of slopes in quarry/open pit mines. Factors affecting stability and deformation of slopes in quarry or open pit mines. Methods of calculation of angle of slope in quarry or open pit mines. Surveying in underground mine systems – control on industrial layout of underground deposits. Construction of shaft and shaft lift; mine survey work on contact with mineral surface (lava). Geometrical projections of mine rocks and other mine features. Geometrical classification of industrial and non-industrial mineral deposit. Parameters of mineral reserve estimation and methods of quantifying mineral reserve. Concept of displacement in underground mining zone. Process of displacement of mine rooks/earth surface. Basic understanding and parameters that characterise the process of rock/earth/displacement. Factors affecting rock displacement in mineral deposit. Mine survey control on displacement of mine rock/earth surface. Application of photogrammetry in mining. Computer application in mineral industry. Field work.

(v) **Mining Systems** **9 Credits**

(300, 400 & 500 Levels)

Surface mining operations; Design of surface mining systems; Surface excavation; Ore handling equipment; Case studies of typical surface mines; Underground mining operations; Tunnelling; Underground mining methods; Handling and haulage; Hydraulic transport and pipeline systems.

Analysis of elements of surface mine operation. Design of surface mining systems with emphasis on minimisation of adverse environmental impact and maximization of efficient use of mineral resources. Surface excavation. Ore estimates, grade control, short and long range planning, unit operations, equipment selection, cost estimation, slope stability and placer mining operation. Ore handling equipment. Case studies of typical surface mines: coal, metallic and non-metallic mines. One or more field trips to operating mines scheduled.

Selection, design and development of most suitable underground mining methods based on the physical and geological properties of mineral deposits. Unsupported and supported underground mining methods. Conservation and environmental systems and equipment, conveyors, cable rope-ways and rope haulage, trackless mining systems, hydraulic transport and pipeline systems. Calculations of ore reserve estimates, development planning and preparations for development and extraction, construction of development openings. Cases studies of typical underground mines: coal, metallic and non-metallic. Field trip(s) to operating mines scheduled.

(vi) **Rock mechanics** **3 Credits**
(500 Level)

Mechanical properties of soils and rocks; Failure prediction methods; Mechanics of mine support and roof control.

Introduction to Rock Mechanics – Definition of terms and importance of rock mechanics; field applications in Mining, Civil and Petroleum Engineering. Classification and Index properties of rocks – Geological classification of rocks (crystalline rocks, organic rocks); Porosity Density; Permeability; Strength: Slaking and Durability: Sonic velocity as an index to degree of fissuring; Classification of rock masses for engineering purposes. Rock strength and Failure Criteria Modes of failure of rocks Common Laboratory strength tests (Uniaxial, Triaxial, Brazilian, Flexural tests); Stress-Strain behaviour in compression; Effect of confining pressure; The meaning of rock strength; Application of the complete Stress-Strain curve. The Mohr Coulomb failure criterion; The effect of water; The influence of the principal Stress ration on failure; Empirical criteria of failure; Coulom-Navier criterion of failure of rocks; Griffth brittle failure Criterion. Elastic properties. Applications of rock mechanics in engineering or underground openings. Rock slope stability. Support systems design and selection – caving and subsidence. Observation of mass deformations – extensometers and strain transducers. Case studies.

(vii) **Drilling & Blasting** **3 Credits**
(400 Level)

Types and properties of explosives; Applications of explosives in rock drilling, boring; and mechanical breakage; Safety consideration in the use of explosives.

Rock characteristics affecting drilling - engineering properties of rock material, rock drillability and blastability. Classification of drilling and penetration methods. Theories of rock penetration. Rotary, percussive, rotary-percussive and thermal drilling. Drill bits and their applications. Diamond drilling and ore recovery. Basic parameters affecting bench drilling-bench height, burden, spacing and drilling pattern. Choice of drilling equipment. Definition of explosives.

Brief history of explosives. Terminology and definition – velocity of detonation, density, detonation pressure, sensitivity, strength, water resistance, fume characteristics. Properties and classification of explosives – dynamites,

ammonium nitrate and fuel oil (ANFO). Explosive accessories. Magazine construction. Blasting methods and practice in surface and underground mines. Blasting patterns; special blasting techniques – smooth, pre-splitting, secondary blasting procedure. Disturbances created by blasting.

(viii) **Mining Process Design** **4 Credits**
(400 & 500 Levels)

Sequence in mining systems; Design of mining process elements and layouts; Safety and control systems; Support system design.

Design of the following mine structures such as access to mineral deposits. Mine layout, surface mine excavation methods. Underground mine excavation methods, drilling and blasting patterns. Underground roof supports, mine drainage system, mine ventilation network, mine transportation system and explosives magazines etc. This course basically involves drawing. Students are expected to provide necessary drawing tools such as drawing pens standard drawing papers, etc.

(ix) **Mine Ventilation** **3 Credits**
(500 Level)

Effects and changes of poor mine ventilation;

Air systems design; Mine ventilation design and control.

Fundamentals of mine ventilation. Techniques for the control of dust, temperature, humidity, gas. Physiological effects and dangers of poor mine ventilation. Basic principles of mine ventilation design. Simple calculations of flow of air through ducts and mine opening. Equipment selection, instrumentation and air measurements. Evaluation of efficiency of ventilation systems.

(x) **Mine Health and Safety** **2 Credits**
(500 Level)

Causes and prevention of mine accidents. Mine rescue procedures. Mine health and safety regulations. Design of safety systems for typical surface and underground mines. Basic concepts of systems safety engineering. Mine health and safety systems.

(xi) **Plant Technology** **3 Credits**
(400 Level)

Plant and process control; Mining machinery, operations; Plant maintenance.

Essential features of a machine: gears, shaft bearings, couplings etc. Construction and application of wire rope used in mine machinery. Care of ropes. Lubricants for mine machinery.

Surface mine Machinery: Power shovel, front-end-loaders, dragline, hydraulic excavators, bucket wheel excavators, bucket change excavators, rippers, scrapers and bulldozers. Dredge monitors and gravel pumps, sluice boxes, dump trucks.

Underground mine machinery: Loaders – gathering arm loaders, bucket type loaders, front-end-loaders, load-and slucher hoist.

Transports: locomotives-battery, trolley wire and diesel conveyor belts haulage trucks, rope haulage-direct and endless rope. Hosting, Types of pumps and their application. Pumps characteristics compressors-reciprocating and rotary types, characteristic s and choice of compressors.

2.18 OPERATIONS RESEARCH

2.18.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.18.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.18.3 **Learning outcome**
As in Section 2.1.3

2.18.4 **Attainment Levels**
As in Section 2.1.4

2.18.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.18.6 **Course Contents and Descriptions**

300 Level Courses

Course Title	**Credit Units**
Engineering Mathematics	3
Introduction to Mathematical Programming	3
Methodology of Operations Research	2
Decision Theory and Games	3
Structured Programming I	3
Industrial Organisation	2
Operations Management	2
Operations Research Practicals	3
Optimisation Techniques	3
Inventory Control	3
Laboratory and Field Course	3
Accounts Financial Reporting	2
Entrepreneurial Studies	4
Sub-Total	**36**

Electives (2 Units)	
Probability	2
Analysis of Variance I	2
Sampling Theory and Survey Methods	2
Statistical Quality Control	2
Numerical Analysis	2
Regression Analysis I	2

400 Level	Course Title	Credit Units
	Technical Communications	2
	Linear Programming and Extensions	3
	Dynamic and Goal Programming	3
	Forecasting and Estimation	3
	Systems analysis	3
	Technical Communication	1
	Structured Programming II	3
	SIWES (Industrial Training)	6
	Sub-Total	**23**

Electives (2 units)

	Introduction to Mathematical Modeling	2
	Regression Analysis II	2

500 Level

Course Title	Credit Units
Simulation Techniques	3
Management Information Systems	3
Applications of Operation Research	3
Structures Programming III	3
Stochastic Processes	3
Project	6
Reliability, Replacement and Maintenance	3
Mathematical Programming	3
Statistical Methods in Operations Research Application	3
Sub-Total	**30**

Electives (4 units)

	Non-parametic Methods	2
	Multivariate Analysis	2
	Econometrics	2
	Sequential Methods in Statistics	2
	Partial Differential Equations	2

Course Descriptions

300 Level

Introduction To Operations Research **(**3 Units)

Philosophy, Concepts, Methods, and techniques of Operations research. History and development of Operations research. The phases of an Operations Research Project. Components of decision problems. The environment of decision problems. The systems approach to problem solving. Interdisciplinary teams. Implementation of solutions, control and maintenance of solutions. Several of the classical problems and some case studies topics include linear programming, the transportation and assignment problems, integer programming, PERT/CPM, inventory models, and the use of analytical techniques in

portfolio management. Resource allocation and smoothing. Gannts charts, scheduling one and two machines. Johnson's algorithm. Networks and their use; shortest paths, minimal tress, maximal flows. Heuristics for solving network problems and other operation research problems.

Introduction to Mathematical Programming (3 Units)

Brief introduction to several areas of mathematical programming; linear, nonlinear, integer, dynamic and goal programming. Emphasis if given to applications, models, computer implementation, and solutions, some algorithms.

Methodology of Operations Research (3Units)

Review of the art of problem solving using the scientific approach logic-introduction to inductive and deductive reasoning, test of validity, propositions and truth tables, tautologies, self contradictions, an arguments. Problem formulation and definition understanding the clients problem, asking the right questions, Psychology of the decision-maker, defining the problem. Active intervention, miss-management, robustness, satisfy applications of OR in developing countries, implementation and criticisms of OR. The course would be taught with extensive case studies and practical action research.

Decision Theory and Games (3 Units)

Decision trees-analysis and problems; the value of information; the concepts of utility, risk and decision-making in a competitive environment applications are drawn from governmental industrial business and financial institutions, social and educational establishments as well as private life. Theory of games, stable and unstable games, Two-person zero sum and matrix games, Nash solution, N-person games, the shapely value strategies criteria for optimal solutions by linear programming. Applications to OR problems in Business and industry.

Structured Programming I 3 Units

Use of structured programming language such as QBASIC and VBASIC in problem solving operation research problems. Mainly laboratory based course.

Industrial Organisation 2 Units

Operations Management 2 Units

Introduction to Operations Management – the growth of science in Management, the genesis of Operations management the operations sub-system, the problems of problems management, the total system. Planning the system – planning concepts and philosophy, planning decision system, capacity planning environments. Capacity models. System location planning and layout planning – Essence of system location planning, system location planning models, layout concepts and processes, system layout planning models. Introduction to forecasting in operation management – general approach to forecasting, forecasting models. Introduction to work study – organization and staff for operations management, design and work measurement introduction to inventory control, quality control, and reliability theory.

Operations Research Practicals **3 Units**

This course is designed to provide a forum where the theories, techniques models and methodology or Operations Research are put into practice in forms of simulations – computer – based and real life and practical investigations. Students are exposed to OR activities outside the classroom. Laboratory activities include: use of computers to solve problems, involvement in real-life activities, evaluation of OR application in developing countries, Seminars and presentation of reports about on-going OR applications in industry, government, business, education, finance, etc.

Optimisation Techniques **3 Units**

Classical Optimization search methods for unconstrained optimization – Grid, Hook and Jeeve's spendley, Hext and Himsworth's Nelder and Meads, Fibonacci; Golden section Gradient methods for unconstrained optimization – steepest descent, Newton – Raphson, Davidon, Fletcher, Powel, conjugate directions. Constrained optimization – Hemstitching, gradient projection, penalty functions

Inventory Control **3Units**

Inventory models: The Economic order quantity for purchasing and manufacture; discounts; inventory policies, periodic review; analysis of lot-size models, deterministic and stochastic models, static and dynamic models, and multi-item models and multi-echelon models. Dynamic programming for inventory analysis; limitations of theoretical models and applications.

400 Level

Linear Programming and Extensions **3 Units**

Linear programming using the simplex method: Review of problem formulation; graphical solution of two-dimensional problems, simultaneous equations, definition of basis objective and feasibility; tests for optimality; the simpler method. Sensitivity Analysis and Duality. Interpretation of the solution tableau for sensitivity; the dual problem and the dual simplex method. Transportation, assignment and transshipment Integer programming. The cutting plane method, the method of Brach and Bound. Case studies, computer odes, and implementation are also discussed.

Dynamic and Goal Programming **3 Units**

Development and treatment of dynamic programming cases of both deterministic and stochastic types. Bellman's principle, definition of state, stages and policies; recursion, Basic computational Algorithms including Howard's. Generalisations. Existence and uniqueness theorems, Markovian decision process, Optimal inventory equations, multistage games. Various examples and applications discussed.

Forecasting and Estimation **3 Units**

This course discusses basic forecasting models. The emphasis is on application of forecasting models and techniques to decision making problems. Topics covered include: Extrapolative methods, linear stationary models, auto-regressive and moving- average models, casual models, smoothing techniques: Polynomial, exponential and trigonometric forecasting models; filters adaptive forecasting models regression and correlation,

econometric models input/output models, Bax-Jenkings, Introduction to qualitative forecasting models, qualitative forecasting models – the Delphi method, technological for casting, etc the forecasting environment in developing countries model building, fitting and estimation.

Systems analysis **3 Units**

This course is an introduction to systems methodology Topics discussed include: history and development of systems analysis, distinguishing features of the systems approach; General systems theory, systems methodology; soft and hard systems; basic systems, metasystems, recursive systems. Strategic systems planning and system stability Applications.

500 Level

Simulation Techniques **3 Units**

This course is intended to be an introduction to discrete-event simulations. Topics covered include: elements of simulation, processes in simulation, uses of simulation, pitfalls of simulation, sampling from distributions uniform Random number generation and tables, Test for generators. General methods for non-uniform random number; Inversion, rejection, and composition methods. Methods for specific distribution normal, gamma, beta t, f, binomial and Poisson simple application statistics, sampling, randomisation, monte-carlo integration. Simulation languages, Analysis of simulation output, and design of simulation experiments.

Management Information Systems **3 Units**

This course is an exposition of the impact of computers on OR. It is an introduction to management information system and decision support systems. The aim is to introduce the students to the use of data to influence decision-making. Topics covered include: Introduction to computer hardware and software, available computer packages, data processing, distinction between data and information characteristics of information for decision making, hierarchy of decision making and the deferring information requirement decision making contexts, information sequence-raw data, processed data, utilization of processed data. Purpose of information, decision types and environments, design and management of information of systems the role of systems analysts, information specialists and programmers and their relationship to the users and decision-maker man-machine interface.

Applications of Operation Research **3 Units**

The art and science of problem formulation. The operations research approach to problem solving. Mathematical modeling, applications of operations research to important problem arising in business, agriculture, industry, commerce, government and society case studies and exercise. Relevant issues in applications to developing countries in general and to Nigeria in particular vis-à-vis in the developed countries.

Reliability, Replacement and Maintenance **3 Units**

Fundamental concepts of reliability; Estimation of reliability of components and of systems; models for systems in series, parallel and mixed; failure analysis; distribution problems IFR

and IFRA distribution optimal designs repair and replacement of systems, applications their integration in surveillance, quality control.

Mathematical Programming **3 Units**

This course deals with the theory and algorithms for solving optimization problems involving nonlinear functions of variables. Topics discussed include: - separable programming, integer programming by cutting-plane methods and by BAB partial enumeration, Farka's Lemma, Theorems of alternatives, KUHU – Tucker theory and extensions Quadratic, convex, fractile and discrete programming. Geometric programming. Applications, especially to Engineering.

Statistical Methods in Operations Research Application (3 units)

This course covers basic foundations of estimation, confidence intervals and hypothesis tests, statistical decision theory, Analysis of variance models, regression analysis, and non-parametric methods.

Project I **(6 Units)**

Seminar on an approved research topic.

Individual research on a selected topic under the supervision of a staff illustrating applications of the theories and techniques covered in the course. A detailed report on the research is presented by the student when the project is completed. The student is expected to submit two bound copies of his project (certified by the supervisor) to the Department.

2.19 PETROCHEMICAL TECHNOLOGY

2.19.1 Philosophy, Aims and Objectives of the Degree Programme
As in Section 2.1.1

2.19.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.19.3 **Learning outcome**
As in Section 2.1.3

2.19.4 **Attainment Levels**
As in Section 2.1.4

2.19.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.19.6 **Course Contents and Descriptions**

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**General Studies**	16
	(ii)	**Basic Sciences**	
		Mathematics	20
		Chemistry	12
		Physics	10
		Geology	7
		Sub-Total	**49**
	(iii)	**Entrepreneurial Studies**	4
	(iv)	**Core Engineering Course**	
		(Petroleum Eng. Courses)	
		Introduction to Petroleum Eng.	3
		Drilling Courses	12
		Formation Evaluations	12
		Petroleum Production Engineering	12
		Reservoir Engineering	12
		Petroleum Economics	3
		Petroleum Eng. Laboratory	6
		Project	4
		Sub-Total	**64**

(v) **Other Courses**

Technical/Engineering Drawing	2
Workshop Practice	2
Strength of Materials	4
Fluid Mechanics	6
Thermodynamics	3
Applied Electricity	4
Computers & Computing	2
Other Engineering Electives	5
Sub-Total	**28**
Specialisation	12

(vi) **Components of Petroleum Engineering**

General Studies	16
Basic Sciences	49
Entrepreneurial Studies	4
Major Engineering Courses	64
Other Engineering Courses	28
Specialisation	12
Total	**173**

Theory/Laboratory Ratio (Contact Hours) 62.5/37.5

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

Industrial Studies	4
Engineering Economy	2
Engineering Analysis	5
Strength of Materials	3
Fluid Mechanics	3
Drilling Fluids Technology	4
Drilling Technology	3
Reservoir Engineering I	6
Petroleum Production Engineering I	3
Foundation Course in Entrepreneurial Studies	2
Petroleum Geology	3
Sub-Total	**38**

400 Level (I Semester)

Industrial Studies	2
Applied Geophysics	2

Engineering Management and Law	2
Drilling Technology II	3
Reservoir Engineering II	3
Petroleum Production Engineering II	3
Well Lodging	3
Introduction to Entrepreneurship Studies	2
Sub-Total	**20**

500 Level

Drilling Technology III	3
Reservoir Engineering III	3
Petroleum Refining Technology	3
Petroleum Production Engineering III	3
Reservoir Modeling and Simulation	3
Enhanced Oil Recovery	2
Project	4
Design	5
Petroleum Product Transport & Storage	2
Process Technology	3
Offshore Operations	2
Natural Gas Processing	3
Sub-Total	**36**

Course Synopses

(a) **300 level**

(i) **Industrial Studies** **2 Credits**

Introduction to the organisational structure of manufacturing organisations. Evolution of an industrial, domestic and commercial product from society's needs, or market survey; problem definition, design tools – simulation, graphs and layouts; feasibility studies. Team implementation/manufacture of selected simple engineering products-for industrial, domestic and commercial purposes.

(ii) **Industrial Studies II** **2 Credits**

Study of projects and contract documents for the various branches of Engineering; Drawing, Bill of Quantities, Identification of Materials, Material location, Quantity, Quality and handling requirements; Specification, Quality control and Measurements, Safety and Safety procedures.

(iii) **Engineering Economy** **2 Credits**

Introduction to Engineering Economy. Engineering Economy and the Engineering process, some Fundamental Economic Concepts. Elementary Selections in Economic Analysis. Interest and Interest Formulas. Calculations of Interest Formulas and Equivalence. Economic Analysis of

Alternatives .Bases for Comparison. Decision Making among Alternatives. Evaluating Replacement Alternatives. Breakeven and Minimum Cost Analysis. The Evaluation of Public Activities. Accounting, Depreciation and Income Taxes. Accounting and Cost Accounting. Depreciation and Depreciation Accounting. Income Taxes in Economy Studies

(iv) **Heat and Mass Transfer 4 Credits**

Models of heat transfer, general heat conduction equation, steady state conduction, unsteady heat transfer by convection, natural and forced, laminar and turbulent. Heat transfer by radiation, fundamentals of black and gray bodies, combined models of heat transfer, radiation exchange between surfaces. Heat exchangers, conductors and dryers. Mass transfer fundamentals, diffusion and convection mass transfer.

(v) **Strength of Materials I 3 Credits**

Beams, Simple bending, Bending movement diagrams. Unsymmetrical bending. Shear centre. Composite beams plastic hinge. Beams in plastic range, continuous beams. Statically indeterminate systems, by elastic and plastic methods. Mohr's circle. Compound stresses. Buckling, Euler's Formular and Empirical Formulae. Energy Methods. Principles of Castigliano. Maxwell, Mohr. Applications.

(vi) **Strength of Materials II 3 Credits**

Elementary concepts in two dimensional theory of elasticity-equations of equilibrium. Strain displacement relation. Generalised Hookes Law. Introduction to plastic behaviour of materials elastic, perfectly plastic and strain hardening materials. Linear Viscoelastic Materials. Thick walled pressure vessels. Stresses due to shrinkage fit.

(vii) **Engineering Analysis II 3 Credits**

Statics of rigid bodies in three dimensions; Distributed Force-Centroids and Centres of Gravity; Analysis of Structures – Internal Forces, Newton's Third Law, Trusses, Frames, and Machines; Forces – moment of inertial – areas and masses; Rotation of rigid body about a fixed axis, plan motion of rigid body; Relative motion; Applications. Principles of virtual work, Efficiency of simple machines. Review and engineering applications of Differential Equations; Partial Differential Equations; Laplace Transformation and other transform methods. Series solutions and special functions such as Bessel's functions, Fourier series.

(viii) **Engineering Analysis III 3 Credits**

Numerical methods and digital computer methods applied to various engineering problems including matrix inversion, numerical approximation methods, optimisation methods and applications in engineering: Introduction to state space formulation, analysis and

applications. Computer design of simple engineering components and systems.

(ix) **Fluid Mechanics I** **3 Credits**

Fundamentals, physical characteristics and properties of fluids, viscosity, surface tension, pressure. Fluid statics, manometry, forces on submerged surfaces, bouyance and floatation, stability of floating bodies. Fluid masses subject to acceleration. Kinematics of Fluid motion, continuity equation, circulation and vorticity. Flow of ideal incompressible fluid, Euler's equation, Bernoulli's equation. Application of Bernoulli's equation and two dimensional flow systems. Impulse and momentum principle, elementary and simple flow machines applications. Some aspects of real flows, laminar and turbulent flow, flow in pipes, flow in open channels.

(x) **Fluid Mechanics II** **3 Credits**

Introduction to Hydrodynamics, stream function, flow fields, steam lined bodies, rotational and irrotational flows, velocity potential, conformal transformation. Jou Kowsky transformation. Thin aerofoil theory, characteristics of two dimensional aerofoil. Sections introduction to turbo – machines. Characteristics curves for pumps, axial flow machines, impulse and reaction turbines, fans, blowers and propellers. Introduction to gas dynamics. Introduction to boundary layer theory. Dimensional analysis and similarity laws

(xi) **Drilling Fluids Technology** **4 Credits**

Functions and composition of drilling fluids. Mud properties; testing, classification and chemical analysis. Drilling mud calculations, control of mud properties. Well completion fluids. Drilling mud performance.

(xii) **Drilling Technology I** **3 Credits**

Techiques for oil well drilling. Drilling rigs; equipment, hoisting , drill string, casing drill bits. Circulating system, drilling fluids, drilling hydraulics. Well head equipment. Drilling and casing programs. Drilling performance. Offshore drilling rigs.

(xiii) **Reservoir Engineering I** **6 Credits**

Fundamental properties of single and multiple fluid saturated rocks; porosity, permeability, relative permeability, fluid saturations, electrical resistivity capillary pressure. Surface forces, wettability, compressibility and correlations between rock properties.

(xiv) **Petroleum Production Engineering I 3 Credits**

Properties of oil and Gas: Composition of oil and natural gas; classification of crude oil; natural gas.

Well Completion: Tubing; types, tubing equipment, uses of tubing, calculations; use of wire lines, packers-types, uses; multiple zone completion; well heads – casing and tubing hangers; Christmas tree.
Cruptive Production: Gas-oil ratio (GOR); productivity index; fluid flow and pressure losses; multiphase formation volume factor (Bt).
Perforation: bullet perforation; jet perforation.
Artificial Production: Gas lift; pumps.

(xv) **Petroleum Geology 3 Credits**
Petroleum prospecting, uses of geological data, reservoir rocks, reservoir fluids, traps, origin of oil and gas geology of the Niger Delta and Lake Chad Basin. Geophysics.

(xvi) P**etroleum Engineering Rock Mechanics 3 Credits**
Fundamentals of rock mechanics, Crater formation: Plastic and pseudo plastic characteristic of rocks load rate mechanism: Static and impact loading; tooth penetration as a function of differential and overburden pressures. Effect of differential pressure on drilling rate.

400 LEVEL

(i) **Industrial Studies III 2 Credits**
Group technology tasks: these may involve group design and manufacture of prepared drawings, specifications and planning schedules, a viable commodity which has a tested performance, and acceptable standard of finish and time and cost constraints, under a chosen leader; service and maintenance group tasks, etc. (Emphasis is for the students to appreciate the necessity to use people, materials and equipment to the best economic conditions and the need for personal relationship and the acceptance of responsibility when working as part of a team).

(ii) **Technical Communications 2 Credits**
Introduction to principles of effective communication with attention to the importance of emphasis, emotive content, and style; principles of technical writing, organisation and presentation of technical reports, feasibility studies, technical correspondence. Oral presentation of technical ideas; technical aids in presentation, organisation of practical applications.

(iii) **Engineering Management and Law 2 Credits**
Engineering profession: Professional ethics and conduct.
Law: Definition and specification; Applications of business law to engineering; Patents and inventions, trademarks and copyrights; Contracts and contract documents; Engineering business – types, the structure and functions of organisations: Professional problems – legal responsibilities, professional liability, role of engineer in law suits.
Management: Organisational structure and behaviour; engineer to engineer manager transition; Managerial functions, principles and techniques of planning,

forecasting, organising technical activities; project selection and management; leadership, styles of leadership and management.
Techniques in engineering management – motivated, appraisal, participative and control techniques.

(iv) **Drilling Technology II 3 Credits**

Pressure Control and Blowout Prevention: The need to control pressure; BOP valves; stack, choke line and choke manifold; choice of BOP system; control o kick; subsurface pressures and mud hydrostatic pressure; data for executing kick control; indications of kick; methods of circulating out a kick – Balanced Bottom Hole Pressure method (BBHP), driller's method; kick when tripping, gas out mud.
Cementing: Equipment; hole conditions; volume calculations and rate of circulation; squeeze cementing; cement plug. Fishing: Fishing tolls; objects lost in the hole; fishing methods.
Casing Design: Mechanical properties – tension, collapse and burst; designing a casing string.

(v) **Reservoir Engineering II 3 Credits**

Reservoir fluid behaviour, PVT analysis, formation volume factors. Estimating reserves; material balance equations. Concepts of fluid flow through porous media, Darcy's law. Steady state and transient fluid flow in reservoirs. Displacement of oil and gas. Reservoir testing and performance analysis. Differential equations for radial flow in a porous medium.

(vi) **Petroleum Production Engineering II 3 Credits**

Surface completion: Gathering systems; service and cleaning systems; design and testing of flow lines. Emulsion problems; oil emulsions; emulsifying agents and deemulsifiers; choice and dosage of de-emulsifiers. Separation and separators; heat treatment. Dehydration: need for dehydration of gas; dew-point depression; absorption with glycol and absorption with solids.

(vii) **Well Logging 3 Credits**

Well logging devices, principles and technology. Electrical, radioactive, acoustic/velocity, caliper, inclinometer, dipmeter and thermometer logs. Well log interpretation. Use of combination logs, cross plots. Production logging. Computer processing of logs.
Measurements-while-drilling systems.

(viii) **Applied Geophysics and Petroleum Exploration 2 Credits**

The scope of geophysics; solid earth geophysics; the shape of the earth; geomagnetism; marine geophysics; isostacy. Geophysical instruments, field data processing, electrical, seismic, radiometric, etc). Geophysical logging of borehole. Geophysical prospecting and exploration.

(ix) **Oil Pollution and Control** **3 Credits**

Causes of oil pollution; blowout; pipeline and flowline leakages, sour-gas production, sea transportation hazards. Need for oil spill prevention and control; Impact on the environment – ecology. Methods of control; mechanical, chemical and biological methods. Global pollution problems; Government regulations.

500 LEVEL

(i) **Drilling Technology III** **3 Credits**

Drilling parameters: Choice of drilling program and drilling rig; mechanical parameters and their optimisation – drilling bits; hydraulic parameters – mud viscosity, density, filtrate and bit nozzles. Directional Drilling: Uses of directional drilling: deviating tools; vertical profile, horizontal profile; deviation measurements.

Offshore Drilling: Underwater BOP stack, marine risers, underwater well head, floater stability; heave compensators.

(ii) **Reservoir Engineering III** **3 Credits**

Water influx; steady-state; pseudo steady – state (Hurst); transient (Van Everdingen and Hurst). Well test: drill-stem tests (DST); Production tests; pressure tests; back-pressure tests on gas wells, productivity tests on oil wells, build-up and draw-down tests on oil wells, coning of water and gas; effects of partial penetration. Secondary recovery; water injection sweep efficiency stiles methods, Dykstra – Parsons method.

(iii) **Petroleum Refining Technology** **3 Credits**

Petroleum processing equipment; storage tanks; rectification columns; heat exchange apparatus; pipe furnaces; pipelines and fittings; compressors and pumps. Preliminary processing. Thermal processes; thermal cracking; coking; pyrolysis. Catalytic processes; brief description; catalytic cracking; catalytic reforming; hydrogenation processes; hydrogen cracking.

(iv) **Petroleum Production Engineering III** **3 Credits**

Problem-well analysis: Work over techniques; well stimulation; fracturing and acidising. Sand control: gravel packing; sand consolidation. Pipelines and transportation; maximum pipeline capacity; other transportation systems. Metering of oil and gas; problems associated with flow measurement; flow measurement systems; liquid level controllers.

(v) **Reservoir Modeling and Simulation** **3 Credits**

Purpose of reservoir simulation. Concepts of Simulation; Darcy's law, fluid in porous media. Reservoir simulation equations. Finite – difference model. Solution of the simulator equations. Matrix of simultaneous equations; Data preparation: fluid data, rock data, production data, flow rate data. Making a simulation study. History matching.

(vii) **Enhanced Oil Recovery** **3 Credits**

Principles of displacement: rock properties; fluid properties in reservoir; phase behaviour; displacement efficiencies. Gas methods; miscible slug; enriched gas-high pressure lean gas; carbon dioxide; nitrogen and other inerts. Chemical methods; miscellar – polymers; polymer augmented waterflood; permeability alteration; caustic. Thermal methods; steam stimulation; steam drive; in-situ combustion.

(vii) **Petroleum Product Transport and Storage 3 Credits**

Transportation of crude oil: Pipelines; tankers – loading and unloading techniques, offshore loading systems, international regulations on tanker transportation. Custody transfer storage of crude oil tank farm operations – gauging, sampling, quality control, underground storage – caverns, porous rocks. Gas transportation: compressors, pipelines; liquefied natural gas transportation. Storage of natural gas; pressure tanks, re-injection in porous rocks, storage in caverns. Storage of LNG.

(viii) **Process Technology** **3 Credits**

Pressure losses in pipes. Pressure losses in armature and fittings. Pumps. Heat exchangers. Nozzle theory and mass transfer. Combustion processes. Heat transfer, Conduction; convection; condensation, heat exchangers. Distillation. Particle fall in liquids cyclones.

(ix) **Offshore Operation** **2 Credits**

Offshore drilling: Offshore prospecting; offshore rigs; stationary and floating rigs; rig movement and stability; drilling from a floating vessel; subsea BOP stack; marine risers; subsea wellhead. Offshore production: subsea well completion methods; offshore processing equipment and design; loading systems and other transportation. Offshore operations: logistics, contingency planning; oilspill and oil removal.

(x) **Natural Gas Processing** **3 Credits**

Gas laws; phase behaviour of natural gas system; gas from condensate and oil fields; field separation processes; dehydration and sweetening of natural gas; scale problems; gas liquification.

(xi) **Petroleum Economics** **2 Credits**

The structure of the petroleum industry; economic geography – impact of oil resources on the economy of oil producing countries; linear programming; refinery economics; oil concessions in Nigeria; government participation; the Nigeria petroleum labour market; marketing and sales calculations; investment analysis; risk analysis and probability; financing energy crisis.

(xii) **Multiple Phase Flow in Pipes** **3 Credits**

Principles of two phase flow: The general energy equation; Evaluation of friction losses. Single phase Flow. Variables used in two phase flow; flow patterns. Horizontal flow: Horizontal pressure loss prediction methods. Prediction of horizontal flow patterns. Flow through restrictions.

2.20 PETROLEUM ENGINEERING

2.20.1 Philosophy, Aims and Objectives of the Degree Programme
As in Section 2.1.1

2.20.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.20.3 **Learning outcome**
As in Section 2.1.3

2.20.4 **Attainment Levels**
As in Section 2.1.4

2.20.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.20.6 Course Contents and Descriptions

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**General Studies**	16
		Sub-Total	16
	(viii)	**Basic Sciences**	
		Mathematics	20
		Chemistry	12
		Physics	10
		Geology	7
		Sub-Total	**49**
	(ix)	**Entrepreneurial Studies**	4
	(x)	**Major Engineering Course**	
		(Petroleum Eng. Courses)	
		Introduction to Petroleum Eng.	3
		Drilling Courses	12
		Formation Evaluations	12
		Petroleum Production Engineering	12
		Reservoir Engineering	12

	Petroleum Economics	3
	Petroleum Eng. Laboratory	6
	Project	4
	Sub-Total	**64**
(xi)	**Other Engineering Courses**	
	Technical/Engineering Drawing	2
	Workshop Practice	2
	Strength of Materials	4
	Fluid Mechanics	6
	Thermodynamics	3
	Applied Electricity	4
	Computers & Computing	2
	Other Engineering Electives	5
		28
	Specialisation	12
(xii)	**Components of Petroleum Engineering**	
	General Studies	16
	Basic Sciences	49
	Entrepreneurial Studies	4
	Major Engineering Courses	64
	Other Engineering Courses	28
	Specialisation	12
	Total	**173**

Theory/Laboratory Ratio (Contact Hours) 62.5/37.5

(b) **Break-Down Of Courses Into Levels of Study**

300 Level	Lecture/Lab. Units
Industrial Studies	4
Engineering Economy	2
Engineering Analysis	5
Strength of Materials	3
Fluid Mechanics	3
Drilling Fluids Technology	4
Drilling Technology	3
Reservoir Engineering I	6
Petroleum Production Engineering I	3
Foundation Course in Entrepreneurial Studies	2
Petroleum Geology	3
Sub-Total	38

400 Level (I Semester)

Industrial Studies	2
Applied Geophysics	2
Engineering Management and Law	2
Drilling Technology II	3
Reservoir Engineering II	3
Petroleum Production Engineering II	3
Well Lodging	3
Introduction to Entrepreneurship Studies	2
Sub-Total	**20**

500 Level

Drilling Technology III	3
Reservoir Engineering III	3
Petroleum Refining Technology	3
Petroleum Production Engineering III	3
Reservoir Modeling and Simulation	3
Enhanced Oil Recovery	2
Project	4
Design	5
Petroleum Product Transport & Storage	2
Process Technology	3
Offshore Operations	2
Natural Gas Processing	3
Sub-Total	**36**

Course Synopses

300 Level

(ii) **Industrial Studies** **2 Credits**

Introduction to the organisational structure of manufacturing organisations. Evolution of an industrial, domestic and commercial product from society's needs, or market survey; problem definition, design tools – simulation, graphs and layouts; feasibility studies. Team implementation/manufacture of selected simple engineering products-for industrial, domestic and commercial purposes.

(ii) **Industrial Studies II** **2 Credits**

Study of projects and contract documents for the various branches of Engineering; Drawing, Bill of Quantities, Identification of Materials, Material location, Quantity, Quality and handling requirements; Specification, Quality control and Measurements, Safety and Safety procedures.

(iii) **Engineering Economy** **2 Credits**

Introduction to Engineering Economy. Engineering Economy Concepts. Elementary Selections in Economic Analysis. Interest and Interest Formulas.Calculations of Interest Formulas and and the Engineering

process, some Fundamental Economic Equivalence. Economic Analysis of Alternatives. Bases for Comparison. Decision Making among Alternatives. Evaluating Replacement Alternatives. Breakeven and Minimum Cost Analysis. The Evaluation of Public Activities. Accounting, Depreciation and Income Taxes. Accounting and Cost Accounting. Depreciation and Depreciation Accounting. Income Taxes in Economy Studies

(iv) **Heat and Mass Transfer 4 Credits**

Models of heat transfer, general heat conduction equation, steady state conduction, unsteady heat transfer by convection, natural and forced, laminar and turbulent. Heat transfer by radiation, fundamentals of black and gray bodies, combined models of heat transfer, radiation exchange between surfaces. Heat exchangers, conductors and dryers. Mass transfer fundamentals, diffusion and convection mass transfer.

(v) **Strength of Materials I 3 Credits**

Beams, Simple bending, Bending movement diagrams. Unsymmetrical bending. Shear centre. Composite beams plastic hinge. Beams in plastic range, continuous beams. Statically indeterminate systems, by elastic and plastic methods. Mohr's circle. Compound stresses. Buckling, Euler's Formular and Empirical Formulae. Energy Methods. Principles of Castigliano. Maxwell, Mohr. Applications.

(vi) **Strength of Materials II 3 Credits**

Elementary concepts in two dimensional theory of elasticity-equations of equilibrium. Strain displacement relation. Generalised Hookes Law. Introduction to plastic behaviour of materials elastic, perfectly plastic and strain hardening materials. Linear Viscoelastic Materials. Thick walled pressure vessels. Stresses due to shrinkage fit.

(vii) **Engineering Analysis II 3 Credits**

Statics of rigid bodies in three dimensions; Distributed Force-Centroids and Centres of Gravity; Analysis of Structures – Internal Forces, Newton's Third Law, Trusses, Frames, and Machines; Forces – moment of inertial – areas and masses; Rotation of rigid body about a fixed axis, plan motion of rigid body; Relative motion; Applications. Principles of virtual work, Efficiency of simple machines. Review and engineering applications of Differential Equations; Partial Differential Equations; Laplace Transformation and other transform methods. Series solutions and special functions such as Bessel's functions, Fourier series.

(viii) **Engineering Analysis III 3 Credits**

Numerical methods and digital computer methods applied to various engineering problems including matrix inversion, numerical approximation methods, optimisation methods and applications in

engineering: Introduction to state space formulation, analysis and applications. Computer design of simple engineering components and systems.

(ix) **Fluid Mechanics I 3 Credits**

Fundamentals, physical characteristics and properties of fluids, viscosity, surface tension, pressure. Fluid statics, manometry, forces on submerged surfaces, bouyance and floatation, stability of floating bodies. Fluid masses subject to acceleration. Kinematics of Fluid motion, continuity equation, circulation and vorticity. Flow of ideal incompressible fluid, Euler's equation, Bernoulli's equation. Application of Bernoulli's equation and two dimensional flow systems. Impulse and momentum principle, elementary and simple flow machines applications. Some aspects of real flows, laminar and turbulent flow, flow in pipes, flow in open channels.

(x) **Fluid Mechanics II 3 Credits**

Introduction to Hydrodynamics, stream function, flow fields, steam lined bodies, rotational and irrotational flows, velocity potential, conformal transformation. Jou Kowsky transformation. Thin aerofoil theory, characteristics of two dimensional aerofoil. Sections introduction to turbo – machines. Characteristics curves for pumps, axial flow machines, impulse and reaction turbines, fans, blowers and propellers. Introduction to gas dynamics. Introduction to boundary layer theory. Dimensional analysis and similarity laws

(xi) **Drilling Fluids Technology 4 Credits**

Functions and composition of drilling fluids. Mud properties; testing, classification and chemical analysis. Drilling mud calculations, control of mud properties. Well completion fluids. Drilling mud performance.

(xii) **Drilling Technology I 3 Credits**

Techiques for oil well drilling. Drilling rigs; equipment, hoisting , drill string, casing drill bits. Circulating system, drilling fluids, drilling hydraulics. Well head equipment. Drilling and casing programs. Drilling performance. Offshore drilling rigs.

(xiii) **Reservoir Engineering I 6 Credits**

Fundamental properties of single and multiple fluid saturated rocks; porosity, permeability, relative permeability, fluid saturations, electrical resistivity capillary pressure. Surface forces, wettability, compressibility and correlations between rock properties.

(xiv) **Petroleum Production Engineering I 3 Credits**

Properties of oil and Gas: Composition of oil and natural gas; classification of crude oil; natural gas.

Well Completion: Tubing; types, tubing equipment, uses of tubing, calculations; use of wirelines, packers-types, uses; multiple zone completion; well heads – casing and tubing hangers; Christmas tree. Cruptive Production: Gas-oil ratio (GOR); productivity index; fluid flow and pressure losses; multiphase formation volume factor (Bt). Perforation: bullet perforation; jet perforation. Artificial Production: Gas lift; pumps.

(xv) **Petroleum Geology 3 Credit**

Petroleum prospecting, uses of geological data, reservoir rocks, reservoir fluids, traps, origin of oil and gas geology of the Niger Delta and Lake Chad Basin. Geophysics.

(xvi) P**etroleum Engineering Rock Mechanics 3 Credits**

Fundamentals of rock mechanics, Crater formation: Plastic and pseudo plastic characteristic of rocks load rate mechanism: Static and impact loading; tooth penetration as a function of differential and overburden pressures. Effect of differential pressure on drilling rate.

400 LEVEL

(i) **Industrial Studies III 2 Credits**

Group technology tasks: these may involve group design and manufacture of prepared drawings, specifications and planning schedules, a viable commodity which has a tested performance, and acceptable standard of finish and time and cost constraints, under a chosen leader; service and maintenance group tasks, etc. (Emphasis is for the students to appreciate the necessity to use people, materials and equipment to the best economic conditions and the need for personal relationship and the acceptance of responsibility when working as part of a team).

(ii) **Technical Communications 2 Credits**

Introduction to principles of effective communication with attention to the importance of emphasis, emotive content, and style; principles of technical writing, organisation and presentation of technical reports, feasibility studies, technical correspondence. Oral presentation of technical ideas; technical aids in presentation, organisation of practical applications.

(iii) **Engineering Management and Law 2 Credits**

Engineering profession: Professional ethics and conduct.

Law: Definition and specification; Applications of business law to engineering; Patents and inventions, trademarks and copyrights; Contracts and contract documents; Engineering business – types, the structure and functions of organisations: Professional problems – legal responsibilities, professional liability, role of engineer in law suits.

Management: Organisational structure and behaviour; engineer to engineer manager transition; Managerial functions, principles and techniques of planning, forecasting, organising technical activities; project selection and management;

leadership, styles of leadership and management. Techniques in engineering management – motivated, appraisal, participative and control techniques.

(iv) **Drilling Technology II** **3 Credits**

Pressure Control and Blowout Prevention: The need to control pressure; BOP valves; stack, choke line and choke manifold; choice of BOP system; control o kick; subsurface pressures and mud hydrostatic pressure; data for executing kick control; indications of kick; methods of circulating out a kick – Balanced Bottom Hole Pressure method (BBHP), driller's method; kick when tripping, gas out mud.
Cementing: Equipment; hole conditions; volume calculations and rate of circulation; squeeze cementing; cement plug.
Fishing: Fishing tolls; objects lost in the hole; fishing methods.
Casing Design: Mechanical properties – tension, collapse and burst; designing a casing string.

(v) **Reservoir Engineering II** **3 Credits**

Reservoir fluid behaviour, PVT analysis, formation volume factors. Estimating reserves; material balance equations. Concepts of fluid flow through porous media, Darcy's law. Steady state and transient fluid flow in reservoirs. Displacement of oil and gas. Reservoir testing and performance analysis. Differential equations for radial flow in a porous medium.

(vi) **Petroleum Production Engineering II** **3 Credits**

Surface completion: Gathering systems; service and cleaning systems; design and testing of flow lines. Emulsion problems; oil emulsions; emulsifying agents and deemulsifiers; choice and dosage of de-emulsifiers. Separation and separators; heat treatment. Dehydration: need for dehydration of gas; dew-point depression; absorption with glycol and absorption with solids.

(vii) **Well Logging** **3 Credits**

Well logging devices, principles and technology. Electrical, radioactive, acoustic/velocity, caliper, inclinometer, dipmeter and thermometer logs. Well log interpretation. Use of combination logs, cross plots. Production logging. Computer processing of logs.
Measurements-while-drilling systems.

(viii) **Applied Geophysics and Petroleum Exploration 2 Credits**

The scope of geophysics; solid earth geophysics; the shape of the earth; geomagnetism; marine geophysics; isostacy. Geophysical instruments, field data processing, electrical, seismic, radiometric, etc). Geophysical logging of borehole. Geophysical prospecting and exploration.

(ix) **Oil Pollution and Control** **3 Credits**

Causes of oil pollution; blowout; pipeline and flowline leakages, sour-gas production, sea transportation hazards. Need for oil spill prevention and control;

Impact on the environment – ecology. Methods of control; mechanical, chemical and biological methods. Global pollution problems; Government regulations.

500 Level

(i) **Drilling Technology III** **3 Credits**

Drilling parameters: Choice of drilling program and drilling rig; mechanical parameters and their optimisation – drilling bits; hydraulic parameters – mud viscosity, density, filtrate and bit nozzles. Directional Drilling: Uses of directional drilling: deviating tools; vertical profile, horizontal profile; deviation measurements.

Offshore Drilling: Underwater BOP stack, marine risers, underwater well head, floater stability; heave compensators.

(ii) **Reservoir Engineering III** **3 Credits**

Water influx; steady-state; pseudo steady – state (Hurst); transient (Van Everdingen and Hurst). Well test: drill-stem tests (DST); Production tests; pressure tests; back-pressure tests on gas wells, productivity tests on oil wells, build-up and draw-down tests on oil wells, coning of water and gas; effects of partial penetration. Secondary recovery; water injection sweep efficiency stiles methods, Dykstra – Parsons method.

(iii) **Petroleum Refining Technology** **3 Credits**

Petroleum processing equipment; storage tanks; rectification columns; heat exchange apparatus; pipe fumances; pipelines and fittings; compressors and pumps. Preliminary processing. Thermal processes; thermal cracking; coking; pyrolysis. Catalytic processes; brief description; catalytic cracking; catalytic reforming; hydrogenation processes; hydrogen cracking.

(iv) **Petroleum Production Engineering III** **3 Credits**

Problem-well analysis: Work over techniques; well stimulation; fracturing and acidising. Sand control: gravel packing; sand consolidation. Pipelines and transportation; maximum pipeline capacity; other transportation systems. Metering of oil and gas; problems associated with flow measurement; flow measurement systems; liquid level controllers.

(v) **Reservoir Modeling and Simulation** **3 Credits**

Purpose of reservoir simulation. Concepts of Simulation; Darcy's law, fluid in porous media. Reservoir simulation equations. Finite – difference model. Solution of the simulator equations. Matrix of simultaneous equations; Data preparation: fluid data, rock data, production data, flow rate data. Making a simulation study. History matching.

(xiii) **Enhanced Oil Recovery** **3 Credits**

Principles of displacement: rock properties; fluid properties in reservoir; phase behaviour; displacement efficiencies. Gas methods; miscible slug; enriched gas-high pressure lean gas; carbon dioxide; nitrogen and other inerts. Chemical

methods; miscellar – polymers; polymer augmented waterflood; permeability alteration; caustic. Thermal methods; steam stimulation; steam drive; in-situ combustion.

(vii) **Petroleum Product Transport and Storage 3 Credits**

Transportation of crude oil: Pipelines; tankers – loading and unloading techniques, offshore loading systems, international regulations on tanker transportation. Custody transfer storage of crude oil tank farm operations – gauging, sampling, quality control, underground storage – caverns, porous rocks. Gas transportation: compressors, piplines; liquefied natural gas transportation. Storage of natural gas; pressure tanks, re-injection in porous rocks, storage in caverns. Storage of LNG.

(viii) **Process Technology 3 Credits**

Pressure losses in pipes. Pressure losses in armature and fittings. Pumps. Heat exchangers. Nozzle theory and mass transfer. Combustion processes. Heat transfer, Conduction; convection; condensation, heat exchangers. Distillation. Particle fall in liquids cyclones.

(ix) **Offshore Operation 2 Credits**

Offshore drilling: Offshore prospecting; offshore rigs; stationary and floating rigs; rig movement and stability; drilling from a floating vessel; subsea BOP stack; marine risers; subsea wellhead. Offshore production: subsea well completion methods; offshore processing equipment and design; loading systems and other transportation. Offshore operations: logistics, contingency planning; oilspill and oil removal.

(x) **Natural Gas Processing 3 Credits**

Gas laws; phase behaviour of natural gas system; gas from condenstate and oil fields; field separation processes; dehydration and sweetening of natural gas; scale problems; gas liquification.

(xii) **Petroleum Economics 2 Credits**

The structure of the petroleum industry; economic geography – impact of oil resources on the economy of oil producing countries; linear programming; refinery economics; oil concessions in Nigeria; government participation; the Nigeria petroleum labour market; marketing and sales calculations; investment analysis; risk analysis and probability; financing energy crisis.

(xii) **Multiple Phase Flow in Pipes 3 Credits**

Principles of two phase flow: The general energy equation; Evaluation of friction losses. Single phase Flow. Variables used in two phase flow; flow patterns. Horizontal flow: Horizontal pressure loss prediction methods. Prediction of horizontal flow patterns. Flow through restrictions.

2.21 PETROLEUM AND GAS ENGINEERING

2.21.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.21.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.21.3 **Learning outcome**
As in Section 2.1.3

2.21.4 **Attainment Levels**
As in Section 2.1.4

2.21.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.21.6 **Course Contents and Descriptions**

		Lecture/Lab. Units
(a)	**Course Summary**	
(i)	**General Studies**	16
	Sub-Total	16

(ii)	**Basic Sciences**	
	Mathematics	20
	Chemistry	23
	Physics	12
	Geology	4
	Sub-Total	**59**
(iii)	**Entrepreneurial Studies**	4
	Sub Total	4
(iv)	**Major Engineering Course**	
	(Petroleum Eng. Courses)	
	Introduction to Petroleum and Gas Eng.	2
	Drilling Courses	3
	Formation Evaluations	9
	Petroleum and Gas Production Engineering	3
	Petroleum Reservoir Engineering	6
	Gas Separation incl. Adsorption & Other Processes	6
	Gas Dynamics	3
	Refrigeration and Liquification	3
	Gas Conditioning and Processing Equipment	4
	Gas and Process Control	5
	Gas Pipeline Design	3
	Gas Transportation and Transport Phenomena	7
	Petroleum and Gas Economics	3
	Petroleum and Gas Eng. Laboratory	6
	Process Analysis	4
	Petroleum Research Project	6
	Gas Process Vessel and Equipment Design	6
	Sub-Total	**79**
(v)	**Other Engineering Courses**	
	Technical/Engineering Drawing	4
	Workshop Practice	2
	Science of Materials	10
	Mechanical Engineering Technology	3
	Thermodynamics	3
	Applied Electricity	3
	Chemical Engineering Entrepreneurship	2
	Sub-Total	**27**
	Specialisation	6
(vi)	**Components of Petroleum Engineering**	
	General Studies	16

Basic Sciences	59
Major Engineering Courses	79
Other Engineering Courses	27
Specialisation	6
Entreprenuerial Studies	4
Total	**175**

Theory/Laboratory Ratio (Contact Hours) 62.5/37.5

(B) **Break-Down Of Courses Into Levels Of Study:**

	Lecture/Lab. Units
300 Level	
Engineering Mathematics	2
Fundamentals of Electrical Engineering	3
Science of Materials	3
Mechanical Engineering Technology	3
Transport Phenomena	2
Gas Separation I	3
Structural Geology	2
Petroleum Geology	2
Operational Methods	2
Introduction to Corrosion of Materials	3
Fluid low Through Porous Medium	2
Formation Evaluation & Geophysical Methods	3
Chemical Engrg. Thermo. I	3
Basic Petroleum Reservoir Engr.	3
Drilling Methods	3
Petroleum Engrg. Lab. I	4
Foundation Course in Entrepreneurial Studies	2
Sub-Total	**45**
400 Level (I Semester)	
Technical Communications	2
Principles of Plant Design I	3
Petroleum Reservoir Engrg.	3
Petroleum Production Engrg.	3
Pressure Build up and Test Methods	2
Gas Processing Equipment	2
Gas Dynamics	3
Petroleum Engrg. Lab II	2
Introduction to Well Logging & Interpretation	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**24**
500 Level	
Engineering Economics	2

Process Dynamics & Control	3
Absorption and Fractionation	3
Gas Transportation	2
Chemical Engrg. Entrepreneur	2
Refrigeration and Liquefaction	3
Law & Management	2
Petroleum Economics	3
Gas Sweetening & Sulphur Recovery	2
Gas Process Control	2
Valve and Pipeline Design	3
Gas Process Vessel & Equipment Design	3
Research Project	6

Optional Courses (2 courses of 3 credits each)

Introduction to Polymer Engrg.	
Environmental Pollution	
Petroleum Reservoir Modeling and Simulation	
Petrolchemical Science & technology	
Petroleum Refining Engrg.	6
Sub-Total	**42**

Course Synopses

300 Level

Structural Geology **2 Units**

The Dynamic Earth. Model convection and plate movement. Rock cycle, Rocks and rock types Geologic symbols. Folding and faulting. Lithography Reservoir rocks. Traps stratography.

Fluid Flow through Porous medium **2 Units**

Darcy's Law. This viscosities of water, natural gas and oil under reservoir conditions. Types of fluids and fluid compressibility. Classification of reservoir flow systems. Linear flow of incompressible fluids-steady state. Linear flow of gases-study state. Linear beds in series and in parallel. Poiseuilles's law for Capillary flow. Flow through fractures. Radial flow of incompressible and compressible fluids. Flow of compressible fluids in bounded drainage areas. Average pressure in radial flow systems and re-adjustment time. Productivity index, Permeability variations. Zonal damage and well stimulation. Gas well spacing, recovery and deliverability. Displacement of Oil and Gas.

Petroleum Geology **2 Units**

Requirement for petroleum accumulation; plate tectonic. Origin of hydrocarbon, migration and trapping mechanisms. Reservoir rock properties. Depositional environment, petro-physical properties.

Formation evaluation and applied geophysical methods. 3 Units

Application of geophysical methods to formation evaluation.

Petroleum Engrg. Lab. 1 **4 Units**
Laboratory analysis of Reservoir rocks.

Basic Petroleum Reservoir Engrg. **3 Units**
General composition of Petroleum. Fundamental properties of fluid permeated rocks. Properties of Porous media containing multiple fluid saturations. Fundamentals of the behavior of hydrocarbon fluids. Determination and application of reservoir fluid properties. Properties of water. Data Evaluation for calculations. The material Balance.

Drilling Methods. **3 Units**
Petroleum explorations methods and general teasing practices. Cable tool Drilling rotary Drilling, Rotary Drilling hydraulics. Factors affecting penetration, Rotary Drilling techniques including vertical drilling, directional drilling and fishing operations. Drilling fluids. Well logging Formulation damage. Well cementing and casing practices well completion.

Petroleum Engrg. Lab II **2 Units**
Coring and core analysis. Porosity and permeability measurements. Liquid saturation measurements.

400 LEVEL
Petroleum Reservoir Engrg. **3 Units**
Study of Gas-condensate and undersaturated reservoirs including recovery methods. Oil reservoirs under simultaneous dissolved Gas drive, Gas cap drive and water drive. Water Influx.

Petroleum Production Engr. **3 Units**
Theoretical basis for the rise of fluids in production columns. Pottman and Carpenter, Gilbert, Duns and Ros and other methods. Production of crude oil by natural eruption. Gas Lift method. Production by pumping collection of Oil well gases and use of compressed gases. Secondary recovery method.

Pressure Buildup and Test methods **2 Units**
Mathematical Basis for pressure analysis, Determination of average reservoir pressure, pressure drawdown analysis. Multiple-Rate flow Test analysis, well interference tests, Pulse Tests, Drill Stem tests. Effect of reservoir Hetrogeneities on pressure behavior.

Gas Processing equipment **2 Units**
Study of compressors, valves including valve mechanics pumps and other processing equipment.

Gas Dynamics **3 Units**
Review of Thermodynamics concepts. One-dimensional Gas dynamics. The continuity equation, Energy and Euler's equations reservoir conditions. The

momentum equation, Isentropic condition, Bernoulli equation. Dynamic Pressure and flow at constant area. I-D wave motion including propagating shock wave and isentropic equations. Supersonic flow in Ducks. Measurement methods. Frictionless flow effects of viscosity and conductivity.

Introduction to well logging and Interpretation 2 Units
Driller's logs, Sample logs, Mud logging. Electric Logging Radioactivity logging. Miscellaneous logging devices. Wire line logs. Well logging interpretation.

500 LEVEL

Adsorption and Fractionation 2 Units
Isothermal adsorption curves. (Gas-solid equilibrium curves) applied industrial gas and liquid adsorption process. Mechanism and technology of adsorption on carbon of mixtures of hydrocarbons. Fractional distillation of an ideal mixture of components (n>2). Fractional columns extractive fractionation.

Petroleum Economics 2 Units
Uncertainty in Evaluations. Decision methods and yardsticks. Petroleum Evaluation review. Return on investment properties of probability Distributions and applications.
Appraisal of uncertain ventures. Decision trees and economic models. Simulation – The Monte Carlo method. Evaluation of expected discoveries in mature regions, Bayos strategies and estimates of valve Evaluation of future production by performance trends.

Refrigeration and Liquefaction 2 Units
Basic principles of refrigeration and liquefaction application of First and Second Laws of Thermodynamics cycles. Refrigerants. Vapour compression systems and equipments. Multistage refrigeration cycles compression fundamentals. Introduction to cryogenic systems. Joule - Thompson effect. Expansion turbines. Equipment selection.

Gas Sweetening and Sulphur recovery 2 Units
Gas purification and odourisation. Absorption processes. Use of DEA, Cuprous solution and Na_2CO_3 in gas purification. Extraction processes. Removal of H_2S from Liquefied gas. Sulphur recovery processes.

Gas Transportation 2 Units
Fluid statics and kinematics. Dynamics of ideal fluids. One dimensional motion of a fluid, Linear flow of viscous fluid. Turbulent flow. Flow of fluids through orifices ands valves. Gas pipelines. Gas transportation through pipes classification for pipes. Pipeline economics. Compression and production pipes application of jet compressors to gas transportation. Gas preparation for transport and distribution.

Gas process Control **3 Units**

Review of Mathematical Concepts process dynamics. Non-Linear systems. Lumoed parameters Feedback control and higher level control systems. Case studies. Multi-variable control systems.

Petroleum Reservoir Modeling and Simulation **3 Units**

Basic principles of Reservoir modeling. Modeling gas, oil and Gas-condensate Reservoir. Numerical techniques-Finite Difference Method, Finite element, Method of weighted residuals etc. Setting up a simulation study: data collection, fluid properties etc. History matching, Performance prediction. Case studies. Specialized applications: Waterflooding, Gas Cycling, Infill drilling, Miscible flooding etc.

2.22 POLYMER ENGINEERING

2.22.1 Philosophy, Aims and Objectives of the Degree Programme
As in Section 2.1.1

2.22.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.22.3 **Learning outcome**
As in Section 2.1.3

2.22.4 **Attainment Levels**
As in Section 2.1.4

2.22.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.22.6 **Course Contents and Descriptions**

		Lecture/ Lab. Units
(a)	**Course Summary**	
(i)	**General Studies**	16
(ii)	**Basic Sciences**	
	Mathematics	20
	Physics	10
	Chemistry	17
	Sub-Total	53
(iii)	**Entrepreneurial Studies**	4
(iv)	**Core Engineering Courses**	
	Applied Polymer Chemistry	6
	Polymer Technology	4
	Transport Phenomena	4
	Polymer Structures & Properties	7
	Kinetics/Reaction Engineering	4
	Thermodynamics	5
	Instrumentation	3
	Control and Optimisation	3
	Polymer Applications	3
	Polymer Processing	3
	Polymer Composites/Surface Properties	3

	Plant Design	6
	Polymer Engineering Project	6
	Polymer Engineering Laboratory	8
	Total	**68**
(v)	**Other Courses**	
	Technical/Engineering Drawing	2
	Workshop Practice	2
	Applied Elect. (Electrical Engineering)	4
	Strength of Materials	4
	Computers & Computing	2
	Chemical Process Calculations	3
	Science of Materials	3
	Other Engineering Electives	3
	Biopolymers/Biochemical Engineering	4
	Total	**27**
(vi)	**Specialisation**	12
(vii)	**Components of Polymer Engineering**	
	General Studies	16
	Pure Sciences	47
	Entrepreneurial Studies	4
	Engineering Depth	66
	Engineering Breadth	27
	Specialisation	12
	Total	**174**
	Theory/Laboratory Ratio	**62.5/37.5**

b) **Break-Down Courses Into Levels Of Study**

300 Level

Mathematics	5
Transport Phenomena	2
Chemical Engineering Thermodynamics	3
Chemical Kinetics	2
Biochemical Engineering	4
Science of Materials	3
Applied Polymer Chemistry	4
Polymer Process Engineering	3
Industrial Applications of Polymetric Materials	2
Technical Writing & Communication	1
Humanities Elective	2
Polymer Engineering Laboratory	4
Engineering Elective	1

Foundation Course in Entrepreneurial Studies	2
Total	**36**

400 Level

Economics	2
Polymer Structures & Properties	4
Polymer Reaction Engineering	2
Polymer Process Engineering II	3
Principles of Plant Design	2
Polymer Engineering Laboratory	2
Process Instrumentation	1
Introduction to Entrepreneurship Studies	2
Engineering Elective	2
Total	**20**

500 Level

Polymer Technology	4
Polymer Structures & Properties	3
Polymer Composites	2
Polymer Surface Properties	1
Design	4
Polymer Engineering Laboratory	1
Project	6
Process Instrumentation	2
Specialisation	12
Process Control and Optimisation	3
Total	**38**

Course Synopses

(a) **300 LEVEL**

(i) **Science Of Materials**

3 Credits

Atomic Structure. Physical model of the atom, Radioactivity, Crystal Structure, Crystal imperfections. Atomic movements, Phase diagrams, Solid State Transformations, Ceramic and composite materials. Fibre-reinforced Materials. Cements, polymers.

(ii) **Polymer Process Engineering I 3 Credits**

A study of the fundamental principles involved in the conversion of polymeric materials into useful articles. Correlation between process variables, material characteristics and product design. Heat transfer and fluid flow in the melt processing. Heat transfer and polymeric dissipation in viscous fluids. Interactions between processing and properties.

(iii) **Industrial Applications Of Polymeric Materials 2 Credits**

Polymeric materials for use in engineering application are described in relationship to their structures and properties. Natural and synthetic polymers. Process engineering applications. Mechanical, electrical and structural engineering applications. Medical applications of polymeric materials.

(iv) **Surface And Colloid Chemistry 2 Credits**

Nature, application and preparation of colloids. The use and application of the ultra centrifuge, light scattering and electron microscopy. Absorption and chemisorption. Dialysis. Inhibition and catalyst poisoning. Activation energy.

(v) **Chemistry Of Polymers 2 Credits**

Polymer synthesis – step growth, free radical addition, ionic and co-polymerisation, stereo regular polymerisation. Effect of polymerisation on molecular weight. Biosynthesis of polymers. Polymer characterisation-macromolecules in solution, Light Scattering Transport measurements. Chromotography. Spectroscopic analysis of polymers. Intrinsic viscosity of polymers.

(vi) **Industrial Chemistry 2 Credits**

Principles of industrial Chemistry, raw materials for the chemical and allied industries. Economics and manufacturing processes of various chemicals from vegetables, coal and petroleum. Manufacture of inorganic agricultural and pharmaceutical chemicals. Glass production.

(vii) **Engineering Mathematics 5 Credits**

Linear Algebra-Elements of matrices, determinants, Inverse of matrix. Theory of linear equations, Eigen-values and Eigen-vectors. Analytic geometry – co-ordinate transformation – solid geometry, cylindrical and spherical co-ordinates. Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equations, curve fitting. Simple linear programming, Fourier series – Euler coefficients, even and odd functions. Sine and Cosine, functions, Simple Applications. Gamma, Beta and probability functions. Differential equation of second order – series solutions. Legendre and Bessel Functions and their properties. Vector Theory – Dot product, divergence, curl and Del operators. Gradient. Line, surface and volume integrals and related theorems, cross product.

Note: All other courses are common with Chemical Engineering.

400 LEVEL

(i) **Polymer Process Engineering II 3 Credits**

An intensive study of the manufacturing techniques used in the plastic industry. Particular attention will be paid to injection moulding, blow moulding, extrusion, thermoforming, compounding and mixing. Investigation of the correlation between the properties of a material and its processability. Waste analysis and recycling in plastics processing.

ii) **Polymer Reaction Engineering 2 Credits**

Classification of polymerisation reactions. Methods of reactor operation and design equations. Temperature and pressure effects. Fluid mixing, Catalyst deactivation. Choice of reactors.

(iii) **Polymer Structure 2 Credits**

A detailed study of the fundamental relationship between molecular structure, properties and end-use applications of rubber, plastics and other polymeric materials. The molecular structural features such as chemical composition, molecular size and flexibility, intermolecular order and binding, supermolecular structure.

Crystalliographic cells in polymers, single crystals, lamellae, fibrils, spherullite and globular crystals. Structure of amorphous polymers. The methods of investigation of polymers structures, such as optical miscroscopy, electron miscroscopy (SEM AND TEM), X-ray diffraction. Infrared spectroscopy and NMR spectroscopy, ESR and RAMAN spectroscopy.

(iv) **Mechanical Properties of Polymers 2 Credits**

Introduction to the basic mechanical properties of polymeric materials. Mechanical Properties of bulk polymers as a class of engineering materials Linear viscoelasticity and its application to realisation, creep dynamics and stress/strain response phenomena. The principles of time/temperature super-position, the relation between the chemical and physical structure and fibres. The effect of molecular weight distribution, branching, cross-linking, order and crystallinity to bulk properties. Statistical and mechanical formulation of rubber elasticity. Deformation behaviour of polymeric materials and the interpretation on the molecular level, Fracture in polymers.

(v) **Petrochemical Industry 2 Credits**

Petroleum chemicals and their place in the chemical industry. Characteristics of petroleum chemical Manufacture. Raw materials. Products from miscellaneous petroleum sources. Speakers may be invited from the industries to give case studies on the problems and developments of the petro-chemical industry. Students are expected to write an easy on a selected topic from the petro-chemical industry.

(vi) **Polymer Rheology 3 Credits**

Rheology of polymer melts. Dynamics and statics of Newtonian fluids. Flow in closed conduits. Measurement of fluid flow. Flow instabilities associated with visco-elastic flow.

500 LEVEL

(i) **Polymer Engineering Design Project 4 Credits**

A design problem involving the study of polymerisation processes. Preparation of flow sheet. Detailed design of some plant items. Economics and safety considerations must be stressed.

(ii) **Polymer Engineering Project 4 Credits**

Project work in selected areas under staff supervision.

(iii) **Mould And Process Design 3 Credits**

Introduction to the principles of plastic mould and design engineering. Students will be involved in the design of new end-products made from polymeric materials applying the total systems approach to the balance between product design, choice of materials and process techniques as they affect competitive choice for commercial success.

(iv) **Plants, Coatings And Adhesives Technology 2 Credits**

Polymers, fillers, solvents and additives used in coatings and paints. Methods of polymerisation, formulation, application and testing. Substrates and applications. Theories of adhesion. Materials and compounding. Methods of application. Adherents and application.

(vi) **Composite Materials And Polymer Additives 2 Credits**

Composites as a class of materials and the associated mechanical and physical properties. Fundamental concepts underlying such properties. Emphasis is placed on fibrous reinforced plastics. Survey of matrices, reinforcements and prediction of composite properties. Factors affecting ultimate strength and fatigue behaviour. Theoretical review of reinforcements, chemical and physical compatibility of additives, plasticiser theory, thermal and oxidative stabilisation/degradation mechanisms, flame retardant actions, and other important additives such as colorants, blowing agents, antistatic treatments, impact and processing aids.

(vi) **Inorganic Polymers 2 Credits**

Classification of inorganic polymeric materials. Physical and chemical properties. The effects of atomic and molecular structure of inorganic polymeric materials on their properties and application. Network structures. Inorganic polymer technology. Advances in inorganic polymer science. Ionic polymers.

(vii) **Rubber Technology (Elective) 2 Credits**

Vulcanized rubber compounds. Production processes in tyre manufacture, Properties of tyres. Processing and applications of rubbers for the production of rubber band, pencil eraser, anti-vibration mounting pads, etc. Rubber analysis. Developments in rubber technology.

(vii) **Ceramic And Glass Technology (Elective)**

Crystal structure and ionic bonding of ceramic materials. Structure of glasses. Phase transformations and the design of glass ceramics. Grain growth and sintering of ceramics. Techniques of processing glass, glass-ceramics and ceramic materials.

(ix) **Plastics Electrical Engineering(Elective) 2 Credits**

A systematic study on applied polymer science as related to current potential electrical engineering. Attention is focused on polymeric materials and reinforced plastics, principal physical properties, processing methods and manufacturing consideration, and testing methods. The course also includes practical applications with emphasis on price, processability and performance.

(x) **Medical Application Of Polymeric Materials Elective 2 Credits**

Dental materials. The use and application of polymeric materials as sealants and restorative materials in dentistry. Ophthalmic application of polymers. The application and properties of polymeric materials used in both hard and soft contact lenses. Other ophthalmic applications of polymers. Properties and characterisation of bioplastics for orthopaedic applications. Fibre reinforced and acrylic bone cements. Use and applications of polymers as prosthetic devices.

(xi) **Plastics Foams (Electives) 2 Credits**

A course on preparation, structure and properties of plastics foams. Industrial systems in development and production. Properties and applications of plastics foams and products made from them.

(xii) **Textile Technology (Electives) 2 Credits**

General classification of textile fibres. An introduction to systems used in the processing of synthetic fibre structures-drawing, winding, texturing, staple fibre production, blending and static control. The methods of conversion textile fibres to finished products, i.e. spinning, weaving and knitting. The technology of bleaching, dyeing, printing and finishing of textiles. The physical and chemical properties of textile materials. The use and application of textiles.

2.23 POLYMER AND TEXTILE ENGINEERING

2.23.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.23.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.23.3 **Learning outcome**
As in Section 2.1.3

2.23.4 **Attainment Levels**
As in Section 2.1.4

2.23.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.23.6 **Course Contents and Descriptions**

		Lecture/Lab. Units
(a)	**Course Summary**	
	(i) **General Studies**	**16**
	(ii) **Basic Sciences**	
	Mathematics	20
	Physics	10
	Chemistry	17
		53
	(iii) **Applied Sciences**	
	Applied Physics	9
	Applied Chemistry	16
	Computers & Computing	2
		27
	(iv) Entrepreneurial Studies	4
	(v) Major Technology Courses	
	Polymer Technology	17
	Weaving and Knitting	14
	Yarn Technology	14
	Textile Technology	17
	Project	4
	Sub-Total	66
	(vi) **Specialisation**	12

(vii) **Components of Polymer and Textile Technology**

General Studies	16
Basic Sciences	47
Applied Sciences	27
Technology	66
Specialisation	12
Entrepreneurial Studies	4
	172

Theory/Laboratory Ratio (Contact Hours) 62.5/37.5

Break-Down Of Courses Into Levels Of Study:

300 Level

Analytical Chemistry	2
Chemical Kinetics	2
Electrochemistry	2
Process Technology	2
Polymer and Fibre Chemistry	2
Polymer and Fibre Physics	2
Yarn Manufacture	3
Weaving Mechanisms	3
Experimental Polymer Science	2
Polymer Processing Technology I	2
Man made Fibre Production	2
Chemical Processing of Textiles	2
Fabric Structure and Design	3
Analysis and Testing of Polymerics and textiles	3
Unit Operations I	3
Financial and Industrial Management	2
Foundation Course in Entrepreneurial Studies	2
Sub-Total	**39**

400 Level

Polymer Processing and Technology II	3
Quality Control in Polymer and Textile Processes	3
Properties of Bulk Polymers	3
Non-Woven Technology	3
Knitting Technology	3
Operations Research/Project Evaluation	3
Introduction to Entrepreneurship Studies	2
Sub-Total	**20**

500 Level

Polymer and Fibre Science	3
Polymer Processing Technology III	3
Polymer Chain Properties and Solutions	2
Modern Yarn Production	3
Polymer Reactions and Degradation	2
Technology of Coloration and Finishing	3
Technology of Elastomers	3
Complex Textiles and Design	3
Theory of Textile Structures	2
Seminar	1
Research Project	6
Electives	6
Sub-Total	**36**

Course Synopses

300 Level

(i) **Polymer and Textile Chemistry** **2 Credits** Introduction to Natural synthetic polymer: Raw materials: Coal, crude oil, cotton samples, proteins, natural rubber:; polymer additives a groups of polymer from mechanical behaviour point of view-molliplasts. Elastomers, fibroplasts, libroelastics, duroplasts, duroelasts.

Polymers characterisation: Essential Characteristics of fibre forming polymers. Polymerisation processes: Chain growth (addition) Polymerisation: Kinetics, initiator efficiency, ento-acceleration, chain transfer regulations, retarders, inhibitors. Step growth (condensation) polymerisation: Kinetics, statistics, mechanism, control and distribution of molecular weights in nylons and polyesters. Distinction between chain and step growth kinetics. Polymerisation Mechanisms: Free radical cationic, anionic and heterogenous catalysis.

Polymerisation Techniques: Bulk, solution, suspension and emulsion Copolymerisation and Copolymer composition: copolymer equation, reactivitification and determination of reactivity ratios.

(ii) **Polymer and Textile Physics** **2 Credits**

Polymer Chain Structure: Isomerism in vinyl and diene polymer chains; optically active polymers. Polymer characterisation: Physical technique to study molecular structure of polymers (I.R. and Rama spectroscopy, electron microscopy) stereo regularity (N.M.R.) crystallinity (X-ray diffraction, DTA, TGA).

Semi-crystalline Polymers: Concept of order in polymers. Crystalline polymers as a pro-phase materials orientations in polymers and fibres. Concepts of glass transition temperature, experimental determination of Tg and theoretical surface. Morphology of structural Units of Fibre Forming polymers.

(iii) **Yarn Manufacture** **3 Credits**

Principles of Opening and Clearing. Blending, Detailed study of blowroom machinery for different varieties and grades of cotton; recent developments. Principles of carding systems. Principles of roller drafting: detailed study of drawing frame mechanisms. Drafting systems; recent developments. Objectives of combine, comber lap preparation; working principles of drafting, twisting and winding; recent development. Detailed study of ring frame mechanisms; recent developments in design and operations. Various systems of doubling production of folded, yarns, fancy yarns, sewing thread manufacture. Reeling, Waste Spinning.

(iv) **Weaving Mechanisms 3 Credits**

Yarn packages; various systems of yarn preparation. Details of non-automatic winding machines; precision winding. Beam and sectional warping processes and mechanisms. Automatic cheese, come and pirn winding machines. Sizing machines; size mixture for different materials. Methods of drawing – in twisting- and knotting. Tappet shedding. Picking and shuttle flight control, shuttle boxes. Sley movements; take-up systems, let-off motions, temples, warp protector and weft stop motions. Loom drives and brakes. Dobby-negative and positive dobbings, multiple box motions ordinary, cross-boarded and fine pitch jacquards and their mechanisms. Narrow fabric looms. Essential requirements for filament weaving; modern developments in non-conventional weaving machinery.

(iv) **Experimental Polymer Science 2 Credits**

Preparation of polymers by solution, solvent, bulk techniques. Preparation of copolymers by free radicals.Instrumental analysis of Copolymers by I.R. Spectroscopy. Chemical analysis of polymers; Determination of Number Average Molecular weight by end-group analysis.

(i) **Man-made Fibre Production 2 Credits**

Introduction to the production of man-made fibres; principles of melt spinning, dry spinning and wet spinning. Viscosity of melts and solutions. Drawing of fibres. Equipment for man-made fibre production. Main features of the production of some important man-made fibres. E.g. viscose, cellulose acetate, polyamides, polyurethane fibres.

(vii) **Chemical Processing of Textiles 3 Credits**

Preparatory processes e.g. singeing, desizing, scouring; bleaching; batch and continuous processes; classification of dyes and intermediates; colour and chemical constitution; methods of dyeing; loose, package, with jig and padding; printing; types and styles; principles and practice of finishing machineries, mangles and their functions, drying machines, stentering, damping and calendaring.

(viii) **Fabric Structure and Design 3 Credits**

Fabric classification and weave notations. Plain weave, its variations and ornamentation. Twill weave and its derivatives. Satin and sateen weaves and fabrics. Simple fancy weave like huck-a-back, mock leno, honeycomb, crepe and badford coards etc. Basic concept of other weaves like terry toweling, extra warp and weft, backed cloths, double cloth and lenos etc. Reproduction of weaves with draft and peg plan from fabrics. Assessment of yarn (quantitatively and qualitatively) and looms particulars used in the manufacture of fabrics from given samples. Study of corded structures including piggu and toilet quilting fabrics.
Extra warp and weft, backed fabrics, double and treble cloths. Introduction to brode, damask and tapestry fabrics. Warp and weft pile fabrics including terry towels. Gauze and leno weaving.

(ix) **Analysis and Testing of Polymerics and Textiles 3 Credits**

Introduction to testing of polymerics and textiles.
Properties of fibres yarns, fabrics and polymerics and their relevance in assessing the performance of the materials (Polymerics and textiles) during and after manufacture. Measurement of length, fineness, crimp and foreign matter content of fibres.
Measurement of dimensions of polymerics; tensile testing; machines for fibres, yarns and fabrics; stress-strain relations, impact tests associated with fabrics handle such as compressibility, rigidity and drape. Testing of fabrics for end use properties such as bursting strength, air permeability, shrinkage, dye fastness and thermal transmission. Evenness testing of silver and yarns, analysis of periodic variation of the products.

400 LEVEL

(i) **Polymer processing Technology II 3 Credits**

Solution and melt viscometry: Solvent types for polymer solutions, evaluation of characteristic parameters for polymers in dilute solution; theoretical models; factors affecting viscosities of concentrated solution and polymer melts. Rubber Technology; classification of elastomers, mastication mixing, compounding, vulcanisation, degradation and stabilisation, reinforcement. Foam production: Methods of foaming and foam mulding processes, characterisation of foams. Cutting, shaping and bonding of plastics.
Cementing, welding, heat sealing, machining, decorating and finishing: painting, coating, colouring, texturing and design. Introduction to mathematical modeling and mechanical analysis of processes: Objectives; capillary rheometry – shear viscosity, its representation and measurement as a function of shear rate, temperature and pressure; elasticity, extensional viscosity, extradate swell, entry losses; flow in tubes and channels, flow in dyes.

(ii) **Quality Control in Polymer and Textile Processes 3 Credits**

Definition of quality control; quality control, organisations and functions; significance and importance of testing polymers, fibres, yarns, fabrics, dyestuffs, chemicals and auxiliaries; importance of keeping standards and factors

responsible for deviation from standards. Quality control in polyer processing, yarn manufacture, control of counts, yarn strength and evenness. Statistical interpretation of data. Measurement and control of quality in winding, warping, sizing, drawing-in and weaving. Wash, stain and light fastness of finished goods.

(iii) **Properties of Bulk Polymers** **3 Credits**

Crystal structures of polymers, single crystals, melt crystals, crystallisation kinetics and thermodynamics para-crystallinity, orientation and drawing; effect of chemical structure on crystallinity; viscous flow, rubber elasticity, viscoelasticity; second order transitions, the glassy state; structural determinants of mechanical properties; melt viscosity, melting points; plasticization reinforcement, cross linking, copolymerisation; property requirements and utilisation, elastomers, fibres and red, nuclear magnetic resonance and electron. Paramagnetic resonance spectroscopyl; X-ray diffraction analysis; thermal analysis; mass spectrometry; light and electron miscroscopy.

(iv) **Non-Woven Technology** **3 Credits**

Classification, definitions, end-uses, economic of non-woven fabrics; preparation of webs and sheets opening, binding and mixing equipment; formation of parallel-laid, cross-laid and random-laid webs, equipment, limitation, speed, weight limits and web control; specifications of typical machines and webs produced, methods of producing continuous filament webs; spun-bonding, methods of yarn-sheet preparation. Composite web and sheet preparation; preparation of wet-laid webs. Physical properties in relation to process variables.

(v) **Knitting Technology** **3 Credits**

Weft Knitting: Definition, characteristics of weft knitted fabrics; machines used for knitting; straight-bar, flat bar, v-bed, single cylinder, cylinder-and-dial; stitches e.g. plain jersey, rib and purl interlock and their decorations. Mechanism of the machine for producing single knit and double knit fabrics; end uses of the fabrics. Geometry and dimensional properties.

Warp Knitting: Definition and characteristics; Two bar warp knit stitches e.g. tricot, locknit satin etc. Notation of warp knit structures, warp knitting machines, tricot and raschel. Mechanisms and methods of achieving fabric specifications. Calculations on production efficiency, run-in measurements.

(vi) **Environmental Management** **2 Credits**

Total quality assurance, waste management, effluent characterisation and treatment, regulations and guidelines for emissions.

500 LEVEL

(i) **Polymer and Fibre Science** **3 Credits**

Polymer stereochemistry and co-ordination of polymerisation, polyethylene polymerisation. Structure and properties; polypropylene and other olefin polymers; modacrytics, fluorine containing polymers: Speciality polymers, fluorinated ethylene-propylene chloro-trifluoroethylene, vinylidene fluoride and

viton polymers. Fine structure of cotton and rayons, theories of fibre structure, moisture sorption by films and fibres; heats of sorption and heats of wetting. Mechanism of setting of fibres. Diffusion of gases through films and relation of the diffusion coefficients with film structure. Diffusion of dyes into films. WLF equation; high tenacity fibres, Nomex Kevlar.

(ii) **Polymer Processing Technology III 3 Credits**

Polymeric engineering materials: review of effects of Polymerisation, molecular weight, structure and composites; review of forming processes; engineering design of plastics, design practice and procedures; design of moulds of compression, injection and thermoforming; reactor designs. Reinforced thermoset processing, laminating moulding processes; dead load, vacuum bagging inflatable bag moulding, fibre spray gun moulding; Review and thermoplastic processing; continuous extrusion blow moulding; injection blow moulding, rotational moulding, a thermoplastic foam processing.

(iii) **Polymer Chain Properties and Solutions 2 Credits**

Configuration of polymer chains; optical activity, stereoregularity; conformation of dissolved polymer chains; irregularities; random chain, boned chains; excluded volume, dimensions of freely jointed chain, bod angle restrictions, thermodynamics of polymer solution, lattice theory, entropy and heat or mixing; criteria of solubility, solubility parameters, phase separations; polymer fractionation, molecular weight distributions; end-group analysis, osmometry, ebulliometry, cryoscopy, light scattering, ultra-centrifugation electron microscopy. Swelling of crosslinked polymers; hydrodynamics of polymer solutions; polyeletrolytes viscosities.

(iv) **Modern Yarn Production 3 Credits**

Detailed study of the operation of cotton system machines for the manufacture of blended yarns; problems of blending; blended yarn properties and fabric performance. Open-end spinning, twistless spinning, self-twist spinning and other latest techniques of yarn formation. Tow conversion processes. Principle of texturisation methods and their application; process variables and their effects on properties of textured yarns.

(v) **Polymer Reactions and Degradation 2 Credits**

Reactivity of functional group, polymer reaction sequences, reaction conditions; random degradation and chain depolymerisation, products, kinetics and mechanisms; polymerisation, ceiling temperature, radiation of polymers; degradation and cross-linking; effect of solid structure in degradation and cross-linking; effect of solid structure in degradation, weathering.

(vi) **Colouration and Finishing of Polymerics and Textiles 3 Credits**

Introduction to the theory of dyeing; thermodynamics, Kinetics and dyepolymer interactions, role of fibre structure in dyeing. Dyeing of man-made fibres, blends;

recent advances in the technology of dyeing. Machines used for printing, dyeing, ageing, steaming. Faults in printing, transfer printing. Sauforisation, easy care finishes, wash wear/durable press cellulosic; rot and mildew proofing, water proofing and water repellent finishes. Flame proofing, setting of synthetic fibres, antistatics and soil release finishes; use of polymeric systems for fabric coating and lamination.

(vii) **Technology of Elastomers** **3 Credits**

Quest for synthetic rubbers. World distribution and production. Thermodynamics of rubber elasticity. Molecular weight between cross-links. Nomenclature and structures of general purpose synthetic rubbers, chlorosulphonated polyethylene, ethylene-propylene, fluorinated elastomers, neoprene, nitrile rubbers, polybutadiene, polyether, polyisoprene, polypentenamers, styrenebutadiene copolymers. Thermoplastic elastomers. Physical and chemical properties; vulcanization, compounding, uses; health and safety factors; environmental factors. Syntheses of polybutadiene, polychloroprene, polyisoprene, ethylene-propylene rubbers, styrenebutadiene rubbers, and butadiene-acrylonitrile rubbers. Analysis of rubbers using chemical and physical means e.g. I.R. Gas Chromatograph, NMR. Analysis of unsaturation, analysis of cross-link desity, swelling volume, sulphur cross-linkages, gel. Content and thermal analysis.

(viii) **Adhesive Technology** **3 Credits**

Theories of adhesion: Mechanical, absorption, diffusion and electrostatics; wetting of surfaces, contact angle, critical surface tension, basic thermodynamic considerations antophobi systems; classification of adhesives; mode of application, origin, cost, suitability and end-products; characteristic of adhesives: storage life, viscosity, rate of spread, solid content, PH, flash point, rate of strength development, degree of tackiness, blocking. Factors affecting permanence, strength of adhesives, ASTHM tests on storage life, working life, coverage, blocking, tack caring rate; selected adhesive materials: Fromaldehyde-based resins, animal and vegetable polyers, hotmelts, rubbers, vinyls, polyamides and polyesters. Design of Adhesive bonds rigid and flexible materials; roll application of adhesives – rheological factors, flaneutation, caritation roll nip rections, caritation and flaneutation dynamics, application problems.

(ix) **Complex Textiles and Design** **3 Credits**

Preparation of double and coloured design, construction of backed, double and treble cloths. Imitation to jacquard designs. Warp and weft pile fabrics including terry pile structure. Gauze and Uno fabrics. Construction of toilet and other quilting fabrics. Introduction to carpet weaving and fabrics for industrial purposes.

(x) **Theory of Textile Structures** **2 Credits**

Simple geometry of single and ply yarns. Yarn diameter and density; theoretical treatment of yarn strength and irregularity: Elements of fabric geometry. Cloth

setting theories. Pierces equations and later modification. Relations of fabric properties, simple geometry. Grimp interchange in woven fabric, cover factor. Tensile modules of plain fabrics, fabric stiffness, bending rigidity.

(xi) **Seminar** **1 Credit**

All students will be required to participate in weekly seminars to be given in turns by members of the class. Selected advanced topics in one area of polymer and Fibre Science and Technology will be assigned to each student who has to prepare a review paper followed by oral presentation and discussion.

(xii) **Research Project** **6 Credits**

Each student will be assigned a research supervisor who will be responsible for the overall supervision of the project. Students will work independently in one of the areas of polymer and fibre science and Technology. The results of the project will be written up in form a dissertation.

(xiii) **Polymer and Textile Engineering** **3 Credits**

Basic principles underlying composite materials properties. Emphasis on design of composite systems to yield desired combinations of properties. Gears and transmission; spur gears, profile modifications; helical and worm gears; gear manufacture; gear trains; introduction to process equipment design: Materials and manufacturing considerations in design rotor dynamics; fundamentals of sound and associated vibration; random aspects of noise.

Technology of different method employed in forming thermoplastic and thermo setting materials with emphasis on analysis of these processes. Chip Formation in Plastic Cutting, mechanics of machining of plastics; forces; optimum tool geometry, surface finish. Grinding of plastics.

(xiv) **Colour Technology** **3 Credits**

Review of printing processes, chemistry and physics of thickeness binder, processes involved in solvent dyeing. Automatic control of dyeing machines and production sequences, illumination for colour discrimination; visual and instrumental colour matching, space dying, computer techniques. Colour measurement; Principles, nature of the spectrum, theories of colour vision, laws of substractive colour mixing; symbols and nomenclatures used in colour. Computation of C.I.E. specification and chromaticity diagrams. CIE values, Additive mixtures Kubelka-Munk analysis of coloured materials.

(xv) **Pulp and Paper Technology** **3 Credits**

Introduction to Wood-polymer principles; emphasis on chemical and physics – chemical properties of wood based on its polymeric chemical structure. Wood and pulping, Chemistry, processes involved in paper manufacture, finishing and adhesive systems widely used in wood products manufacturing. Analysis and testing.

2.24 PUBLIC HEALTH ENGINEERING

2.24.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.24.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.24.3 **Learning outcome**
As in Section 2.1.3

2.24.4 **Attainment Levels**
As in Section 2.1.4

2.24.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.24.6 Course Contents and Descriptions

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Core Courses**	
		Engineering Mathematics/Analysis	15
		Engineering Drawing	3
	(i)	**Engineering Design of**	
		Public Health Engineering (10)}	
		Industrial Waste Engineering (2) }	
		Solid Waste Engineering (3) }	
		Bio-Engineering (3) }	27
		Unit Operations & Processes (3) }	

	Treatment Plants	(6) }		
	Engineer-in-Society			1
	Project			6
(ii)	**Laboratory Practicals**			21
(iii)	**Other Courses**			
(iv)	**Structural Engineering**			
	Structural Mechanics	(4)}		
	Design of Structures	(4)}		
	Strength of Materials	(5)}		15
	Civil Eng. Materials	(2)}		
(v)	**Geotechnical Engineering**			
	Soil Mechanics	(3)}		
	Foundations	(2)}		8
	Engineering Geology	(3)}		
(vi)	**Water Resources Engineering**			
	Hydraulic Structures		(3)}	
	Hydrology		(4)}	11
	Fluid Mechanics		(4)}	
	Thermodynamics			
	Electrical Engineering			2
	Material Science			4
	Manufacturing Technology			2
	Applied Mechanics			2
	Engineering Surveying & Photogrammetry			3
	Quantity Surveying			2
	Engineering Man., Economics and Law			4
	Computers & Computing			2
	Information Technology in Engineering			2
	Technical Communications			2
(vii)	**Basic Science Course:**			
	Mathematics (Pure and Applied)			12
	Physics			10
	Chemistry			10
(viii)	**General Studies**			
	General Studies			16
(ix)	**Entrepreneurial Studies**			4
(x)	**Options/Electives From:**			6
	Industrial Waste Engineering			

Solid Waste Engineering	
Bio-Engineering	
Total	**194**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level	
Strength of Materials	3
Engineering Mathematics/Analysis	6
Fluid Mechanics	2
Structural Mechanics	4
Design of Structures	4
Hydraulics and Hydrology	4
Public Health Engineering	4
Engineering Geology	3
Engineering Surveying & Photogrammetry	4
Soil Mechanics	2
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Total	**44**
400 Level	
Engineering Mathematics/Analysis	3
Public Health Engineering	2
Industrial Waste Engineering	2
Engineering Management	1
Civil Engineering Materials	2
Soil Mechanics and Foundations	3
Quantity Surveying	2
Design of Hydraulic Structures	3
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Sub-Total	**25**
500 Level	
Project	6
Design of Treatment Plants	6
Electives	6
Units Operations and Processes	3
Solid Waste Engineering & Air Pollution	3
Bio-Engineering	3
Advanced Public Health Engineering	4
Economics and Law	3
Laboratory Practicals	6

Options/Electives

(i) Industrial Waste Engineering
(ii) Solid Waste Engineering
(iii) Bio-Engineering

Total **40**

Course Synopses
300 Level Courses – Common To:
i) Water Resources Engineering And Technology Programmes
ii) Public Health Engineering And Technology Programmes

(i) **Strength of Materials 3 Credits**

Advanced topics in Bending moment and shear force in beams. Theory of bending of beams. Deflections of beams. Unsymmetrical bending and shear centre. Applications. Strain Energy. Bi-axial and tri-axial state of stress. Transformation of stresses. Mohr's circle. Failure theories. Springs. Creep, fatigue, fracture and stress concentration.

(ii) **Engineering Mathematics/Analysis 6 Credits**

Linear Algebra – Elements of matrices, determinants, Inverse of matrix. Theory of linear equations, Eigen-values and Eigen-vectors. Analytic geometry – Co-ordinate transformation – Solid geometry, polar, cylindrical and spherical co-ordinates/ Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equations. Curve fitting. Simple linear programming. Fourier series – Euler coefficients, even and odd functions, Sine and cosine functions, simple applications. Gamma. Beta and probability functions.

Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient. Line, surface and volume integrals and related theorems.

(iii) **Fluid Mechanics 2 Credits**

Fluid statics; Floatation and stability. Dynamics of fluid flow – conservation. Equation of mass and momentum: Euler and Bernoulli equations. Reynold's number. Dimensional analysis – philosophy, similitude, Buckingham PI theorems. Applications. Hydraulic models. Flow measurements. Flow meters and errors in measurement.

(iv) **Structural Mechanics 4 Credits**

Analysis of determinate structures, Beams, Trusses; Structures Theorems. Graphical methods; Application to simple determinate trusses. Williot Mohr-diagram Reflection of statically determinate structures. Unit load, moment area method Strain. Energy Methods. Introduction to statically indeterminate structures.

(v) **Design of Structures 4 Credits**

Fundamentals of design process, material selection, building regulations and codes of practice. Design philosophy. Elastic design: Limit state design. Design of structural elements in Reinforced concrete. Computer Aided Design of structures.

(vi) **Hydraulics and Hydrology 4 Credits**

Introduction, descriptive Hydrology: Hydrologic cycle, precipitation, evaporation and transpiration. Quantitative Hydrology: Hydrography, Volume runoff, storage routing. Groundwater: Occurrence, hydraulics, well, yield.

(v) **Hydraulics 2 Credits**

Open channels: Hydraulics of open channel flow, culverts and bridges. Steady uniform flow. Steady gradually varied flow. Hydraulic Jump. Surge waves. Measurement of flow in open channels. Drainage: Estimates of flow, municipal storm drainage, land drainage, highway drainage. Culverts and Bridges.

(vii) **Public Health Engineering 4 Credits**

Structure and growth of Micro-organisms. Sterilisation and culture techniques. Water use and water-related diseases. Physical, chemical and biological characteristics of water and wastewater, their determination and significance. Appropriate technology of water supply and treatment. Coagulation, storage, filtration, disinfection and distribution. Excreta Disposal; appropriate technology (Septic tanks, oxidation ponds relevant to Nigerian situation) and wastewater treatment. Sewage. Source and Effects of pollution. Water quality standards and controls. Agents of Air pollution, Effects and control. Management and finance of PHE systems.

(viii) **Engineering Geology 3 Credits**

Geological structures and mapping. Rocks and minerals. Stratigraphy – time scale – fossils and their importance; special reference to Nigeria. Introduction to geology of Nigeria. Engineering applications – Water supply – site investigations – Dams, Dykes, etc.

(viii) **Engineering Surveying & Photogrammetry 4 Credit**

Chain surveying. Compass surveying – Methods; Contours and their uses. Traversing – methods and applications. Levelling – Geodetic levelling –

errors and their adjustments. Applications. Tacheometry –methods: Substance heighting, self adjusting and electromagnetic methods. Introduction to Photogrammetry. Introduction to GIS.

(x) **Soil Mechanics** **2 Credits**

Formation of soils. Soil-air-water relationship – void ratio, porosity, specific gravity and other factors. Soil classification: Atterberg limits – particle size distribution. Flow in soils – Seepage and permeability, Laboratory work

(xi) **Laboratory Practicals** **6 Credits**

All courses share the laboratory schedules to suit; sometimes alternate weeks.

400 LEVEL

(i) **Engineering Mathematics/Analysis** **3 Credits**

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier transforms – applications. Introduction to non-linear differential equations – stability and Applications. Probability – Elements of probability, density and distribution functions, moments, standard distribution, etc. Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(ii) **Public Health Engineering** **2 Credits**

Sources of pollutants in air, water and soil. The role of man as agent of environmental pollution. Check and balances on environmental ecosystem. Environmental law or policy. Waste management: mechanics of aerobic and anaerobic digestion. Relative energy flow in methane fermentation of complex organics. Waste treatment, Digestibility of wastes and effluent quality monitoring. Land disposal system and pollution transport. The impact of agricultural, industrial and highway on the river system.

(iii) **Industrial Waste Engineering** **2 Credits**

Industrial wastes – general considerations, specific industries including dairy industry, abattoirs, oil pollution, etc. Biodegradability and treatability of the industrial effluents. Specific physical-chemical treatment methods and pollution control measures. Toxic and Nuclear waste management.

(iv) **Engineering Management** **1 credit**

Fundamentals of system objectives and economic analysis in the design and analysis of engineering projects. Resources Management: Materials management, purchasing methods, stores and inventory control. Resource utilisation. Methods of economic evaluation selection between alternatives. Planning and Decision making: Forecasting, planning, scheduling, production control. Optimisation. Decision making under risk and uncertainties: Applications.

(v) **Civil Engineering Materials** **2 Credits**

Concrete Technology – Types of cements, aggregates. Properties. Concrete mix, design. Properties and determination. Steel Technology – Production, fabrication and properties, corrosion and its prevention. Tests on steel and quality control. Timber Technology – Types of wood, properties, defects. Stress grading. Preservation and fire protection. Timber products. Rubber, plastics; Asphalt, tar, glass, lime, bricks, etc.

vi) **Soil Mechanics and Foundations** **3 Credits**

Soil Structures.Compaction and soil stabilisation, stability of slopes. Earth pressures, Retaining Walls.Concepts permeability, stress distribution, sheer strength and pressure in relation to foundation engineering. Bearing capacity of soils.Shallow and Deep foundations.Pile foundations.Site Investigation.

(vii) **Quantity Surveying** **2 Credits**

Measurement contracts. Final Accounts Measurement: Practical interpretations, contract conditions; cost reimbursement contract. Procedures for fixing rates. Application of measurements, estimating to practical situations. Analysis of tenders and evaluation of projects in water resources building, etc. Materials, labour, plant, production standards. Methods of statement, waste factors. Applications.

(viii) **Design of Hydraulic Structures** **3 Credits**

Hydraulic Models; Hydraulic design criteria, problems of reservoirs, river training and regulations, transition structures. Dams; weirs, spillways, gates and outlet works, stilling basins. Cofferdams, Breakwaters, moles, surge tanks. Design of open channels, conduit systems and hydraulic machinery. Design of Municipal Storm Drains, land drainage systems and culverts and bridges.

Design of (a) Drains
(b) Manholes
(c) Catchbasins

Introduction to multiple purpose designs involving flood control water supply, irrigation, recreation, drainage navigation and erosion control. Computer Aided design of Hydraulic structures

(ix) **Technical Communications** **2 Credits**

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills-extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing.

(x) **Laboratory Practicals** **3 Credits**

All courses share the Laboratory schedules to suit; sometimes alternate weeks.

500 Level

i) **Project** **6 Credits**

Projects will depend on staff expertise and interests most preferably should be of investigatory nature. Preferably students should be advised to choose projects in the area of their options/elective subjects.

(ii) **Design of Treatment Plant Wastewater 3 Credits**

Storm water Sewage: Rational methods for Design. Preliminary Treatment: Flow measurement, weirs, flumes, flow separation screening, storm water settlement, Grit removal, overflow rates. Batch settlement analysis; radial and rectangular tank design. Secondary Treatment: Activated sludge process, percolating filters, oxidation ponds, biological kinetics and application in sludge treatment and disposal. Anaerobic digestion. Sludge processing, pumping and power requirements.

Water Supply 3 Credits

Flow diagrams of the treatment of surface and groundwater Preliminary Treatment: Screening, coagulation, flocculation and sedimentation. Slow and, rapid sand and pressure filters. Disinfection; water softening, iron and manganese removal. Chemicals for water treatment.

(iii) **Electives/Options 6 Credits**

One option subject taken from any of the following:

1. Industrial Waste engineering
2. Solid Waste Engineering
3. Bio-Engineering

The options should aim at standards normally higher than the Bachelor's degree but below Master's degree expectations and calling for an in-depth study in any of the above mentioned areas.

(iv) **Unit Operations and Process 4 Credits**

Engineering treatment of the forms of calculus of variations, maximum principle, dynamic programming. Optimisation of staged systems. Optimum seeking methods. Network analysis of water and waste water systems. Theory and Design of physical, chemical and biological unit processes pertinent to the water, wastewater and air environment.

(v) **Solid Waste Engineering and Air Pollution 3 Credits**

Solid Waste

Basic concepts and theory and design of solid waste collection and Disposal systems. Field and laboratory sampling and monitoring of solid wastes. Analysis of municipal, industrial and agricultural solid wastes. Solid waste handling and disposal methods.

Air Pollution

Air-borne wastes and the control of atmospheric pollution: sources, type and effects of air pollutants. Analysis of particulate and gaseous pollutants by classical and instrumental methods. Meteorological phenomena affecting

dispersal or deposit. Methods of pollution control including use of fuels and cleaning of gases. Noise and Noise Control.

Inter-relationship between the disposal of solid, liquid and gaseous wastes and the pollution of air, soil and water.

(vi) **Bio-Engineering** **3 Credits**

Principles of biochemical kinetics and reactor engineering as applied to aerobic and anaerobic reactor systems for removal of soluble organic matter, destruction of organic matter and the conversion of soluble inorganic matter.Design criteria and Designs for biochemical operations used in control of water pollution and organic solid waste disposal.

(vii) **Advanced Public Health Engineering**

Water Related Tropical Diseases **2 Credits**

Tropical Public Health; Introduction to Epidemiology; Water-borne, water-washed, water-based, water-related, insect-borne and helminth diseases, their control in relation to water supply. Sanitation and Irrigation: Sanitation systems and transmission of diseases and Design of these systems.

Water Quality Management **3 Credits**

Introductions: Concepts of energy biodegradation, aerobic and anaerobic cycles and BOD and COD. Quality interchange systems. Quality change by Domestic, industrial, agricultural uses. Quality considerations in estuarine waters. Quality changes in surface and Groundwaters. Refractory compounds as a factor in water Quality.Engineering aspects of water quality. Management and Design.

(viii) **Economics and Law** **3 Credits**

General Introduction to Law and Water Resources. Common law equity, statutes (acts, ordinances, Decree, Edict, Statutory instruments, Bye-laws). The relationship between social, political and economic problems and engineering procedures and programmes. The law of contracts; preparation and criticism of contract documents and specifications. The engineers role in management and administration.

Areas of Legal Liabilities: Law of contracts, law of torts, land-law, water laws, water quality standards.The economics of pollution: stream standards and effluent standards. Case studies of development projects, public and private organisations.

(ix) **Laboratory Practicals** **6 Credits**

All courses share the laboratory schedules to suit; sometimes alternate weeks.

2.25 REFRIGERATION AND AIRCONDITIONING ENGINEERING

2.25.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.25.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.25.3 **Learning outcome**
As in Section 2.1.3

2.25.4 **Attainment Levels**
As in Section 2.1.4

2.25.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.25.6 **Course Contents and Descriptions**

(a) **Course Summary**

(i) **Core Courses**

	Lecture/Lab. Units
Mechanics of Machines	6
Workshop Practice (including Automobile Workshop)	4
Manufacturing Technology	2
Engineering Drawing	4
Thermodynamics	8
Fluid Mechanics	8
Science & Engineering of Materials and and Metallurgy	6
Mechanical Engineering Design	3
Control Systems	3
Properties and Characteristics of Refrigerants	4
Advanced Psychrometry & Systems Design	6
Refgr./Air – Cond. Workshop practice	2
Equipment Design and Manufacture	3
Engineering Materials Selection and Economics	3
Engineer-in-Society	1
Technology policy and Development	2
Engineering Communication	2
Advanced CAD/CAM	3
Project	6
Total	**76**

(ii) **Other Courses**

	Electrical & Electronic Engineering	10
	Law and Management	3
	Basic Civil Engineering	2
	Total	**15**
(iii)	**Basic Science Courses**	
	Mathematics	20
	Physics	10
	Chemistry	10
	Computers & Computing	6
	Total	**46**
(iv)	**Entrepreneurial Studies**	4
(v)	**Humanities**	
	General Studies	16
	Electives:	8
	Total	**24**
	Grand Total	**165**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

Engineering Mathematics	6
Computers & Computing	2
Manufacturing Technology	2
Theory of Machines I	3
Thermodynamics	2
Fluid Mechanics	2
Engineering Drawing	2
Workshop Practice	2
Engineering Metallurgy I	2
Engineer-in-Society	1
Electrical & Electronic Engineering	4
Properties and Characteristics of Refrigerants	2
Refrigeration and Air-conditioning Workshop Practice	2
Psychrometry and Systems Design	3
Control Systems	3
Laboratory Practicals	3
Foundation Course in Entrepreneurial Studies	2
Total	**43**

400 Level

Theory of Machines II	3
Thermodynamics	2
Fluid Mechanics	2
Mechanical Engineering Design	3
Properties and Characteristics of Refrigerants	2
Technology Policy and Development	2
Engineering Communications	3
Engineering Statistics	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Total	**23**

500 Level

Thermodynamics	2
Fluid Mechanics	2
Engineering Metallurgy II	2
Equipment Design and Manufacture	4
Advanced Psychrometry and Systems Design	3
Engineering Materials Selection and Economics	3
Project	6
Law and management	3
Electives	8
Advanced CAD/CAM	3
Laboratory Practicals	3
Total	**39**

Course Synopses

(i) See Sec 2.15.6. for Core Course Synopses Common to all Levels.

(ii) **Properties and Characteristics of Refrigerants (300 and 400 Levels) 4 Credits**

Types and availability of refrigerants
Properties of various refrigerants
Selection of refrigerants.

(iii) **Psychrometry and System Design (300 and 500 Levels) 6 Credits**

Load estimation
Basic Psychrometry
Idea Vapour power cycles
Cycle and systems design and analysis.

(iv) **Refrigeration and Air-conditioning Equipment Design and Manufacture (300 and 500 Levels) 3 Credits**

Refrigeration Equipment Design
Air-conditioning Equipment Design
Duct Design

Equipment Parts manufacture
Equipment Assembly.

(v) **Refrigeration and Air-conditioning Workshop Practice**
2 Credits

(300 Level)
Testing of Refrigeration Equipment
Testing of Air-conditioning Equipment
Fault detection
Scheduled maintenance
Other cooling techniques

2.26 STRUCTURAL ENGINEERING

2.26.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.26.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.26.3 **Learning outcome**
As in Section 2.1.3

2.26.4 **Attainment Levels**
As in Section 2.1.4

2.26.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.26.6 **Course Contents and Descriptions**

					Lecture/Lab. Units
(a)	**Course Summary**				
	(i)	**Core Courses:**			
		Engineering Mathematics/Analysis			15
		Engineering/Construction Drawing			6
		Information Technology in Engineering			2
	(ii)	**Structural Engineering**			
		Structural Mechanics	(7)	}	
		Design of Structures	(7)	}	
		Strength of Materials	(5)	}	22
		Civil Eng. Materials	(5)	}	
		Services Engineering			5
		Construction Technology			6
		Quantity Surveying			2
	(iii)	**Building Management & Planning:**			
		Building Construction Materials		(2)}	5
		Building Construction & Management		(3)}	
		Building Maintenance			2
		Foundation Engineering			2
		Engineer-in-Society			1
		Project			6
	(iv)	Laboratory/Design Studio			22

(v)	**Other Courses:**		
	Thermodynamics		4
	Fluid Mechanics		2
	Applied Mechanics		3
	Material Science		2
	Manufacturing Technology		2
	Electrical Engineering		4
	Soil Mech. & Engineering Geology		4
	Engineering Surveying		5
	Acoustics		2
	Management and Economics		6
	Law		2
	Computers & Computing		3
(vi)	**Basic Science Courses:**		
	Mathematics		12
	Physics		10
	Chemistry		8
(vii)	**General Studies**		
	General Studies		16
(viii)	**Entrepreneurial Studies**		4
(ix)	**Option/Electives From:**		
	Building Services Engineering		6
	Building Management & Planning		
	Building Structures		
	Building Maintenance Engineering		
	Sub-Total		**191**

(b) **Break-Down of Courses into Levels of Study:**

300 Level	
Engineering Mathematics	6
Thermodynamics and Acoustics	4
Construction Technology	4
Strength of Materials	3
Soil Mechanics & Engineering Geology	4
Elements of Architecture	3
Civil Engineering Materials	3
Design of Structures	3
Structural Mechanics	3
Engineering Surveying	3
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Total	**44**

400 LEVEL	
Engineering Mathematics	3
Engineering Services	2
Building Construction Materials	2
Structural Mechanics	2
Design of Structures	2
Law	2
Construction Technology	2
Engineering Surveying & Photogrammetry	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory	4
Total	**25**
500 LEVEL	
Management and Economics	6
Structural Engineering	4
Services Engineering	3
Building Construction & Management	3
Quantity Surveying	2
Building Maintenance	2
Project	6
Foundation Engineering	2
One Option Course (See below)	6
Laboratory Practicals	6
Option Courses	
Building Services Engineering	
Building Management & Planning	
Building Structures	
Building Maintenance Engineering	
Total	**40**

Course Synopses

300 Level

(i) **Engineering Mathematics 6 Credits**

Linear Algebra – Elements of Matrices, determinants, Inverse of matrix. Theory of linear equations, eigen-values and eigen-vectors. Analytic geometry – co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates. Elements of functions of several variables. Numerical differentiation, solution of ordinary differential equations. Curve fitting. Simple linear programming. Fourier series – Euler

coefficients, even and odd functions, Sine and Cosine functions, simple applications. Gamma, Beta and probability functions.

Differential equation of second order – series solutions. Legendre and Bessel functions and their properties.

Vector Theory – dot product, cross product, divergence, curl and Del operator. Gradient . Line, surface and volume integrals and related theorems.

(ii) **Thermodynamics and Acoustics**

Thermodynamics **2 Credits**

Thermodynamics properties of pure substances. Heat and work transfer: first and second laws of thermodynamics and operations. Mixtures: Mixture of perfect gases, gas and saturated vapours, psychrometry application.

Acoustics **2 Credits**

Basic Principles of acoustics
Sources and effects of noise
Attenuation and control.

(iii) **Construction Technology** **4 Credits**

Principles of building strength and stability. Site mobilisation, setting out and building process. Types and methods of construction of principal building elements. Basic structural building frames. Elements of industrialized building systems.

(iv) **Strength of Materials** **3 Credits**

Advanced topics of bending moment and shear force in beams. Theory of bending of beams. Deflections of beams, unsymmetrical bending and shear center. Application; strain energy. Bi-axial and tri-axial state of stress, transformation of stresses – Mohr's circle. Failure theories. Springs. Creep, fatigue, fracture and stress concentration.

(v) **Soil Mechanics and Engineering Geology 4 Credit** **Engineering Geology**

Geological structures and mapping. Rocks and minerals. Stratigraphy: time scale, fossils and their importance (special reference to Nigeria). Some engineering application – Site investigations and water supply.

Soil Mechanics: Formation of soils. Soil-air water relationship, void ratio, porosity, specific gravity, etc.Soil classification: Atterberg limit, particle size distribution, etc.

(vi) **Elements of Architecture** **4 Credits**

Introduction – Dimensional awareness, Graphic communication, relation to environments. Free hand drawing – forms in terms of shades, light and shadow. Orthographics, dimetrics, perspective projections: applications.

Common curves; Elementary Designs. Computer Aided Design and Drafting (CADD)

(vii) **Civil Engineering Materials 3 Credits**

Concrete Technology – Types of cements; aggregates; properties. Concrete mix, Design, Properties and their determination. Steel Technology – Production, fabrication and properties; Corrosion and its prevention. Tests on steel and quality control. Timber Technology – Types of wood, properties, defect Stress grading. Preservation and fire protection. Timber products. Rubber, plastics; Asphalt, Tar, Glass, lime, bricks, etc. Application to buildings, roads and Bridges.

(viii) **Design of Structures 3 Credits**

Fundamentals of design process, materials, selection, building regulations and codes of practice. Design philosophy, elastic design; Limit state design.Design of structural elements in Reinforced Concrete.Further work in Computer Aided Design (CAD)

(ix) **Structural Mechanics 3 Credits**

Analysis of determinate structures, beams, trusses; Structures theorems. Graphical methods: Application to simple determinate trusses. Williot Mohr – diagram. Deflection of statically determinate structures, Unit load, moment area methods. Strain Energy Methods. Introduction to statically indeterminate structures.

(x) **Engineering Surveying 4 Credits**

Chain Surveying. Compass Surveying – Methods: contours and their uses. Traversing – methods and application. Levelling – Geodetic levelling – errors and their adjustments. Applications. Tacheometry – Methods: Substance heighting, self adjusting and electromagnetic methods. Introduction to photogrammetry.

(xi) **Laboratory Practicals 6 Credits**

All courses share the Laboratory schedules to suit; sometimes alternate weeks.

400 Level

(i) Engineering Mathematics 3 Credits

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier transforms – Applications. Introduction to non-linear differential equations, stability and Applications. Probability – elements of probability, density and distribution functions, moments, standard distribution, etc.

Statistics – Regression and correlation – Large sampling theory. Test of hypothesis and quality control.

(ii) **Engineering Services (Water Resources) 2Credits**

Water supply and distribution: hot and cold water systems. Drainage and sewage disposal. Drainage schemes. Design and construction of Drains, sewers and water supply systems

(iii) **Building Construction Materials 2 Credits**

Advanced consideration of the processing and application of major building materials, concrete, steel, timber and plastics. Sound and thermal insulation materials. Finishing materials – Ceramics; paints, glass, etc. Traditional building materials.

(iv) **Structural Mechanics 2 Credits**

Indeterminate structural analysis: Energy and virtual work methods, Slope deflection and moment distribution methods. Elastic stability. Simple plastic theory of bending Collapse loads. Stress-grading of timber; Visual, mechanical and electronic stress grading of timber.

(v) **Design of Structures 2 Credits**

Limit state philosophy and design in steel: Elastic and Plastic moment designs. Design of structural elements in steel and connections and joints. Limit state philosophy and design in timber. Elastic methods and design in timber. Design of structural elements in timber and timber connectors. Laboratory tests on structural elements in Concrete. Timber and Steel. Further work in Computer Aided Design (CAD)

(vi) **Law 2 Credits**

General introduction to common Law and contracts. Formation of contract: Offer and acceptance, consideration, etc.Nature of building contract: Tenders terms, standard forms, bills of quantities, avoidance.Types of contract and contract documents.Regulations and byelaws, Factory acts and special requirements.JCT, FIDIC, I.C.B., GC/Works, etc.

(vii) **Construction Technology 2 Credits**

Earthwork and earth moving and construction equipment.Tanking and basement construction.Vertical communication in buildings: Staircase, elevators, ramps, escalators, etc. Systems building.Advanced building structural systems: Space frames, folded, plates, arches, etc.

(viii) **Engineering Surveying and Photogrammetry 3 Credits**

Further work on contours and contouring: Methods of contouring, contour interpolation and uses of contour plans and maps. Areas and volumes. Setting out of Engineering Works. Elementary topographical surveying: Elements of photogrammetry. Photogrammetric equipment and Errors of measurements. Introduction to GIS

(ix) **Technical Communications 2 Credits**

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills-extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing.

(x) **Laboratory Practicals/Studio 4 Credits**

All courses share the Laboratory schedules to suit; sometimes alternate weeks.

500 Level

(i) **Management and Economics 6 Credits**

The Management of Environment – Formation of a company, sources of finance, money and credit. Insurance. National policies. GNP growth rate and prediction. Organisational Management: Principles and Elements of organisation. Organisation charts. Functions. Types. Principles of Management. Schools of thought. Office and production Management, Management by Objectives. Financial Management: Accounting methods. Financial statement. Elements of costing. Cost planning and control. Budget and Budgeting control. Cost reduction programmes. Depreciation accounting, valuation of assets.

Personnel Management: Selection, recruitment and training. Job evaluation. Merit rating. Incentive schemes. Industrial Committees and Joint consultations. Trade Unions and collective bargaining.

Industrial Psychology: Individual and Group Behaviour. The learning Process. Motivation and morale. Influence of the Industrial Environment. Resources Management; materials management; Purchasing methods. Contracts. Interests formulae. Rate of return. Methods of economic evaluation. Selection between alternatives. Tendering evaluation and contract administration. Planning and Decision Making: forecasting Planning, Scheduling. Production control. Gantt chart. C.P.M. and PERT. Optimisation. Linear programming as an aid to decision making policies under risk and uncertainties. Transport and Materials Handling: Selection of Transport media for finished goods, raw materials and equipment. Faculty layout and location. Work Study and Production Processes: Basic principles of Work Study. Principles of motion economy. Ergonomics in the design of equipment and processes.

(ii) **Structural Engineering**

(a) . Structural Mechanics

(b) Design of Structures

Structural Mechanics 2 Credits

Plastic methods of Structural analysis. Elastic Instability.

Continuum of plane strain, elastic flat plantes and torsion, solution by series, finite difference, finite element.

Yield line Analysis and Strip Methods for slabs.

Design of Structures **2 Credits**

Composite Design and construction in Steel and Reinforced concrete. Design of Structural Foundations. Pre-stressed concrete Design. Modern Structural Form. Tall Buildings, Lift shafts and shear walls, System Buildings. Design Projects. Applications of Computer Aided Designs (CAD)

(iii) **Services Engineering** **3 Credits**

Principles of air movement. Mechanical air supply system and fume extraction. Heat transmission and study of air/water vapor mixtures. Psychometry, air-conditioning and refrigerators. Design of mechanical services and systems including ducts. Designs, selection, stability and control.

(iv) **Building Construction and Management** **3 Credits**

Construction planning and administration – Cost control, policies and procedures, incentives, financial control. Network Analysis: Arrow diagrams, construction of a network, scheduling, time scales and project duration. Structure of the Construction industry: Design and construction teams, statutory authorities, approval processes, notices, etc. Pre and Post-contract Planning: Project evaluation, tendering, site organisation and coordination, productivity and resource management, fast tracking, etc

Operations Research: Applications in construction management, linear programming, sequencing, queuing theory and work study.

(v) **Quantity Surveying** **2 Credits**

Bills of Quantities: Price building up, analysis of work content and method Statement SMM. Specifications, resource rates, etc.

Types of building Contracts: Measurement and cost reimbursement contracts, condition of contracts. Measurement contracts: Final accounts measurement, fixing of rates, estimating; etc

Analysis of tender and evaluation of building projects.

(i) **Building Maintenance** **2 Credits**

Definition and concept of maintainability.

Maintenance management: Programmes and policy designs, types and methods of estimation and control, statistical methods in maintenance management. Analysis and diagnosis and rectification of defects in buildings. Demolition of structures.

(vii) **Project** **6 Credits**

For proper guidance of the students, Projects will depend on the available academic staff expertise and interest but the projects should be preferably of investigatory nature. Preferably, students should be advised to choose projects in the same area as their Option subjects (see below).

(viii) **Foundation Engineering** **2 Credits**

Methods of subsurface exploration. Slope stability – types and mechanics of slope failure. Dams and retaining wall structures – types, analysis and

construction. Special foundations – flotation, steel grillage, piles, etc. Groundwater Control and Analysis.

(ix) **Option Courses** **6 Credits**

One Option course is to be taken from the following:
Building Services Engineering.Building Management and Planning Building Structures.Building Maintenance Engineering. The Options should aim at standards normally higher than the Bachelor's degree but below Master's degree expectations and calling for an in-depth study in the above areas.

(x) **Laboratory Practicals** **6 Credits**

All courses share the laboratory schedules to suit; sometimes alternate weeks.

2.27 SYSTEMS ENGINEERING

2.27.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.27.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.27.3 **Learning outcome**
As in Section 2.1.3

2.27.4 **Attainment Levels**
As in Section 2.1.4

2.27.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.27.6 **Course Contents and Descriptions**

			Lecture/ Lab. Units
(a)	**Course Summary**		
	(i)	**Humanities**	
		General Studies	16
		Basic Sciences:	
		Mathematics	12
		Physics	10
		Chemistry	8
		Sub-Total	**30**
		Entrepreneurial Studies	4
		Basic Engineering Courses	
		Engineering Mathematics	12
		Computers & Computing	4
		Engineering Drawing	4
		Applied Mechanics	4
		Strength of Materials	2
		Material Science	3
		Thermodynamics	2
		Fluid Mechanics	2
		Basic Electrical Engineering	6
		Manufacturing Technology/Workshop Practice	2
		Engineer-in-Society	1
		Sub-Total	**42**

Core Courses

Engineering Mathematics	3
Operational Methods	4
Mathematical Modelling for AI systems	3
Statistical Distributions	3
Special Analytical Techniques	3
Differential Equations	3
Operations Research	6
Elements of Game Theory	2
Rigid Body Dynamics	3
Control Theory	4
Programming Languages	2
Algorithms and Data Structure	3
Engineering Materials – Properties and selection	2
Engineering Material & the Environment	1
Numerical Methods	3
Mathematical Models of Chemical Engrg. System	3
Mechanics of Robotics System	3
Systems Simulation	4
Advanced Engrg. Statistics (Stochastic Models)	2
Project in Systems Engineering	6
Engineering System Analysis	2
Artificial Intelligence	2
Automated Reasoning	2
Systems Reliability & Maintainability	2
Computer Graphics	2
Techniques of Planning & Scheduling	3
Image Processing	3
Facility Planning	3
Total	**81**

Break-Down Of Courses Into Levels Of Study:

Major Courses 300 Level (2 Semesters) And400 Level (1 Semester): 3 Semesters)

300 Level

Engineering Mathematics	3
Operational Methods	2
Mathematical Modelling for AI systems	3
Statistical Distributions	3
Special Analytical Techniques	3
Differential Equations	3
Operations Research I	3
Operations Research II	3
Elements of Game Theory	2
Rigid Body Dynamics	3

Control Theory	2
Programming Languages	2
Algorithms and Data Structure	3
Engineering Materials – Properties and selection	2
Engineering Material & the Environment	1
Computer Systems and Architecture	4
Foundation Course in Entrepreneurial Studies	2
Sub-Total	**44**

400 Level	
Numerical Methods	3
Operational Methods	2
Mathematical Models of Chemical Engrg. System	3
Mechanics of Robotics System	3
Systems Simulation	2
Introduction to Entrepreneurship Studies	2
Advanced Engrg. Statistics (Stochastic Models)	2
Sub-Total	**17**

500 Level	
Project in Systems Engineering	6
Engineering System Analysis	2
Artificial Intelligence	2
Automated Reasoning	2
Systems Reliability & Maintainability	2
Computer Graphics	2
Techniques of Planning & Scheduling	2
Image Processing	2
Facility Planning	2
	22

Course Synopses

Core Courses 300 Level, 400 Level And 500 Level

300 Level

Engineering Mathematics **3 Units**

Calculus of several variables: limits and continuity. Partial derivatives of first and higher orders. Total differential of a function Jacobians. Higher order partial and total derivatives and gradient of a function. Integration of total differentials with application to mechanics. Introduction to vector fields – divergence and curl. Generalised Taylor's series; the calculus of variations. Lines integral with application on computation of areas and volumes. Functions of complex variables. Cauchy-Riemann Equations. Analytical functions. Mapping by elementary functions.

Operational Methods **2 Units**

Fourier series: periodic functions; Diricxhlet conditions; odd and even functions; half-range Fourier sine and cosine series. Parseval's identity. Differentiation and integration of Fourier series. Boundary values problems.
The Laplace transform and applications excluding the use of inversion integral and convolution theorem).

Mathematical Modeling For Artificial Intelligence Systems 3 Units
Introduction to Artificial Intelligence (AI); Fundamentals of artificial reasoning and expert systems, Mathematical basis of AI. Introduction to MATLAB software; introduction to neural networks; elements of conventional AI search techniques; Cantor set search techniques.

Statistical Distributions 3 Units
Discrete distributions. Binomial, poison, Multinomial. Continuous distributions: Normal, Chi-Square t-F and Gamma Distributions. Sampling theory. Estimation of population parameters and statistical tests. Regression analysis . Analysis of variance.

Special Analytical Techniques 3 Units
Fuzzy set and logic Graph theory: Methods of fractiles; Genetic and evolutionary algorithms such as ant-colony algorithm etc.

Differential Equations 3 Units
Classification and characteristics of partial differential equations: elliptic, parabolic and hyperbolic equations. Cauchy problem; existence, uniqueness and representation of solutions. Methods of solution; Separation of variables, Laplace transforms. The Laplace equation in rectangular, cylindrical and spherical co-ordinates. The Poison equation. The Navier-Stokes equation, Maxwell equations of Electromagnetism.

Operations Research I 3 Units
Introduction to operations research. Linear programming models. Primal and dual problems; graphical solutions, simplex method; post optimality analysis; special algorithms, transshipment and assignment problems. Maximal flow, shortest route, minimum spanning tree; travelling salesman problems.

Operations Research II 3 Units
Integer programming; dynamic programming; non-linear programming algorithms; direct search, gradient method, separable programming, complex optimisation method. Sequential unconstrained maximisation algorithm (SUMT).

Elements Of Games Theory 2 Units
Games, strategy and saddle points. Minimax theorem. Methods of solving games. Two person, zero-sum games. Utility Theory. Non co-operation two person games. The axioms of Nash. Three strategy games. Infinite games. Games of timing.

Rigid Body Dynamics 3 Units

Review of particles dynamics – the three dimensional projectile (as an illustration of moving axes). Motion in general electromagnetic field. Rigid body dynamics. Key theorems. Moments and products pf inertial. The inertial tensor. Angular velocity and angular momentum. Systems of particles and rigid bodies. Rate of change of angular momentum and moment of the rate of change of momentum. Rolling. Motion under no forces. Motion of spins and gyrostats. Legueree's and applications.

Control Theory **2 Units**

Dynamic systems. Time domain and frequency domain analysis. The exponential matrix. Transfer functions. Discrete time system. Linear control systems. Feedback. Determination of stability and response of linear systems. Lyapunov methods for the investigation of non-linear systems stability. The Pontryangin maximum principle for optimal control.

Programming Languages **2 Units**

FORTRAN Programming

(i) File processing with FORTRAN

(ii) Solution of advanced numeric problems

PASCAL Programming:

(i) Heading and declaration

(ii) Concepts (Action, scalar subrange, array set, record and file types)

(iii)Procedures and functions

(iv) Input/Output

Object-oriented C++ Programming:Introduction to the concept of Object-oriented Programming (OOP); Properties of OOP with C++ as a case study – Object definition, language elements, data abstraction, Composition and Inheritance; Illustrations using Vector class, materials and arrays.

Algorithms And Data Structures **3 Units**

Review of elementary algorithm and flow chart;

Algorithmic Design Method; sorting and Order statistics, Recursive algorithm; Dynamic Information structure; Number system and their representation; Code error, detection and correction; Data item; elementary item; structured data; (array; Ordered list, pare matrices, tack Queue)

Tree, simple sorting and searching techniques, Concept of record and file: Record formats and label; logical file, definition label, record blocking and de-blocking.

Engineering Materials – Properties And Selection For Use

2 Units

Introduction to the science and structure of engineering materials classified into the following major groups – Metals and allows, Polymers and Rubber, Ceramics and glasses and composites. Mechanical (i.e strength, toughness and stiffness), chemical (i.e oxidation resistance and corrosion) and physical (i.e density, thermal conductivity, electrical conductivity and magnetic) properties.

Manufacturing methods, uses and major application of each engineering material. Selection and use of engineering materials – motivation for selection, cost basis for

selection and establishment of service requirements and failure analysis. Selection for mechanical properties (i.e static strength, toughness, stiffness, fatigue, creep and temperature resistance), selection for surface durability (i.e corrosion resistance and resistance to wear). Case studies ion materials selection (i.e materials for gas turbine, bearing, engines and power generation, ship structures, screw driver, hammer, aeroplane design and construction etc.

Engineering Materials And The Environment 1 Unit

The influence and impact of the environment on engineering materials and its properties. Degradation of engineering materials and their impact on the environment. International Standards relating to the environmental (ISO 14000). Waste generation and handling. Environmental safety and engineering materials. Waste management and recycling. Reoyoling technology and its economy. The role of generic engineering in the sourcing of new engineering materials. Current developments in engineering materials (Library/research) – Metals & Alloys. Polymers & Rubber, Ceramic & Glasses and Composites. Visit to at least a manufacturing/processing plant involved in any two of the four major groups of engineering materials (submit a report on plant and its environment) Environmental impact assessment in Nigeria and its effect on the Nigerian environment. Economic relevant of flue gas (e.g in the production of Carbon dioxide).

Computer Systems And Architecture 3 Units

Fundamental Principle of Computer Organisation Basic concept of simple machine architecture. Major component; functional relationship between components of the processing unit (Control, memory and ALU). Mini Computer: Microprocessor architecture; systems design, microprocessors; microcomputer operation; soft ware development for microprocessor.

400 Level

Numerical Methods In Engineering 3 Units

Numerical Analysis: Numerical analysis with applications to the solution of ordinary and partial differential equations. Interpolation formulae. Finite difference and finite elements methods. Applications to solution of non-linear equations.

Operational Methods 2 Units

Complex function theory: Elementary functions, complex integration. Cauchy's theorem. Cauchy's integral formula. Taylor and Laurent series. Residual Calculus and applications. Convolution theorem and Bromwich integral; Multiplication theorem. Inverse transforms. Properties and applications. Multiple Fourier transforms.

Mechanics Of The Continua 3 Units

Mechanics of the Continuous media: Introduction to Cartesian tensors. Analysis of stress in a continuum. Analysis of deformation in a continuum. Eulerian forms of the basic physical laws governing of motion of a continuous medium.

Stochastic Models 2 Units

Markov chains: The Poisson Process; Memoryless random variable. Replacement models, Continuous-time stochastic processes. General Queuing Systems. Renewal process.

500 Level

Control Theory **2 Units**

The phase plane portrait. Documentation of the qualitative behaviour of non-linear second order systems by Linearisation (Lyapunov's first method). Envelop methods; the Popov and circle criteria. Limit cycles and relaxation oscillations. Liennard's equation. Gradient system decomposition.

Engineering Systems Analysis **2 Units**

Fundamental concepts: Dynamic system variables. Fundamental postulates of systems analysis. The concept of information, signal and feedback. System model representation. Relationship between model system variables. Formulation of equations for dynamical model networks. Analytical solution of system equations. Solution of free and forced response of linear systems.

Artificial Intelligence **2 Units**

Introduction to search methods in AI problems. Self organising systems, information theory, rational decision making, pattern recognition, parametric and non-parametric training for developing pattern classifiers; problem solving. The Minimax and alpha-beta algorithms and heuristic approaches to state space search problems.

Automated Reasoning **2 Units**

Representing and reasoning with knowledge. The case for logics. Introduction to logic-programming. PROLOG, LISP. Introduction to some AI applications of logic programming. Expert systems and their implementation. Planning. Natural language processing. Machine learning.

Mechanics Of Robotics Systems **3 Units**

Numerical methods for the kinematics inversion of several manipulators. The handling of redundancies and singularities. Kinematics and dynamics of parallel manipulators Manipulator performance evaluation and optimisation; multi-fingered hand gasping and manipulation, robot compliant and constrained motion. Obstacle avoidance.

Systems Animation **2 Units**

Procedural modeling and animation. The use of animation software; the Proof Animation and others. Problems drawn from different systems models.

Systems Simulation **2 Units**

Discrete event simulation. Examples in different production and service systems. Principles and computer languages e.g GPSS/H, SIMAN, e.t.c. and Pro Model Analysis of Simulation data.

Manufacturing Systems Automation **3 Units**

Computer assisted manufacturing systems: NC, CNC, DNC; robotics, materials, handling, group technology, flexible manufacturing systems, process planning and control Computer Integral Manufacturing (CLM).

Systems Reliability 2 Units

Deterministic reliability. Archenius model. Failure mechanisms, screening. Statistical reliability: operational reliability, quantities, derived quantities. Failure distributions: negative exponential, Normal, Lognormal, Wiebull and Gamma distributions. Life distribution measurements. Reliability models. Non-maintained systems. Maintained systems. Evaluation methods.

Control Of Robots And Human Arms 3 Units

Robot actuation and arm design. Identification of actuator and joint dynamics. Kinetics calibration and inertial parameter estimation. Model-based control for position and force. Human operator dynamics and teleoperation.

Computer Graphics 2 Units

The study of fundamental mathematics algorithmic and representational issues in graphics. Graphics process, projective geometry, homogenous coordinates; projective transformation, quadrics and tensors, line drawing, surface modeling and object modeling; reflectance models and rendering, texture mapping; polyhedral representations. Procedural modeling.

Image Processing 2 Units

Psychophysics of vision. Properties of images sampling, digitizing and display images; geometric and algebraic processing spatial filtering; image coding and transmission, binary image analysis, segmentation; description of lines and shapes. Representation. Software and hard ware systems. Applications. Science analysis.

Techniques Of Planning And Scheduling 2 Units

Project definition and work breakdown structure, scheduling and control models and techniques such as AOA, AON, Bar charting, line of balanced and time & and location. Allocation of resources. Optimal schedules. Documentation and reporting services. Time and cost control. Progress monitoring evaluation. Computer applications.

Facility Planning 2 Units

Basic theory of facility location. Facility layout and material handling systems design with emphasis on application in a wide variety of industries. Design principles and analytical solution procedures presented with emphasis on modern practice including comprised approaches

2.28 TELECOMMUNICATIONS ENGINEERING

2.28.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.28.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.28.3 **Learning outcome**
As in Section 2.1.3

2.28.4 **Attainment Levels**
As in Section 2.1.4

2.28.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.28.6 **Course Contents and Descriptions**

			Lecture/Lab. Units
(a)	**Course Summary**		
	(i)	**Humanities**	
		General Studies	16
	(ii)	**Basic Sciences**	
		Mathematics	12
		Physics	10
		Chemistry	8
		Total	46
	(iii)	**Entrepreneurial Studies**	4
	(iv)	**Basic Engineering Courses**	
		Engineering Mathematics	6
		Computers & Computing	4
		Engineering Drawing	4
		Applied Mechanics	4
		Strength of Materials	2
		Material Science	3
		Thermodynamics	2
		Fluid Mechanics	2
		Basic Electrical Engineering	6
		Manufacturing Technology/Workshop	2

	Engineer-in-Society	1
	Total	**36**

(v)	**Core Courses**	
	Engineering Mathematics	12
	Physical Electronics	2
	Analogue Electronic Circuits	3
	Digital Electronic Circuits	3
	Measurements and Instrumentation	3
	Circuit Theory	6
	Digital Devices and Logic Circuits	3
	Control Theory	3
	Communications Principles	3
	Electrical Machines	2
	Electrical Power Systems	2
	Computer Programming	2
	Assembly Language Programming	2
	Numerical Computer Technology	3
	Laboratory Practicals	9
	Advanced Circuit Design	3
	Solid State Electronics	3
	Communication Theory	3
	Telecommunications Engineering	2
	Digital Communication System	3
	Optical Communication System	2
	Image and Data Transmission System	2
	Industrial Electronics Design	2
	Digital Signal Processing	2
	Feedback and Control Systems	2
	Communication System Planning	2
	Project	4
	Electives	6
	Total	**98**

Break-Down Of Courses Into Levels Of Study
Core Courses

300 Level

Course Title	
Engineering Mathematics	4
Physical Electronics	3
Circuit Theory	3
Analogue Electronics Circuits	3
Digital Electronics Circuits	3

Measurements and Instrumentation	3
Electrical Machines	2
Electric Power Systems	2
Computers & Computing	2
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Introduction to Entrepreneurship Studies	2
Sub-Total	**35**

400 Level

Course Title	
Engineering Mathematics	2
Digital Devices and Logic Circuits	3
Control Theory	3
Communications Principles	3
Assembly Language Programming	3
Digital Computer Technology	3
Laboratory Practicals	3
Sub-Total	**20**

500 Level

Course Title	
Advanced Circuit Design	3
Solid State Electronics	3
Communication Theory	3
Telecommunications Engineering	2
Digital Communication System	3
Optical Communication System	2
Image and Data Transmission System	2
Industrial Electronics Design	2
Digital Signal Processing	2
Feedback and Control Systems	2
Communication Systems Planning	2
Project	4
Electives	6
Total	36

Course Synopses

Core Course 300 Level (2 Semesters) And 400 Level (1 Semester): 3 Semesters

(i) **Engineering Mathematics**
See Sec 2.15.6

(ii) **Physical Electronics**
See Sec 2.15.6

(iii) **Analogue Electronics Circuits**
See Sec 2.15.6

(iv) **Digital Electronics Circuits**
See Sec 2.15.6

(v) **Measurements And Instrumentation**
See Sec 2.15.6

(vi) **Circuit Theory**
See Sec 2.15.6

(vii) **Digital Devices And Logic Circuits**
See Sec 2.15.6

(viii) **Control Theory**
See Sec 2.15.6

(ix) **Communications Principles**
See Sec 2.15.6

(x) **Electrical Machines**
See Sec 2.15.6

(xi) **Electrical Power Systems**
See Sec 2.15.6

(xii) **Computer Programming**
See Sec 2.15.6

(xiii) **Assembly Language Programming**
See Sec 2.15.6

(xiv) **Numerical Computer Technology**
See Sec 2.15.6

(xv) **Practicals**
See Sec 2.15.6

Core Courses 500 Level: (2 Semesters)

(i) **Advanced Circuit Design**
See Sec 2.15.6

(ii) **Solid State Electronics**
See Course Opt. 12 Of Sec 2.15.6

(iii) **Telecommunication Theory**
See Course Opt. 9 Of Sec 2.15.6

(iv) **Telecommunications Engineering**
See course OPT. 10 of Sec 2.15.6

(v) **Digital Communication System**

See course OPT. 14 of Sec 2.15.6

(vi) **Optical Communication System**
Optical transmitting devices, LEDs optical receivers, optical fibres/types, features, joining, couphing/deep space communication system/capacity, reliability economy/application of PCM and A DPCM concepts.

(vii) **Image And Data Transmission System**
A/D and D/A transformation, coding, error detection and correction, Asynchronous and synchronous transmission, modern schemes, channel capacity, equalisation techniques, practical modern applications, simplified network configurations, data switching.

(viii) **Industrial Electronics Design**
See Course OPT 7 of Sec 2.15.6

(ix) **Digital Signal Processing**
See Course OPT 13 of Sec 2.15.6

(x) **Feedback And Control Systems**
See Course 5.3 of Sec 2.15.6

(xi) **Telecommunication Systems Planning**
FDT, Modulation Plan, High Order PCMCCITT Requirement Delta Modulation And ADPM, Different Type Systems Co-Operation Integrated Network, Network Planning.

(xii) **Project**
See Sec 2.15.6

(xiii) **Electives**
See Sec 2.15.6

2.29 WATER RESOURCES ENGINEERING

2.29.1 Philosophy, Aims and Objectives of the Degree Programme
As in Section 2.1.1

2.29.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.29.3 **Learning outcome**
As in Section 2.1.3

2.29.4 **Attainment Levels**
As in Section 2.1.4

2.29.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.29.6 **Course Contents and Descriptions**

				Lecture/Lab. Units
(a)	**Course Summary:**			
	(i)	**Core Courses**		
		Engineering Mathematics/Analysis		15
		Engineering Drawing		3
	(ii)	**Engineering Design of**		
		Hydraulic Structures	(4)}	
		Water & Wastewater T/Plants	(6)}	16
		Unit Operation & Process	(3)}	
		Water and Waste Water Eng.	(3)}	
	(iii)	**Water Resources Engineering**		
		Hydraulics	(10)}	
		Hydrology	(4)}	18
		Fluid	(4)}	
		Drainage and Irrigation		
		Engineer-in-Society		1
		Project		6

(iv)	**Laboratory Practicals**		21
(i)	**Other Courses**		
	Structural Mechanics	(4)}	
	Design of Structures	(4)}	15
	Strength of Materials	(5)}	
	Civil Engineering Materials	(2)}	
(ii)	**Geotechnical Engineering**		
	Soil Mechanics	(3)}	
	Foundations	(2)}	8
	Engineering Geology	(3)}	
(iii)	**Environmental Engineering**		
	Public Health Engineering	(4)}	
	Pollution Control	(3)}	7
	Thermodynamics		2
	Systems Man. (Operations Research)		3
	Electrical Engineering		4
	Material Science		2
	Manufacturing Technology		2
	Applied Mechanics		3
	Quantity Surveying		2
	Engineering Surveying & Photogrammetry		4
	Engineering Man., Economics and Law		4
	Computers & Computing		2
	Information Technology in Engineering		2
(iv)	**Basic Science Course**		
	Mathematics (Pure and Applied)		12
	Physics		10
	Chemistry		10
(v)	**General Studies**		
	General Studies		16
(vi)	**Entrepreneurial Studies**		4
(vii)	**Options/Electives From:**		6
	Water Resources Engineering		
	Hydraulics and Hydrology		
	Environmental Engineering		
	Hydraulic Structures & Treatment Plants		
	Drainage and Irrigation		
	Total		**193**

(b) **Break-Down Of Courses Into Levels Of Study**

300 Level

	3
Strength of Materials	6
Engineering Mathematics/Analysis	2
Fluid Mechanics	4
Structural Mechanics	4
Design of Structures	4
Hydraulics and Hydrology	4
Public Health Engineering	3
Engineering Surveying & Photogrammetry	4
Soil Mechanics	2
Laboratory Practicals	6
Foundation Course in Entrepreneurial Studies	2
Total	**44**

400 Level

Engineering Mathematic Analysis	3
Soil Mechanics and Foundation	3
Civil Engineering Material	2
Engineering Management	1
Design of Hydraulic Structures	4
Hydraulics and Hydrology	3
Quantity Surveying	2
Technical Communications	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	3
Total	**25**

500 Level

Project	6
Electives	6
Unit Operation and Processes	3
Design of Treatment Plants	6
Hydro-Geology (Groundwater Hydrology)	3
Economics and Law	3
Water and Waste Water Engineering	3
Pollution Control	3
Drainage and Irrigation Engineering	4
Systems Management (Operations Research)	3
Laboratory Practicals	6

Options/Electives From

1. Hydraulics and Hydrology
2. Hydraulic Structures and Treatment Plants
3. Drainage and Irrigation
4. Water Resources Engineering
5. Environmental Engineering

Total **46**

Course Synopses

(a) **300 Level Courses – Common To:-**

Water Resources Engineering And Technology
Public Health Engineering And Technology

(i) **Strength of Materials** **3 Credits**

Advanced topics in Bending moment and shear force in beams. Theory of bending of beams. Deflections of beams. Unsymmertrical bending and shear centre. Applications. Strain Energy. B-iaxial and tri-axial state of stress. Transformation of stresses. Mohr's circle. Failure theories. Springs. Creep, Fatigue, fracture and stress concentration.

(ii) **Engineering Mathematics/Analysis 6 Credits**

Linear equations, eigen-values and eigen-vectors

Analytic geometry – Co-ordinate transformation – solid geometry, polar, cylindrical and spherical co-ordinates.Elements of functions of several variables.

Numerical differentiation, solution of ordinary differential equations – Curve fitting. Simple linear programming. Fourier series – Euler coefficients, even and odd functions, Sine and cosine functions, simple applications. Gamma, Beta and probability functions. Differential equation of second order – series solutions. Legendre and Bessel functions and their properties. Vector Theory – Dot product, cross product, divergence, curl and Del operators. Gradient, Line, surface and volume integrals and related theorems.

(iii) Fluid Mechanics **2 Credits**

Fluid statics: Floatation and stability. Dynamics of fluid flow – conservation. Equation of mass and momentum; Euler and Bernoulli equations. Reynold's number. Dimensional analysis – Philosophy, similitude, Buckingham PI theorems. Applications. Hydraulic models. Flow measurements. Flow meters and errors in measurements.

(iv) **Structural Mechanics** **3 Credits**

Analysis of determinate structures, Beams, trusses; Structures Theorems. Graphical methods: Application to simple determinate trusses. Williot Mohr-diagram. Deflection of statically determinate structures. Unit load, moment area methods. Strain Energy Methods. Introduction to statically indeterminate structures.

(v) **Design of Structures 3 Credits**

Fundamentals of design process, material selection, building regulations and codes of practice. Design philosophy. Elastic design: Limit state design. Design of structural elements in Reinforced concrete.

Computer Aided Design in structures.

(vi) **Hydraulics and Hydrology I 4 Credits**

Introduction, descriptive hydrology: Hydrologic cycle, precipitation, evaporation and transpiration. Quantitative Hydrology: Hydrography, Volume runoff, storage routing. Groundwater: Occurrence, hydraulics, well, yield.

Hydraulics and Hydrology II 3 Credits

Open channels; Hydraulics of open channel flow, culverts and bridges. Steady uniform flow. Steady gradually varied flow. Hydraulic Jump. Surge Waves.

Measurement of flow in open channels.

Drainage: Estimates of Flow, municipal storm drainage, land drainage, highway drainage, Culverts and Bridges.

(vii) **Public Health Engineering 4 Credits**

Structure and growth of Microorganisms. Sterilisation and culture techniques. Water use and water-related diseases. Physical, chemical and biological characteristics of water and wastewater, their determination and significance. Appropriate technology of water supply and treatment. Coagulation, storage, filtration, disinfection and distribution.

Excreta Disposal: appropriate technology (Septic tanks, oxidation ponds relevant to Nigerian situation) and wastewater treatment. Sewage. Source and Effects of pollution. Water quality standards and controls. Agents of Air pollution, Effects and control.

Management and finance of PHE systems.

(viii) **Engineering Geology 3 Credits**

Geological structures and mapping. Rocks and minerals. Stratigraphy – time scale – fossils and their importance: Special reference to Nigeria.

Introduction to geology of Nigeria: Engineering Applications – Water supply – site investigations – Dams, Dykes, etc.

(ix) **Engineering Surveying & Photogrammetry**
4 Credits

Chain Surveying. Compass surveying – Methods; Contours and their uses. Traversing – methods and applications. Levelling – Geodetic levelling – errors and their adjustments. Applications. Tacheometry – methods: Substance heighting, self adjusting and electromagnetic methods. Introduction to Photogrammetry.

(x) **Soil Mechanics 2 Credits**

Formation of soils. Soil-air-water relationship – void ratio, porosity, specific gravity and other factors. Soil classification: Atterberg limits – particle size distribution. Flow in soils – Seepage and permeability. Laboratory work.

400 LEVEL

(i) **Engineering Mathematics/Analysis 3 Credits**

Complex variables – advanced topics, differentiation and integration of complex functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier transforms – Applications.

Introduction to non-linear differential equations – stability and Applications. Probability – Elements of probability, density and distribution functions, moments, standard distribution, etc.

Statistics – Regression and correlation – Large sampling theory. Test hypothesis and quality control.

(ii) **Soil Mechanics and Foundation 3 Credits**

Soil Structures. Compaction and soil stabilisation, stability of slopes earth pressures, Retaining Walls. Concepts of permeability, stress distribution, shear strength and pressure in relation to foundation engineering. Bearing capacity of soils. Shallow and Deep foundations. Pile foundations. Site Investigation.

(iii) **Civil Engineering Materials 2 Credits**

Concrete Technology – Types of cements, aggregates:
Properties. Concrete mix, Design. Properties and their determination. Steel Technology – Production, fabrication and properties: corrosion and its prevention. Tests on steel and quality control.

Timber Technology – Types of wood, properties defects. Stress grading, Preservation and fire protection. Timber products. Rubber, plastics; Asphalt, tar, glass, lime.

(iv) **Engineering Management 1 Credit**

Fundamentals of system objectives and economic analysis in the design and analysis of engineering projects. Resources Management: materials management, purchasing methods, stores and inventory control. Resource

utilisation. Methods of economic evaluation selection between alternatives.
Planning and Decision making: Forecasting, planning, scheduling, Production control. Optimisation. Decision making under risk and uncertainties. Applications.

(v) **Design of Hydraulic Structures 4 Credits**

Hydraulic Models: hydraulic design criteria, problems of reservoirs, river training and regulations, transition structures. Dams; weirs, spillways, gates and outlet works, stilling basins. Cofferdams, Breakwaters, moldes, surge tanks. Design of open channels, conduit systems and hydraulic machinery. Design of Municipal Storm Drains, land drainage systems and culverts and bridges.

Design of
(i) Drainage Inlets
(ii) Manholes
(iii) Catchbasins.

Introduction to multiple purpose designs involving flood control, water supply, irrigation, recreation, drainage navigation and erosion control.
Computer Aided Design of structures

(vi) **Hydraulics and Hydrology 3 Credits**

Laminar and Turbulent Flows. Boundary layer separation Lift and Drag Stream Function, Velocity Potential and Application to Flow Nets. Steady and Unsteady flow in Closed Conduits. Principles of Surface Water Hydrology. Analysis of Hydrological Data. Land Drainage and Inland navigation problems.

(vii) **Quantity Surveying 2 Credits**

Measurement contracts. Final Accounts Measurement: Practical interpretation of contract conditions; types of contract. Procedures for fixing rates. Application of measurements, estimating to practical situations. Analysis of tenders and evaluation of projects in water resources, buildings, etc. Materials, labour, plant, production standards. Methods of statement, waste factors. Applications.

(viii) **Technical Communications 2 Credits**

Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills- extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing, Project report presentation.

(ix) **Laboratory Practicals 3 Credits**

All courses share the laboratory schedules to suit; sometime alternate weeks.

500 LEVEL

(i) **Project** **6 Credits**

Projects will depend on staff expertise and interest but most preferably should be of investigatory nature. Preferably, students should be advised to choose projects in the area of their option/elective subjects.

(ii) **Electives/Options** **6 Credits**

One option subject taken from any of the following:

(i) Hydraulics and Hydrology
(ii) Hydraulic Structures and treatment plants
(iii) Drainage and Irrigation.

The option should aim at standard normally higher than the Bachelor's degree but below Master's degree expectations and calling for an in-depth study in any of the above-mentioned areas.

(iv) **Design of Treatment Plants** **6 Credits**

Wastewater **3 Credits**

Storm water Sewage: Rational method for design

Preliminary Treatment: Flow measurement, weirs, flumes, flow separation, screening, storm water settlement, Grit removal, overflow rates.

Batch settlement analysis; radial and rectangular design. Secondary Treatment: Activated sludge process, percolating filters, oxidation ponds, biological kinetics and application in sludge treatment and disposal. Anaerobic digestion. Sludge processing, pumping and power requirements.

Water Supply **3 Credits**

Flow diagrams for the treatment of surface and groundwater Preliminary Treatment; screening, coagulation, flocculation and sedimentation. Slow sand, rapid sand and pressure filters. Disinfection; water softening, iron and manganese removal. Chemicals for water Treatment.

(v) **Hydro-Geology (Groundwater Hydrology)**

3 Credits

Groundwater and Aquifers: Physical Properties of Aquifers. Darcy's Law and Hydraulic conductivity. Well Flow Systems: Measurement of hydraulic conductivity, Transmissivity, Specific yield and storage coefficient. Groundwater Exploration, well construction and pumping. Mathematical Techniques – Analytical and numerical solutions and simulation. Digital Computers – Finite Difference and Finite Element techniques in groundwater modeling. Unsaturated Flow. Surface – Subsurface water relations. Computer Aided Design in Water Resources.

(vi) **Economics and Law 3 Credits**

General Introduction to law and Water Resources.

Common law – Equity, statutes (acts, ordinances, Decree, Edict, statutory instruments, By-Laws)

The relationship between social, political and economic problems and engineering procedures and programmes. The law of contracts: preparation and criticism of contract documents and specifications. The engineers role in management and administration.

Areas of Legal Liabilities: Law of contract, law of torts, land-law, water laws, water Quality standards. The Economics of pollution – Stream standards and Effluent standards. Case studies of development projects, public and private organisations.

(vii) **Water and Waste Water Engineering 3 Credits**

Water and wastewater inter-relationship, water and health water-borne diseases. Elements of water chemistry. Treatment processes for surface water and for groundwater. Design fundamentals for water supply, treatment and water distribution systems, including storage, pumping and piping.

Sources of wastewater, Industrial and domestic wastewater surveys. Elements of wastewater microbiology; waste – water collection, treatment and disposal and their designs.

Wastewater re-use-option and alternatives. Effluent standards.

(viii) **Pollution Control 3 Credits**

Water Supply: Treatment, design of systems.

Wastewater: Collection, treatment and Disposal and design of systems. Air Pollution and control. Industrial Wastes: Toxic, non-toxic and nuclear waste management.

(ix) **Drainage and Irrigation Engineering 4 Credits**

Land classification: Crop Water requirements;

Crop: Irrigation requirements; Farm delivery requirements; Diversion requirements; Soil-water relationships; Movement of soil moisture; Measurement of Infiltration and Soil Moisture: Irrigation water quality. Irrigation Planning Criteria.

Irrigation Methods; supplemental Irrigation, Irrigation structures. Design, construction, operation and maintenance of surface, sub-surface and sprinkler irrigation systems.

Surveys and Investigation – Sources of water, soils and salinity. Water Tables; Drainage structures. Subsurface drains. Design criteria – Drain size, materials used; Installation of subsurface Drains; Urban Storm Drainage. Land Drainage.

(x) **Systems Management (Operations Research)**

3 Credits

Basics of Operations Research: Introduction, Development of Operations Research. Art of modeling phases of (OR) study. Applied Linear Programming, examples. General Definition of Linear Programming, problems. The Simplex Method: Development and Computation Procedure of the Simplex method. Artificial variables Techniques:
Variants of the Simplex Method. Application, Problems. The Dual Problem and Post-optimality Analysis. Dual Simplex Methods: Sensitivity Analysis. The Transportation Problem. Review of Vectors and matrices. Introduction to PERT-CPM in systems Management. Queueing Theory and applications.

(xi) **Laboratory Practicals** **6 Credits**

All courses share the laboratory schedules to suit; sometimes alternate weeks.

2.30 WOOD PRODUCTS ENGINEERING

2.30.1 **Philosophy, Aims and Objectives of the Degree Programme**
As in Section 2.1.1

2.30.2 **Admission and Graduation Requirements**
As in Section 2.1.2

2.30.3 **Learning outcome**
As in Section 2.1.3

2.30.4 **Attainment Levels**
As in Section 2.1.4

2.30.5 **Resource Requirement for Teaching and Learning**
As in Section 2.1.5

2.30.6 **Course Contents and Descriptions**

(i) Design and Production (Wood Processing)
(ii) Forestry and Wood Technology
(iii) Forestry Engineering

		Lecture/Lab. Units
(a)	Course Summary	
(i)	**General Studies**	
(ii)	**Basic Sciences**	16
	Mathematics	6
	Physics	10
	Chemistry	10
(iii)	**Entrepreneurial Studies**	4
	Sub-Total	**46**
(iv)	**Management and Humanities**	
	Economics	2
	Principles of Management	3
	Marketing	2
	Technical Communications	2
	Engineer-in-Society	1
	Sub-Total	**10**
(v)	**Basic Agriculture**	
	Soil Science	3
	Silviculture	4
	Sub-Total	**7**

(vi)	**Engineering Mathematics and Computers Computing**	
	Engineering Mathematics	15
	Computers & Computing	3
	Sub-Total	**18**
(vii)	**Basic Engineering**	
	Applied Electricity	4
	Applied Mechanics	3
	Engineering Drawing	3
	Machine Drawing and Design	2
	Fluid Mechanics	2
	Hydraulics	2
	Hydrology	3
	Geology for Engineers	2
	Metallurgy	2
	Strength of Materials	2
	Materials Science	2
	Mechanics of Machines	2
	Thermodynamics	2
	Laboratory Practicals	6
	Sub-Total	**37**

Core Courses

		Lecture/Lab. Units
(viii)	**Wood Products Engineering**	
	Introduction to Wood Products Engineering	2
	Land Surveying	3
	Workshop Practice	3
	Land Clearing and Development	2
	Soil and Water Conservation	2
	Basic Properties of Wood	3
	Wood Conversion Equipment and Processes	4
	Chemical Properties of Wood	2
	Wood Deterioration and Preservation	2
	Wood Based Panel Products	2
	Wood Structures	3
	Wood Seasoning	2
	Wood adhesives and Finishes	2
	Pulp and Paper Technology	2
	Quality control	1
	Laboratory Practicals	7

	Final Year Project	6
	Sub-Total	**48**
(ix)	Electives	7
	Grand Total	**166 Credits**

Break-Down Of Courses Into Levels Of Study

300 Level	
Engineering Mathematics	6
Introduction to Wood Products	2
Engineering	3
Land Surveying	3
Hydrology	2
Geology for Engineers	2
Machine Drawing and Design	2
Hydraulics	2
Metallurgy	2
Mechanics of Machines	2
Soil Science	3
Silviculture	4
Basic Properties of Wood	3
Technical Communications	2
Foundation Course in Entrepreneur Studies	2
Laboratory Practicals	3
Sub-Total	**41**
400 Level	
Engineering Mathematics	3
Economics	2
Wood Conversion Equipment and Processes	4
Chemical Properties of Wood	2
Wood Structures	3
Marketing	2
Introduction to Entrepreneurship Studies	2
Laboratory Practicals	2
Sub-Total	**20**
500 Level	
Principles of Management	3
Soil and Water Conservation	3
Land Clearing and Development	2
Wood Seasoning	2
Wood Deterioration and	

Preservation	2
Wood Based Panel Products	2
Wood adhesives and Finishes	2
Pulp and Paper Technology	2
Quality Control	1
Laboratory Practicals	2
Final year Project	6
Electives	7
Sub-Total	**34**

Course Synopses

(i) **Introduction to Wood Products Engineering 2 Credits**

Definition and scope of wood products engineering.
Its importance in the Nigerian economy. Job opportunities. Regulations covering the industry: Forestry and factory. Tractor driving and test. Use of tractor for various field Operations.

(ii) **Marketing 2 Credits**

Marketing company, Marketing environment and its effect on company structure market research and advertising agencies. Product design and packaging. Marketing share. Product life cycle. Marketing techniques for wood products. Lumber stock level. Warehousing and warehouse hygiene. Distribution system for products and distribution costs.

(iii) **Silviculture 4 Credits**

Forest reserves in Nigeria. Concept of ecosystem. Aforestation. Characteristics of major timber and their uses. Identification of species. Distribution of forest products in Nigeria. Production practices from land preparation to harvesting. Environmental requirements. Soil and Water requirements. Enumeration techniques. Felling and log transportation. Protection from pests and fire.

(iv) **Basic Properties of Wood 3 Credits**

Fluid in wood. Effects on wood properties. Equilibrium moisture content. Thermodynamics of sorption. Physical and mechanical properties. Permeability. Durability Structure of tropical hardwoods. Effect of deposits, extractives on wood properties. Anisotrophy. Hankinson's equation. Loads and loading. Strength. Natural defects. Wood deterioration.

(v) **Wood Conversion Equipment and Processes 4 Credits**

Wood cutting, saws, cutters, Sawmilling and re-sawing equipment. Mill handling equipment. Dust extraction. Sawing patters. Mill efficiency. Vibration and noise in sawmills. Buckling of sawblades. Equipment and methods of producing veneers. Wood mill wastes and their utilisation. Safety in wood conversion mills. Factory laws.

(vi) **Chemical Properties of Wood** **2 Credits**

Chemical components and reactions of wood. Wood derived chemicals. Process problems in wood chemical industry.

(vii) **Wood Based Panel Products** **2 Credits**

Properties and production techniques of plywood, block-board, particle board, particle board, fibre board. Methods of testing and determining basic and grade strength of each product. Structural grade plywood and particle board. Use of products in constructions.

(viii) **Wood Deterioration and Preservation** **2 Credits**

Air-and-kiln season of wood. The energy input into wood during kiln-drying. Design of fans, vents, humidifier and heating elements in a kiln. Drying schedules. Drying schedules. Drying effects: Unconventional methods of wood seasoning.

(ix) **Wood Deterioration and Preservation** **2 Credits**

Deterioration of wood based panels in service. Casual agents of wood deterioration: fungi, termites, insects, fire, chemical agents. Methods of preserving wood. Structures by design. Non-pressure, vacuum-pressure and other methods of wood treatment with preservatives.

(x) **Wood Adhesives and Finishes** **2 Credits**

Adhesives theory. Requirements of wood adhesives. Types and classifications. Use of adhesives in the production of glulam scarf and finger joints.

(xi) **Pulp and Paper Technology** **3 Credits**

Pulping by the draft, soda sulfite and semichemical processes. Defibration processes Pulping Machinery.

(xii) **Quality Control of Wood Products** **1 Credit**

Quality standards and quality control in lumber, panel products and pulp/paper industries. Determination of lumber target size, control and tolerance limits. Product inspection and certification.

(xiii) **Wood Structures** **3 Credits**

Wood as structural material. Basic theory of structures. General requirements for structural design. Dimensions of structural timbers, tolerance, properties of sections. Grade stresses. Design of wooden beams. Stability. Design of wooden columns composite columns. Mechanical fasteners. Design and testing of wooden trusses. Exterior structures.

3.0 APPENDIX

A.0 ACADEMIC LOADING FOR STUDENTS:

All students in Engineering and Technology Programmes should take a minimum load of 18 credits or units per semester. To reflect the importance of practical work, a minimum of 9 hours per week (3 credits) should be spent on students' laboratory practicals. In addition to lectures and laboratory practicals, it is very important that tutorials are held for students in small groups. Students should, therefore, be divided into small groups for practicals in the laboratories, but each student should be made to work on a specified final year project which should carry a minimum of 4 credits.

A.1 ACADEMIC LOADING FOR STAFF:

With a minimum load of 18 credits for students and a minimum of six full-time equivalent of staff in each programme, staff should have a maximum of 15 contact hours per week for lectures, tutorials, practical and supervision of projects.

(a) STAFFING:

The NUC guidelines on staff/students ratio for Engineering and Technology Departments shall apply. However, there should be a minimum of six full-time equivalent of staff on the ground in a department. There is need to have a reasonable number of staff with doctoral degrees as well as sufficient industrial experience. It is important to recruit very competent senior technical staff to maintain teaching and research equipment.

(b) **Criteria For Assessment and Weighting For Academic Appointments And Promotion**

Appointment and Promotion should be based solely on merit and should be applicable to all academic positions. For promotion, academic staff should spend a minimum of three years on a position before being considered.

The following criteria should be used for assessment and weighting for academic appointments and promotion:

(i) **Academic Qualifications**

The highest qualification, a PhD, would attract the maximum of 10 points, and a Second Class Upper, is to attract 4 points. Therefore the points are to be awarded thus:

A Doctorate Degree	10 points
A Masters Degree obtained by research e.g. M.Phil	8 points
A Masters by course work and examination	6 points
A 1st Class Honours Degree	5 points
A 2nd Class Upper Honours Degree	4 points

(ii) **Professional Qualification**

A maximum of 5 points is to be awarded to the highest professional qualification.

(ii) **Teaching/Research**

1. Length: - 10 points

   1 point is to be awarded for one year of full time teaching or research as Assistant Lecturer upwards at a University or comparable Institution.

2. Quality - 5 points

   A random sample of students evaluation of teacher's teaching quality by the use of carefully designed questionnaires; comments of External Examiners and evaluation of Heads of Department:

   Teaching effectiveness

   Nature of courses
   Level of courses

Minimum score = 2 points, below which promotion should be denied

(iv) **Current Research - 5 points**

On-going Research
Designs
Research Reports

(v) **Recognised Publications - 40 points**

The assessment of publications shall include the extent of their contribution to the advancement of engineering and technology knowledge in the field, or usefulness to the profession concerned.

(i) The maximum number of points per recognised journal publication is pegged at 3 points,

(ii) Maximum 3 points for patents with a maximum of 2 patents and

(iii) Sole authored books, maximum 5 points in case of a book with a maximum of 2 books

(iv) Contribution to books must not attract more than 1 point each per chapter. Books must be properly referred and at tertiary level.

(v) Chapters in books should not exceed 3 points grand total.

(vi) Conference proceedings should not exceed 3 points grand total

Marks should be awarded for each article bearing in mind such factor as the overall minimum a candidate must obtain to qualify for a position, the number of authors who published the article, the extent to which a paper is original and its relevance and contribution to Engineering and Technological knowledge.

Minimum scores in publication:-

Professor	-	28 points
Associate Professor	-	24 points
Senior Lecturer	-	20 points

Summary of Detailed Scoring

	Criteria		**Weighting Maximum Points**
(i)	Academic Qualifications	-	10
(ii)	Professional qualifications	-	5
(iii)	Teaching Length	-	10
(iv)	Teaching Quality*	-	5
(v)	Interview Performance	-	10
(vi)	Current Research	-	5
(vii)	Recognised Publications	-	40
			85

*For internal candidates

(vi) **Minimum Scores Required for Academic Positions**

Professor	-	60
Associate Professor	-	55
Senior Lecturer	-	51
Lecturer I	-	26
Lecturer II	-	17
Assistant Lecturer	-	13

A.2 Agricultural Engineering

A.2.1 List of Laboratories/Workshops

(i) Farm Power and Machinery Laboratory
(ii) Irrigation and Drainage Laboratory
(iii) Crop processing and Storage Laboratory
(iv) Farm Structures and Environmental Control Laboratory
(v) Farm Mechanics Workshop
(vi) Machinery Maintenance Base
(vii) Drawing Studio
(viii) Machine Tools Workshop fabrication.

The practical content of all the programmes should not be less than 35 per cent of the total contact hours.

A.2.2 List of Major Equipment

(a) **Farm power and Machinery Laboratory**:

Tractors for field operation
Disc and moldboard ploughs
Disc ridger
Disc harrow – offset and tandem
Planter with fertilizer unit
Seed drill
Hydraulic boom and hand sprayers
Grain combine harvester
Agricultural trailer
Conveyor test belt
Knapsack sprayer test rig
Tillage and traction model study unit
Single cylinder Engine test bed
Variable compression ration petrol engine test bed
Tractor power take-off dynamometer
Exhaust calorimeter heat exchanger
Fuel Consumption measurement system for engine testing
Lubricating oil rig
Hydraulic power pack
Tractor model showing working parts
Six speed gear box
Tractor rear axle section
Tractor electrical system
Basic transducers for measuring torque, pressure, temperature, etc.

(b) **Irrigation and Drainage Laboratory**:

General purpose Theodolite
Liquid prismatic compass
Surveyor's umbrella
Stereoscope
Nylon-coated steel tapes – 50m
Leveling staff
Abney level
Physical Survey Basic Set
(Pocket Altimeter, range finder, automatic level set, double prismatic square, ranging Rods, land chains-30m, chain, arrows, clinometers)
Soil Sampling Augers
Soil Texture set
Sieve sets with shaking machine
Centrifuge
Weighing balance

Tension meters
Double ring infiltrometer
Various types of flumes
Current Meters
Pump tests set
Pump impeller display panel
Laboratory infiltration apparatus
Sprinkler Irrigation set
Drip Irrigation set
Rainfall simulator
Oven

(c) **Crop Processing and Storage Laboratory**:
Laboratory air-screen cleaning and grading machine
Laboratory gravity separator
Hammer grinding mill and kit
Sieve shaker and a set of sieves
Analytical balances
Oven
Maize Sheller
Grain moisture meters
Crop Drying Test apparatus
Grain Cleaner
Grain storage bins
Centrifugal and axial flow fans
Refrigerator
Temperature and humidity measuring set.

(d) **Farm Structures & Environmental Control Laboratory**:
Load Measurement:
Compression Testing Machine
Integral boss Load measuring rings on Compression and Tension application
100-KN Compression/500-KN tension machine
33-KN flexural and transverse machine
100-KN heavy beam flexural and transverse machine
Drying and Weighing:
General purpose electric laboratory oven
Incubators
Electronic Weighing machine
Semi-automatic balance
Counter flat form scale
Mettler Weighing machine
Spring balance
Soil Equipment:
Melting pot
Extruders (Big and small)

Sample mixer
Liquid limit device machine
Grooving tools
Spatulars (Big and small)
Measuring cans
Glass plate for plastic limit
Shrinkage limit apparatus
Density bottle
High Speed stirrer
Hydrometer (Big and Small)
Standard compaction rammer
Automatic soil compactor
Proctor mould
Compaction mould
C.B.R – Marshal tester
C.B.R – Mould and accessories
Sand cone
Trays (Big and small)
Scoops
Desiccators
Field density tools
Field density spoons
Field Rubber headed maller
Field Club hammers
Field Density chisel
Field Metal dibber tool
Field Scrappers
Field Density hand pick
Field Steel pointed rod
Glass jar
Mortar
Rubber headed pestle
Glass evaporating dish
Filter papers
Conical beaker
Concrete Equipment:
Slip test apparatus
Compacting factor apparatus
Penetrometer
100mm cube mould
150mm cube mould
Beam mould
Cylinder mould
Standard curing tank
Three-gang mould for 50mm mortal cube
Hand steel float

Headpans
Wheel barrows
Diggers
Band trowel
Sand Aggregates and Fillers Equipment:
Aggregate impact value apparatus
Abrasion machine
Metal measure, 115mm diameter x 180mm deep
Asphalt Equipment:
Thermometer
Laboratory Thermometer
Surface Thermometer
Muffle furnace
General Equipment:
Distiller
Measuring tapes
Refrigerator
Strain Gauge Indicators
Sieve shakers
Set of sieves
Set of 200mm diameter (various sizes)
Set of 300mm diameter (various sizes)
Set of 450mm diameter (various sizes)
Vernier calipers

(e) **Farm Mechanics Workshop**:
Measuring Tools and Instruments:
Pocket rule with belt clip (235m)
Steel measuring tape
Caliper rule
Procession external micrometer
Universal measuring instrument for depth measurement
Procession inside micrometer
Dial indicator
Outside spring caliper
Inside spring caliper
Metal bar divider
Precision tri square
Metric threading gauge
Welding and Soldering Accessories:
Welding shield
Welding helmet
Goggle clear
Welding Goggle
Electrode holder
Earth Clamp

Welding hammer
Wire Brush
Welding and cutting touches set
Oxygen acetylene hoses
Safety helmet
Working and welding gloves
Blowlamp with butane
Electrode – All sizes
Soldering iron (all sizes light-heavy duty)
Soldering lead wire – 2mm
Soldering lead in rod.
Workshop Hand Tools (Technicians):
Hacksaw frame
Hacksaw blades high speed steel
Tube cutter 3 – 32mm; 3 – 16mm
Steel wire brush
Clip plier for external clip
Clip plier for internal clip
Combination plier 160, 180mm
Heavy duty diagonal cutter
Constructed steel cutter 800mm
Universal grip plier 250mm
Welding grip plier 280mm
Riveting tool set
Engineer hammer 200g – 150g
Sledge hammer 1-2kg
Rubber hammer
Clipping chisel 150 – 250mm
Welding hammer
Standard ring spanners
Combination spanner set
Scrapper
Hand gloves
Centre punch set 120 x 12mm
Chisel set
Flat file (150 – 300)mm
Square file (150 – 300)mm
Half round file 150 – 300mm
Round file 150 – 300mm
Black smith tong 150 – 300mm
All steel vices 100 – 175mm
Pipe cutter 10 – 60mm; 42 – 10mm
Anvil with two horns – 100 kos
Technician tool box (empty).

Wood Working Equipment:

Band saw-table size – 700 x 980mm – 3HP
Radial arm saw 3HP (with extra blades)
Circular saw – blade dia – 400mm with external blades
Universal woodworker combined – 4HP seven works model
Sing cylinder planner 4HP (Surface planner with extra blades)
Vertical Mortiser – chain motiser – 3HP with extra bits
Router drilling machine – 3HP
Combined tennoning and scibing machine
Belt standing machine – 2HP (with extra sanding paper reels).

Hand Tools (Carpentry):
Marking gauge
Mortise gauge
B. spirit level Universal
Mortise chisel – 6.4 ,9.6, 12.7, 16mm
Flat chisel – 6.4, 9.6, 12.7, 16mm
Bevel edge chisel – 6.4, 9.6, 12.7, 16mm
Round chisel 6.4, 9.6, 12.7, 16mm
Smooth plane – Jack Plane, plough plane
Wood rasp
Hand saw or panel saw
Rip saw, cross cut
C – Glamp
F – Glamp
Wood bench vice
Jack plane
Hand drilling machine/rachet brazed bits
Sanding machine – heavy duty
Surface and thickness 100 – 150mm blade
Extra knives carpentry machine planner and thicknesser
Air Compressor – Tank capacity 500 litres complete with accessories – type spray gun and air blow – gun
Hydraulic Garage jack 1, 2, 6, tons
Hydraulic workshop Crane 2.5 tons
Battery tester, cell tester, Acid Tester
Battery fast and slow charger (6 – 24V, 20A)
Battery service equipment
Spark plug tester and cleaner
Hydraulic mobile crane 1.5 – 5 ton
Wire rope winch – 1500 – 3000kg
Chain host
Pedal operated grease gun
Hand lever grease gun
Exhaust gas tester
Standard tool box mechanics
Standard tool box for electricians

Electric hand drill 100mm
Electric two speed drill 23mm
Electric hand drill 13mm
Straight electric hand grinder 125mm
Angle electric hand grinder 230mm

(f) **Machinery Maintenance Base**:
Hydraulic trolley
Wheel alignment gauge
Electrical/Electronic kit
Clutch alignment gauge
Vacuum tester
Battery charging equipment
Injector repair machine
Carburetor service kit
Hydraulic press
Vulcanising set
Oxyacetylene equipment
Nozzle testing outfit
Tool Boxes
Complete set of various maintenance kits.

A.3 AUTOMOTIVE ENGINEERING

A.3.1 List of Laboratories

Mechanics of Machines Laboratory
Strength of Materials Laboratory
Thermodynamics Laboratory
Fluid Mechanics Laboratory
Metallurgy Laboratory
General Workshop
Drawing and Design Studios
IC Engines and Fuels Laboratory
Automobile Systems and Vehicle. Dynamics Laboratory
Automobile Systems Maintenance and Testing Laboratory
Automobile Workshop.

A.3.2 List of Major Equipment/Experiments

All facilities required for Mechanical Engineering (Sec A.16.2) plus the following:

(a) **IC Engines and Fuels Laboratory:**
Properties of air-fuel mixtures
Effect of mixture strength on ignition, flame
Formation, flame velocity, combustion rate, peak pressure and temperature
Engine emission and omission control.

(b) **Automobile Systems and Vehicle Dynamics Laboratory**

Performance and reliability of Brake systems
Carburettors and Injection nozzles
Performance characteristics of components of ignition system
Performance of batteries, alternators, voltage regulators, etc
Performance characteristic of power transmission system
Vehicle body shape and air resistance
Factors affecting tyre wear rate
Effect of Tyre pressure on Road traction (fuel consumption) and manoeuvrability
Manoeuvrability of vehicles.

(c) **Automobile Systems Design Maintenance and Testing Laboratory**

Design of System components for production
Testing of models and prototypes
Testing of vehicles for off-design performance
Schedules for preventive maintenance for various automobile components, taking local conditions into consideration.
Calibration and Operation of test equipment
Crank shaft grinder
Cam shaft grinder
Valve grinder
Pedestal grinder
Cylinder boring machine
Hydraulic ramp
Portable crane
Compressor
Mechanical press
Plug re-conditioning machine
Battery charger
Beam setter
Centre lathe
Chain block
Torque wrench (various)
Tool kit, stock and dies
Dynamic performance testing unit

(d) **Automobile Workshop**

Auto pit
Auto engine rigs
Auto transmission systems
Wheel balancing and alignment equipment
Panel beating apparatus
Welding equipment
Production facilities for simple automobile parts
Apparatus set up for fault tracing and repair of automobile systems including engine overhaul.

Lubricating oil tester.

A.4 Ceramics Engineering

A.4.1 List of Laboratories

Mechanics of Machines Laboratory
Strength of Materials Laboratory
Thermodynamics Laboratory
Fluid Mechanics Laboratory
Metallurgy Laboratory
General Workshop
Drawing and Design Studio

A.4.2 List of Major Equipment/Experiments

All the facilities required for Mechanical Engineering (Sec A.16.2) plus the following well equipped laboratories:
Glass Blowing Laboratory
Ceramic Raw Materials Laboratory
Heat Treatment Laboratory
Ceramic Materials Testing Laboratory
Ceramic Production Laboratory.

A.5 Chemical Engineering

A.5.1 List of Laboratories

(a) **Separation Process**
Distillation
Absorption
Extraction

(b) **Transport Phenomenon**
Fluid Flow
Heat Transfer
Mass Transfer

(c) **Reaction Engineering control**
Kinetics
Reactor Systems
Process Control Systems

A.5.2 List of Major Equipment

Flow Measuring Apparatus
Dryer
Filteration System (Filter Press)
Sedimentation System/Fluid
Particles System
Distillation System

Gas Absorption System
Fluid Circuit System
Free and Forced Convection System
Thermal Conduction System
Heat Exchange System
Milling (Communication) System
Multi-purpose Flow Equipment
Evaporation System
Stirred Tank Reactor
Chemical Reactor System
Demonstration Control System
Viscometer
Oven
PH-Meter
Balances
Centrifuges
Freezers/Refrigerators.

A.6 Civil Engineering

A.6.1 List Of Laboratory/Workshop

(a) **Structural Engineering:**
- (i) Civil Engineering Materials Laboratory
- (ii) Structures Laboratory:
  - Routine Testing
  - Models and Prototype Testing
  - Studio/Design Office.

(b) **Geotechnical Engineering:**
- (i) Field soil survey and testing (including sub-soil investigation and drilling).
- (ii) Laboratory Soil/Rock Testing

(c) **Geodetic Engineering and Photogrammetry:**
- (i) Laboratory Equipment Stores
- (ii) Photogrammetry & Remote sensing Laboratory

(d) **Water Resources & Environmental Engineering**
- (i) Hydraulics Laboratory
- (ii) Hydrology Laboratory

(i) Environmental Health Laboratory

(e) **Highway & Transportation Engineering**
- (i) Highway Materials Testing Laboratory
- (ii) Pavement Laboratory.

A.6.2 List of Major Equipment

(a) **Structural Engineering Laboratory**

(i) **Universal Testing Machine** with accessories for Tension, Compression, Transverse 180^{o} cold Bend, Double Shear, Punching and Brunel Hardness Tests. Capacity – 10000KN, Transverse Beam – 500KN.

(ii) **Proto-type Tests Facilities** for testing of proto-type in structural elements, i.e. Beams, Frames, Trusses, etc. Accessories for the purpose include 1000KN, 250KN load rings, Electronic load cells, Faculty Workshop facilities, Demec High accuracy Gauges, Hydraulic Jacks, etc.

(iii) **Compression Testing Machine and Transverse Flexural Testing Frame:**
Suitable for standard compression, flexural tensile tests and split cylinder tests on standard concrete and wood specimens to BS 1881 and CP 112 respectively. Shear rig can be manufactured and attached to this machine for testing shear strength of wood and glued wood joints. Capacity of the machine is 2500KN.

(iv) **Routine Testing and Demonstration Equipment:**
This includes Armfield Extensometers, arch frames, suspension bridge frame and pin-jointed frame work.

(v) **Concrete Batching and Making Equipment**

(a) Multi-flow mixers, 112 Dm^3 ($4ft^3$) and 56 Dm^3 ($2ft^3$) capacities 200-240V.
(b) Test BS Sieves of various sizes.
(c) Semi-Automatic scale 25kg capacity
(d) Automatic scale 500kg capacity
(e) Standard moulds of various sizes and tamping rods
(f) Vibrating table.

(vi) **Concrete Quality and Workability Equipment:**

(a) Slump cone apparatus to BS 1881 ASTM CI43
(b) Compacting factor apparatus to BS 1881. (2 sizes)
(c) Vibro Consistometer to BS 1881
(d) Vicat Apparatus
(e) Air Enmetertainment

(b) **Water Resources and Environmental Engineering Laboratory**

(i) Laminar/Turbulent pipe flow apparatus
(ii) Radial flow pump
(iii) Radial flow turbine
(iv) Surges in pipes apparatus
(v) Surge Tower
(vi) Water Hammer apparatus
(vii) Evaporating dish
Steam bath or infarred lamp
Drying oven

Dissiccator
Analytical balance
Reagents – Sodium hydroxide, in distilled
Water, phosphate buffer solution, magnesium
Sulfate solution, calcium chloride solution, ferbric chloride solution, acid and alkali solution, etc

(viii) (a) Incubators
(b) Colony countrer (Quebec)
(e) pH Meters
(f) Pipettes and Cylinders
(g) Petri dishes
(h) Sample bottles
(i) Burner

(ix) Laboratory flow channel
(x) Fibre glass
(xi) Thermometers
(xiii) Funnels
(xiv) Test Tubes

(c) **Geotechnical Engineering/Highway and Transportation Engineering Laboratory:**

(i) Tri-axial testing machine complete with transducers cells and accessories.
(ii) Motorised direct/residual shear box machine complete with load rings, set of weights and accessories.
(iii) CBR Testing machine complete with moulds, load ring gauges and accessories.
(iv) Consolidation apparatus complete with cells, gauges and set of weights
(v) Laboratory vane test apparatus complete with set of springs and motorizing attachment.
(vi) Large capacity floor-mounting electric ovens 40^{o}C to 16^{o}C.
(vii) Hotplates with simerstat heat control unit 220–240V,2000 W.
(viii) Mettler top-loading balance with optical scale 100 g, Readability 0.01 g, capacity 1.3 kg.
(ix) Graduated twine beam scale complete with two stainless steel pans 0 to 200 g x 10 g.
(x) Semi-automatic balances, 25kg capacity complete with scoope and set of counter weights.
(xi) Augographic unconfined compression apparatus complete with platens springs.
(xii) Unconfined compression apparatus complete with platens and strain gauge mounting assembly and dial gauge.
(xiii) Automatic sieve shaker for up to 200 mm diameter sieve.
(xiv) BS sieves 212 mm to 8 mm and 200mm diameters.
(xv) Simple hand boring sampling augers complete with accessories.
(xvi) Portable drilling unit with two-stroke petrol engine and two pairs of handles complete with extension rods
(xvii) Atterberg limits determination apparatus complete with liquid limit device and accessories.

(xviii) High-speed stirrer complete with cup and baffler.

(xix) Constant temperature bath complete with hydrometer jars, watt heater, thermostat, etc.
(xx) CBR Marshall tester complete with breaking head stability mould and flow meter dial gauge.
(xxi) Compaction pedestal complete with hammer and mould body.
(xxii) Constant head permeability apparatus complete with cells and accessories.
(xxiii) Standard proctor compaction mould, 1000 cm^3 capacity complete with rammers and accessories.
(xxiv) Geonor swelling test apparatus complete with cells and accessories.
(xxv) Riffle boxes complete with three rigid metal containers.
(xxvi) Wax melting pot with thermostatic control up to 150^oC range.
(xxvii) Hand-operated extruder – screw type sample extruder for 38mm dia. Complete with built-in sample tube supports.
(xxviii) Procotor/core cutter extruder comprising a frame and a 15-KN hydraulic jack.
(xxix) Universal extruder comprising a frame and a 15-KN hydraulic jack.
(xxx) Bench-moulding mixer with three-speed gear box complete with stainless steel bowl 7.5 dm^3 capacity.
(xxxi) Long stem soil hydrometer graduated 0.995 to 1.030 g/ml.
(xxxii) Sieving extractor complete with clamps and clamming ring for use with sieves of 200mm dia.
(xxxiii) Minor centrifuge complete with 8-place angle head, 8 x 50 ml metal buckets and caps.
(xxxiv) Ductilometer for testing 4 specimens complete with briquette moulds and base plate.
(xxxv) Flash and fire-points apparatus gas heated.

(d) **Geodetic Engineering and Photogrammetry Laboratory:**

(i) Theodolites
(ii) Levels
(iii) Compasses
(iv) Umbrellas
(v) Protractors
(vi) Steel tapes
(ii) Engineer’s chains
(iii) Ranging rods
(iv) Surveyor’s scales
(v) Various graph paper
(vi) French curves
(vii) Log tables
(viii) Planimeters
(ix) Plumbulbs
(x) Arrows
(xi) Field Books

Workshop Facilities

Students should be subjected to the following workshop facilities:

(ii) Lathe machine
(iii) Milling machine
(iv) Benchwork (for metals and carpentry)
(v) Welding, Auto Servicing, Minor Sheet metal work.

A.7 Computer Engineering

A.7.1 List of Laboratory/Workshop

1. Basic Electrical Laboratory (Shared with Electrical Engineering (Sec. A.8.1))
2. Basic Electronics Laboratory (Shared with Electronic Engineering (Sec A.10.1))
3. Microprocessor Laboratory
4. Computer Laboratory
5. Prototyping Workshop

A.7.2 List of Equipment

(i) Basic electrical laboratory equipment as specified in Electrical Engineering (Sec A.8.2)
(ii) Basic electronic laboratory equipment as specified in Electronic Engineering (Sec A.10.2)
(iii) Logic Analyser
(iv) PCB Development Kits
(v) Digital Oscilloscope 3 (Qty)
(vi) Microprocessor Development Kit (Intel) 3 Qty
(vii) Microprocessor Development Kit (Motorola) 3 Qty
(viii) Microcontroller Development Kit (Intel/Motorola) 4Qty
(ix) PIC Microcontroller Development Kit 3 Qty
(x) FPGA Development Kit 3 Qty
(xi) Computer systems 20 (Qty)
(xi) Multimedia Projector 1 (Qty)
(xii) Overhead Transparency Projector 4 (Qty)
(iv) Software Packages(MASM Assembler, Verilog, etc) Lots

A.8 Electrical Engineering

A.8.1 List of Laboratories

Applied Electricity Laboratory
Electronics and Telecommunication Laboratory
Control and Computer Laboratory
Electrical Power and Machines Laboratory
High Voltage Laboratory
Standard Measurements Laboratory
Final Year Project Room

A.8.2 List of Major Equipment & Experiments

(see Electrical and Electronics Engineering; Sec. A.9.2)

A.9 Electrical and Electronics Engineering

A.9.1 List of Laboratories

Applied Electricity Laboratory
Electricity and Telecommunications Laboratory
Control and Computer Engineering Laboratory
Electrical Power and Machines Laboratory
Standard Measurements Laboratory
Final Year Project.

A.9.2 List of Major Equipment and Experiments

(a) **Equipment**

(i) **For Applied Electricity, Circuit Theory and Electronics Circuits**

A set of laboratory test and measurements equipment, it's large enough quantity to enable a reasonable number of experiments to go on at the same time, bearing in mind the number of students. The same type of measuring equipment and components can be used for the various experiments. The following are essential:

Power supplies (D.C. and A.C. various voltage, and current ranges).
Signal generators (low frequency, KHZ high frequency, MHZ ranges).
Function generators (sine, square-wave, saw-tooth)
Oscilloscopes (single-beam, double-beam, 5MHZ, 10MHZ, 20MHZ, frequency ranges).
Wide range of meters, voltmeters, multimeters DC and AC bridges.
Frequency counters.
Large collection of circuit components (resistors, capacitors, inductors, transistors, IC's logic modules, operational amplifiers, etc).
Decade resistance boxes, potentiometers, decade capacitance and inductance boxes.

(ii) **Automatic Control Experiments**

Hybrid AC/DC servomechanism system, Pneumatic control teaching system, Electro-hydraulic servo system
Process control system
(A number of control system equipment are in ready-made complete units such as those listed above available from Feedback Instruments (Ltd). U.K. and similar organisations. They are designed to illustrate a number of principles on control theory and systems).

(iii) **Electrical Machines Experiments**

A complete motor-generator set and switchgear equipment available from Siemens, designed to suit most of the experiments necessary for motors and generators. The equipment are of industrial types.

For simpler and basic experiments. Feedback Instruments (Ltd) and J.J. LLoyd Instruments (Ltd) manufacture Laboratory type sets.
If such ready-made equipment could not be purchased, then it is essential that a large number of individual items be purchased such that students could make up their own circuits and devices.

The following is a list from which selections could be made:
Shunt-wound d.c. machines
Compound-wound d.c. machines
3-phase squirrel-cage motor
Starters, field rheostats, resistors
3-phase starter, load resistor unit, 3-phase load resistor unit Capacitor, load.
3-phase synchronous generator
3-phase slip-ring motors
3-phase salient-pole synchronous machines
Single-phase transformer
3-phase transformer
Eddy-current brake
Switchgear and measuring equipment such as moving-iron meters.
Wattmeters, current transformers, CRT, frequency meters, stroboscopes.
Phase-sequence indicator, connecting cable, etc
Acquisition of software packages e.g. PSCAD for simulation studies of the above listed power devices

(iv) **Digital Electronics, Computers and Communications Experiments**
Most of the equipment required for experiments in these areas consist mainly of circuit components, logic modules and test and measuring equipment. What is required is to acquire a large number of such components, IC's and modules, and students wire up or connect on breadboards necessary circuits for the experiments at hand.

However, Feedback Instruments have a variety of digital, microprocessor process control and computing training systems with relevant and detailed manuals of experiments to satisfy the students' needs. There are other similar bodies also in the market. A few microcomputers and the peripherals are required, for programming and for experiments.

(v) **Students Group at Laboratory Class**
Ideally, there should be only two students to a laboratory bench. The number should, in any case, not be more than four.

(vi) **List of Laboratories**
One laboratory for Applied Electricity, to cater for the needs of the Faculty students at large. This is where basic measurement, testing,

equipment familiarisation and safety precautions are first encountered in Electrical Engineering.

One laboratory for Electrical Machines. Two other laboratories which can be shared for the light current experiments on Circuit Theory, Electronics Circuit, Measurements and Instrumentation, basic communication and Control Theory experiments. One laboratory for the computer engineering, which should be equipped with well controlled environmental conditioning (temperature, humidity and dust), and highly stabilised voltage supply, to house the microcomputers and sensitive electronic components.

It is desirable to have a separate laboratory for the final year students as projects laboratory.

(vii) **Workshop Facilities**

There should be departmental store for equipment and components storage; other smaller stores could be attached to the various laboratories. There should be a well-equipped electrical/electronics workshops.

(b) **Experiment**

(iv) **Practical Content of Programmes**

It is essential to emphasize that stipulated basic and core courses should be accompanied by laboratory practicals to adequately illustrate the fundamental principles. At 200 level, at least 3 hours per week should be devoted to the Applied Electricity aspect of the Programme. At 300 and 400 levels, at least 9 hours per week should be spent in the Electrical Engineering laboratories by each student. For the final year, students should devote a reasonable amount of time (12 to 15 hours per week) to projects which should be mainly of design, construction and testing types.

(v) **Suggested Experiments**

(1) **Applied Electricity**

Series and parallel circuits
Line circuit theory (Thevenin's and Norton's theorems)
Kirchoff's voltage and current laws
Internal resistance of voltage sources
Maximum power transfer
Inductance and inductive circuits
R.L.C. Circuits and resonance
Junction diode characteristics
Power supply: rectification, smoothing, stabilisation
Simple generators and motors

(2) **Circuit Theory**

T – and PI – Network: Star-Delta transformation
Transient response in R-C circuits

Differentiating and integrating circuits
DC and AC bridges
Filters: Low pass, High pass, Bandpass, Active filters
Transmission line characteristics.
Software packages e.g. PSPICE

(3) **Electronics Circuits: Analogue & Digital**

Zener diode characteristics and use of Zener diode as reference sources.
Transistor characteristics (Junction and FET transistors)
Transistor as an amplifier (single – and two-stage amplifiers)
Feedback amplifier
Operational amplifier
Oscillator circuits
Basic logic circuits
Digital combinational logic circuits: (verification of Boolean Algebra theorems)
Wave shaping circuits (monostable and astable multivibrators)
Memory circuits and counters.
Software packages e.g. PSPICE, ELECTRONIC WORK-BENCH & SOFTWARE FOR PCB DESIGN

(4) **Measurements and Instrumentation:**

Electrical components:
Resistors

- Tolerance, power rating, colour coding,preferred valued types.
- Variable resistors and potentiometers.

Capacitors

- Types and composition: electrolytic capacitors safety in the use of capacitors in high voltage circuits.Inductors
- Circuit inductance: high impendance coils and chokes

Transducers

-Piezoelectric, Photoelectric, thermo-electric, magneto-electric variable impendance, thermo couples, strain gauges variable inductance (LVDT).

Cathode Ray

- Constructional details, principle of operation, applications in voltage, current, frequency, and phase measurements.Oscilloscope Ammeters and Voltmeters
- Multimeters and shunts, power meter (KWH meter) Circuit control and protection Devices: Isolators, contactors, circuit breakers, fuses and their ratings.

(5) **Control Experiments:**

Operational

- Uses as adder/substractor, scaler, integrater and differentiator amplifier.

Serve amplifier, servometer/tachogenerator: motor speed characterists

Open-loop position control system
Close-loop position control system
Frequency response and stability of closed-loop control system
Analogue, hybrid and numerical control of servo-mechanism.
Software packages e.g. MATHLAB, POWER 4

(6) **Machines Laboratory Experiments**
Transfer load characteristics
Open and short circuit tests on transformers
DC series – and compound-wound motors
DC – Generator: compound-wound
AC – 3 phase, squirrel cage and induction motor
AC – 3 phase synchronous motor
Delta – connected reactive load on alternator
Circle diagram for a 3-phase induction motor
Synchronisation of a 3-phase alternator
4-pole single phase induction motor
Software Packages e.g. PSCAD, NEPLAN, POWERWORLD etc

(7) **Digital Electronics, Computer and Communications Engineering**
Logic modules
Logic circuits, shift registers, shift counters
Ring counters
Single-latch and clocked flip-flops
DK flip flops
Synchronous and Asynchronous counters
Up-Down counters
Codes and code converters
D/A and A/D converters
Microcomputer interface techniques
Modulators and Demodulators (MODEM) and their uses in communication circuits
Multiplexing techniques
PAM and PCM circuits
Analogue and digital telephony systems.
PLD Programmers
Verilog Hardware Description Language

A.10 Electronics Engineering

A.10.1 List of Laboratories

Applied Electricity Laboratory
Electronics and Telecommunication Laboratory
Control and Computers Laboratory
Electrical Power and Machines Laboratory

Standard Measurements Laboratory
Final Year Project Room

A.10.2 List Of Major Equipment & Experiments

(see Electrical and Electronics Engineering (Sec A.9.2))

A.11 Food Science And Technology

A.11.1 List of Laboratories/Workshops

Food Microbiology/Fermentation Laboratory
Food Processing/Preservation Laboratory
Biochemistry/Nutrition Laboratory
Food Chemistry/Analytical Laboratory
Workshop.

A.11.2 List of Major Equipment

(a) **Food Microbiology/Fermentation Laboratory**:
Microscopes
Incubators
Fermenters
Stomacher

(b) **Food Processing/Preservation Laboratory**
Complete canning line
Open top evaporator
Dicing machine
Drying carbonate
Chinbing film evaporator
Homogeniser
Drum Dryer
Humidity chamber
Fluidised bed dryer
Filter press
Harmer mill
Pin disc mill (attrition mill)
Ribbon mixer
Pilot tray dryer
Plate heat exchanger
Oven for bread making
Kiln.

(c) **Biochemistry/Nutrition Laboratory**
Flame analyser

Spectrophotometer
Animal cages
Kjehldhal auto analyser

(d) **Food Chemistry/Analytical Laboratory**
PH meter
Weighing balance
Vacuum Oven
Rotary evaporator
Flame analyser
Water bath
Cold centrifuge
Furnace
Spectrophotometer
Air oven
Infrared spectrophotometer
Fluoremeter
Auto sampler
Atomic Absorption Spectrophotometer
Specpolus
Brabender Amylograph
Brabender Frarinograph
H.P.L.C.
Gas Chromatography machine.

A.12 Industrial And Production Engineering

A.12.1 List of Laboratories/Workshops

Mechanics of machines Laboratory
Strength of materials laboratory
Thermodynamics Laboratory
Fluid mechanics Laboratory
Metallurgy Laboratory
General Workshop
Drawing and Design Studio
Machine Tools Laboratory
Production Laboratory
Foundry and Heat Treatment Laboratory
Welding Shop
Metrology Laboratory
Work Study and Systems Design Laboratory
Computer Software laboratory
Manufacturing/Production Laboratory
Ergonomics (Human Factors Engineering) Laboratory.

A.12.2 List of Major Equipment/ Experiments:

All the Mechanical Engineering facilities (Sec A.16.1) plus the following:

(a) **Machine Tool Laboratory:**

Tool and Cutter grinding machine
Cutting Tools, Milling Cutters, etc.
Cylindrical grinding machine
Puncher Slotting machine
Gear Cutters
Gear Hobbing machine
Milling machine
Radial drilling machine
Turning lathe
Spiral Gear cutter machine
Gear profile tester
Gear profile measuring machine.

(b) **Production Laboratory:**

Universal grinding machine
Centre Lathe
Boring machine
Plate bending machine
Surface grinding machine
Numerically controlled lathe
Power Hacksaw
Surface finishing machine
Cross-cutter machine
Surface lapping machine
Honing machine
Vices
Rolling mill
Wire drawing unit
Wire winding machine
Extrusion press
Various moulding machines and tools
Wire enamelling set
Electroplating set
Drop forging machines

(c) **Foundry and Heat Treatment Laboratory:**

Blacksmith Hearth
Anvil
Compressor and Exhaust Unit
Drop hammer
Phoumatic forging hammer
Ovens

Complete Heating furnace
Automatic riveter
Hydraulic – press
Hardening furnace
Oil bath with quenching oil
Crank shearing machine
Die sinking machine
Reheating furnace
Vacuum Annealing furnace
Graphite crucibles
Preheating Blower
Oil fired tilting furnace
Coreless induction furnace
Hot chamber
Die casting machines
Ladles, tackles and dollys
Portable crane hoist
Operators safety kit.

(d) **Welding Laboratory:**
Welding booths
Automatic oxy-cutting machine accessories
Arc Welding machine and accessories
Plasma welding machine
Oxy-acetylene set
Spot welding machine
Circle cutting machine
Die blanks, tools, etc
Welder's safety kit.

(e) **Metrology Laboratory**
Surface measuring instruments
Interferometer
Optical pyrometer
Photo-elastic test unit
Universal measuring machine
Vernier Callipers
Micro-optic Auto-Collimator
Gauges, Optical Flats and X-Y plotters
Micrometer Screw Gauges

(f) **Work Study and Systems Design Laboratory:**
Motion Studies
Workplace Layout
Time Study
Work Sampling

Work Systems Design method
Simulation in Systems Design
Method Improvements Techniques.

(g) **Computer Software Laboratory:**
Personal Computers
Computers Display Units
Relevant Computer Software and Programming Aids.

(h) **Manufacturing/Production Laboratory:**
Simple lathe machine, drilling machine, grinding machine
Various cutting and moulding machines and accessories
Use of various hand tools
Electric and gas welding techniques
Standardisation Techniques in manufacturing
Production Equipment maintenance and servicing
Product testing facilities.

(i) **Ergonomics (Human Factors Engineering) Laboratory:**
Various models of factory layout
Effect of machine positioning and operators in a production set up
Effect of factory lighting on the efficiency of workers
Effect of noise and other pollutants on the performance of works
Determination of optimum workers' working time for various operations
Effect of routineness of operation on a worker
Effect of effective supervision and co-ordination on the overall output of a production line
Workers break-time, their utilisation and influence on performance.

A.13 Information And Communication Technology

A.13.1List of Laboratory/Workshop

1. Basic Electrical Laboratory (Shared with Electrical Engineering (Sec A.8.1))
2. Basic Electronics Laboratory (Shared with Electronic Engineering (Sec A.10.1)
3. BasicTelecommunication Laboratory (Shared with Telecommunication Engineering (Sec A.28.1))
4. Microwave Laboratory
5. Computer Laboratory

A.13.2List of Equipment

(i) Basic electrical laboratory equipment as specified in Electrical Engineering (Sec A.8.2)
(ii) Basic electronic laboratory equipment as specified in Electronic Engineering (Sec A.10.2)
(iii) Basic telecommunication laboratory equipment as specified in Telecommunication Engineering (Sec A.28.2)

(iv) Experimental Ku VSAT system 1 (Qty)
(v) Computer systems 20 (Qty)
(ii) Multimedia Projector 1 (Qty)
(iii) Overhead Transparency Projector 4 (Qty)
(iv) Telecommunication & Simulation Software Packages Lots

A.14 Marine Engineering

A.14.1 List of Laboratories

Mechanics of Machines Laboratory
Strength of Materials Laboratory
Thermodynamics Laboratory
Fluid Mechanics Laboratory
General Workshop
Metallurgy Laboratory
Drawing and Design Studio
Fluid Dynamics Laboratory
Marine Operations Laboratory
Propulsion Systems Laboratory
Naval Architecture Laboratory
Meteorology and Navigation Laboratory.

A.15 Materials And Metallurgical Engineering

A.15.1 List of Laboratories

Mechanics of Machines Laboratory
Strength of Materials Laboratory
Thermo/Fluid Mechanics Laboratory
General Workshop
Drawing and Design Studio
Production Laboratory
Foundry and Heat Treatment Laboratory
Welding Laboratory
Physical Metallurgy Laboratory
Process Metallurgy Laboratory
Materials Processing Laboratory
Material Structure Inspection Laboratory
Materials Testing Laboratory.

A.15.2 List of Major Equipment/Experiments

All Mechanical Engineering Facilities (Sec A.16.2) plus the following:

(a) **Fluid Dynamics Laboratory**
Fluid Coupling

Flow in open channels
Surge tank and Water hammer
Model Tests to determine ship resistance
Dynamics of Ocean waves
Stability of ocean-going vessels at large angles of heel.

(b) **Marine Operations Laboratory**
Aero-dynamics characteristics of sails
Performance characteristics of communication equipment
Prediction of currents, tides and surges
Effect of hydro-dynamic interactive forces on shallow water behaviour of navigational instrument and engine performances.

(c) **Propulsion Systems Laboratory**
Performance characteristics of pumps, compressors, turbines, heat transfer equipment, I.C. engines and steam engines.
Performance of fuels injectors systems
Performance characteristics of ship propulsion systems.

(d) **Naval Architecture Laboratory**
Waves characteristics in shallow and deep water
Effect of general ship arrangement and differential loading on stability and drag.
Visualisation through modes of arrangement of hull and outfit
Deck houses, bulk head, moors and anchors
Model studies of ship motion through water.

(c) **Meteorology and Navigation Laboratory**
Calibration and Operation of Meteorological instruments
Interpretation of Meteorological data
Demonstration of the principles of operation of navigational devices
Radar systems and radar-activated systems.

List of Major Equipment/Experiments

All facilities required for Mechanical and Industrial and Production Engineering (Sec A.16.2 and A.12.2) plus the following well-equipped specialized laboratories:

(a) P**hysical Metallurgy Laboratory**

(b) **Process Metallurgy Laboratory**

(c) **Materials Processing Laboratory**
Mechanical Processing of materials
Chemical Processing of Materials.

(d) **Materials Structure Inspection Laboratory**
Electron Microscope
X-ray Unit
Radiography Test Unit
High Power Metallurgical Microscope with camera unit
Surface measuring Instruments
Cathode ray oscilloscope (CRO).

(e) **Materials Testing Laboratory**

A.16 Mechanical Engineering

A.16.1 List of Laboratories/Workshops

Mechanics of Machines
Strength of Materials
Thermodynamics
Fluid Mechanics
Metallurgy
General Workshop
Drawing and Design Studio.

A.16.2 List of Major Equipment/Experiments

(a) **Mechanics of Machines Laboratory**

Free oscillation of point and distributed masses (Simple and Compound Pendulum).
Quick Return Mechanisms (WHITWORTH) SCOTTED LINE SLIDER-CRANK, SCOTH YOKE GENEVA STOP.
Power transmission systems (BELTS, GEARS, SHAFTS AND CLUTCHES).
Coefficient of friction apparatus (BELT, DRIVE, SLIPPING FRICTION).
Free and Force vibration of single degree of freedom systems with and without damping.
Static and Dynamic Balancing Systems.
Power regulation (by Flywheel and Governors).
Demonstration of Coriolis and Centrifugal forces.
Gyroscopic motion.
Journal Bearings
Vibration and Noise test set up.

(b) **Strength of Materials Laboratory**

Apparatus for tensile, compression and torsion tests.
Simple bending apparatus.
Unsymmetrical bending apparatus.
Impact tests apparatus.
Elastic behaviour of thin- and thick-walled pressure vessels.
Creep and Fatigue.
Theories of failure.
Helical springs.
Deflection of curved beams.
Columns and struts.
Strain Gauging, photo-elastic behaviour.

(c) **Thermodynamics Laboratory**

Temperature measurement apparatus.
Power measurement apparatus (Compressor, Dynamometer etc).
Pressure measurement apparatus.
Steam Boiler.
Equilibrium of mixtures of Air and Steam, Quality of Wet Steam.

IC Engine apparatus.
Calorific values of fuels
Analysis of products of combustion
Gas and bomb calorimeters
Gas and Steam Turbine apparatus
Heat-Exchange apparatus
Free and Forced convection Heat and Mass transfer systems.
Thermal conductivity apparatus
Apparatus for the determination of radiative Properties of Materials
Jet propulsion systems
Vapour power cycles
Positive displacement engines and compressors
Refrigeration and Air-conditioning cycles.

(d) **Fluid Mechanics Laboratory**

Manometry
Hydrostatic forces on plane and curved surfaces
Forced vortex apparatus
Stability of Floating bodies
Meter calibration and flow test set up
Hydraulic Test Benches
Nozzle and Orifice flow apparatus
Laminar and Turbulent flow in pipes
Friction loss in pipes
Heat losses in pipe fittings.
Flow visualisation apparatus
Flow of fluid round bodies
Hydraulic power circuitory and measurement units
Reciprocating pump system
Centrifugal pump system
Pelton wheel
Resistance to motion of air through banks of finned and unfinned tubes
Calibration and performance of flow measurement devices
Subsonic wind tunnel and accessories
Supersonic flow apparatus.

(e) Metallurgy Laboratory

Apparatus for visualisation of atomic and crystal structures
Cooling curve apparatus
Simple metallography
Simple heat treatment apparatus
Apparatus for creep, hardness and fracture tests
X-ray Crystallography Equipment
Electric Microscope
High power metallurgical microscope with camera unit.

(f) **General Mechanical Workshop**

Wood processing machines and equipment (for sawing, surface planning, thicknessing, mortising, wood turning, etc).
Tennoning machine
Vertical Mortising machine
Dovetailing Machine
Lathe Machines
Drilling machines
Grinding machines
Folding machines
Work Tables
Vice
Tool Boxes
Gas and Arc. Welding machines and accessories
Casting facilities.

(g) **Drawing and Design Studio**
Drawing Tables and chairs
Drawing boards, T-squares and instruments
Automatic drafting machine
Drafting Gadgets, stencils, etc
Automatic Stencil cutter.

A.17 Metallurgical Engineering

A.17.1 List of Laboratories

Mechanics of Machines Laboratory
Strength of Materials Laboratory
Thermo/Fluid Mechanics Laboratory
General Workshop
Drawing and Design Studio
Production Laboratory
Foundry and heat Treatment Laboratory
Welding Laboratory
Physical Metallurgy Laboratory
Process Metallurgy Laboratory
Materials Processing Laboratory
Materials Structure Inspection Laboratory
Material Testing Laboratory

A.17.2 List of Major Equipment/Experiments

(See Materials and Metallurgical Engineering (Sec A.15.2))

A.18 Minning Engineering

A.18.1 List of Laboratories

Mechanics of Machines Laboratory
Strength of Materials Laboratory

Thermodynamics Laboratory
Fluid Mechanics Laboratory
Metallurgy Laboratory
General Workshop
Drawing and Design Studio
Mine Surveying Facilities
Mining Systems Laboratory
Rock Mechanics Laboratory
Mineral Processing Laboratory
Mine Ventilation Laboratory.

A.18.2 List of Major Equipment/Experiments

All the facilities required for Mechanical Engineering (Sec A.16.2) plus the following well-equipped specialised laboratories:
Mine Surveying Facilities
Rock Mechanics Laboratory
Mine Ventilation Laboratory
Mineral Processing Laboratory and
Mining Systems Laboratory.

A.19 Operations Research

A.19.1List of Laboratory

1. Operation Research Laboratory I
2. Advance Operation Research Laboratory

A.19.2List of Equipment

(i) Computer Systems	14 (Qty)
(ii) Multimedia Projector	1 (Qty)
(iii) Overhead Transparency Projector	4 (Qty)
(iv) Operation Research Software Packages	Lots

A.20 Petrochemical Technology

A.20.1 List of Laboratories

(a) **Drilling Laboratories**
Mud Laboratories
Cement Laboratories

(b) **Reservoir Engineering Laboratory:**
Fluid Properties
Flow in Porous Media
Petrophysics.

(c) **Petroleum Production Engineering Laboratory**

Flow Measurements
Fluid Quality.

A.20.2 List of Major Equipment

Mud preparation system
Mud testing system
Cement preparation system
Fluid Particle system – Permeability measurement equipment
Fluid circuit system – Porosity measurement equipment
Flow measurement equipment
Fluid resistivity measurement equipment
Relative permeability measurement system
Filtration system
Fluid properties measurement equipment
Viscometers
Oven
PH – Meter
Fluid Saturation measurement system
Mud balance
Centrifuges
Pheometer
Porous Media fluid flow systems.

A.21 Petroleum Engineering

A.21.1 List of Laboratories

(a) **Drilling Laboratories**
Mud Laboratories
Cement Laboratories

(b) **Reservoir Engineering Laboratory:**
Fluid Properties
Flow in Porous Media
Petrophysics.

(c) **Petroleum Production Engineering Laboratory**
Flow Measurements
Fluid Quality.

A.21.2 List of Major Equipment

Mud preparation system
Mud testing system
Cement preparation system
Fluid Particle system – Permeability measurement equipment
Fluid circuit system – Porosity measurement equipment
Flow measurement equipment
Fluid resistivity measurement equipment

Relative permeability measurement system
Filtration system
Fluid properties measurement equipment
Viscometers
Oven
PH – Meter
Fluid Saturation measurement system
Mud balance
Centrifuges
Pheometer
Porous Media fluid flow systems.

A.22 Petroleum And Gas Engineering

A.22.1 List of Laboratories

(a) **Drilling Laboratories**
Mud Laboratories
Cement Laboratories

(b) **Gas and Petroleum Reservoir Engineering Laboratory:**
Fluid Properties
Flow in Porous Media
Petro-physics.

(c) **Gas and Petroleum Production Engineering Laboratory**
Flow Measurements
Fluid Quality.

A.22.2 List of Major Equipment

Mud preparation system
Mud testing system
Cement preparation system
Fluid Particle system – Permeability measurement equipment
Fluid circuit system – Porosity measurement equipment
Flow measurement equipment
Fluid resistivity measurement equipment
Relative permeability measurement system
Filtration system
Fluid properties measurement equipment
Viscometers
Oven
PH – Meter
Fluid Saturation measurement system
Mud balance
Centrifuges

Pheometer
Porous Media fluid flow systems.

A.23 Polymer Engineering

A.23.1 List of Laboratories

(a) **Polymer Technology Laboratory**
Viscosity
Normal Stresses

(b) **Polymer Processing Laboratory**
Continuous processes
Batch processes
Rubber Processing

(c) **Applied Polymer Chemistry Laboratory**
Polymer Synthesis
Polymer Physical Chemistry

(d) **Polymer Structure And Properties**
Mechanical properties
Polymer Physics and Characterisation

A.23.2 List of Major Equipment

Tensile and compression testing machine
Creep machine
Brinell/Rockwell hardness tester
Charpy Impact Tester
Plastics moulding machine with blow moulding accessories
Extruder machine
Mechanical Spectrometer
Micro-Macro Projector
Student Miscroscope
Viscometer
Milling System
Compression moulding system
Rubber Blending System
Polymer Synthesis System
Polymer Characterisation Instruments
Melting point apparatus
Polarizing microscope
Ovens
Balances
Thermostatic Water Bath.

A.24 Polymer And Textile Technology

A.24.1 List of Laboratories

Polymer Laboratory

Textile Testing Laboratory
Textile Production Laboratory
Yarn Processing Laboratory

A.24.2 List of Major Equipment

Tensile & Compression Testing Machine
Creep Machine
Brinell/Rockwell Hardness Tester
Charpy Impact Tester
Plastics Moulding Machine with Blow Moulding Accessories
Extruder Machine
Mechanical Spectrometer
Fibre/Yarn Testing Machine
Single Fibre Tester
Fineness Maturity Tester
Fibre Blender
Combo Sorters
Micro/Macro Project
Student Microscopes
Viscometer
Fluidity Test Equipment.

A.25 Public Health Engineering

A.25.1 List of Laboratory/Workshop

(a) Sanitary chemistry Laboratory
(b) Sanitary Microbiology Laboratory
(c) Hydraulics and Hydrology Laboratories

A.25.2 List of Major Equipment

(see Civil Engineering (Sec A.6.2))

WORKSHOP FACILITIES

Students should be subjected to the following workshop facilities.

1. Lathe machine
2. Drilling machine
3. Benchwork (for metals and carpentry)
4. Welding, Auto servicing, Minor sheet metal works.

A.26 Refrigeration and Airconditioning Engineering

A.26.1 List of Laboratories

Mechanics of machines Laboratory
Strength of materials Laboratory
Thermodynamics Laboratory
Fluid Mechanics Laboratory
Metallurgy Laboratory
General Workshop
Drawing and Design Studio
Refrigerant Testing Laboratory
Refrigeration and Air-conditioning Systems Laboratory
Refrigeration and Air-conditioning Workshop

A.26.2 List of Major Equipment/Experiments

All the Mechanical Engineering facilities (Sec A.16.2) plus the following:

(a) **Refrigerant Testing Laboratory**

Facilities for the determination of:
Thermodynamic properties of refrigerants
Transport properties of refrigerants
Flow characteristics of refrigerants
Variation of phase-change temperatures with pressure.

(b) **Refrigeration and Air-conditioning Systems Laboratory:**

Thermodynamic properties of air-water vapour mixture
Transport properties of air-water vapour mixture
Air-water vapour mixture in flow and non-flow processes
Head and mass transfer in condensers and air-handling units
Flow Measurement in Ducts, pipes and Vents
Flow characteristics of air-water vapour mixture in ducts, and through vents and grilles.

(c) **Refrigeration and Air-conditioning Workshop**

Leak detection
Refrigerant changing apparatus
Facilities for installation of water and refrigerant line
Electrical fault tracing with Avometer
Equipment for Fabrication and Installation of ducts
Equipment Installation commissioning facilities
Handling of motors/generators
Equipment for the Diagnosis and Rectification of Mechanical and Electrical faults in Refrigeration and Air-conditioning systems
Facilities for equipment design and manufacture, including systems prototypes
Air-conditioning units, split air conditioning unit
Simulated central air-conditioning arrangement
Refrigeration units, deep freezing, and simulated cold storage systems.

A.27 Structural Engineering

A.27.1 List of Laboratory/Workshop

(a) **Structural Engineering**
- (i) Civil Eng. Materials Laboratory
- (ii) Structures Laboratory:
- (iii) Routine Testing

(ii) Models and Prototype Testing, e.g. Trusses, Columns; Beams and Frames.

(iii) Studio/Design Office.

(b) **Geotechnical Engineering:**
- (i) Field Soil Survey and Testing (including sub-soil investigation and drilling).
- (ii) Laboratory Soil/Rock Testing

(c) **Geodetic Engineering & Photogrammetry**
- (i) Laboratory Equipment Stores
- (ii) Photogrammetry & Remote Sensing Laboratory.

(d) **Water Resources & Environmental Engineering**
- (i) Hydraulics Laboratory
- (ii) Hydrology Laboratory
- (iii) Environmental Health Laboratory

(e) **Highway and Transportation Engineering**
- (i) Highway Materials Testing Laboratory
- (ii) Pavement Laboratory

A.27.2 List of Major Equipment

(See Civil Engineering (Sec A.6.2))

WORKSHOP FACILITIES

Students should be subjected to the following workshop facilities:

(viii) Lathe machine

(ix) Drilling machine

(x) Benchwork (for metals and carpentry)

(xi) Welding, Auto Servicing, Minor sheet metal work.

A.28 Telecommunications Engineering

A.28.1 List of Laboratories

Applied Electricity Laboratory
Electronics and Instrumentation Laboratory

Control and Computer Engineering Laboratory
Communication Engineering Laboratory
Electrical Power and Machines Laboratory
Standard Measurements Laboratory
Final Year Project Room.

A.28.2 List of Major Equipment & Experiments

(See Electrical and Electronics Engineering (Sec A.9.2))