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NATIONAL UNIVERSITIES COMMISSION

BENCHMARK MINIMUM ACADEMIC STANDARDS

For

UNDERGRADUATE PROGRAMMES

In

NIGERIAN UNIVERSITIES

ENGINEERING AND TECHNOLOGY

NOVEMBER 2014

PREFACE

Section 10 (1) of the Education (National Minimum Standards and Establishment of Institutions) Act, Cap E3, Laws of the Federation of Nigeria 2004, empowers the National Universities Commission to lay down minimum standards for all programmes taught in Nigerian universities. In 1989, the Commission, in collaboration with the universities and their staff, developed minimum academic standards for all the programmes taught in Nigerian universities and the Federal Government subsequently approved the documents.

After more than a decade of using the Minimum Academic Standard (MAS) documents as a major instrument of quality assurance, the Commission in 2001 initiated a process to revise the documents. The curriculum review was necessitated by the fact that the frontiers 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 dynamics of the skills set required to face the challenge of competition engendered by globalization were also compelling reasons 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 and appropriate skills, competencies and dispositions that will make them globally competitive and capable of contributing meaningfully to Nigeria's socio-economic development. Recognising 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 best practice. To actualize this, the Commission organized a stakeholders' workshop to benchmark each programme in all the disciplines taught in Nigerian universities. Following comments and feedback from critical stakeholders in the universities indicating that the Benchmark-style Statements were too sketchy to meaningfully guide the development of curricula and were also inadequate for the purpose of accreditation, the Commission put in place the mechanism for the merger of the Benchmark-style Statements and the revised Minimum Academic Standards into new documents referred to as the Benchmark Minimum Academic Standards (BMAS).

The resultant documents, an amalgam of the outcome-based Benchmark statements and the content-based MAS clearly enunciates the learning outcomes and competencies expected of graduates of each academic programme without being overly prescriptive while at the same time providing the requisite flexibility and innovativeness consistent with institutional autonomy.

The first step in the process of amalgamation of the Benchmark statements and the content-based MAS was the conduct of a needs assessment survey and the publication of the findings in the report titled *Needs Assessment Surveys 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 Needs 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. The second stage was the organisation of a workshop at which academic experts across Nigerian universities, including

Vice-Chancellors, participated with the objective of ensuring that the designed BMAS for the various disciplines took into cognizance the identified knowledge and skill gaps. At the end of the workshop, draft BMAS documents were produced for the various programmes in the thirteen broad academic disciplines into which the Nigerian University System has been structured. Of significance was the introduction of science- and social science/humanities-based courses under the General Studies programme which are compulsory for all first- year students in Nigerian universities, irrespective of their course of study.

The documents were later sent to the Universities offering relevant disciplines for comments and input. Following the collation of the input and comments from the Universities, another workshop was held at which invited academic experts studied and incorporated the relevant comments and input received into the draft documents.

After content and language editing, by relevant experts, a one-day workshop was held at which the edited documents were harmonized to produce the final BMAS documents.

Consequent upon the afore-mentioned processes, BMAS documents were produced for the under-listed 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; and
- xiii. Veterinary Medicine.

For each programme, the document contains suggestions of the status of each course in terms of *compulsory*, *required* and *elective*. Universities are encouraged to take due cognizance of the BMAS while bringing necessary innovation into the content and delivery of their programmes towards achieving their overall objectives and goals. Programmes are to be structured in such a way that a typical student does not carry less than 30 credit units or more than 48 credit units per session.

It is the Commission's expectation that this BMAS document will serve as a guide to the universities in the design of curricula for their programmes in terms of the minimum acceptable standards of input, process as well as measurable benchmark of knowledge, skills and competences expected to be acquired by an average graduate of each of the academic programmes.

Professor Julius A. Okojie, OON
Executive Secretary

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GLOSSARY OF COURSE CODES

These are the 3-letter codes for the identification of courses offered in the various programmes in the Engineering and Technology discipline as well as courses offered in other disciplines covered in the BMAS for the Nigerian University System. They are in three categories dictated by the sources of courses involved:

Category A: Course codes for courses offered in programmes outside the Engineering and Technology Discipline

Category B: Course codes for the general and foundation courses offered by all students registered in the various programmes in the Engineering and Technology Discipline.

Category C: Course codes for courses offered by the various programmes in the Engineering and Technology Discipline.

Category A:

The Programme offering the Courses	Course Code
Chemistry Programme in the Science Discipline	CHM
Mathematics Programme in the Science Discipline	MTH
Physics Programme in the Science Discipline	PHY
Statistics Programme in the Science Discipline	STA
Microbiology Programme in the Science Discipline	MCB
Agriculture Programme in the Agriculture, Forestry, Fisheries and Home Economics Discipline	AGR

Category B:

The Programme offering the Courses	Course Code
General Studies Courses offered at the University Level for students registered for s in all the disciplines in the university.	GST
Foundation courses for all the programmes in the Engineering and Technology Discipline	GET

Category C:

The Programme offering the Courses	Course Code
Aerospace Engineering	ASE
Agricultural Engineering	TAG
Automotive Engineering	TAE
Biomedical Engineering/Technology	BME
Ceramic Engineering	TCE
Chemical Engineering	TCH
Civil Engineering	CEE
Computer Engineering	CPE
Electrical Engineering	TEL
Electrical and Electronics Engineering	EEE
Electronics Engineering	ELE
Environmental Engineering	EVE
Food Science and Technology	FST
Industrial and Production Engineering	TIE
Information and Communication Technology	ICT
Marine Engineering	MAR
Materials and Metallurgical Engineering	MME
Mechanical Engineering	MEE
Mechatronics Engineering	MCT
Metallurgical Engineering	MTE
Mining Engineering	MNE
Operations Research	OPR
Petrochemical Technology	PCT
Petroleum Engineering	PEE
Petroleum and Gas Engineering	PGE
Polymer Engineering	PYE
Public Health Engineering	PHE
Refrigeration and Air-conditioning Engineering	RAE
Structural Engineering	STE
Systems Engineering	SYE
Telecommunications Engineering	TEE
Textile and Polymer Engineering	TPE
Water Resources Engineering	WRE
Wood Products Engineering	WPE

SECTION ONE:

BASIC ELEMENTS OF THE OPERATION OF THE BENCHMARK MINIMUM ACADEMIC STANDARDS IN ENGINEERING AND TECHNOLOGY PROGRAMMES

Preamble

These Benchmark Minimum Academic Standards (BMAS) are designed for the education and training of undergraduate students wishing to obtain first degrees in the different areas of Engineering and Technology in the Nigerian University System. Presented in this Section are the basic operational elements that serve to define the minimum academic standards required to achieve the cardinal goal of producing graduates in Engineering and Technology with sufficient academic background and practical exposure to face the challenges of a developing economy in the increasingly globalised world economy.

It is pertinent to note that this BMAS Document is expected to guide institutions in the design of curricula for their engineering and technology programmes by stipulating the minimum requirements. Being such, institutions are encouraged to take due cognizance of the BMAS while bringing necessary innovation into the content and delivery of their programmes towards achieving the overall goals of engineering education and training in the country.

1.1 Programmes and Degrees

Presented in Table 1.1 is the list of programmes and the degrees in view covered in the BMAS Document. An attempt has been made to cover not only the programmes being currently run in various faculties of Engineering and Technology, but, also, proposed new programmes in response to the local and global dynamics of the requisite knowledge and skills of products of Engineering and Technology. Overall, it is expected to serve the needs of existing faculties contemplating minor or major programme review and also new institutions seeking to chart a new path away from the existing programmes in the system.

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

S/N	PROGRAMME	DEGREE(S) IN VIEW
1	Aerospace Engineering	B.Eng./B. Tech./B.Sc.
2	Agricultural Engineering	B.Eng./B. Tech./B.Sc.
3	Automotive Engineering	B.Eng./B. Tech./B.Sc.
4	Biomedical Engineering/Technology	B.Eng./B. Tech./B.Sc.
5	Ceramic Engineering	B.Eng./B. Tech./B.Sc.
6	Chemical Engineering	B.Eng./B. Tech./B.Sc.
7	Civil Engineering	B.Eng./B. Tech./B.Sc.
8	Computer Engineering	B.Eng./B. Tech./B.Sc.
9	Electrical Engineering	B.Eng./B. Tech./B.Sc.
10	Electrical and Electronics Engineering	B.Eng./B. Tech./B.Sc.

11	Electronics Engineering	B.Eng./B. Tech./B.Sc.
12	Environmental Engineering	B.Eng./B. Tech./B.Sc.
13	Food Science and Technology	B.Eng./B. Tech./B.Sc.
14	Industrial and Production Engineering	B.Eng./B. Tech./B.Sc.
15	Information and Communication Technology	B.Eng./B. Tech./B.Sc.
16	Marine Engineering	B.Eng./B. Tech./B.Sc.
17	Materials and Metallurgical Engineering	B.Eng./B. Tech./B.Sc.
18	Mechanical Engineering	B.Eng./B. Tech./B.Sc.
19	Mechatronics Engineering	B.Eng./B. Tech./B.Sc.
20	Metallurgical Engineering	B.Eng./B. Tech./B.Sc.
21	Mining Engineering	B.Eng./B. Tech./B.Sc.
22	Operations Research	B.Eng./B. Tech./B.Sc.
23	Petrochemical Technology	B.Eng./B. Tech./B.Sc.
24	Petroleum Engineering	B.Eng./B. Tech./B.Sc.
25	Petroleum and Gas Engineering	B.Eng./B. Tech./B.Sc.
26	Polymer Engineering	B.Eng./B. Tech./B.Sc.
27	Public Health Engineering	B.Eng./B. Tech./B.Sc.
28	Refrigeration & Air-conditioning Engineering	B.Eng./B. Tech./B.Sc.
29	Structural Engineering	B.Eng./B. Tech./B.Sc.
30	Systems Engineering	B.Eng./B. Tech./B.Sc.
31	Telecommunications Engineering	B.Eng./B. Tech./B.Sc.
32	Textile and Polymer Engineering	B.Eng./B. Tech./B.Sc.
33	Water Resources Engineering	B.Eng./B. Tech./B.Sc.
34	Wood Products Engineering	B.Eng./B. Tech./B.Sc.

The above programmes are designed, in general, to be broad-based to equip the products with the diverse tools of the profession. However, where it is considered absolutely essential to reflect the various areas of specialization in a programme, such area can be indicated appropriately in the degree title.

1.1.1 Philosophy, Aims and Objectives of the Discipline

1.1.2 Philosophy and Mission Statement

The Philosophy and Mission Statement underlying the programmes in Engineering and Technology aimed at achieving the goals and objectives of the National Policy on Industrialisation and Self-Reliance. This is to be achieved through:

- (i) Broad-based foundation in Engineering and Technology as well as specialized knowledge and practice in a particular discipline therein.
- (ii) Practical exposure to application of Engineering and Technology to problem solution.
- (iii) Adequate training in human and organisational behaviour and management.

- (iv) Developing in the products entrepreneurial knowledge, a sense of public responsibility and a spirit of self-reliance.
- (v) Nurturing of partnership between the institution and industry for effective programme delivery.
- (vi) Creating an awareness and understanding of the moral, ethical, legal, and professional obligations needed to function as part of a professional enterprise while protecting human health and welfare and the environment in a global society.
- (vii) Creating an awareness and understanding of the need to develop leadership and team building skills to maximize the benefits of an engineering education and its application to solving problems

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

1.1.3 Aims and Objectives

The general goal and objectives of Engineering and Technology education and 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 engineering systems.
 - (iii) To design and develop new products and production techniques in industries.
 - (iv) To install and maintain complex engineering systems for optimal performance 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 execution of important tasks.
 - (vii) To be able to manage people, fund, materials and equipment.
 - (viii) To improve on indigenous technology for deployment to the solution of local problems.
- (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 for deployment to the solution of local problems.

1.2 Basic Admission Requirements and Expected Duration of the Programmes

Candidates are admitted into the degree programmes in any of the following three ways:

- The University Tertiary Matriculation Examination (UTME)
- Direct Entry
- Inter-University Transfer

UTME Entry Mode

In addition to acceptable passes in UTME, the minimum academic requirement is credit level passes in at least five subjects at O'Level in nationally recognised examination including English Language, Mathematics, Physics, Chemistry and other acceptable science subject at not more than two sittings. It is also desirable for candidates to pass Further Mathematics and Technical Drawing at credit level, such candidates shall have added advantage.

Direct Entry Mode

For Direct Entry, in addition to 'O' Level requirements, candidate 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.

Inter-University Transfer Mode

Students can transfer into 200-Level courses provided they have the relevant qualifications. Universities are to satisfy themselves that the grades obtained by such candidates are acceptable.

1.3 Duration of Study

The minimum duration of Engineering and Technology programmes is five academic sessions for candidates who enter through the UTME Mode. Direct Entry candidates admitted to the 200 level of the programmes will spend a minimum of four academic sessions while those admitted to the 300 level will spend a minimum of three years.

1.4 Graduation Requirements

1.4.1 Course 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.

Credits are weights attached to a course. One credit is equivalent to one hour per week per semester of 15 weeks of lectures or three hours of laboratory/studio/workshop work per week per semester of 15 weeks

Definition of Course 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 levels of academic progress. There shall be five levels of courses numbered 101-199, 201-299, 301-399, 401-499 and 501-599. For ease of identification, course numbers can be prefixed by a three-character programme/subject code. Thus, the course code is in the form: DEP LNJ (where the three-letter code DEP identifies the programme, 'L' in LNJ represents the level of the course (1 or 2 or 3 or 4 or 5 for all undergraduate courses) and NJ is a two-digit numbering of courses. Thus, for example, MEE 207 is a 200-Level course with number 07 offered in the mechanical engineering programme. The glossary of all the course codes are presented under Glossary of Codes on page.

The second aspect of the system is that courses are assigned weights allied to Units.

Units

Consist of specified number of student-teacher contact hours per week per semester. Units are used in two complementary ways: one, as a measure of course weighting, and the other, as an indicator of student work load.

- (i) As a measure of course weighting for each Unit course (e.g) HIS 105, ZOO 203, ARCH 504), the credit unit to be earned for satisfactorily completing the course is specified; e.g. a 2-credit unit course may mean two 1-hour lecture per week per semester or one 1-hour lecture plus 3-hour practical per week per semester.
- (ii) As a measure of work load, "One Credit Unit" means one hour of lecture or one hour of tutorial per week per semester. For other forms of teaching requiring student teacher contact, the following equivalents may apply:

two hours of seminar: three hours of laboratory or field work, Clinical practice/practicum, studio practice or stadium sporting activity, six hours of teaching practice; four weeks of industrial attachment where applicable.

Normally, in Course Credit System, courses are mounted all year round, thus enabling students to participate in examinations in which they are unsuccessful or unable to participate on account of ill health or for other genuine reasons. In such a system, no special provisions are made for re-sit examinations.

The minimum number of credit units for the award of a degree is 120 units, subject to the usual Department and Faculty requirements. A student shall therefore qualify for the award of a degree when he has met the conditions.

The minimum and maximum credit load per semester is 15 and 24 credit units respectively.

For the purpose of calculating a student's cumulative GPA(CGPA) in order to determine the class of Degree to be awarded, grades obtained in **ALL** the courses whether compulsory or optional and whether passed or failed must be included in the computation.

Even when a student repeats the same course once or more before passing it or substitutes another course for a failed optional course, grades scored at each and all attempts shall be included in the computation of the GPA. Pre - requisite courses must be taken and passed before a particular course at a higher level.

1.4.2 Standard Terminologies

The following standard terminologies are used for different categories of courses.

Core/Compulsory Course:

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

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.

Required Course

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

1.4.3 Grading of Courses

Grading of courses shall be done by a combination of percentage marks and letter grades translated into a graduated system of Grade Point as shown in Table 1.2.

Grade Point System

Mark %	Letter Grade	Grade Point
70 – 100	A	5
60 - 69	B	4
50 – 59	C	3
45 – 49	D	2
40 – 44	E	1
< 40	F	0

Grade Point Average and Cumulative Grade Point Average

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 Units x Grade Point (TUGP) by the total number of units (TNU) for all the courses taken in the semester as illustrated in Table 2.3.

The Cumulative Grade Point Average (CGPA) over a period of semesters is calculated in the same manner as the GPA by using the grade points of all the courses taken during the period.

Table 1.3: Calculation of GPA or CGPA

Course	Units	Grade Point	Units x Grade Point (UGP)
C ₁	U ₁	GP ₁	U ₁ x GP ₁
C ₂	U ₂	GP ₂	U ₂ x GP ₂
-	-	-	-
-	-	-	-
C _i	U _i	GP _i	U _i x GP _i
-	-	-	-
-	-	-	-
C _N	U _N	GP _N	U _N x GP _N
TOTAL	TNU		TUGP

$$TNU = \sum_{i=1}^N U_i \quad TUGP = \sum_{i=1}^N U_i * GP_i \quad CGPA = \frac{TUGP}{TNU}$$

1.4.4 Degree Classifications

The following regulations shall govern the conditions for the award of a honours degree.

- i. Candidates admitted through the UTME mode shall have registered for at least 150 units of courses during the 5-year degree programme.
- ii. Candidates must have registered and passed all the compulsory courses specified for the programme.

The determination of the class of degree shall be based on the Cumulative Grade Point Average (CGPA) earned at the end of the programme. The CGPA shall be used in the determination of the class of degree as summarized in Table 1.4. It is important to note that the CGPA shall be calculated and expressed correct to two decimal places.

Table 1.4: Degree Classification

Cumulative Grade Point Average (CGPA)	Class of Degree
4.50 – 5.00	1 st Class Honours
3.50 – 4.49	2 nd Class Honours (Upper Division)
2.40 – 3.49	2 nd Class Honours (Lower Division)
1.50 – 2.39	3 rd Class Honours

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 from another programme in the Faculty or other faculties for any approved reason shall be credited with those units passed that are within the curriculum of the programme to which he/she has transferred. Appropriate decisions on transfer cases shall be subjected to the approval of Senate on the recommendation of the Faculty.

1.4.5 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:

- i. the regulation in respect of student work-load is complied with; and
- ii. the pre-requisite courses for the higher level courses have been passed.

1.4.6 Withdrawal

A candidate whose Cumulative Grade Point Average is below 1.5 at the end of a particular year of probation should be required to withdraw from the programme. However, in order to minimize waste of human resources, consideration should be given to withdrawal from programme of study and possible transfer to other programmes within the same University.

1.5 Evaluation

1.5.1 Techniques of Student Assessment

(a) Practicals

By the nature of the programmes in Engineering and Technology, laboratory practicals are very important in the training of students. To reflect the importance of practical work, a minimum of 9 hours per week or 135 hours per semester (equivalent to 3 units) should be spent on students' laboratory practicals. Consequently, some of the courses have both theory and practical components. Thus, in the description of courses to be taken in any programme, as presented in Sections 2 and 3, the number of lecture hours (LH) and the number of practical hours (PH) per semester are indicated. The overall performance of students in such courses is to be based on the evaluation of the performance in written examination (which tests theory) and also the performance in the laboratory work (based on actual conduct of experiments and the reports).

The experiments to achieve the practicals components of the courses must be designed in quality and quantity to enrich the grasp of the theoretical foundations of the courses. It is left for the department to organize all the experiments in the best way possible. One of the ways to achieve this is to lump all the laboratory practicals under a course, which the student must pass.

(b) **Tutorials**

The timetable for courses shall be designed to make provision for tutorials of at least one hour for every four hours of lecture. Thus a 3-unit course of 45 hours per semester should attract about 10 hours of tutorials. Postgraduate students are normally employed to help in giving tutorials to undergraduate students. This is a veritable training ground for academic career.

(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 full marks for courses which are primarily theoretical.
- ii. For courses which are partly practical and partly theoretical, scores from continuous assessment shall constitute 40% 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% 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. All courses shall be graded out of a maximum of 100 marks comprising:

Final Examination: 60% - 70%

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

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

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 in the faculty. Furthermore, the existing practice of using different External Examiners for major subject areas in professional programmes, such as Engineering and Technology, should be continued.

1.5.3 SIWES Rating and Assessment

In Engineering education, industrial attachment is very crucial. The minimum duration of the Students Industrial Work Experience Scheme (SIWES) should be 44 weeks accomplished in 3 modules as discussed in greater detail in Section 2.

- SIWES I : (2 Units) 8 weeks during long vacation at the end of 200-Level session
- SIWES II : (3 Units) 12 weeks during the long vacation at the end of the 300-Level
- SIWES III: (6 Units) 24 weeks from second semester of 400-Level to the beginning of the following session.

1.5.4 Students' Evaluation of Courses

There should be an established mechanism to enable 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.

The evaluation should be conducted 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. The completed questionnaires should be professionally analysed and results discussed with the course lecturer(s) towards improvement in course delivery in all its ramifications.

1.5.5 Maintenance of Curricula 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 for 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.

A committee of staff senior enough and competent to carry out an effective review shall do each curriculum 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 as well as the Learning Outcomes for 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

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 and services.

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.

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 Units per semester 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, practicals and supervision of projects.

Qualifications for Appointments/Promotion of Academic Staff

	LEVEL	QUALIFICATIONS
i.	Graduate Assistant	A good Bachelor's Degree (with a minimum Second Class Upper Division) This is a training position, and staff in this category are expected to complete their Master's degree within two years of their appointment.
ii.	Assistant Lecturer	A Master's Degree in addition to a good Bachelor's Degree.
iii.	Lecturer II	<ul style="list-style-type: none"> • A PhD Degree for direct appointment; • By promotion from Assistant Lecturer rank after a minimum of three years in addition to fulfilling other promotion requirements
iv.	Lecturer I	In addition to the qualifications specified for Lecturer II, Lecturer I should have had at least three years post-doctoral teaching experience and demonstrated ability for research work and evidence of scholarship.
v.	Senior Lecturer	A PhD Degree in addition to meeting the requirements for publications, teaching and other conditions stipulated in the guideline.
vi.	Reader (Associate Professor)	Basic qualifications set out for Senior Lecturer plus at least three years of experience. Must have considerable publications resulting from research as well as demonstrated academic leadership ability. A Reader should have evidence of participation in University administration and community activities. External assessment is required for promotion to the level of a Reader.
vii.	Professor	Basic qualifications as for Reader/Associate Professor. Must have had at least three years of experience as Reader/Associate Professor in addition to meeting the necessary publications. A Professor should demonstrate clear evidence of scholarship as well as academic and administrative/professional leadership.

(b) **Academic Support Personnel**

Teaching Assistant/Demonstrators to help lecturers in the conduct of tutorials, practicals and field work. This category of personnel is not expected to be regular staff as they are to be paid on the basis of approved hourly rate.

(c) **Administrative Support Staff**

The services of the administrative support staff are indispensable in the proper administration of the departments and faculty offices. It is important to recruit very competent senior staff that are computer literate.

(d) **Technical Support Personnel**

The services of technical support staff, which are indispensable in the proper running of laboratories and workshop/studios are required. It is important to recruit very competent senior technical staff to maintain teaching and research equipment. They are also to undergo regular training to keep them abreast of developments in equipment operation and maintenance. The minimum of academic staff to technical staff ratio of 5:1 should be maintained.

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 programme which should be in accordance with the 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 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 needs of staff and students in all the programmes in the faculty. These include current journals, handbooks, textbooks, manuals, codes of practice, standards and specifications etc. in sufficient numbers. Most importantly, there shall be provision for ICT-based access to electronic resources and the information super highway.

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).

The details of the courses under the general studies are presented in Section 2.

SECTION TWO:

ENGINEERING/TECHNOLOGY DEGREE PROGRAMMES - STRUCTURE AND SYNOPSES OF COMMON FOUNDATION COURSES

Preamble

The foundation courses for the different engineering degree programmes are basically the same for all programmes in the faculty. An important aspect of engineering training is the need for some measure of flexibility and transferability. At the tender age that most students gain admissions into universities coupled with lack of exposure to in-depth career guidance and counselling, it is difficult for a young person to make a life-long commitment to an engineering discipline. While he or she may know that she wants a career in engineering, it might be too soon to decide which particular branch of engineering is most suited for him/her. It is therefore imperative to have an inbuilt flexibility that enables transfer from one engineering discipline to another in a continuous journey through the system. Better still, if the first two years are basically the same, most, if not all, would have received sufficient exposure to enable them enter into the discipline that they are most likely to thrive in rather than just coping. This is one of the principal reasons why American Universities have fairly uniform requirements for the first two years in their Colleges of Engineering. In fact, the student does not have to declare a major (that is a field of engineering specialization) until after these two years.

2.1 The Foundation Courses

The foundation courses are basically in five categories:

- ✚ Courses in the basic sciences of chemistry, physics and mathematics
- ✚ Basic engineering courses
- ✚ General Studies
- ✚ Entrepreneurship
- ✚ Student Industrial Work Experience

2.1.1 Courses in Basic Sciences

The foundation courses in basic sciences are mainly Mathematics, Physics and Chemistry. The number of units of these courses to be taken at the 100- and 200-Levels is presented below.

Course	Total Number of Units/(Courses)	
	100-Level	200-Level
Mathematics	6 (MTH 101, MTH 102)	6 (GET 207, GET 210)
Physics	8 (PHY 101, PHY 102, PHY 107, PHY 108)	-
Chemistry	8 (CHM 101, CHM102, CHM107, CHM 108)	-

TOTAL	22	6
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2.1.2 Basic Engineering Courses

There are basic engineering courses that are expected to be offered by every student of engineering. This group of courses includes:

- GET 205: Fundamentals of fluid mechanics (3 Units)
- GET 206: Fundamentals of Thermodynamics (3 Units)
- GET 212: Engineering materials (3 Units)
- GET 208: Strength of Materials (3 Units)
- GET 207: Applied Mechanics (3 Units)
- GET 201: Applied Electricity I (3 Units)
- GET 202: Applied Electricity II (3 Units)
- GET 111: Basic Engineering Drawing (2 Units)**
- GET 203: Engineering Drawing I (3 Units)
- GET 222: Engineering Drawing II (3 Units)
- Workshop Practice (1 Unit)

** Basic Engineering Drawing is introduced in the first year to take care of quite a large number of students that have not had the opportunity of taking such course in their secondary schools. Only a few secondary schools in the country have been offering such course to their students. The Basic Engineering Drawing course will therefore prepare the students adequately for the proper engineering courses in the second year.

2.1.3 General Studies Programme

The aim of the General Studies Programme is to expose students to a course of liberal education through which they can develop and expand their awareness of their social, cultural and natural environments. The goal is to produce well-rounded graduates that are intellectually sound, competent in the use of English Language.

The objectives of the programme include:

- Acquisition of a body of situational relevant knowledge outside of the respective field of specialization of the students for productive, healthy living and promotion of peaceful coexistence.
- Development of competence in the use of English Language as a tool for their studies and effective means of communication in the society and in their future employment/enterprise.

Students are expected to register for at least 8 units of GST courses from among the courses tabulated below.

2.1.4 General Studies: Course structure

Course Code	Course Title	Units
GST 111	Communication in English I	2
GST 112	Logic, Philosophy and Human Existence	2
GST 113	Nigerian Peoples and Culture	2

GST 121	Use of Library, Study Skills and ICT	2
GST 122	Communication in English II	2
GST 123	Basic Communication in French	2
GST 124	Basic Communication in Arabic	2
GST 125	Contemporary Health Issues	2
GST 211	Environment and Sustainable Development	2
GST 222	Peace and Conflict Resolution	2
GST 223	Introduction to Entrepreneurship	2
GST 224	Leadership Skills	2
GST 311	Entrepreneurship	2

2.1.5 Entrepreneurship

Towards Nigeria's quest for accelerated economic growth, it is important that active and virile youth population is assisted to develop and convert their innovative ideas into business ventures. These skills can be acquired particularly by those so innately inclined. This underscores the need to actively promote and train students to be entrepreneurial within our educational system. The course aims at re-orientating students towards a job-creation mind-set rather than the fixed attitude of job seeking. It will equip them with the skills required in establishing businesses or making them add value to existing systems, if employed in organizations. The main objective is to introduce students to concepts and opportunities available in entrepreneurship and innovation. It assumes no previous knowledge and takes students through the rudiments of entrepreneurship to selecting a desired business and starting it with a Feasibility Report.

The specific objectives of the GST 223 (Introduction to Entrepreneurship) and GST 311 (Entrepreneurship), also to be taught under the General Studies Programme as reflected in the above table, are to enable students to:

- Understand the basic concepts of enterprise, entrepreneur, business, entrepreneurship, innovation and creativity.
- Analyse the historical perspective of entrepreneurship in Nigeria, and relate it to the recent trend of unemployment, under-employment and job dissatisfaction, personal, national and global economic recession.
- Identify the roles of entrepreneurial development agencies and regulatory bodies.
- Cultivate the spirit of entrepreneurship.
- Correct wrong attitudes and mind-sets and develop high entrepreneurial potential in student.
- Select possible business ideas.
- Build the capacity to develop business plan to start a business.

2.1.6 Students Industrial Work Experience Scheme (SIWES)

An important aspect of the education and training of engineering students in the universities is organised exposure to some elements of industrial art as articulated below under the Students Industrial Work Experience Scheme (SIWES) and the Technical Support Unit

(TSU). This is being emphasised herein in view of the rather poor handling of SIWES, in particular, in most existing faculties of engineering and technology in the country.

Faculties of Engineering in our universities are expected to organise Students Industrial Work Experience Scheme (SIWES) or what most commonly refer to as Industrial Training. Universities are expected to establish a Unit to coordinate SIWES not only for engineering programmes, but also programmes in other faculties that have SIWES component. The SIWES Unit is to shoulder the following responsibilities:

- ✚ Soliciting co-operative placements (jobs) in business, industry, government or service agencies depending upon the needs and qualifications of the student, and placing students on such training assignments after analysing the technical contents.
- ✚ Need to establish firm strategy to ensure students get placements and options when they cannot get places.
- ✚ Coordinating and supervising the co-operative employment of students in such a way that students have the opportunity of learning useful engineering and technological skills on real jobs and under actual working conditions.
- ✚ Conducting follow-up activities regarding all placements by checking regularly each student's job performance through company visits and individual student's interview.
- ✚ Assembling individual inventory records of students and employers for the purposes of placements and supervision in addition to maintaining functional departmental and personal records and reports.
- ✚ Providing necessary advice to students as to the relevance of their chosen field to the industrial requirements of the country.
- ✚ Organizing and conducting students' seminars on Work Reports.
- ✚ Liaison with NUC, ITF, other agencies and industries on student industrial training programme of the University.

Students are expected to have a total of at least 44 weeks of industrial attachment distributed as follows:

200 Level : 8 weeks (2 Units) (GET 299: SIWES I)

300 Level : 12 weeks (3 Units) (GET 399: SIWES II)

400 Level : 24 weeks (6 Units) (GET 499: SIWES III)

It should be noted that Industrial Training as a course involves the following:

- Working successfully in the industry for the specified period.
- Submitting of a Work Report to the Industrial Training Coordinating Centre at the end of the training period.
- Presentation of seminar on the industrial training experience.

2.2 Structure of the Foundation Courses

Presented below are the major courses that undergraduate engineering/technology students are expected to take to prepare them for the different specialisations, which are expected to commence from the 3rd academic year. In cases where some more in-depth coverage of a subject matter is needed for a particular discipline (e.g. Chemical engineering where some more in-depth knowledge of chemistry may be necessary than for, example, mechanical engineering), such additional coverage can take place in the 3rd year.

With this philosophical framework, the proposed courses for all engineering students mainly in the first two years of study, that is 100- and 200-levels, are presented in Tables 2.1 and 2.2 respectively. A few other proposed common courses at higher levels are presented in Table 2.3.

Course structure at 100-Level

Course Code	Course Title	Units	Status	LH*	PH*
GST 111	Communication in English I	2	C*	30	-
GST 112	Logic, Philosophy and Human Existence	2	R	30	-
GST 113	Nigerian Peoples and Culture	2	R	30	-
GST 121	Use of Library, Study Skills and ICT	2	C	30	-
GST 122	Communication in English II	2	C	30	-
GST 123	Basic Communication in French	2	E	30	-
GST 124	Basic Communication in Arabic	2	E	30	-
GST 125	Contemporary Health Issues	2	R	30	-
GET 111	Basic Engineering Drawing	2	C	15	45
CHM 101	General Chemistry I	3	C	45	-
CHM 102	General Chemistry II	3	R	45	-
CHM 107	General Practical Chemistry I	1	C	-	45
CHM 108	General Practical Chemistry II	1	R	-	45
MTH 101	Elementary Mathematics I	3	C	45	-
MTH 102	Elementary Mathematics II	3	R	45	-
PHY 101	General Physics I	3	C	45	-
PHY 102	General Physics II	3	R	45	-
PHY 107	General Practical Physics I	1	C	-	45
PHY 108	General Practical Physics II	1	R	-	45
	TOTAL UNITS	40			

NOTE:

C = Compulsory

E = Elective

R = Required

LH = Lecture Hours per semester

PH = Practical Hours per semester

Course structure at 200-Level

Course Code	Course Title	Units	Status	LH	PH
GST 211	Environment and Sustainable Development	2	R	30	-
GST 222	Peace and Conflict Resolution	2	R	30	-
GST 223	Introduction to Entrepreneurship	2	R	30	-
GST 224	Leadership Skills	2	R	30	-
GET 201	Applied Electricity I	3	C	45	-
GET 202	Applied Electricity II	3	C	45	-
GET 203	Engineering Drawing I	2	C	15	45
GET 222	Engineering Drawing II	2	C	15	45
GET 204	Students Workshop Experience	1	C	-	45
GET 205	Fundamentals of Fluid Mechanics	3	C	45	-
GET 206	Fundamentals of Thermodynamics	3	C	45	-
GET 207	Applied Mechanics	3	C	45	-
GET 208	Strength of Materials	3	C	45	-
GET 209	Engineering Mathematics I	3	R	45	-
GET 210	Engineering Mathematics II	3	R	45	-
GET 211	Computer Programming I	3	R	30	45
GET 212	Engineering Materials	3	R	45	-
GET 213	General Engineering Laboratory Course	1	R	-	45
GET 299	SIWES I	2	C	8 weeks	
	TOTAL	46			

Course structure at 300- to 500-Levels

Course Code	Course Title	Units	Status	LH	PH
GST 311	Entrepreneurship	2	R	30	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineering in Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
STA 305	Statistics for Physical Science and Engineering	3	C	45	-
MEE 331	Engineering Drawing III	3	C	15	90
GET 501	Engineering Management	3	C	45	-
GET 502	Engineering Law	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GET 499	SIWES III	6	C	24 weeks	
	TOTAL	32			

2.3 Course Synopses

Presented below are the synopses of all the courses presented in Tables 2.1, 2.2 and 2.3. The Units of each course, the number of lecture hours (LH) and the number of practical hours (PH), for those with practical component, have been indicated.

100-Level Courses

Students take most of these courses from the Faculty of Science and also the General Studies and Entrepreneurial Unit, where the latter exists in a university.

GST 111: Communication in English I: (2 Units: LH 30)

Effective communication and writing in English Language skills, essay writing skills (organization and logical presentation of ideas, grammar and style), comprehension, sentence construction, outlines and paragraphs.

GST 112: Logic, Philosophy and Human Existence (2 Units: LH 30)

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 or 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: LH 30)

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; Environmental problems.

GST 121: Use of Library, Study Skills and ICT (2 Units: LH 30)

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: LH 30)

Logical presentation of papers; Phonetics; Instruction on lexis; Art of public speaking and oral communication; Figures of speech; Précis; Report writing.

GST 123: Basic Communication in French

(2 Units: LH 30)

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.

GST 124: Basic Communication in Arabic

(2 Units: LH 30)

Introduction to Arabic alphabets and writing systems. Elementary conversational drills. Basic reading skills and sentence construction in Arabic.

GST 125: Contemporary Health Issues

(2 Units: LH 30)

Diet, exercise and health, nutritional deficiency diseases, malaria, other infections, hypertension, organ failure, air-borne diseases, sexually transmitted diseases, cancer and its prevention, sickle cell disease. HIV/AIDS: Introduction, epidemiology of HIV, natural history of HIV infection, transmission of predisposing factors to HIV, Impact of HIV/AIDS on the society, management of HIV infection, prevention of HIV. Drugs and Society: sources of drugs, classification of drugs, dosage forms and routes of drug administration, adverse drug reactions, drug abuse and misuse, rational drug use and irrational drug use. Human kinetics and health education: personal care and appearance, exercise and health, personality and relationship, health emotions, stress, mood modifiers, refusal to tobacco, alcohol and other psychoactive drugs.

GET 111: Basic Engineering Drawing

(2 Units: LH 15; PH 45)

Introduction to Engineering Drawing as a means of communication. Drawing paper format. Use of drawing instruments. Types of lines and their uses in Engineering Drawing. Circles and tangent. Circles to satisfy conditions involving other circles, lines and points. Conic sections, various methods of their construction.

Cycloid, epi and hypocycloids. Involute. Archimedes spiral. Loci: the helix (cylindrical and conical) single and multi-start threads. Coiling of compression and tension springs. Loci – Paths of points on moving link work. The theory of projection. Perspective (briefly), parallel projections (oblique – general, cavalier, cabinet). (Orthographic – Multi-view, two views, three views, auxiliary views). (Axonometric – Isometric, dimetric, trimetric). Multiview representation. 1st and 3rd angle representations. Isometric drawing. Oblique drawings. Revisions.

CHM 101: General Chemistry I

(3 Units: LH 45)

Atoms, molecules and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridisation and shapes of simple molecules. Valence Forces; Structure of solids. Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: GENERAL CHEMISTRY II

(3 UNITS: LH 45)

Historical survey of the development and importance of Organic Chemistry; Electronic theory in organic chemistry. Isolation and purification of organic compounds.

Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of groups IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Practical Chemistry I (1 Unit: PH 45)

Laboratory experiments designed to reflect the topics taught in CHM 101 and CHM 102 such as qualitative and quantitative chemical analysis, acid-base titrations. Gravimetric analysis. Calculation, data analysis and presentation. Functional group analysis.

CHM 108: General Practical Chemistry II (1 Unit: PH 45)

Continuation of laboratory experiments designed to reflect the topics taught in CHM 101 and CHM 102. Some of the experiments will have been carried out in CHM 107.

MTH 101 Elementary Mathematics I (3 Units: LH 45)
(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.

MTH 102 Elementary Mathematics II (3 Units: LH 45)
(Calculus)

Functions of a real variable, graphs, limits and idea of continuity. The derivative, as limit of rate of change. Techniques of differentiation, maxima and minima. Extreme curve sketching, integration, Definite integrals, reduction formulae, application to areas, volumes (including approximate integration: Trapezium and Simpson's rule).

PHY 101 General Physics I (3 Units: LH 45)
(Mechanics, Thermal Physics and Waves)

Space and Time, Units and Dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; work and energy; Conservation laws. Moments and energy of rotation; simple harmonic motion; motion of simple systems; Elasticity; Hooke's law, Young's shear and bulk moduli, Hydrostatics; Pressure; buoyance, Archimedes' Principles; Surface tension; adhesion, cohesion, capillarity, drops and bubbles; Temperature; heat; gas laws; laws of thermodynamics; kinetic theory of gases; Sound. Types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sound in gases, solids and liquids and their properties. The unified spectra analysis of waves. Applications.

PHY 102 General Physics II (3 Units: LH 45)
(Electricity, Magnetism and Modern Physics)

Electrostatics; conductors and currents; dielectrics; magnetic fields and electro- magnetic induction; Maxwell's equations; electromagnetic oscillations and waves; Coulomb's law; methods of charging; Ohm's law and analysis of DC circuits; AC voltages applied to Inductors, capacitors and resistance; Applications.

PHY 107 General Practical Physics I (1 Unit: PH 45)

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 PHY 101 and PHY 102. However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PHY 108 General Practical Physics II (1 Unit: PH 45)

This is a continuation of the experiments designed for PHY 101 and PHY 102 some of which have been covered under PHY 107.

200-Level Courses

GST 211 Environment and Sustainable Development (2 Units: LH 30)

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 materials, Chemical and radiochemical hazards, Introduction to the various areas of science and technology. Elements of environmental studies.

GST 222 Peace and Conflict Resolution (2 Units: LH 30)

Basic Concepts in peace studies and conflict resolution; Peace as vehicle of unity and development; Conflict issues; Types of conflict, 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 organizations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

GST 223 Introduction to Entrepreneurship (2 Units: LH 30)

Introductory Entrepreneurial skills: Relevant Concepts: Enterprise, Entrepreneur, Entrepreneurship, Business, Innovation, Creativity, Enterprising and Entrepreneurial Attitude and Behaviour. History of Entrepreneurship in Nigeria. Rationale for Entrepreneurship, Creativity and Innovation for Entrepreneurs. Leadership and Entrepreneurial Skills for coping with challenge. Unit Operations and Time Management. Creativity and Innovation for Self-Employment in Nigeria. Overcoming Job Creation

Challenges. Opportunities for Entrepreneurship, Forms of Businesses, Staffing, Marketing and the New Enterprise. Feasibility Studies and Starting a New Business. Determining Capital Requirement and Raising Capital. Financial Planning and Management. Legal Issues, Insurance and Environmental Considerations. Also to be incorporated, on the other side of the spectrum, are employability skills – interview techniques, Oral Presentation Skills, etc.

GST 224 Leadership Skills (2 Units: LH 30)

Transformation is a fundamental shift in the deep orientation of a person, organization or society such that the world is seen in new ways and new actions and results become possible that were impossible prior to the transformation. Transformation happens at the individual level but must be embedded in collective practices and norms for the transformation to be sustained. Leadership Development Programme (LDP) proposes novel approaches to teaching and learning, which emphasizes the practical involvement of participants. It is interactive and involves exercises and actual implementation of breakthrough projects by teams that make difference in the lives of the target population. In this course, leadership concepts comprising of listening, conversation, emotional intelligence, breakthrough initiatives, gender and leadership, coaching and leadership, enrollment conversation and forming and leading teams will be taught.

GET 201 Applied Electricity (3 Units: LH 45)

Fundamental concepts - Electric fields, charges, magnetic fields. current, B - H curves Kirchhoff's laws, superposition. Thevenin, Norton theorems, Reciprocity, RL, RC, RLC circuits. DC, AC bridges, Resistance, Capacitance, Inductance measurement, Transducers, Single phase circuits, Complex J - notion, AC circuits, impedance, admittance, susceptance.

GET 202 Applied Electricity II (3 Units: LH 45)

Basic machines - DC, synchronous alternators, transformers, equivalent circuits. Three phase balanced circuits, PN junction Diode, Transistors, Thyristors FETs, Zener, Rectifiers. Basic control systems, open/closed loop systems. Communications fundamentals, introduction of TV, Radio, Telephone systems.

GET 203 Engineering Drawing I (2 Units: LH 15; PH 45)

Revision of multi-view representation. Harder examples on two and three view representation (1st and 3rd angles). Harder examples on isometric drawing to include simple pictorial assembly drawing in isometric. Harder examples on oblique drawing (Cavalier, Cabinet and Angles other than 45 degrees). Dimensioning. Sections and Conventions. Auxilliary views. Representation and specification of threads. Bolted joints. Keys and cottered joints. Conventional representations (see BS 308).

GET 222: Engineering Drawing II (2 Units: LH 15; PH 45)

Cams. Interpretation of solids. Development of surfaces. Detail drawing. Belts, Chains, Gears. Bearing and lubrication arrangements. Couplings brakes, Flexible shafts, Universal joints, etc. Assembly drawings. Revisions.

GET 204 Students Work Shop Experience (1 Unit: PH 45)

Introduction to practices and skills in general engineering through instruction in operation of hand and powered tools for wood and metal cutting and fabrication. Supervised hands - on experience in safe usage of tools and machines for selected tasks.

GET 205 Fundamentals of Fluid Mechanics (3 Units: LH 45)

Properties of fluids, Fluids statics, Basic conservation laws, friction effects and losses in laminar and turbulent flows in ducts and pipes. Dimensional analysis and dynamic similitude, principles of construction and operation of selected hydraulic machinery. Hydropower systems.

GET 206 Fundamentals of Thermodynamics (3 Units: LH 45)

Basic concepts, quantitative relations of Zeroth, first, second and third laws of thermodynamics. Behaviour of pure substances and perfect gases. Ideal gas cycles.

GET 207 Applied Mechanics (3 Units: LH 45)

Forces, moments, couples. Equilibrium of simple structures and machine parts. Friction. First and second moments of area; centroids. Kinematics of particles and rigid bodies in plane motion. Newton's laws of motion. Kinetic energy and momentum analyses.

GET 208 Strength of Materials (3 Units: LH 45)

Consideration of equilibrium; composite members, stress-strain relation. Generalized Hooke's law. Stresses and strains due to loading and temperature changes. Torsion of circular members. Shear force, bending moments and bending stresses in beams with symmetrical and combined loadings. Stress and strain transformation equations and Mohr's circle. Elastic buckling of columns.

GET 209 Engineering Mathematics I (3 Units: LH 45)

Limits, Continuity, differentiation, introduction to linear first order differential equations, partial and total derivatives, composite functions, matrices and determinants, Vector algebra, Vector calculus, Directional Derivatives.

GET 210 Engineering Mathematics II (3 Units: LH 45)

Second order differential equations, line integral, multiple integral and their applications, differentiation of integral. Analytical functions of complex variables. Transformation and mapping. special functions.

GET 211 Computer Programming I (3 Units: LH 30; PH 45)

Introduction to computers and computing. Problems solving on computer algorithm, design using flowchart and pseudo-code. Introduction to high level programming languages, Basic and FORTRAN syntax, flow of control, input/output constructs, data types. Programming in FORTRAN. Extensive exercises in solving engineering problems using flowchart and pseudo-code.

GET 212 Engineering Materials (3 Units: LH 45)

Introduction to electronic configuration, atomic structures, inter-atomic bonding mechanisms, crystal and microstructure. Relationships between structure and properties of metals, alloys, ceramics and plastics. Principles of the behaviour of materials in common environments. Fabrication processes and applications.

GET 213 General Engineering Laboratory Course (Unit 1: PH 45)

Laboratory investigation and report submission for selected experiments and projects in Thermodynamics, Applied Mechanics and Applied Electricity and Fundamentals of Fluid Mechanics.

GET 299 Students Industrial Work Experience (2 Units: 8 weeks)

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (8 weeks during the long vacation following 200 level).

300- to 500-Level Courses

There are still some courses even at the 300-level and 400-levels that would be common to all engineering/technology programmes. These include advanced mathematics, engineering communications, industrial training, etc. These courses are also important in providing tools that will enhance the much-needed interactions between students in different engineering disciplines and foster multidisciplinary team building. In addition, all engineering students must acquire supervised industrial training programmes; hence these are designated as common courses as well. All these courses are listed below.

GST 311 Entrepreneurship (2 Units: LH 30)

Profiles of business ventures in the various business sectors such as:

Soap/Detergent, Tooth brush and Tooth paste making; Photography; Brick making; Rope making; Brewing; Glassware production/ Ceramic production, Paper production; Water treatment/conditioning/packaging; Food processing/preservation/packaging; Metal fabrication; Tanning industry; Vegetable oil extraction; Farming; Fisheries/aquaculture; Plastic making; Refrigeration/Air-conditioning; Carving, Weaving; Bakery; Tailoring; Printing; Carpentry; Interior Decoration; Animal husbandry etc. Case Study Methodology applied to the development and administration of Cases that bring out key issues of business environment, start-up, pains and gains of growth of businesses, etc. with particular reference to Nigerian businesses. Experience sharing by business actors in the economy with students during Case presentations.

GET 301 Engineering Mathematics III (3 Units: LH 45)

Linear Algebra. Elements of Matrices, Determinants, Inverses of Matrices, Theory of Linear Equations, Eigen Values and Eigen Vectors. Analytical Geometry, Coordinate Transformation, Solid Geometry, Polar, Cylindrical and Spherical Coordinates. Elements of Functions of Several Variables, Surface Variables. Ordinary Integrals, Evaluation of Double Integrals, Triple Integrals, Line Integrals and Surface Integrals. Derivation and Integrals of Vectors, The Gradient of Scalar quantities. Flux of Vectors, The Curl of a

Vector Field, Gauss, Greens and Stoke's Theorems and Applications. Singular Valued Functions. Multivalued Functions, Analytical Functions, Cauchy Riemann's Equations. Singularities and Zeroes, Contour Integration including the use of Cauchy's Integral Theorems, Bilinear Transformation.

GET 302 Engineering Mathematics IV (3 Units: LH 45)

Series solution of second order linear differential equations with variable coefficients. Bessel and Legendre equations. Equations with variable coefficients. Sturm-Liouville boundary value problems. Solutions of equations in two and three dimensions by separation of variables. Eigen value problems. Use of operations in the solution of partial differential equations and Linear integral equations. Integral transforms and their inverse including Fourier, Laplace, Mellin and Handel Transforms. Convolution integrals and Hilbert Transforms. Calculus of finite differences. Interpolation formulae. Finite difference equations. RungeKutta and other methods in the solutions of ODE and PDEs. Numerical integration and differentiation.

GET 303 Engineering in Society (2 Units: LH 30)

Philosophy of Science and Engineering. History of Engineering and Technology. The Engineering profession - engineering - engineering literacy professional bodies and engineering societies. Engineers' code of conduct and ethics. Engineers and nation building - economy, politics, business, safety in Engineering and introduction in Risk analysis, invited lecturers from professionals.

GET 304 Engineering Communication (2 Units: LH 30)

Professional use of English Language for letters, specification descriptions, presentation of charts, graphs, tables, writing of proposals in reports. Case studies of major engineering designs and construction/fabrication as well industrial failures; professional presentation of reports and proposals.

STA 305 Statistics for Physical Sciences and Engineering (3 Units: LH 45)

Descriptive statistics, frequency distribution, populations and sample, central tendency, variance data sampling, mean, median, mode, mean deviation, percentiles etc. Probability. Binomial, poisson hyper-geometric, normal distributions, etc. Statistical inference intervals, tests hypothesis and significance. Regression and correlation.

MEE 331 Engineering Drawing III (3 Units: LH 15 ; PH 90)

Introduction to AUTOCAD. Use of AUTOCAD for 2-D and 3-D drawings. Descriptive geometry. Limits and fits. Geometric tolerancing. Welding drawing and design. Redesigning of casts components using welded joints. Harder examples on exploded assembly drawing (e.g. a complete gear box in exploded assembly drawing). Pipe joints. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant). Revision.

GET 399 Students Industrial Work Experience II (3 Units: 12 weeks)

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (12 weeks during the long vacation following 300 level).

GET 499 Students Industrial Work Experience III (6 Units: 24 weeks)

On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (24 weeks from the end of the First Semester at 400-Level to the beginning of the First Semester of the following session. Thus, the second semester at 400-Level is spent in industry.)

GET 501 Engineering Management (3 Units: LH 45)

Principles of organization; elements of organization; management by objectives. Financial management, accounting methods, financial statements, cost planning and control, budget and budgetary control. Depreciation accounting and valuation of assets. Personnel management, selection, recruitment and training, job evaluation and merit rating. Industrial psychology. Resource management; contracts, interest formulae, rate of return,. Methods of economic evaluation. Planning decision making; forecasting, scheduling. Production control. Gantt Chart, CPM and PERT. Optimization, linear programming as an aid to decision making, transport and materials handling. Raw materials and equipment. Facility layout and location. Basic principles of work study. Principles of motion economy. Ergonomics in the design of equipment and process.

GET 502: Engineering Law (2 Units: LH 30)

Common Law: Its history, definition, nature and division. Legislation codification interpretation. Equity: Definition and its main spheres. Law of contracts for Engineers: offer, acceptance, communication termination. General principles of criminal law. Law of torts: definition, classification and liabilities. Patents: requirements, application, and infringement. Registered designs: application, requirements, types and infringement. Company law. Labour law and Industrial Law

SECTION THREE:

ENGINEERING/TECHNOLOGY DEGREE PROGRAMMES COURSE STRUCTURE AND SYNOPSES

Preamble

The foundation courses for the various engineering degree programmes covered in this Document have been presented in Section 2. The courses are mainly at the 100- and 200-levels. This Section is devoted to the presentation of the structure and the synopses of courses prescribed for each programme. The courses are mainly at the levels 300 to 500. In the presentation, compulsory courses (C), required courses (R) and electives (E) have been identified.

3.1 AEROSPACE ENGINEERING

Aerospace Engineering is concerned with Aeronautical and Astronautical Engineering. It is a key Engineering sector in which Nigeria should be a key player in the 21st century. Nigeria's interest in communication and satellite technology supports this position. Thus, Aerospace Engineering Education in the Nigerian University System will strengthen National Space Research Development Agency (NASRDA) in the fulfillment of its mandate.

A recent research report, "Aerospace Industry Forecast to 2013", shows that the aerospace industry has emerged as the high potential market worldwide despite the negative impact of financial crisis. Significant increase in military budget and growth in air traffic have given the necessary impetus to the industry in tough times. In Nigeria there has been a substantial increase in civilian aviation expenditure and the military transport budget has also continued to increase over the last couple of years. The Nigerian aviation industry currently spends substantial foreign exchange on the maintenance of a fleet of aircrafts, due to a lack of local capability to effect the different categories of industry-specified aircraft maintenance schedules.

Newly developed and emerging economies, such as Brazil, Malaysia and Taiwan, have used this sector to facilitate the development of their economies. This is because Aerospace Engineering is technology intensive and it is at the leading edge of scientific and technological innovation. Indeed, it is a key driver not only of its immediate sector, but also for facilitating spin off industries.

Thus, the aerospace engineering education, in addition to the general philosophy of engineering education, is to be geared towards:

- i. The development of a thorough practice in Aerospace Engineering
- ii. Broad-based acquisition of fundamental knowledge in aerospace engineering, basic science, social science and the humanities.

- iii. Close association of the programme with key industrial sectors, such as the military and civilian aviation.
- iv. Production of graduates with high academic standards and adequate practical background who can contribute to the development of our national economy in aerospace and associated spin-off industries.

In consequence of the above, the graduates of the programme must be resourceful, creative, knowledgeable and able to perform the following functions:

- a. To be conversant with Aerospace Engineering materials, technology and processes.
- b. To design and manufacture Aerospace Engineering components, machines, equipment and allied systems;
- c. To install and maintain complex Aerospace Engineering systems so that they can perform optimally under diverse operating conditions;
- d. To demonstrate understanding of the appropriate Information and Communications Technology (ICT) associated with Aerospace Engineering;
- e. To be abreast of numerical and computational tools for solving Aerospace Engineering problems;
- f. To acquire leadership and management techniques related to Aerospace Engineering for exercising original thought, professional judgment and taking responsibility for direction of important tasks;
- g. To adapt and adopt exogenous technology in order to solve domestic Aerospace Engineering problems;
- h. To acquire knowledge of safety, quality and reliability of Aerospace Engineering systems and components including airworthiness of Aerospace vehicles;
- i. To demonstrate innovation and entrepreneurship in Aerospace Engineering;
- j. To improve on indigenous technology to facilitate the development of the Aerospace Engineering sector in Nigeria.

Overall Programme Focus:

Flight vehicles and systems, covering both space flight (spacecraft, rockets, satellites, etc.) and sub-space flight (airplanes, helicopters, missiles, etc.). Many Aerospace Engineers also work on land-based vehicles as well (race cars, regular cars, etc.), typically focusing on aerodynamics (designing external surfaces)

Related Fields:

Astronautical Engineering (focusing just on space flight) and Aeronautical Engineering (focusing just on sub-space flight). Most offered academic programs are in Aerospace Engineering.

Primary Areas of Specialization:

1. Aerodynamics (design of external surfaces)
2. Structural Design & Materials Selection
3. Propulsion Systems
4. Guidance & Control Systems

3.1.1 Course Structure

100 LEVEL

Common engineering courses

200 LEVEL

The following introductory courses are to be taken together with the prescribed common engineering courses.

200-LEVEL AEROSPACE ENGINEERING					
Course Code	Course Title	Units	Status	LH	PH
ASE 201	Introduction to Aerospace Systems I	2	C	30	-
ASE 202	Introduction to Aerospace Systems II	2	C	30	-
	TOTAL	4			

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

Course structure at 300-Level Aerospace Engineering

Course Code	Course Title	Units	Status	LH	PH
ASE 301	Aircraft Materials	2	C	30	-
ASE 302	Computer Aided Design (CAD)	4	C	45	45
ASE 306	Experimental Methods and Instrumentation	2	R	15	45
ASE 307	Aircraft Flight Principles I	2	C	15	45
ASE 308	Aircraft Flight Principles II	2	C	15	45
ASE 309	Computer Software Engineering	2	R	30	-
EEE 305	Electrical Machines	4	R	60	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
MEE 309	Thermodynamics	3	C	45	-
MEE 310	Fluid Mechanics I	2	C	30	-
MEE 321	Mechanics of Materials	3	C	45	-
MEE 331	Engineering Drawing III	3	C	45	45
	TOTAL	39			

Course structure at 400-Level Aerospace Engineering

Course Code	Course Title	Units	Status	LH	PH
ASE 401	Group Aircraft Design Project	2	C	-	90
ASE 403	Technical Report Writing	1	E	15	-
ASE 405	Control Engineering I	3	C	30	45
ASE 407	Aircraft Aerodynamics	3	C	30	45
ASE 409	Computer Aided Manufacturing	2	R	15	45
ASE 411	Aircraft Structural Analysis	3	C	45	-
ASE 413	Aircraft Performance	3	C	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 499	SIWES III	6	C	24 weeks	
	TOTAL	26			

Course Structure at 500-Level Aerospace Engineering

Course Code	Course Title	Units	Status	LH	PH
ASE 599	Project	6	C	-	270
ASE 503	Systems Modelling and Simulation	2	R	30	-
ASE 504	Lean Management and Logistics	3	E	45	-
ASE 505	Aircraft Propulsion Technology	3	C	30	45
ASE 506	Aircraft Conceptual Design II	3	C	30	45
ASE 507	Flight Controls and Dynamics	3	C	30	45
ASE 508	Aircraft Maintenance Management	3	R	45	-
ASE 509	Aircraft Conceptual Design I	3	C	30	45
ASE 510	Reliability and Quality Assurance	3	R	45	-
ASE 512	Avionic Systems Engineering	2	C	15	45
ASE 514	Air Transport Management	2	E	30	-
ASE 516	Aircraft Structural Integrity	2	R	30	-
ASE 518	Rocket Propulsion	2	C	30	-
ASE 520	Spacecraft Flight	2	C	30	-
ASE 522	Vibrations	2	C	30	-
ASE 524	Energy Resources for Aerospace Industry	2	R	30	-
GET 501	Engineering Management	3	C	45	-
GET 502	Engineering Law	2	R	30	-
MEE 509	Fracture of Structural Materials	4	E	45	45
		52			

	TOTAL				
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3.1.2 Course Synopses

ASE 201 Introduction to Aerospace Systems I (2 Units: LH 30)

Overview of Aerospace Engineering Industry, Differing Job Roles for Aerospace Maintenance Staff, Training Opportunities and Job Progression, Licence, Examination, Qualification, Airworthiness Regulation, Aircraft Maintenance, Safety Culture.

ASE 202 Introduction to Aerospace Systems II (2 Units: LH 30)

Introduction to Aerodynamics, Review of Atmospheric Physics, Elementary Aerodynamics, Flight Forces, Aircraft Loading, Flight Stability and Dynamics, Aircraft Control and Controllability.

ASE 301 Aircraft Materials (2 Units: LH 45)

Introduction to the mechanical properties of materials commonly used in the aircraft structures, materials failure, and structure inspections. Properties of aluminium alloys, titanium steel, composite materials, fractures, fatigues, corrosion, and NDT. At the end of the course, students are expected to have basic knowledge on choosing materials for aircraft structure.

ASE 302 Computer Aided Design (4 Units: LH 45; PH 45)

Computer Aided Drawing: Communication, Orthographic Projection, Auxiliary and Sectioned Views, Dimensional and Geometric Tolerancing, Maximum Metal Condition, Limits and Fits - MMC, BS 308 Conventions, Assembly Drawings and Parts Lists. Computer Aided Design: Production Drawings created from 2D and 3D CAD Systems covering Solid and Surface Modelling, Mass Properties, Finite Element Analysis, Rapid Prototyping and Computer Aided Manufacturing Software.

ASE 306 Experimental Methods and Instrumentation (2 Units: LH 15; PH 45)

Fundamentals of measurement systems; standards; treatment of data; statistics; uncertainty analysis, data acquisition; transducers; strain; force, acceleration; pressure; temperature; fluid flow.

ASE 307 Aircraft Flight Principles I (2 Units: LH 30)

Review of Underlying Concepts: Newton's laws, ISA and Imperial Engineering Systems of Units, Hydrostatic Pressure, Manometry, Work, Energy, Vector Addition and Resolution. Forces on an Aircraft (regarded as a particle) in Non-accelerated Flight. Nature of Aerodynamic Force: Pressure and Viscous Force, Definitions of Lift and Drag, Concept of an Aerofoil; Lift, Drag Ratio, Glide Angle. Coefficients of Lift and Drag. Calculation of the Properties of the International Standard Atmosphere: Use of ISA Tables in ISA and Imperial Engineering Units.

ASE 308 Aircraft Flight Principles II

(2 Units: LH 30)

Altitude and Rate of Climb Measurement: Static, Dynamic and Total Pressure, Bernoulli's Incompressible. Principle Applied to Air Speed Measurement using both Pitot-Static and Venturi Methods: Air Speed Indicator, Indicated (IAS), Equivalent (EAS) and True Air Speed (TAS), Knots. Principles of the Gyroscope and Basic Flight Instrumentation: Basic Concepts of Classical Aerodynamics for Incompressible Flow, Using the 2-D Circular Cylinder Model: Significance of Inviscid Assumption and Incompressible Approximation: The use of the Continuity Principle to Provide Surface Velocity Distribution, The Link between Surface Velocity and Pressure Distribution, Symmetrical Velocity and Pressure Distributions, d'Alembert's Paradox, Viscosity (dynamic and kinematic), Boundary Layers (qualitative treatment); Characteristics of Laminar and Turbulent Boundary Layer Velocity Profiles; Skin Friction (including simple calculations). Form and Profile Drag: Cause and Nature of Boundary Layer Separation and Methods, Effect of Delaying Separation. Lift:

Concept of Circulation; Magnus Effect; 2-D Aerofoil as a Lifting, Vortex, Importance of Sharp Trailing Edge. Aerofoil Terminology and Characteristics (based on NACA conventions). Leading Edge. Trailing Edge and Deep Stalls: Causes, Effects and Means of Recovery, Incipient Spin. Lift Augmentation: Requirement for Lift Augmentation, Lift Curve, Extension Methods; Camber-enhancing Methods.

ASE 309 Computer Software Engineering

(2 Units: LH 30)

Introduction to Software Engineering, Fundamentals, Object Oriented Programming, Number Representations. Data Structure and Algorithms, Abstraction, Modules and Objects, Systems Modeling Designing for Efficiency, Introduction to MatLab.

ASE 401 Group Aircraft Design Project

(2 Units: PH 90)

Identifying Problem Requirements, Generating and Evaluating Design Concepts, Design and Fabrication. Design Control Software. Testing and Debugging of Systems. Documentation of Design and Results.

ASE 403 Technical Report Writing

(1 Unit: LH 15)

Technical Correspondence, Technical Proposals, Field Trip Reports.

ASE 405 Control Engineering I

(3 Units: LH 30; PH 45)

Introduction: Concepts of Feedback Control. Mathematical Model of Physical Systems. Block Diagrams. Reduction Techniques. Block Diagram Algebra. Signal Flow Graphs. Mason's Rule. Analysis and Design in S-Plane. Steady State and Transient Response to Step and Ramp Input. Use of P+I, P+D Lag, Lead and Tacho-compensators for improvement of overall response. Negative Velocity and Positive Acceleration Feedback. Error rate Damping. Stability Analysis: Routh's Stability Criterion, Frequency Response

Methods using Polar, Bode and Nichol's Methods. Nyquist Compensation. Design of System with Lead, Lag, Lead-Lag Compensators in Frequency Domain. System Identification from Experimental Data, Analog Computing; Basic Computing Element. Solutions of Linear ODE. Simulation of Simple Transfer Functions, D.C Bias Design. Analysis and Design of Single Stage and Multiple Stage Amplifiers at Low and High Frequencies. Dealington pair, Cascoe Amplifiers. Bootstrapping, Negative Feedback Concepts and Feedback Amplifiers.

ASE 407 Aircraft Aerodynamics

(3 Units: LH 30; PH 45)

Introduction to Boundary layer: Boundary Layer Transition, Dynamic Similarity, Reynolds Number, Force and Moment Scaling and Scale Effect. Critical Reynolds Number, Transition, Fixing. Boundary Layer: Boundary Layer Analysis: Velocity Profile Modelling; Displacement Thickness; Effective Body; Momentum Thickness; Relationships between Skin Friction Coefficient, Boundary Layer Thickness and Local Reynolds Number. One-dimensional Compressible Flow: Steady Flow Energy Equation Results, Normal Shock Relations; Quasi-1-D flow; Variable Area Stream Tube, Propelling Nozzles, Pitot Intakes, Supersonic Airspeed Measurement. Underlying Principle of Lift: Lift Reduction, Down Force Generation and Drag Reduction in Road Vehicles, Wing Planform Considerations (qualitative only), 3-D Lifting Line model, Principles of Biot-Savart's Law, Stalling and Planforms: Structural and Stalling Characteristics of Rectangular, Elliptical, Tapered, Swept-back and Swept-and-Tapered Wing, Tip-stalling Solutions. Leading Edge Vortices. Characteristics of forward Swept Wing, Gust response to Step Input, Dependence on Aspect Ratio, Sweep-back Wing, Loading and Flight Condition.

ASE 409 Computer-Aided Manufacturing

(2 Units: LH 15; PH 45)

Computer Aided Manufacturing: Operation and Sequence Planning, Machine Definition, NC sequences, Post Processing. Finite Element Analysis: Mesh types, Constraints, Loads, processing, interpretation of results. Data Transfer: IGES, STEP, DXF. Product Data Management: Overview of the role of PDM and research through 'case studies' Rapid Prototyping Overview of Methods and Applications, Manufacturing Techniques.

ASE 411 Aircraft Structural Analysis

(3 Units: LH 45)

Analysis of Thin Walled Structures: Bending, Shear Stress Distribution, Shear Centre, Torsion of Single and Multi-celled Sections, Combined Bending and Torsion, Idealised Section analysis. Introduction to Energy Methods: Unit Load Method, Strain Energy, Principle of Virtual Work, Castigliano's Theorems, Application to Deflection Problems, Statically Indeterminate Structures Buckling: Buckling of Struts, Buckling of Thin Plates, Use of Energy Methods for Calculating Buckling Loads in Columns, Buckling of Sheets in Shear and End Loads. Introduction to Aircraft Composite Structures: Introduction to Carbon Fibre Composites, other Types of composite, Overview of Manufacturing Process,

Basic Method of Stress Analysis, Mechanical Properties and Applications in the Aircraft Industry.

ASE 413 Aircraft Performance

(3 Units: LH 45)

Introduction, Review of Aircraft Aerodynamics: Pressure Plots, Lift Curves, Drag Polars, Wing Downwash, and Wing Sweep. Climb and Descent: Climb Path Force Analysis, Rate of Climb, Time to Climb, Non-accelerated and Accelerated Climb.

Take-off and Landing Estimation: Take-off Run Estimation - including Ground and Airborne Distance. Airborne-Transition before and after the Screen Height. Landing Distance Estimation, in terms of the Flare Angle and Distance to Touchdown. Turning Performance: Banked Turns, Load Factor, Turn Rate, Limitations, and Turning Performance. Engine Selection: Number of Engines, Engine Ratings, Turbojet Engine, Sizing, Propeller Propulsion Systems. Propulsion System Characteristics: Turbofan, Turbo-prop, Piston Propulsion Characteristics including Specific Fuel Consumption; Power Characteristics and Propulsive Efficiency, Thrust Efficiency and Altitude Limitation. Cruise Performance and Optimisation: Fuel Flow Rate, True Airspeed, Equivalent Airspeed, Specific Range, Specific Endurance, Breguet Range and Endurance Equations. Introduction to Helicopter Performance: Momentum Theory in Hover, Vertical and Forward Flight, Azimuth Angle and Rotor Blade Relative Velocity, Performance in Hover, Vertical and Forward Flight, Maximum Level Speed and Power Requirements. Introduction to Aircraft Design: Aircraft Purpose and Payload, Cruise and Maximum Speed, Normal Cruise Altitude, Range and Endurance, Take-off and Landing Distances Estimation and Cost of Purchase. Preliminary Estimate of Take-off Weight: Fuel Fraction Estimates and Take-off Weight Analysis.

ASE 503 System Modelling and Simulation

(2 Units: LH 30)

System Identification and Characteristic, System Modelling. Installation Consideration, Generation of Noise and its Attenuation, Selection of Equipment for particular Applications. Review of Currently available Products. Control Elements, System Analysis and Design, Industrial application. Interfacing with Programmable Logic Controllers and Computers.

ASE 504 Lean Management and Logistics

(3 Units: LH 45)

Material and information flows within a company, providing practical experience for all employees involved in lean production projects, inventory minimisation as an important basis for increased productivity, the principle of pull production control, advantages compared to conventional production control methods, types and function of different pull production control methods, application of methods, Kanban – the classic pull principle, introduction to Value Stream Mapping (VSM). Lean manufacturing, flow production, throughput time and inventories while increasing flexibility, analysis of workplaces with the Standard Operation Sheet, adjusting the cycle times of individual workplaces, flow and

takt time production, avoidance of material transport with linear and U layouts, • Structure and development of open-plan production, Line Back system, integration of logistic processes with Kanban, flexible employee systems: relay and caravan systems, multimachine operation. Quality control.

ASE 505 Aircraft Propulsion Technology

(3 Units: LH 30; PH45)

Thermodynamic Fundamentals: Behaviour of Perfect Gases, Equations of State, Enthalpy and Specific Heats. First Law of Thermodynamics applied to Non-flow and Steady Flow Energy equations. Second Law and the Concept of Entropy, Nature and Use of P-V and T-S Diagrams. Isothermal, Isobaric, Isentropic and Polytrophic Processes. Analysis of Otto and Brayton Cycles including: determination of, Thermal Efficiency, Work Ratio, Mean Effective Pressure, Pressure Ratio and Compression Ratio. Performance Parameters and Measurement: Gross Thrust, Net Thrust, Choked Nozzle Thrust, Resultant Thrust, Thrust Horsepower, Specific Fuel Consumption, By-pass Ratio, Ram Pressure and Temperature Rise. Engine Ratings, Static Thrust, Flat Rating, Limitations, Influence of Speed, Altitude and Climate, Exhaust Gas. Turbine, Jet Pipe and Oil Temperature Measurement Systems, Engine Thrust, Engine Pressure Ratio, Fuel, Turbine Discharge/Jet Pipe Pressure Measurement Systems. Fuel flow, Engine Speed, Vibration, Torque and Power Measurement Systems. Comparison of Performance Characteristics and Efficiency Losses: Piston Propulsion, Turbo Propulsion, Turbo Fan and Turbojet Aircraft Propulsion Units, Construction, Materials, Operation, Efficiencies and Performance: Gas Turbine Engine, Intakes, Ducts, Compressors, Combustion Systems, Turbines, Jet Pipes and Propelling Nozzles, Construction, materials, operation, efficiencies and Performance of Piston Engine: Propellers, Propeller Controls, Engine Gearbox, Piston Arrangements, Engine Assemblies, Timing, Fuel Delivery Mechanisms and Superchargers.

ASE 506 Aircraft Conceptual Design II

(3 Units: LH 30; PH 45)

Horizontal and Vertical Tail Design: Tail Arrangements, Horizontal and Vertical Tail Sizing, Tail Planform Shape, Aerofoil Section Type and Tail Placement. Enhanced Lift Design: Passive Lift Enhancement, Active Lift, Enhancement Structural Design and Material Selection: Structural Loads, Internal, Structure Design, Material Selection. Static Stability and Control: Refined Weight Estimate and Static Stability. Cost Estimate: Cost Estimating Relationships and Unit Price.

ASE 507 Flight Controls and Dynamics

(3 Units: LH 30; PH45)

FLIGHT DYNAMICS: Aircraft Response and Stability: Concepts of Static and Dynamic Stability in Translational and Rotational Systems, Conflicting Requirements of Aircraft Stability and Control, Definition and Conventions of Stability Axes and of Kinematic Parameters, Flight Speed Stability and the Total Drag Curve, Longitudinal Trim and Static Stability Equation and Analysis, Centre of Pressure, Aerodynamic Centre, Trim Drag. Conventional Tailplane, Tail-less and Canard Aircraft compared. Relaxed Static

Stability, Lateral and Directional Static Stability, Effects of Dihedral, Sweepback, High Keel and Fin Surface, Wing-Fuselage Junction Height and Wing Shielding. Description of the Short period Pitching Oscillation, Phugoid, Heading Mode, Dutch Roll and Spiral Dive Mode, in Terms of Physical Cause and Effect using the Terminology of Aerodynamic Derivatives and Inertia Terms. Aircraft Control and Response: Uses and abuses of Conventional Controls - Ailerons, Rudder and Elevator, Control Problems and Limitation, Low Dynamic Pressure, Compressibility, Flutter Control in the normal plane of Symmetry, Elevator Angle, Stick Force to Trim. Use of Elevator and Throttle, Tabs and other devices for Trimming, Aircraft Handling, Gust Alleviation, Active Flutter Suppression and Autopilot Concepts.

AIRCRAFT CONTROL: Concepts in Control: Open and Closed-Loop Systems, Accuracy and Stability, Examples - Electric Motor and Engine Speed Control Governor, Temperature Control, and Servomechanism (Position Control), Differential Equation Models, The Laplace Transform, Transfer functions, Block Diagrams and Signal Flow, Definition of terms for closed-loop systems. Controlled-variable Response: Time Response of Typical Control Systems, Accuracy and Stability, Servomechanism Step Response with variable damping, Natural Frequency, and Damping Ratio, Viscous and Coulomb Friction Damping. Undamped Response, Use of Velocity Feedback Damping, Proportional-plus-Derivative Control for Servo Stability, Proportional-plus-integral for accuracy of typically Speed Control or Force

Balance Accelerometer. Aircraft Control and Response: Longitudinal, Lateral and Yaw Control and Response Equations for Small Perturbations about Aircraft Axes, Power Control Units and their Interfacing, Rate Gyro Sensors, Explanation and Analysis of Auto-stabilisation Systems, Pitch Rate and Roll Rate Command Loops, Use of Control Laws in these Loops.

ASE 508 Aircraft Maintenance Management

(3 Units: LH 45)

Maintenance Programmes: Requirement and purpose of maintenance. Maintenance Review Board and MSG-2 and 3 logic applied to aircraft systems, power plant and structures, Hard-time, On-condition and Condition Monitored maintenance. Data collection, component history and statistical information sources. Reporting procedures, occurrence reporting and corrective action methodology. Minimum equipment list and acceptable deferred defects. Production of maintenance schedules and programmes. Aircraft Maintenance and Reliability: Airworthiness requirements and documentation. Safety standards and safety assessment, including reliability assessment. Failure modes and failure analysis. Reliability mathematics directly associated with aircraft maintenance. Predicting system, engine and structural reliability and effect on reliability of scheduled and non-scheduled maintenance. Reliability programme development and continuing airworthiness. Reliability and economics. Maintenance Planning and Scheduling: Maintenance facilities. Provisioning and supply systems. Maintenance tasks, Task development and analysis, downtime, repair, replacement, rectification and modification.

Use of project planning methods such as CPM, PERT and computer programmes, to allocate timely physical and human resources. Special considerations when planning and scheduling maintenance for geriatric aircraft. Technological aids to maintenance. Future of aircraft maintenance, third party maintenance, whole life maintenance packages.

Human Factors in Aircraft Maintenance: Effect on maintenance planning of, human performance and limitations. Analysing human errors in aircraft management, case studies, and safety considerations. Investigation of the SHEL and Reason models of human interaction. Production of a management plan, designed to limit human error in the execution of aircraft maintenance activities.

ASE 509 Aircraft Conceptual Design I (3 Units: LH 30; PH45)

Introduction to Aircraft Design: Aircraft Purpose and Payload, Cruise and Maximum Speed, Normal Cruise Altitude, Range and Endurance, Take-off and Landing Distances and Cost of Purchase. Preliminary Estimate of Take-off Weight: Fuel Fraction Estimates and Take-off Weight. Wing Loading Selection and Effect: Take-off, Landing, Climb, Cruise, Acceleration, Range, Flight Ceiling and Glide Rate.

Main Wing Design: Aerofoil Cross-Section Shape, Taper and Sweep Angle Selection, 3-D Wing Coefficient, Wing Drag Estimation and Planform, Geometric Relations.

Fuselage Design: Volume Consideration, Aerodynamics Consideration, and Drag Estimation.

ASE 510 Reliability and Quality Assurance (3 Units: LH 45)

Principles of Quality: Product quality, Statistical quality control; and Combination of Probabilities. Principles of Reliability: The meaning of reliability; Practical Reliability Definition; The Meaning of Availability; Instantaneous Failure Rate and its Relation to Reliability; Typical Forms of Hazard Rate Function. Reliability of Systems: Series Systems, Parallel Systems, General Series-parallel Systems, Majority Parallel Systems, Standby Redundancy, Common Mode Failures, Availability of Systems with Repair; Fault Tolerant Systems. Failure rate data and models: Failure rate data, Factors influencing failure rate, Failure rate models, Calculation of equipment failure rate from component failure rate data, Software reliability, Human reliability. Quality and reliability in design and manufacture: The achievement of quality, Economics of quality and reliability, Design for quality, Quality in manufacture, Testing of finished product. Design Summary and Trade Study

ASE 512 Avionic Systems Engineering (2 Units: LH 15; PH 45)

The role of avionics and the avionic environment; weight, temperature, vibration, high 'g', electromagnetic compatibility. Flight data displays, Head-down, Head-up, and Helmet-mounted displays. Air data and air data systems. Sensors, data acquisition and computing. Inertial sensors and systems. Dynamically-tuned gyroscope, use in the stable platform and

in the torque balance rate gyro. Ring-laser and fibre-optic gyros. Force-balance accelerometer. Operation of attitude/heading reference systems.

Navigation Systems. Navigation by dead reckoning. Air data base. Doppler/heading reference, inertial navigation system, and Doppler/inertial navigation system. Navigation by position fixing. Radio navigation by VOR/DME and TACAN. Hyperbolic radio navigation by LORAN C, OMEGA, and DECCA. Satellite navigation by GPS and GLONASS. Terrain reference navigation systems. Airborne computers, data-buses. Electrical PowerDirect current Power Supplies: Aircraft generator principles, characteristics, outputs and construction.

Regulation and control of generator outputs including paralleling, load sharing and voltage control. Aircraft batteries, battery systems and charging. Alternating Current Power Supplies: Review of fundamental principles of single phase and three-phase AC. The aircraft three-phase generator characteristics, outputs and construction; star and delta interconnections, real and apparent power. Frequency wild and constant frequency generator systems; voltage regulation and load-sharing. Power Conversion, Distribution and Control: Principles and construction of aircraft, rectifiers, and transformers, rotary and static inverters. Typical external and auxiliary power supplies and their interconnection into main power distribution system; typical twin and four-engine power distribution systems and means for system emergency provision. Circuit protection fuses, circuit breakers, cut out relays, over voltage protection of both AC and DC generating systems. Aircraft Motors and Actuators: Principle of operation, construction, control and protection of DC/AC motors including; induction, synchronous, stepper and multi-phase cage motors; linear and rotary actuators. Aircraft application of motors and actuators.

ASE 514 Air Transport Management

(2 Units: LH 30)

Introduction to Transport: General characteristics of supply and demand The Air Transport Industry: Structure of the industry, specific characteristics of air transport, organisational roles, hardware operating considerations, freight operations, client base, passenger perceptions and expectations, trend monitoring, international organisations and competition. Airline Organisation: Ownership, organisation structures, buying versus leasing airframes, the market for air transport. Mergers and alliances, code-sharing, franchising, route networks. The Legal and Regulatory Framework:- organisations and conventions; International law and agreements, air safety, economic regulation and deregulation. Aircraft Operation: Structural and operational limitations, flight planning, flight operations, slot allocation issues. Air Traffic Control: Regulations, safety considerations, use of emerging technology, airline involvement and other current issues. Aircraft Movements and Airfield Safety Considerations: Effects of terrorism, unruly passengers and the need for increased security, on airline operations and planning. Strategic Planning: Budgeting and forecasting, investment planning, performance measurement Customer Service: Standards, requirements, communications, care, loyalty and marketing.

ASE 516 Aircraft Structural Integrity (2 Units: LH 30)

Non Destructive Testing Methods of Detecting Cracks in Materials: Oil and Chalk, Dye and fluorescence method, ultra-sonic method, eddy current method, electro-magnetic flaw detection method. Linear Elastic Fracture Mechanics (LEFM): Aircraft material properties data, significance of fracture mechanics, Modes of failure, Griffith energy balance approach, Irwin's stress intensity approach, fracture toughness as a function of materials thickness, stress distribution at the crack tip. Von Mises Yield Criterion, plastic zone radius and correction, fracture toughness testing using compliance method, plane strain and plane stress conditions at the crack tip, crack resistance concept and derivation Fatigue: Fatigue loading cycles, Aircraft loading spectrum, limit load, effect of stress concentration, typical aircraft materials S-N curves, Miner's cumulative damage rule, low cycle fatigue, fatigue incubation concept, fatigue crack propagation (FCP), Paris's equation, fatigue life estimation, analysis of factors affecting fatigue strength of the aircraft structures, fatigue fractography. Creep: creep crack growth, stress –rupture test, structural changes during creep, low temperature creep, concept of activation energy for steady state creep, high temperature creep, Analysis of the main factors affecting creep behaviour of the aircraft structures.

ASE 518 Rocket Propulsion (2 Units: LH 30)

Liquid, Solids and hybrid propellants. Consideration of nozzle flows, propellant feed, thermo chemistry, real gas effects, heat transfer, combustion and structural constraints. Velocity requirements, velocity increments and staging for rocket flight. Applications of rocket propulsion.

ASE 520 Spacecraft Flight (2 Units: LH 30)

Introduction and history, circular motion and gravity, energy in orbits, conic sections, introduction to satellites, satellite orbit geometry, satellite ground tracking, satellite systems, comms and navigation, remote sensing, launch vehicles, propulsion systems, orbit transfers and manoeuvres, interplanetary mission.

ASE 522 Vibrations (2 Units: LH 30)

The course is in 3 parts, namely: Vibrations Theory, Introduction to Aero-elasticity and Noise Assessment and Control. The Vibrations Theory element of the course is focussed on the derivations of the equations of motion, natural frequencies, mode shapes and responses of multiple degrees-of-freedom (MDOF) discrete and continuous systems under free and forced vibrations conditions.

The modal analysis technique is used to transform the equations of motion from physical space to modal space in order to facilitate the process for computing the responses of MDOF discrete systems. The introduction of Aero-elasticity examines the effect of fluid

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flow on vibrating structures and considers vortex shedding, divergence and flutter. In the Noise Assessment and Control part of the course, the environmental effects of vibration, in the form of environment noise generation and propagation, are investigated. This includes characterisation, measurement and assessment of noise, and investigation of the regulatory/legislative frameworks for the control of noise pollution.

ASE 524 Energy Resources for Aerospace Industry (2 Units: LH 30)

Possible Future Scenarios for Energy from Conventional to Renewable Sources, Energy Conservation Principles, Energy Distribution and System Integration, Solar Energy, Hydro, Wind and Geothermal Energies, Biofuels and Biomass, Energy Storage Options in form of Hydrogen, Batteries, Liquid Fuels, Compressed Gas by the use of Heat Exchangers, Sustainability.

ASE 599 Project (6 Units: PH 270)

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.

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3.2 AGRICULTURAL ENGINEERING

The programme is designed to prepare students for careers involving the application of engineering principles to agricultural mechanization and crop production, food processing, and conservation of land and water resources. The programme covers the basic areas of agricultural engineering, including farm power and machinery, food processing and crop storage, post harvest handling, land and water management (irrigation and drainage systems, erosion control, pesticide/fertilizer use/management), farm electrification and farm structures. Students can take any of the following options in the final year:

- ❖ Crop processing and storage
- ❖ Farm power and machinery
- ❖ Soil and water engineering

DETAILS OF COURSES

100 LEVEL

Common engineering and technology courses

200 LEVEL

Common engineering and technology courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.2.1 Course Structure

Course structure at 300-Level Agricultural Engineering

Course Code	Course Title	Units	Status	LH	PH
AGR 301	Soil Science	2	R	30	-
AGR 302	Animal Production	3	R	45	-
AGR 303	Crop Production	3	R	45	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	C	30	-
MEE 307	Theory of Machines I	3	R	45	-
MEE 313	Engineering Metallurgy I	2	R	30	-
MEE 321	Mechanics of Materials	3	C	45	-
MEE 331	Machine Drawing III	3	R	15	90

TAG 301	Basic Agricultural & Bio-Resources Engineering	2	C	30	-
TAG 302	Land Surveying	3	C	45	-
TAG 303	Hydrology	3	C	45	-
TAG 304	Geology for Engineers	2	R	30	-
TAG 305	Hydraulics	2	C	30	-
TAG 306	Soil Mechanics	2	C	30	-
TAG 307	Laboratory Practicals	3	R	-	135
	Total	51			

Course structure at 400-Level Agricultural Engineering

Course Code	Course Title	Units	Status	LH	PH
AGR 405	Farm Management, Rural Sociology and Agricultural Extension	2	R	45	-
GET 499	SIWES III	6	C	24 weeks	
TAG 401	Farm Power and Machinery	3	C	45	-
TAG 402	Irrigation and Drainage	3	C	45	-
TAG 403	Farm Structures and Environmental Control	3	C	45	-
TAG 404	Properties, Handling, Processing and Storage of Agric. Materials	3	R	45	-
TIE 402	Engineering Economics	2	R	45	-
	Total	22			

Course structure at 500-Level Agricultural Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	C	45	-
GET 502	Engineering Law	2	C	30	-
TAG 501	Farm Electrification	3	C	45	-
TAG 502	Soil and Water Conservation	3	C	45	-
TAG 503	Land Clearing and Development	2	C	30	-
TAG 504	Agric. Mechanization	2	C	30	-
TAG 555	Final Year Project	6	C	-	270
	(Specialization from choice of courses indicated below)	17-20	C/R*		
	Total	38 to 41			

TAG 505	Agricultural Power	3	E	45	-
TAG 506	Agricultural Machinery	3	E	45	-
TAG 507	Mechanics of Deformable Bodies	2	E	30	-
TAG 508	Design of Agricultural Machines	2	E	30	-
TAG 509	Operation and Management of Farm Power and Machinery Systems	2	E	30	-
TAG 510	Irrigation	3	E	45	-
TAG 511	Agricultural Land Drainage	2	E	30	-
TAG 512	Advanced Hydraulics	3	E	45	-
TAG 513	Rural water Supply and Sanitation	2	E	30	-
TAG 514	Design of Irrigation and Soil Conservation Structures	2	E	30	-
TAG 515	Environmental Engineering	3	E	45	-
TAG 516	Foundation Engineering	3	E	45	-
TAG 517	Advanced Thermodynamics	3	E	45	-
TAG 518	Engineering Properties and Handling of Agricultural Materials	3	E	45	-
TAG 519	Processing and Storage of Agricultural Products	3	E	45	-
TAG 520	Solar Energy Applications to Processing and Storage	2	E	30	-
TAG 521	Farm Transportation	2	E	30	-

3.2.2 Course Synopses

TAG 301 Basic Agric. & Bio-Resources Engineering (2 Units: LH 30)

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.

TAG 302 Land Surveying (3 Units: LH 45)

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.

TAG 303 Hydrology (3 Units: LH 45)

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.

TAG 304 Geology for Engineers (Units 2: LH 30)

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

TAG 305 Hydraulics (2 Units: LH 30)

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.

TAG 306 Soil Mechanics (2 Units: LH 30)

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

AGR 301 Soil Science (2 Units: LH 30)

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.

AGR 302 Animal Production (3 Units: LH 45)

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.

AGR 303 Crop Production (3 Units: LH 45)

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.

TAG 401 Farm Power and Machinery (3 Units: LH 45)

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.

TAG 402 Irrigation and Drainage (3 Units: LH 45)

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.

TAG 403 Farm Structures and Environmental Control (3 Units: LH 45)

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 psychometric charts. Farmstead planning and layout.

TAG 404 Properties, Handling, Processing and Storage of Agricultural Materials (3 Units: LH 45)

Properties and characteristics of agric. Materials. Cleaning, sorting and grading. Handling methods. Processing techniques. Crop drying. Crop storage.

AGR 401 Farm Management, Rural Sociology and Agricultural Extension (2 Units: LH 30)

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.

TAG 501 Farm Electrification (3 Units: LH45)

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.

TAG 502 Soil and Water Conservation (3 Units: LH 45)

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.

TAG 503 Land Clearing and Development (2 Units: LH 30)

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.

TAG 504 Agricultural Mechanisation (2 Units: LH30)

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.

TAG 505 Agricultural Power (3 Units: LH 45)

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.

TAG 506 Agricultural Machinery (3 Units: LH 45)

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.

TAG 507 Mechanics of Deformable Bodies (2 Units: LH 30)

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 centre. Curved beams.

TAG 508 Design of Agricultural Machines (2 Units: LH 30)

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.

TAG 509 Operation and Management of Farm Power and Machinery Systems (2 Units: LH 30)

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.

TAG 510 Irrigation (3 Units: LH 45)

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.

TAG 511 Agricultural Land Drainage (3 Units: LH 30)

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.

TAG 512 Advanced Hydraulics (3 Units: LH 45)

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.

TAG 513 Rural Water Supply and Sanitation (2 Units: LH 30)

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.

TAG 514 Design of Irrigation and Soil Conservation Structures (2 Units: LH 30)

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

TAG 515 Environmental Engineering (3 Units: LH 45)

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.

TAG 516 Foundation Engineering (3 Units: LH 45)

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.

TAG 517 Advanced Thermodynamics (3 Units: LH 45)

Thermodynamics of gases, vapours and reactive and non-reactive mixtures. Process relations. Centrifugal and axial flow compressors. Turbine theory. Combustion and product analysis.

TAG 518 Engineering Properties and Handling of Agricultural Materials

(3 Units: LH 45)

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.

TAG 519 Processing and Storage of Agricultural Products (3 Units: LH 45)

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. Containerization. Design of grain storage structures. Environmental control in storage.

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TAG 520 Solar Energy Applications to Processing and Storage (2 Units: LH 30)
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.

TAG 521 Farm Transportation (2 Units: LH 30)
Farm roads. Farm transportation system. Development and construction of farm transport equipment. Farm transport system – standards and specifications. Ergonomics.

TAG 555 Final Year Project (6 Units: PH270)
Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report.

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3.3 AUTOMOTIVE ENGINEERING

Automotive engineering is the application of principles drawn from the sciences in order to develop economical and sustainable automotive designs or to solve automotive problems. The programme which builds on the traditional mechanical engineering courses has its own core courses in the following areas:

Vehicle power systems

An introduction to the development, design, specification, and operation of internal combustion engines for mobile applications with a focus on traditional spark-ignited and diesel engines. It is also extended to alternative power plants and fuels.

Motor vehicle design and vehicle manufacturing systems

Geared towards the analysis and solution of advanced engineering problems, particularly in the modern structural design and manufacturing of vehicles and automotive components. The course includes introduction to advanced computer modelling techniques of real engineering problems

Vehicle handling and control

Covers performance prediction relatively early in the design process and identifies the conflicts in designing for optimal performance in different modes.

Vehicle aerodynamics

Emphasis is placed on solving aerodynamic problems using a balance of computation and experimental techniques. The growing influence of styling on body shape is approached from both an artistic and a scientific viewpoint. It also draws attention to the growing trends in body shape design.

Vehicle noise and vibration

Analysis of the relationship between noise and vibration with emphasis on the difference between structure-borne and air-borne sources.

3.3.1 Course Structure

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

Course structure at 300-Level Automotive Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 305	Electrical Machines	4	R	60	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	E	30	-
GET 304	Engineering Communication	2	E	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
MEE 307	Theory of Machines I	3	C	45	-
MEE 308	Manufacturing Technology	2	R	30	-
MEE 309	Thermodynamics	2	C	30	-
MEE 310	Fluid Mechanics	2	C	30	-
MEE 312	Workshop Practice	2	R	15	45
MEE 313	Engineering Metallurgy I	2	R	30	-
MEE 321	Mechanics of Materials	3	C	45	-
MEE 322	Metrology	3	R	45	-
MEE 331	Engineering Drawing III	3	C	15	90
STA 305	Statistics for Physical Science and Engineering	3	E	45	-
TAE 300	Laboratory Practicals	3	R	-	135
TAE 302	Automotive Combustion, Power Train & NVH	3	C	45	-
TAE 303	Mechatronics	3	C	45	-
TAE 304	Dynamics and Control I	3	C	45	-
	Total	56			

Course structure at 400-Level Automotive Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 499	SIWES III	6	C	24 weeks	
MEE 404	Theory of Machines II	3	R	30	45
MEE 403	Applied Thermodynamics & Heat Transfer	4	C	45	45
MEE 405	Fluid Mechanics II	3	C	30	45
MEE 406	Machine Design I	3	C	45	-
TAE 403	Automobile System Design	4	C	45	45

TAE 404	Finite Element Analysis of Structures	3	R	45	-
TAE 405	Applied Aerodynamics	3	R	45	-
TAE 406	Dynamics and Control II	3	R	45	-
	Total	32			

Course structure at 500-Level Automotive Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
MEE 501	Applied Thermodynamics	3	C	45	-
MEE 502	Fluid Dynamics	3	C	45	-
MEE 503	Heat Transfer	3	C	30	45
MEE 508	Engineering Design Process	2	R	30	-
MEE 509	Fracture of Structural Materials	4	R	45	45
TAE 500	Laboratory Practicals	3	C	-	135
TAE 501	Advanced Computer Aided Engineering	3	R	45	-
TAE 502	Automotive Materials and Structures	3	C	45	-
TAE 503	CFD for Engineering Applications	3	R	45	-
TAE 505	Automobile Vehicle Dynamics & Safety	3	C	45	-
TAE 506	Automobile Maintenance and Testing	3	C	45	-
TAE 555	Project	6	C	270	-
	Total	44			

3.3.2 Course Synopses

TAE 302 Automotive Combustion, Power Train & Noise, Vibration and Harshness (3 Units: LH 45)

This course has two components and is taught by two lecturers. The first part introduces students to internal combustion engines, their efficiency and pollutants emission. It looks at the various emerging power technologies in the automotive industry and the current and alternative fuels and combustion processes. Choice of fuel and the design of efficient engine operating parameters and their by products will also be discussed. The second part covers an introduction to vehicle refinement, characteristics of sound, exterior noise and control and interior noise and control.

TAE 303 – Mechatronics (3 Units: LH 45)

To provide an introduction to the application of electronic control systems in mechanical and electrical engineering. To give framework of knowledge that allows students to develop an interdisciplinary understanding and integrated approach to mechatronics engineering.

TAE 304 - Dynamics and Control I (3 Units: LH 45)

Students will be introduced to various applications of feedback control systems and develop fundamentals associated with modelling, analysis, design and simulation of automatic control systems. This course also aims to introduce the basic concepts of machine dynamics and their engineering applications, and deals with the analysis, design and application of a variety of mechanisms.

TAE 403 Automobile System Design (4 Units: LH 60)

Auto Engine design; Design of steering systems; Design of transmission systems.

TAE 404 Finite Element Analysis of Structures (3 Units: LH 45)

The course will equip the students with the necessary knowledge to use finite element analysis to solve problems related to solid mechanics, dynamics and heat-transfer. In particular, students will have hands-on experience in using finite element analysis software ANSYS and MSC Nastran to solve realistic engineering problems.

TAE 405 Applied Aerodynamics (3 Units: LH 45)

The aim of this course is to introduce students to the fundamentals and practical aspects of incompressible and compressible flows and the design and operation of flow systems, including pipe networks, automobiles and flight vehicles. The course content includes: flow of inviscid and viscous fluids; laminar and turbulent flow in pipes and boundary layers; losses in pipe systems; lift and drag forces on moving bodies, aerofoil theory; incompressible-flow machines; fundamentals of compressible flow; 1-D pipe flow; compressible flow nozzles; Rayleigh flow; Fanno flow; external compressible flow around bodies including transonic and supersonic vehicles; design considerations; experimental techniques

TAE 406 Dynamics and Control II (3 Units: LH 45)

Dynamic systems are found everywhere, from musical instruments to transportation vehicles such as automobiles and aircraft. Even static civil structures such as bridges and buildings exhibit a dynamic response, which must be considered during design and construction of such systems. This course introduces the fundamental concepts of vibrating dynamical systems, from single degree of freedom systems through to continuous and multi-degree of freedom systems. Design of vibration control devices, such as vibration isolators and vibration absorbers, is also considered. Concurrently with the introduction to vibratory systems described above, this course also addresses how to control such dynamic systems using modern state-space control. This involves time domain descriptions of dynamic systems using state-space system models. The characteristics responsible for the dynamic response (poles, zeros, eigenvalues) are presented. Control laws using state-space are introduced, including specification of controller characteristics, controller design using

pole placement and optimal (LQR) control (introduction). State observers are presented, including observer design using both pole placement and optimal (Kalman) observers (introduction). Finally, a computer aided control system design methodology is applied to a real MIMO Aerospace platform and several other unstable MIMO systems.

TAE 501 Advanced Computer Aided Engineering (3 Units: LH 45)

This course introduces the student to a variety of CAD, CAM and CAE packages that are currently available and in common use by the automotive industry. There will be hands on opportunities and the function and theories behind of each piece of software reviewed. Students will be encouraged to familiarize themselves with the operation of the software through problem based assignments.

TAE 502 Automotive Materials and Structures (3 Units: LH 45)

The course examines the different types of materials used in the automotive industry, including metals, ceramics and composites. Selection of the appropriate material for a variety of applications will be discussed in terms of the material properties, ease of manufacture and performance in the anticipated service environment. Case studies will be used to demonstrate the design principles used when using each of these materials for automotive applications. The course develops an understanding of the mechanics of complex practical situations through the establishment and solution of an appropriate boundary value problem

TAE 503 CFD for Engineering Applications (3 Units: LH 45)

The course will equip the students with the necessary knowledge to use advance computational techniques to solve problems related to flow mechanics. In particular, students will have hands on experience in using computational fluid dynamics to solve engineering problems. Numerical representation of flow behaviour and solution schemes and convergence criteria will be also covered in the course.

TAE 505 Automotive Vehicle Dynamics & Safety (3 Units: LH 45)

This course will educate students in automotive vehicle dynamics and safety. The course will cover the dynamics of vehicles on the road during normal operation as well as during impact and other crash scenarios. Specific topics include vehicle handling, stability and control, tyre dynamics, suspension design, braking performance, automotive safety, impact dynamics, road safety engineering and safety regulations.

3.4 BIOMEDICAL ENGINEERING/TECHNOLOGY

3.4.1 Philosophy, Aims and Objectives of the Programme

Philosophy

- i. To provide excellence in knowledge acquisition, management and usage of Health Diagnostic and Therapeutic Tools,
- ii. Explore the frontiers of technology and provide solutions to various problems in biomedical science and engineering
- iii. Provide intuitively relevant scientific and innovative focus on application of engineering principles, methodologies and techniques to the medical field,
- iv. To combine the design and problem solving skills of engineering with medical and biological sciences to improve overall healthcare diagnosis and treatment.

Aims and Objectives:

- i. The Main aims of a Bachelor's degree in Biomedical Technology are:
- ii. To provide students with a broad and balanced scientific and practical foundation to be able to function as professional Biomedical Technology practitioners.
- iii. To inculcate in students a sense of enthusiasm in the profession in order to enhance their capacity to apply skills in biomedical technology in the solution of theoretical and practical problems in healthcare.
- iv. To involve the students in an intellectually stimulating and satisfying experience of learning, studying and research.
- v. The application of engineering principles and techniques to the medical field, to combine the design and problem solving skills of engineering with medical and biological sciences to improve healthcare diagnosis and treatment.
- vi. To develop in students, through education in biomedical technology, a range of transferable skills of value in medical equipment design, research and development.
- vii. To provide students with a knowledge and skills base from which they can proceed to further studies in specialized areas involving medical sciences and ever changing technological innovation to enhance healthcare delivery.
- viii. To empower graduates of Biomedical Technology with skills that will enable them engage in income yielding ventures as well as increasing their entrepreneurial capacity.

3.4.2 Admission Requirements

There are three different pathways by which candidates can be admitted into the programmes in the discipline: the Unified Tertiary Matriculation Examination (UTME), the Direct Entry, and Inter-University Transfer.

Unified Tertiary Matriculation Examination (UTME)

Candidates seeking enrolment into the Programme must obtain Ordinary level passes at credit level (at not more than two sittings) in five subjects including Mathematics, Physics, Chemistry, Biology and English Language.

Direct Entry

Candidates seeking enrolment into the Programme must obtain two A Level passes in WAEC or GCE in Biology, Chemistry and Physics, provided they have satisfied the requirements of UTME as stated above.

Inter-University Transfer Mode

Students can transfer into 200-Level courses provided they have the relevant qualifications and the requisite CGPA.

3.4.3 Learning Outcomes

Regime of Subject Knowledge

Major aspects of the basic science courses including Biology, Chemistry, Physics, Mathematics, Genetics and Molecular Biology, Biostatistics, Computer Sciences up to advanced levels.

Major General Studies courses including use of English language to ensure that students are conversant with the English Language structure and function, writing skills, lexis, letters and memorandum, speech writing and term papers, etc.; other General Studies including Social Sciences and Humanities.

The Basic Medical Science including Gross Anatomy, Physiology and Biochemistry.
Core subjects of Biomedical Technology

Laboratory postings are conducted at specified and regular intervals in all core Biomedical Technology courses. Students are posted to specific hospital based clinics and laboratories for professional experience under the supervision of experienced clinicians/technologists in Biomedical Technology and Lecturers as part of the students industrial work experience scheme (SIWES).

Field trips are conducted and students are taken for further professional exposure/experience in utility departments (e.g. water treatment plants); industries (e.g. Breweries, Food and Beverage especially for quality assurance and control); community

health centres for epidemiological studies; especially clinics and bays e.g. leprosaria, tuberculosis/HIV units; sickle-cell anaemia clinics; renal units etc., for further experience on monitoring and diagnosis. They will also be posted to related companies/factories to acquire some entrepreneurial skills.

Scored log books are kept and signed for day-to-day posting experiences for each student.

Students are also expected to take the following auxiliary courses before graduation.

Laboratory instrumentation and techniques covering all the areas of biomedical technology.

Laboratory management and functions

Pharmacology and Toxicology

Research Methodology

Professional ethics in biomedical technology practice

Biomedical engineering to expose them to fabrication and repairs of

Medical equipment and instruments

Theory and practice of entrepreneurship

Information Technology

A foreign language (e.g. French) as an elective

Competences and Skills

At bachelor's degree level, students are expected to develop a wide range of different abilities and skills including:

- i. Biomedical Technology related cognitive abilities and skills relating to intellectual tasks, including problem solving.
- ii Biomedical Technology related practical skills i.e. relating to the conduct of laboratory research work.
- iii Transferable skills that may be developed in the context of a general nature.

Transferable Skills may include:

- i. Communication Skills (both written and oral). It is suggested that the French language be offered as a 2 unit elective.
- ii. Problem – solving skills, numeracy and computational skills – including qualitative and quantitative information extending to conditions where evaluations have to be made on the basis of limited information, including error analysis, correct use of units and modes of data presentation.
- iii. Information retrieval skills e.g. on-line computer searches, also other information sources; other information technology skills – word processing; data logging and storage, internet communication.

- iv. Interpersonal skills, fine management and organisational skills – relating to the ability to interact with others and to engage in team-working, ability to plan and implement efficient and effective modes of working.
- v. Study skills needed for continuing professional development (CPD).

Behavioural Attributes

On graduation, students would have been well equipped with sound professional ethics for the profession of Biomedical Technology – including good reputation and fulfilment of professional role with integrity; refraining from its misuse to the detriment of patients particularly in respect to health and safety as well as information confidentiality and general responsibility; discipline and the use of reason, personal relationships – inter and intra professional; Act of good faith, value judgment, skill and care, with well-being of patients; Conscientious in all his/her undertakings.

3.4.4 Course Structure

YEAR I 100 LEVEL COURSES CORE COURSES

Course Code.	Course Title	Units	Status	LH	PH
PHY 101	General Physics I	4	C	60	
ENG 101	Workshop practice I	1	C	-	45
ENG 103	Engineering Drawing I	1	C	-	45
MTH 101	Elementary Mathematics I	4	C	60	-
CHM 101	General Chemistry I	4	C	60	-
BIO 101	General Biology I	3	C	45	-
MTH102	Elementary Mathematics II	4	C	60	-
BIO 102	General Biology II	3	C	45	-
GST 111	Communication in English 1	2	C	30	-
GST 121	Use of Library, Study Skills and ICT Humanities	2	C	30	-
GST 122	Communication in English II	2	C	30	-
GST 125	Contemporary Health Issues	2	R	30	-
GST 123	Communication in French	2	E	30	
BIO 104	Biology for Agric and Biological Science II	3	C	15	-
CHM 102	General Chemistry II	4	C	60	-
PHY 102	General Physics II	4	C	60	-

ENG 102	Workshop Practice II	1	C	-	45
ENG 104	Engineering Drawing II	1	C	-	45
	TOTAL	47 Units			

YEAR II
200 LEVEL COURSES
CORE COURSES

Course Code.	Course Title	Units	Status	LH	PH
GST 211	Environment and Sustainable Development	2	E	30	-
CSC 201	Computer and Applications	4	C	60	-
ENG 213	Engineering Mechanics I (Statics)	2	C	30	-
ENG 221	Electrical and Electronic Engineering I	3	C	45	-
ENG 219	Bioengineering Materials I	2	C	30	-
BME 201	Human Anatomy I	2	C	30	-
BME 203	General Biochemistry	2	C	30	-
BME 205	General Microbiology	2	C	30	-
BME 211	Human Physiology I	3	C	45	-
ENG 224	Engineering Mechanics II (Dynamics)	2	C	30	-
ENG 226	Electrical & Electronic Engineering II	2	C	30	-
ENG 228	Bioengineering Materials II	2	C	30	-
BME 202	Human Physiology II	2	C	30	-
BME 204	Medical Biochemistry	2	C	30	-
BME 206	Medical Microbiology	2	C	30	-
BME 208	Organic Chemistry for Health Professionals	2	C	30	-
PHT 204	Health and Human Behaviour	2	C	30	-
BME 202	Introduction to Biomedical Technology	1	C	15	-
ENG 204	Biomedical System Analysis	2	C	30	-
BME 212	Human Anatomy II	2	C	30	-
SIWES 200	SIWES	2	C	-	90
	TOTAL	45 Units			

YEAR III
300 LEVEL COURSES
CORE COURSES

Course Code.	Course Title	Units	Status	LH	PH
ENG 319	Thermo fluids for Health Professionals	2	C	30	
PTE 301	Polymer Chemistry in Medicine	2	C	30	-
BME 301	General Pathology	2	C	30	-
BME 303	Introduction to Pharmacology	2	C	30	-
BME 305	Introduction to Clinical Studies	2	C	30	
BME 306	Clinical Deformities and Rehabilitation Engineering	2	C	30	
BME 307	Introduction to Bionics	2	R	15	45
BME 309	Organization and Delivery of Health Services	2	C	30	-
BME 311	Biomedical Electronics 1	2	C	30	
BME 313	Biomedical Instrumentation 1	2	C	30	
BME 321	Human Biomechanics	2	C	30	-
BME 331	Biomedical Electronics II	2	C	30	-
BME 333	Biomedical Instrumentation I	2	C	30	-
BME 381	Introduction to Human Biotechnology	2	C	30	-
GST 314	Entrepreneurship I	2	R	30	-
BME 304	Statistics for Health Technology	2	C	30	-
BME 322	Introduction to Sports Medical Technology	2	C	30	-
BME 312	Clinical Deformities and Management	2	C	30	-
BME 342	Introduction to Safety Engineering	2	C	30	
BME 334	Biomedical Instrumentation II	2	C	15	45
BME 352	Biomedical Radiation Technology	2	C	30	-
	TOTAL	42 Units			

YEAR IV
400 LEVEL COURSES
CORE COURSES

Course Code.	Course Title	Units	Status	LH	PH
ENG 407	Mechanisms of Biomedical Devices	3	C	30	45
ENG 409	Biomechanics	2	C	30	-
BME 401	Health Management Information System	2	C	30	-
BME 403	Research Methods and Techniques	2	C	30	-
ENG 405	Biomedical Equipment Design	2	C	30	
BME 407	Mechanism of Biomedical Devices	3	C	30	45
BME 441	Introduction to Biomedical Equipment & Devices	3	C	45	-
BME 443	Indigenous Biomedical Technologies	2	C	30	-
BME 471	Introduction to Clinical & Rehabilitation Engineering Technology	2	C	30	-
BME 473	Ergonomics and Occupational Safety	3	C	45	-
BME 475	Environmental Pollution Biohazards and Laboratory Safety	3	C	45	-
BME 405	Seminars	2	C	30	-
SIW 400	Clinical Engineering Internship/Industrial Training in a relevant industry/hospital	4	C	-	180
SIW 402	Long Vacation SIWES in a relevant industry/hospital	2	C	-	90
	TOTAL	35 Units			

YEAR V
500 LEVEL COURSES
CORE COURSES

Course Code.	Course Title	Units	Status	LH	PH
ENG 501	Biomedical Devices Design	3	C	45	-
ENG 503	Biomedical Devices Manufacturing Processes	2	C	15	45
BME 501	Project	2	C		180
BME 511	Biomedical Signal Processing	2	C	30	-
BME 531	Biomedical Telemetry	3	C	45	-
BME 581	Genetic and Tissue Engineering	3	C	45	-
BME 561	Biomedical Informatics	3	C	45	-
BME 591	Industry-based Project	6	C	-	240
GST 504	Entrepreneurship III	2	R	15	45
BME 552	Clinical Imaging Technology	2	C	60	-
BME 562	Computer-Aided Design of Biomed, Equipment	2	C	60	-
BME 572	Equipment Reliability and Safety Technology	2	C	60	-
	TOTAL	32 Units			

3.4.5 Course Synopses

100 LEVEL COURSES

GST 111: Communication in English

(2 Units: LH 30)

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

GST 112: Logic Philosophy and Human Existence

(2 Units: LH 30)

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 or 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: LH 30)

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 Environmental problems.

GST 121: Use of Library, Study Skills & ICT **(2 Units: LH 30)**

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: LH 30)**

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: LH 30)**

Introduction to French, Alphabets and numeric for effective communication (written and oral), Conjugation and simple sentence construction based on communication approach, Sentence construction, Comprehension and reading of simple texts. OR 18

GST 211: Environment and Sustainable Development **(2 Units: LH 30)**

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: LH 30)**

Basic Concepts in peace studies and conflict resolution, Peace as vehicle of unity and development, Conflict issues, Types of conflict, 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 organizations in conflict resolution, e.g. ECOWAS, African Union, United Nations, etc.

GST 223: Introduction to Entrepreneurship

(2 Units: LH 30)

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.

GST 224: Leadership Skills

(2 Units: LH 30)

Transformation is a fundamental shift in the deep orientation of a person, organization or society such that the world is seen in new ways and new actions and results become possible that were impossible prior to the transformation. Transformation happens at the individual level but must be embedded in collective practices and norms for the transformation to be sustained. Leadership Development Programme (LDP) proposes novel approaches to teaching and learning, which emphasizes the practical involvement of participants. It is interactive and involves exercises and actual implementation of breakthrough projects by teams that make difference in the lives of the target population. In this course, leadership concepts comprising of listening, conversation, emotional intelligence, breakthrough initiatives, gender and leadership, coaching and leadership, enrolment conversation and forming and leading teams will be taught

GST 311: Entrepreneurship I

(2 Units: LH 30)

Some of the ventures to be focused upon include the following: Soap/Detergent, Tooth brushes and Tooth paste making. Photography; brick, nails, screws making; dyeing/Textile blocks paste making; rope making, plumbing, vulcanizing, brewing, glassware, production/Ceramic, production Paper production; Water treatment/Conditioning/ Packaging; Food processing/packaging/preservation; Metal working/Fabrication – Steel and aluminum door and windows; Training industry; Vegetable oil/and Salt extractions; Fisheries/Aquaculture; Refrigeration/Air conditioning; Plastic making; Farming (crop); Domestic Electrical wiring; Radio/TV repairs; Carving; Weaving; Brick laying/making; Bakery ; Tailoring; Iron welding; Building drawing; Carpentry; Leather tanning; Interior decoration ;Printing; Animal husbandry (Poultry, Piggery, Goat etc); Craft – Blacksmith, Tinsmith etc ;Sanitary wares; Vehicle maintenance; Bookkeeping;

Common Science courses-100 Level

BIO 101: General Biology I

(3 Units: LH 45)

Characteristics of living and non-living things. Scientific methods to biology concepts. Taxonomy of living organisms – Microbes, Plants including field and herbarium methods, animals including vertebrates and invertebrates. Morphology and life cycles of phyla and plant kingdoms. Cell concepts, structure, organization, functions, and chemical and physical characteristics. Cells, tissues and organ systems and organisms. Elements of biological chemistry – cellular metabolism

- aspects of organic, inorganic and physical chemistry relevant to biology. Elements of ecology and types of habitats

BIO 102: General Biology II (3 Units: LH 45)

Genetics and its scope. Mendel and his laws of inheritance. Physical and chemical basis of inheritance. Man as an object of genetics. Modifications of classical Mendelian ratios. Heredity and environment. Probability and the chi square test. Quantitative and multiple allelic inheritance. Sex determination and development, sex linkage and sex abnormalities. Mutations, Heredity, Eugenics and the future of mankind.

BIO 107: General Biology Practical I (1 Unit; PH 45)

Laboratory experiments designed to illustrate the topics covered in

BIO 108: General Biology Practical II (1 Unit; PH 45)

Experiments designed to emphasise the practical aspects of topics of course

CHM 101: General Chemistry I (3 Units: LH 45)

Atoms, molecules and chemical reactions. Modern electronic theory of atoms. Electronic configuration, periodicity and building up of the periodic table. Hybridization and shapes of simple molecules. Valence Forces; Structure of solids. Chemical equations and stoichiometry; Chemical bonding and intermolecular forces, kinetic theory of matter. Elementary thermochemistry; rates of reaction, equilibrium and thermodynamics. Acids, bases and salts. Properties of gases. Redox reactions and introduction to electrochemistry. Radioactivity.

CHM 102: General Chemistry II (3 Units: LH 45)

Historical survey of the development and importance of Organic Chemistry; Electronic theory in organic chemistry. Isolation and purification of organic compounds. Determination of structures of organic compounds including qualitative and quantitative analysis in organic chemistry. Nomenclature and functional group classes of organic compounds. Introductory reaction mechanism and kinetics. Stereochemistry. The chemistry of alkanes, alkenes, alkynes, alcohols, ethers, amines, alkyl halides, nitriles, aldehydes, ketones, carboxylic acids and derivatives. The Chemistry of selected metals and non-metals. Comparative chemistry of group IA, IIA and IVA elements. Introduction to transition metal chemistry.

CHM 107: General Chemistry Practical I (1 Unit: PH 45)

Laboratory experiments designed to reflect topics presented in courses CHM 101 and CHM 102. These include acid-base titrations, qualitative analysis, redox reactions, gravimetric analysis, data analysis and presentation.

CHM 108: General Chemistry Practical II (1 Unit: PH 45)

Continuation of CHM 107. Additional laboratory experiments to include functional group analysis, quantitative analysis using volumetric methods.

CSC 101: Introduction to Computer Science (3 Units: LH 30, PH: 45)

Survey of computers and information processing and their roles in society. This course introduces a historical perspective of computing, hardware, software, information systems, and human resources and explores their integration and application in business and other segments of society. Students will be required to complete lab assignments using the PC's operating system, and several commonly used applications, such as word processors, spreadsheets and graphics presentations applications. Internet and on-line resources, browsers and search engines.

MTH 101: Elementary Mathematics. (3 Units: LH 45)

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.

PHY 101: General Physics I (3 Units: LH 45)

(Mechanics, Thermal Physics and Waves). Space and time, units and dimension, kinematics; Fundamental laws of mechanics, statics and dynamics; work and energy; Conservation laws. Moments and energy of rotation; simple harmonic motion; motion of simple systems; Elasticity; Hooke's law, Young's shear and bulk moduli, hydrostatics; Pressure, buoyancy, Archimedes' principles; Surface tension; adhesion, cohesion, capillarity, drops and bubbles; Temperature; heat, gas laws; laws of thermodynamics; kinetic theory of gases; Sound. Types and properties of waves as applied to sound and light energies. Superposition of waves. Propagation of sound in gases, solids and liquids and their properties. The unified spectra analysis of waves. Applications.

PHY 102: General Physics II (3 Units: LH 45)

(Electricity, Magnetism and Modern Physics) Electrostatics; conductors and currents; dielectrics; magnetic fields and electro- magnetic induction; Maxwell's equations; electromagnetic oscillations and waves; Coulomb's law; methods of charging; Ohm's law and analysis of DC circuits; AC voltages applied to Inductors, capacitors and resistance.

PHY 107: General Practical Physics I (1Unit: PH 45)

This introductory course emphasizes quantitative measurements, the treatment of measurement errors, and graphical analysis. A variety of experimental techniques should be employed. The experiments include studies of meters, the oscilloscope, mechanical systems, electrical and mechanical resonant systems, light, heat, viscosity, etc., covered in PHY 101 and PHY 102.

However, emphasis should be placed on the basic physical techniques for observation, measurements, data collection, analysis and deduction.

PHY 108: General Practical Physics II

(1 Unit: PH 45)

This is a continuation of PHY 107

ENG 101 Workshop Practice I

1Unit PH 45

General: Use of Engineering Measuring instruments – Calipers e.g. Vernier calipers; Gauges e.g. Micrometer screw gauge and other devices. Introduction to hand tools, proficiency in the use of wood planer, Hand saw, Sanders and Pattern making. Sheet metal work: Production of sheet metal products layouts, cutting, shaping, simple bend theory etc. Introduction of joining techniques: Soldering, brazing, fusion welding, fastening and assembly. Basic wood working principles and tools finishing and evaluation of finished products.

ENG 102 Workshop Practice II

1 Unit PH 45

Industrial Safety: Safety Code of conduct and safety consciousness. Survey of common sources of accidents in the work place. Accident prevention and control.

Machine Shop Work: Working Components in a Lathe machine, instructions in simple metal working processes e.g. shaping, milling, grinding, reaming, metal spinning, design of jigs and fixtures and CAD, automobile wok, simple automotive diagnosis and repairs.

Electrical Workshop Practice: Convention and application of colours, codes for cables, resistors etc and signs, use of simple electrical tools, machines etc.

ENG 103 Engineering Drawing I

1 Unit PH 45

Introduction to Engineering Tools: Planning and layout of Engineering Drawing. Engineering Drawing Concept. Introduction to Dimensioning Types; Dimensioning of circles, holes, radii, tolerance, descriptive Geometry, Freehand sketching.

Introduction to Drawing/Drafting software and CAD basic tools. Orthographic multi view projection. Construction of plane shapes using CAD Construction techniques.

Presentation of Data and results. Using charts, graphs etc by appropriate Computer Software. Further dimensioning, addition of dimensions to drawing using CAD.

ENG 104 Engineering Drawing II

1 Unit PH 45

Connections in Engineering Drawing. Introduction to IS Code of Drawing. Conics and Engineering Curves ellipse, parabola, hyperbola, cycloid, trochoid, involutes. Projection of planes and solids (cube, prism, pyramid, cylinder, core and sphere).Projection on auxiliary planes. Isometric projection. Introduction to section drawing a use of CAD Construction techniques. Development and intersection of surfaces. Detail drawing with the addition of machine and surface texture symbols. Simple assembly drawing with suitable fits and a part list and introduction to limits and tolerances. Screw threads, fasteners and springs including keys and key ways.

200 LEVEL COURSES

GST 211 Nigerian and African Culture 2 Units LH 30

Introduction: The nature and scope of politics and economics. Definition of basic concept in economics and political science

Nigeria's Public Sector: The political set up in Nigeria. The civil service structure, public investment and economic infrastructure. The economic role of government: government expenditures and revenues, fiscal federalism and revenue allocation.

Nigeria's private Sector: The financial system in Nigeria. The role of the agricultural sector in the development process. The industrial sector and public investment in Nigeria. Human resources development and utilization in Nigeria. National development planning-problems and prospects, aspects of economic and technological dualism. Political and Economic future of Nigeria. A global perspective of economics; economic system and developing nations' economies. International trade and economic development; balance of payments, commercial policies of Nigeria and other developing countries. Economic integration; state and structure of economies of ECOWAS countries, ECA and Economics Co-operation in Africa. Foreign aid and investments: The multinational corporations, technological transfer and technology dependence. Global inter dependence and the new international economic order. World economic crisis-energy and OPEC, food storage and armament.

CSC 201 Computer and Applications 4 Units LH 45 PH 45

Introduction to digital computer, their uses and modern programming techniques. Brief history of computers, generation of computers, structure of a general purpose computer general problem solving, systematic development of algorithms, flow diagrams, meaning of logical processes analysis of computational problems coding of programs, verification and validation of programs. Practical experience operating computers, and peripheral equipment. Extensive practice with one or more higher level language. Emphasis on technical applications. Elementary numerical algorithms.

ENG 213 Engineering Mechanics I (Statics) 2 Units LH 30

Basic concepts in statics, Statics of particles and rigid bodies in a plane; analysis of forces; distributed forces, vectors, flexible cable, friction static and dynamic. Equilibrium of a particle and equilibrium of Rigid body, Areas, Centroids, masses, centres of gravity, analysis of structures; internal forces, Newton's third law, shearing forces, moments, trusses and frames. The basics of free body diagrams. General mathematical principles. Moments of inertia of an area. Computer application and simulations in statics.

ENG 219 Bioengineering Materials I 2 Units LH 30

Atomic structure; Solid state; Biomolecular structure; Structures of selected materials used in biology and medicine; physical, chemical, mechanical, electrical, magnetic, optical and thermal properties of materials; Introduction to natural and artificial biomaterials – transplants, implants, prostheses and artificial organs; mechanics of biomaterials

ENG 221 Electrical and Electronic Engineering I 3 Units LH 45

Review of electrostatics and electromagnetism. Transient and steady-state analysis of circuits. theorem and techniques. Passive and active circuits and building blocks. Sinusoidal circuits. Introduction to electronic circuits and devices. Bipolar analysis and phases. PN junctions and diodes. Transistors. Introduction to integrated circuits and design.

ENG 224 Engineering Mechanics II (Dynamics) 2 Units LH 30

Newtonian principles of dynamics of particles and rigid bodies applied to one-dimensional and two-dimensional motions. Force system resultants. Structural analysis, kinematics and kinetics of particles and rigid body motions, methods of impulses and momentum, linear and angular momentum, work and energy, relative motion concepts. Computer applications and simulation of engineering mechanics and dynamics.

ENG 226 Electrical and Electronic Engineering II 2 Units LH 30

Transformers and their principles of operation. Motors, generators; single and poly-phase system. Introduction to instrumentation. Introduction to bionics

ENG 228 Bioengineering Materials II 2 Units LH 30

Engineering properties of biomaterials; Fatigue of biomaterials Applications of Materials in medicine – cardiovascular, surgical, dental ophthalmologic, orthopaedic applications; Bioelectrodes and bio(medical) sensors; Compatibility of biomaterials; Tissue-material interactions; host response to biomaterials; Biomaterials failure.

BME 201 Human Anatomy I 2 Units LH 30

Overview of cell biology; tissue structures and human histology; Basic structure of the human body; Body planes and positions; The Skeleton; regional anatomy of the Upper limb, Lower limb, Thorax and Abdomen

BME 202 Human Physiology II 2 Units LH 30

Gastrointestinal system; Integumentary system; Immune system; Endocrine system; Reproductive system; Fetal and Neonatal physiology; Nervous system,. Introduction to electrophysiology

BME 203 General Biochemistry 2 Units LH 30

Review of general chemistry: chemical elements and the periodic table. Electronic configuration, electronic orbital, valency of atoms, and types of Chemical bonds; Metals and non-metals; Acids and bases, highlighting Lewis Conception; Carbon, sp³ hybridization, the tetrahedron and covalent bond; functional groups; water and its special properties. Introduction of the cell and hierarchy of organization of living things: macromolecules, organelles, cells, tissues. Organs and organism. Amino acids, proteins; the peptide bond and polypeptides; proteins as biological catalysts, immune agents and structural molecules. Carbohydrates; the glycosidic bond; relationship of photosynthesis and tissue respiration; carbohydrate as storage molecule of easily accessible metabolic energy. Fatty acids and lipids: the ester bond of lipids and triglycerides; Fat as efficient energy storage molecule. Nucleic acids and nucleotides: DNA and RNA as polymers of nucleotides; the phosphodiester bond; Gene and genetic information transcription and translation.

BME 204 Medical Biochemistry

2 Units LH 30

Carbohydrate metabolism; Glycolysis and Intermediary metabolism. Electron transport and oxidative phosphorylation. Disorders of carbohydrate metabolism (e.g. Diabetes etc.). Body lipids and lipid metabolism; Disorders of lipid metabolism. Amino acid and protein metabolism; disorders of protein metabolism. Gene expression and molecular diseases (e.g. Sickle cell. etc.). Liver function and tests. Renal function and tests. Blood chemistry (including haemopoiesis). Hormones and metabolism; endocrinal diseases (e.g. goiter, etc.)

BME 205 General Microbiology

2 Units LH 30

History and scope of microbiology; the general characteristics of microorganisms. Prokaryotic and eukaryotic microorganisms. Bacterial morphology and cell structure. Growth and reproduction of microorganisms. Biochemical reactions of microorganisms. Antimicrobial agents Systematic classification of bacteria, fungi, viruses, algae and protozoa.

BME 206 Medical Microbiology

2 Units LH 30

Introduction to Medical microbiology: Basic concept and terminology infection and disease, pathogenicity and virulence. Immunity, hypersensitivity, latency and communicability, pathogenic properties of Bacteria... Invasiveness. Toxigenicity and Exotoxins. Virulence properties. Host Defence Mechanisms. Skin and Mucous Membrane Barriers, phagocytic Defence and inflammation.

Bacterial infections: The pathogenicity, morphology and cultural characteristics of certain groups of bacteria. Gram-positive bacteria: Bacillus, Clostridium, staphylococcus and streptococcus. Gram-negative bacteria – the family Enterobacteriaceae, neisseria, pseudomonas and Vibrio.

Types of mycoses – The morphology, Laboratory diagnosis and treatment of diseases caused by certain group of fungi to include Aspergillus's. Blastomyces, Candida, Cryptococcus, Histoplasma, Sporotrichum and yeasts.

Viral infections: Classification of Viruses – Distinctive properties of Viruses – Methods for the diagnosis of viral infections.

BME 208 Organic Chemistry for Health Professionals 2 Units LH 30

Organic Chemical bonds: formation, types and bond energy, organic chemical reaction types/mechanism: addition, substitution (Nucleophilic and Electrophilic); Thermodynamic and kinetic control of products: Function groups and functional group analysis. Aromatic compounds: Benzene ring, etc. stereochemistry and Stereoisomerism, Steroids: structure and function. Organometallic compounds; haemoglobin, chlorophyll etc.

PHT 204 Health and Human Behaviour 2 Units LH 30

Application of social theories towards understanding the behavioural aspects of health and medical care. Consideration of behavioural dimensions in illness and disease. Prophylactic behaviour, the role of culture, compliance behaviour, social epidemiology etc.

BME 202 Introduction to Biomedical Technology 1 Unit LH 15

Assessment of forces experienced by the bones, joints and muscles during exercise osteo-kinematics and arthro-kinematics; Application of fundamental physics, biological, and chemical principles to human body function.

Bio- and Medical technology: Impact of technology on biology and medicine. Biomedical engineering: definition, history and components.

Biomedical Engineering, Health technology and Human System: Man as a living machine; Human System and Instrumentation Research, Development, Education, Training, Certification and Practice of biomedical engineering and health technology. Problems and prospects of biomedical engineering and health technology in Nigeria and Africa.

Economic consideration. Medical Equipment procurement and maintenance. Technology transfer. Safety and regulatory concerns. Ethical factors in human experimentation.

Future perspectives in biomedical engineering.

ENG 204 Biomedical System Analysis 2 Units LH 30

Advanced Mathematical Concepts: Linear relations and Functions: Systems of equations and Inequalities; Polar coordinates and complex numbers; Exponential and Logarithmic functions; Iteration; Statistics and Data Analysis; Limits, Derivatives and integrals: Applications of Differentiation and Integration.

Mathematical methods and Models; Numerical methods; Finite differences; Solutions of Differential equations; Role and Application of models in biology and medicine. Development of Computer simulation techniques to study physiological system.

BME 211 Human Physiology I 3 Units LH 45

Basic concept of Human physiology; Cellular physiology; Homeostasis; Musculoskeletal System; Cardiovascular System; Respiratory System; Urinary System.

BME 212 Human Anatomy II

2 Units LH 30

Embryology and human Development; Regional anatomy of the pelvis, Perineum, Head, Neck, Brain, Vertebral canal and Spinal cord.

300 LEVEL COURSES

BME 301 Introduction to General Pathology (1, 0, 1)

2 Units LH 15 PH 45

Definition of pathology, disease and relevant terms used in pathology, the causes and classification of diseases, cell damage and its sequel. Inflammation, its function and types. Cardinal signs and mechanisms of inflammation. Infection and body's defense against it. Cross infection and its control. Some important bacterial, fungal and viral infection including Tuberculosis, hypertrophy, dysplasia and dystrophy. Tumors, their aetiology, types, Classification and characteristics. Cysts, their formation and classification Developmental anomalies or disturbances. Effects of ionizing radiation on human tissues. Trauma – wounds. Fractures dislocations and bleeding. Systems pathology, disorders of blood disorders of red cells. WBC's and thrombocytes. Disorders of circulation. Disorders of the heart, disorders of the respiratory system. Diseases of the gastro – intestinal tract, disorders of bones and joints.

BME 303 Introduction to Pharmacology

2 Units LH 30

Historical Development of Pharmacology; Divisions of pharmacology and their applications: Definitions of terms and abbreviations: concept and nature of drugs; Pharmacodynamics; pharmacokinetics; classification of drugs and their importance; drug abuse and controlled; drug; drug noncompliance or misuse, introduction to Toxicology and its importance general principles of poisoning managements.

BME 311 Biomedical Electronics I

2 Units LH 30

Electrostatics and electromagnetism; Electronic devices – Thermionic and Semiconductor devices; Basic electronic circuits – transformers, power supply, dc and ac circuits; Amplifier, oscillators, operation amplifiers and thyristors.

BME 313 Biomedical Instrumentation I

2 Units LH 30

Biosensors and transducers – types and forms; Instrumentation system processors – analog and digital signals, signal conversion and data processing; Display and storage systems – data acquisition and recorders.

BME 321 Human Biomechanics

2 Units LH 30

Fundamental Principles of mechanics applied to study the physiology of biological systems; Introduction to the basic concepts of continuum mechanics – tensors, finite deformation kinematics, stress, conservation laws of mass, momentum and energy applied to deformable

continua; Rigid body kinematics in the context of applications in biomechanics. Application of biomechanics in tissues such as bone, ligaments, skeletal, cardiac muscles and cartilages. Skeletal muscle and mechanism of movement; Biomechanical implications of the sliding filament theory; velocity-force curves; Lever mechanics; Types of muscle fibers.

BME 352 Biomedical Radiation Technology 2 Units LH 30

Review of physical concepts of radiation – atomic and nuclear structures, electromagnetic spectrum, x-ray production, radioactive decay; Ionizing and non-ionizing radiation; X-ray interaction, basic radiobiology, radiation dosimetry and protection; Legislation and regulations for radiation protection.

BME 342 Introductions to Safety Engineering 2 Units LH 30

Principles of general safety and safety education; home safety, fire safety, personal protection and firearm safety; Road traffic and pedestrian safety; Occupational safety; Natural and man-made disasters; Health assurance.

BME 305 Introduction to Clinical Studies 2 Units LH 30

Introduction to the clinical sciences; Overview of medicine and surgery and the medical technologies involved in disease diagnosis and treatment; Basic obstetrics, gynaecology and paediatrics and a review of biomedical technologies in medical diagnosis and therapeutics.

BME 334 Biomedical Instrumentation II 2 LH 15 PH 45

Blood pressure measurement; Blood flow measurements; Measurement of the respiratory system; Clinical laboratory instrumentation; Electrical safety in instrumentation.

BME 331 Biomedical Electronics II

Study of medical equipment used in health care, especially critical care; Sources of bioelectric potentials and use in electrocardiograms, electroencephalograms and electromyograms; Operating principles of patient monitors, defibrillators, pace makers etc.; Electrical hazards and patient/user safety.

GST 314 Entrepreneurship II 2 Units LH 30

Technology development and entrepreneurship; evolution of industrial, domestic, and commercial products; identification of society's need, market surveys, invention, diffusion, patents, trademarks, and copyrights.

Maintenance culture: Concepts of repair and maintenances of equipment and units. Maintenance scheduling. Business planning; financial accounting and marketing; consultancies; small business start-ups and managements. Internet connectivity methods and analysis. Products research and development methods using internet browsing. Practice; innovative solutions to inventions needs

chosen by students; development of new product or processes. Development of business plans and proposals.

ENG 319 Thermo-fluids for Health Professionals 2 Units LH15 PH 45

Fundamental concepts of thermo-fluids; First law of thermodynamics. Conservation of mass in a closed system. Second law of thermodynamics; relationships of enthalpy and free energy. Concept of thermodynamics efficiency. Pressure, volume and temperature (PVT) relationships; general gas law and equation. Third law condition for absolute order in crystalline system. Definition of fluid. Monometry; forces on plane and curved surface; buoyancy and floatation. Kinetics of fluid motion. Types of flow; continuity equation; energy equation; momentum equation. Fluid resistance; laminar flow and turbulent flow. Modes of heat transfer. Systems with heat sources; heat transfer in extended surfaces; conduction, radiation and convection; combined modes of heat transfer. Mass diffusion. Condensation. Radiation of heat between black and grey bodies, thermal condensation principles.

CHM 301 Polymer Chemistry in Medicine 2 Units LH 30

Initiation mechanisms (free radical, cationic, stereo-specific) in the polymerization reactions through functional groups and multiple bonds (vinyl and diene). Ring opening, polymer modification, living polymers; distribution between chain and step growth kinetics of vinyl polymerization and poly-condensation. Methods of determination, deviation of equipment, parameters of polymerization. Auto-acceleration, chain transfer, inhibitors, retarders. Raw material; polymerization techniques and properties of polyethylene, polypropylene, polystyrene, polyvinyl chloride, polyvinyl acetate, polyvinyl alcohol, polymethyl methacrylate, polyamides, polyether, polyurethane and inorganic polymers. Polymer characterization; essential characteristics of fiber forming, polymers.

BME 306 Clinical Deformities and Rehabilitation Engineering 2 Units LH 15 PH 45

Definition of Deformity; Classification of Deformity; Causes of Deformities; Amputation; Definition, Indications for amputation, causes of amputation, levels of amputation especially in the lower limbs; Review of lower limb muscles (origin, insertion and action) Causes. Feature and Management of Coxa Vara, Genu Valgum and Varum; Spinal deformity such as scoliosis; Osteogenesis imperfecta, Pes planus and Talipes Equinovarus (Causes, features and management).

BME 307 Introduction to Bionics 2 Units LH 15 PH 45

Definition of bionics; basic and operational; biomimetic and interphase of biology and electronics. Review of the basic principles of electronic. Interphase of biology and electrons to mimic living system. Electronically operated mechanical systems that function as prostheses. Different kinds of bionic appliance. Bionic (biocompatible materials). Design and manufacture of bionic devices. The safety of bionic devices. The maintenance of bionic appliance. Appropriate bionic devices for the Nigerian health system. Ethical concerns in bionics.

BME 304 Statistics for Healthcare Professions 2 units LH 30.

Applications of descriptive, inferential, parametric and non-parametric statistics to health. Theory of probability, sampling techniques, hypothesis testing. Dealing with errors; construction and interpretation of graphs and data tables. Biostatistics; population sampling, structural measurements. Statistical applications to health and medicine. Drug counting. Statistics of health-delivery.

BME 309: Organization and Delivery of Healthcare Services 2 units LH 30

A survey course dealing with the various pattern of organization and delivery of healthcare services. Topics include personal versus public health services, levels of personal health services (primary, secondary, tertiary). Community health services, proprietary healthcare services, ambulatory care services, group practice, complementary care services including traditional medicine and phyto-medicine. Regionalization of healthcare services, various specialties in health and medical care. The implications of various patterns of organization and delivery of health care services for health technology are discussed in relation to each topic indicated.

400 LEVEL COURSES

BME 401 Health Information Management System 2 units LH 30

Study of contemporary medical and information systems, especially as used in morbidity surveys, disease surveillance system, disease registers, etc. Also includes introduction to computer simulation techniques and life-table techniques. Medical and health data based management. Internet and extra-net applications-library, information globalization and teleconferencing.

BME 403 Research Methods and Techniques 2 Units LH 30

Rudiments of research methodology and its application to the health field. Course covers a basic learning of the following aspects; research problems definition, research questions, research and null hypothesis, theoretical – conceptual formulation of research designs, method of research observations, measurements of variables, data analytic techniques, interpretation of research findings, Randomization techniques, epidemiologic research designs and controlled clinical trial.

ENG 405 Biomedical Equipment Design I

Generalized biomedical system; Types and categories of biomedical equipment;
Design criteria – general requirement, design process, mathematical modeling and simulation techniques

ENG 407: Mechanisms of Biomedical Devices (2, 0, 1) 3 Units LH 30 PH 45

Concepts of mechanisms; links, kinematic pairs, kinematics chains and inversion. Types of mechanism; slider- crank mechanisms, muscle as sliding mechanical system; analysis; coupler curves, velocity and acceleration; static and dynamic force; theory of involutes gearing; simple compound and epicyclic gear trains. Dynamics of rotating and reciprocating devices. Information and communication technology in the understanding and application of mechanisms. Friction, wear, lubrication; application in kinematical and selection of power screws; belts and rope drives; chains, brakes, and clutches, hydrodynamic and hydrostatic lubrication; hydrodynamic drives; torques, converters, hydraulic system.

BME 407 Introduction to Clinical Engineering

Evolution of clinical engineering; The health care environment; the role of clinical engineering in enhancing patient's safety; A model clinical engineering department; careers, roles and responsibilities of a clinical engineers.

BME 405 Seminars

2 Units LH 30

Each student will be required to present a seminar on an approved topic in biomedical technology. Industrial visits to hospitals and other industries engaged in biomedical engineering and allied fields will be organized. Reports of these will be assessed accordingly.

ENG 409 Biomechanics

2 Units LH 15 PH 45

Basics concepts of statics, dynamics of particles and rigid bodies in a plane; analysis of forces; distributed force vectors, flexible cables, friction, Static and Dynamic Equilibrium of a particle and equilibrium of rigid bodies; areas of centroids, masses, centre of gravity; analysis of structure; internal forces. Newton's third law; shearing forces; moments, trusses and frames. Forces system resultants; structural analysis, kinematics and kinetics of particles and rigid bodies in motion. Methods of impulses and momentum; linear and angular momentum; work and energy.

BME 441 Ergonomics and Occupational Safety

Occupational health standards; Occupational exposure to hazardous chemicals and blood-borne pathogens; Stress, fatigue and the work environment; Precautions in equipment handling in the industries; Workman compensation act.

500 LEVEL COURSES

ENG 501: Biomedical Devices Design (2, 0, 1)

3 Units

LH 30

PH 45

Principles of reliability and economy in design for production. Forces in design; machine components; designs of keys and coupling prototype development. Factors for safety and strength wear and material consideration. Design of riveted joints, screw- fasting, spring's pressure vessels

and material selection of power – screws; belts and rope drives; chains breaks and clutches. Cast structures; hydrodynamic lubrication and journal bearing computerized design.

ENG 503: Biomedical Devices Manufacturing Processes (1, 0, 1) 2 Units LH 15 PH 45

The lathe and its function. Driving and feeding work. Holding devices. Turning on centers, taper turning, screw-cutting; eccentric turning, form-turning. Boring and saddle. Button bearing. Automatic lathe. Copy turning and capstan lathe. Types of milling machines; milling cutters. Machine feed and rotation. The driving head; linear indexing and linear graduating. Gear cutting, rack cutting attachment. General principle of machining, using point and multi – point cutting tools. Chip formulation, cutting forces cutting parameters. Tools temperature, life and wear. Cutting threads, surface roughness. Tools materials. Design of single point and multiple – point cutting tools. Drills and milling cutters; causes of vibration and chatter in machine tools operation. Principles of casting; sand casting, plaster and mould casting; shell moulding, investment cast; permanent mould casting; centrifugal casting, die casting, continuous casting. Defects in casting. Design of casting; riser designer and placement; solidification control.

GST 504 Entrepreneurship III 2 Units LH 15 PH 45

Creativity and starting off a business enterprise. Methods of generating ideas: brainstorming, synergetics, checkbook method, Gordon method of generating ideas, Reverse brain- storming; free association. Collective notebook; heuristic, scientific method; value analysis; attribute listing; matrix charting; Big – dream approach, parameter analysis; legal issues in entrepreneurship marketing; Financial and organizational plans. Financing the new business enterprise. Going public. Managing, growing and ending enterprise.

BME 501 Project (0, 0, 2) 2 Units PH 180

This course aims at individualized tutoring and guidance of students towards the acquisition of research techniques, ability to manipulate relevant technologies, as well as reporting skills. An assigned supervisor guides / mentors the student through transfer and development will be considered. Technologies evaluation and patenting inventions; patent rights and limitation of access to best technologies. Skills needed form professional technology evaluation. Digital signals and system; Analog to digital conversion; Digital filter circuits; Transfer functions; Sources of biomedical signals; Processing of biomedical signal; Image processing.

BME 531 Biomedical Telemetry 2 Units LH 30

Introduction to telemetry system; Transmitters and modulation; Receivers and demodulation; Monitoring with telemetry systems inpatient, outpatient, stationary and ambulatory patients.

BME 591 Industry – Based Project 6 Units PH 240

Independent individual or group student product probably nominated and sponsored by a biomedical corporation under the direction of a staff or team of staff, involving engineering design,

laboratory experimentation, construction and testing of biomedical systems; Project is to be completed and a written technical report submitted at the end. A viva-voce examination will normally be conducted in order to help assess the student(s) performance

BME 572 Equipment Reliability and Safety 2 Units LH 30

Safety consideration in equipment design – reliable equipment earthing, reduction of leakage current, operation at low voltage; Safe instrumentation – physiological effects of electricity, shock hazards, electrical safety codes and standards, power distribution protection, electric system testing; Quality assurance in equipment design

BME 552 Clinical Imaging Technology 2 Units LH 30

X-rays; characteristics and applications; Computerized tomography; technology and applications; Gamma camera; Nuclear magnetic resonance imaging; systems and applications; Ultrasound imaging; forms and comparative safe applications.

BME 562 Computer-Aided Design of Biomed, Equipment 2 Units PH 90

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3.5 CERAMIC ENGINEERING

The Ceramic Engineering programme is aimed at producing engineers who combine the knowledge of the relationships between engineering properties and the chemistry and structure of ceramic materials to the design of new formulations and manufacturing processes in key areas such as: electronic and optical assemblies; aerospace parts; biomedical components; nuclear components; high temperature, corrosion-resistant assemblies; fuel cells; electronic packaging; biomaterials, high strength materials, materials for energy generation, etc. Thus, ceramic engineers generally work with inorganic, non-metallic materials processed at high temperatures.

The specific objective of the ceramic engineering programme is to provide a comprehensive, modern ceramic engineering curriculum that emphasizes the application of fundamental knowledge and design principles to solve practical problems. This is expected to translate to the following specific outcomes:

- ❖ Ability to apply mathematical, science and engineering principles to ceramic systems;
- ❖ Ability to utilize experimental, statistical and computational methods to solve ceramic problems;
- ❖ Ability to design systems, components, or processes to meet identified needs;

3.5.1 Course Structure

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirement.

3.5.2 Course Synopses

TCE 301 Atomic Structure of Crystalline Ceramics (3 Units: LH 45)

The crystal-chemical principles used to design and manufacture materials with specified properties are developed and applied to oxides, clays, silicates and other non-metallic compounds.

TCE 302 Ceramics in the Modern World (2 Units: LH 30)

An introduction to traditional and modern applications of ceramics providing a broad overview of all aspects of current ceramic technology.

TCE 303 Ceramic Materials Laboratory I - Characterization of Materials (2 Units: PH 90)

Laboratory experience in collection, beneficiation, and characterization of ceramic raw materials; granulation, compaction, and sintering of particulate materials; and characterization at an introductory level. Standard laboratory practice including safety, report writing, and error analysis are also emphasized.

TCE 304 Introduction to Glass Science and Technology (3 Units: LH 45)

A study of the atomic-level structure of oxide glasses and the relationships between composition, properties and structure of glass forming systems. Simple rate processes will be introduced to explain temperature-dependent properties.

TCE 305 Thermodynamics of Materials (3 Units: LH 45)

Basic thermodynamic concepts are applied to materials. Calculations involving enthalpy, entropy, and Gibbs' free energy are studied. Inter-relationships among properties are emphasized. Fundamental concepts of phase equilibria are presented.

TCE 306 Ceramic Materials Laboratory II - Glass and Ceramic Processing (2 Units: PH 90)

Laboratory experience in design, processing, and characterization of glasses and ceramics. Glasses are formulated, melted and characterized to correlate composition and properties. Clay-based ceramics are formulated to meet performance specifications, prepared by slip casting/extrusion, and fired.

TCE 401 Thermal Processes in Ceramics (3 Units: LH 45)

Considerations in rate controlled processes in the fabrication of ceramics, packing of powders, comminution and calcination, drying and firing of ceramic ware, polymorphic transformations, sintering, grain growth and hot pressing, relationships of fabrication techniques to physical properties.

**TCE 402 Phase Equilibria (3 Units:
LH 45)**

The study of unary, binary and ternary inorganic, phase equilibrium systems with examples for solving practical engineering problems.

**TCE 403 Ceramic Processing Laboratory I (2 Units:
PH 90)**

The first half of a two-semester sequence that gives students practical knowledge of the methods and techniques used in the fabrication of ceramics.

**TCE 404 Characterization of Inorganic Solids (3 Units:
LH 45)**

X-ray diffraction analysis is emphasized including lattice parameter determination, qualitative and quantitative analysis methods, and sources of error. In addition, the basic principles of other common characterization techniques including electron microscopy, thermal analysis, and energy dispersive spectroscopy are discussed.

**TCE 405 Ceramic Processing Laboratory II (2 Units:
PH 90)**

The second half of a two-semester sequence that gives students practical knowledge of the methods and techniques used in the fabrication of ceramics.

**TCE 501 Thermal Properties of Ceramics (3 Units:
LH 45)**

This course will teach the crystal physics underlying heat capacity, internal energy, phonon and photon conduction, and thermal expansion. These properties will be used to rationalize the behaviour of a wide variety of ceramic materials in severe thermal environments.

**TCE 502 Ceramic Processing (3 Units:
LH 45)**

Powder, colloidal and sol-gel processing, forming methods, drying, sintering and grain growth. Relation of processing steps to densification and microstructure development.

**TCE 503 Materials Senior Design I (1 Unit:
PH 45)**

Students working in groups will be assigned a capstone design project related to a specific materials technology. This course will focus on project plan and all aspects of product and process design.

TCE 504 Electrical Properties of Ceramics (4 Units: LH 45; PH 45)

The application of ceramic chemistry and physics to the development and evaluation of electronic, dielectric, magnetic, and optical properties. Emphasis is placed on the relationships between properties and crystal structure, defects, grain boundary nature, and microstructure.

TCE 505 Materials Senior Design II (2 Units: PH 90)

A continuation of the Materials Senior Design I. Students working in groups will complete a capstone design project including process and product simulation and/or fabrication, safety aspects, environmental impact and capital and operating economics.

TCE 506 Mechanical Properties Of Ceramics (4 Units: LH 45; PH 45)

This course will treat the theory and testing practice related to design based on the mechanical properties of ceramics. The course also includes a laboratory consisting of experiments for the characterization of the mechanical properties of ceramics.

TCE 508 Electrical Ceramics (3 Units: LH 30; PH 45)

The application and design of ceramics for the electrical industry is discussed. Particular emphasis is placed on how ceramic materials are altered to meet the needs of a specific application. The laboratory acquaints the student with measurements which are used for electrical property evaluation.

TCE 509 Microelectronic Ceramic Processing (3 Units: LH 45)

Materials, processing and design of microelectronic ceramics are covered. Introduction to devices, triaxial ceramics, high aluminas, tape fabrication, metallizations, thick film processing and glass-to-metal seals.

TCE 510 Glass Science and Engineering (3 Units: LH 45)

The development, manufacturing methods, applications, and properties of flat, fibre, container, chemical, and special purpose glasses. Composition/ property relationships for glasses and nucleation-crystallization processes for glass-ceramics are also covered.

TCE 511 Principles of Engineering Materials (3 Units: LH 45)

Examination of engineering materials with emphasis on selection and application of materials in industry. Particular attention is given to properties and applications of materials in extreme temperature and chemical environments. A discipline specific design project is required.

Please, forward your comment on any section of this document to the following email:
nucassessment@gmail.com
You can also call the following phone numbers: 08033145087, 08033201097
All comments should be received before 31st October, 2015

**TCE 512 Refractories
LH 45)**

(3 Units:

The manufacture, properties, uses, performance, and testing of basic, neutral and acid refractories.

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3.6 CHEMICAL ENGINEERING

Chemical engineering is the branch of engineering which deals with changing the composition, energy content, and state of aggregation of materials. The programme encompasses the fundamental properties and nature of matter (chemistry), the forces that act on matter (physics), and the precise expressions of the relationships between them (mathematics). It therefore incorporates computer-based modelling techniques to handle the application of these sciences to engineering problems. The programme includes courses aimed at process design of different production systems such as: food processing systems, fertilizers, rubber, fibres, and fuels. There is now a growing field of biomedical engineering involving chemical engineers in the development of specialized polymeric materials for use in artificial arms, legs, and other human organs. Thus, the programme is designed to provide a broad technical basis with an emphasis on material balances, energy balances, separation processes, rate processes, unit operations, and process economics and design. This will serve as input into chemical-based manufacturing - applying chemistry for commercial-quantity production of a wide variety of products, including:

- Fuels (gasoline, natural gas) • Petro-Chemicals (chemicals obtained from petroleum or natural gas)
- Agricultural Chemicals (fertilizers, pesticides) • Industrial Chemicals (acids, alkalis, organics, salts)
- Plastics, Polymers and Fibers
- Paper and Paper Products
- Pharmaceuticals and Drugs
- Consumer Products (paints, soaps, household cleaners, etc.)
- Food Additives/Products
- Advanced Materials (ceramics, electronic materials, composites, etc.)

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

Course Structure**Course structure at 300-Level Chemical Engineering**

Course Code	Course Title	Units	Status	LH	PH
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	45	-
STA 305	Statistics for Physical Science and Engineering	3	C	45	-
TCH 300	Chemical Engineering Laboratory I	2	C	0	90
TCH 301	Transport Phenomena I	4	C	45	45
TCH 302	Chemical Engineering Thermodynamics I	2	C	30	-
TCH 303	Separation Processes I	3	C	30	45
TCH 304	Chemical Kinetics	3	C	45	-
TCH 305	Biochemical Engineering	3	C	45	-
TCH 306	Science of Materials	3	C	45	-
TCH 307	Polymer Process Engineering	3	R	45	-
TCH 308	Process Instrumentation	2	R	30	-
TCH 309	Process Simulation	2	C	30	-
	Total	45			

Course structure at 400-Level Chemical Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 499	SIWES III	3	C	24 weeks	
TCH 400	Chemical Engineering Laboratory	2	C	-	90
TCH 401	Transport Phenomena II	4	C	45	45
TCH 402	Chemical Engineering Thermodynamics II	2	R	45	-
TCH 403	Separation Processes II	3	C	30	45
TCH 404	Plant Design I	4	C	60	-
TCH 405	Chemical Engineering Analysis	2	R	30	-
TCH 406	Particle Technology	2	E	30	-

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TCH 407	Environmental Engineering	3	R	45	-
TIE 402	Economics for Engineers	2	R	30	-
Total		27			

Course structure at 500-Level Chemical Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
TCH 500	Chemical Engineering Laboratory	1	C	0	45
TCH 501	Separation Processes III	3	C	30	45
TCH 502	Plant Design II	4	C	15	135
TCH 503	Process Control	4	C	60	-
TCH 504	Process Optimisation	3	C	45	-
TCH 505	Reservoir Engineering	3	C	45	-
TCH 506	Loss Prevention in Process Industries	2	C	30	-
TCH 507	Chemical Reaction Engineering	4	C	45	45
TCH 508	Coal Processing Technology	3	E	45	-
TCH 509	Sugar Technology	3	E	45	-
TCH 510	Detergent Technology	3	E	45	-
TCH 511	Fermentation Technology	3	E	45	-

TCH 512	Pulp and Paper Technology	3	E	45	-
TCH 513	Polymer Science and Technology	3	C	45	-
TCH 514	Technology of Fossil Fuel Processing	3	E	45	-
TCH 515	Biochemical Engineering	3	C	45	-
TCH 555	Chemical Engineering Research Project	6	C	-	270
	Total	59			

3.6.1 Course Synopses

TCH 300 Chemical Engineering Laboratory I (2 Units: PH 90)

Laboratory experiments in transport phenomena. Kinetics and separation process.

TCH 301 Transport Phenomena I (4 Units: LH 45; PH 45)

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 vapours. Diffusion in liquids and solids.

TCH 302 Chemical Engineering Thermodynamics I (2 Units: LH 30)

Cycles, Carnot; thermodynamic Turbines Steam and Gas, Refrigeration; General P-V-T Relations. The P-V-T behaviour of pure substances; Equation of state for gases; The principle of corresponding state; Compressibility relations; reduced pressure; reduced volume; temperature; pseudo critical constants. P-V-T approximations for gaseous mixture ideal gas mixtures. Dalton's law of additive pressure; Amagat's law of additive volumes; Pseudocritical point method; Kay's rule, Gililand's method; Behaviour of liquids. Heat Effects. Heat capacities as a function of temperature, specific heats of liquids and solids; Heat effects accompanying phase change Clausius-Clapeyron equation, standard heats of reaction formation and combustion effect of temperature on heat reaction. Heat of mixing and solution, Enthalpy concentration diagrams for H_2SO_4, H_2O , etc., partial enthalpies, single and multiple effect evaporators with regards to heat effects. Thermodynamics of Flow Processes. Fundamental equations, continuity equation; equation of motion; energy equation; Bernoulli's equation; Flow in pipes, laminar and turbulent flows; Reynolds number, friction factor. Fanning equation; Flow meter, Nozzles; Compressors single stage and multistage, effect of Clearance.

TCH 303 Separation Processes I (3 Units: LH 30; PH 45)

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

TCH 304 Chemical Reaction Kinetics (3 Units: LH 45)

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.

TCH 305 Biochemical Engineering (4 Units: LH 60)

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

TCH 306 Introduction to Material & Energy Balances (3 Units: LH 45)

Units and dimensions. The mole unit. Conventions in the method of analysis and Measurement. Temperature. Pressure. Physical and chemical properties and measurement. Techniques of solving problems. The chemical equation stoichiometry, material balances. Program of analysis of material balances. Program of analysis of material balances problem problems with direct solutions. Material balances using algebraic techniques control surface and stage balances for open and closed system. Problems involving components (elements). Recycle, Bypass, Purge; Effect of recycle and purge on mass and energy balances. Gases, vapours, liquid and solids. Ideal gas law, Real gas relationships. Vapour pressure. Saturation. Partial saturation and humidity. Material balanced involving condensation and vaporization phase phenomena. Energy balances. Concepts and Units. Heat capacity. Calculation of enthalpy changes without change phase. Enthalpy for phase transition. General Energy balance. Reversible process the mechanical energy balance. Heat of reaction. Heat of solution and mixing combine material and energy balances; Application fundamental concept of mass and energy balances and mass transfer to unit operation in distillation. Simultaneous use of material and energy balances for the steady state. Enthalpy concentration chart. Humidity chart and their use. Complex problems; Lever rule Geometrical construction for mass. I energy balances for adiabatic and non adiabatic process. Unsteady state material and energy balances.

TCH 307 Polymer Process Engineering (3 Units: LH 45)

Introduction to the manufacture, processing, and applications of organic polymeric materials. The chemistry of polymer manufacture, the molecular structure of

polymers, and the structure-property relationships for thermoplastic and thermosetting polymers are covered.

TCH 308 Process Instrumentation (2 Units: LH 30)

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

TCH 309 Process Simulation (2 Units: LH 30)

Introduction to process simulation using the HYSYS software or any other process simulation software.

TCH 400 Chemical Engineering Laboratory II (2 Units: LH 30)

Laboratory experiments in transport phenomena. Separation processes and thermodynamics.

TCH 401 Transport Phenomena II (4 Units: LH 60)

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.

TCH 402 Chemical Engineering Thermodynamics II (3 Units: LH 45)

Phase Equilibria; Criteria of equilibrium; Fugacity of pure component; General Fugacity relations for gases; Fugacity of gas mixtures, Effects of temperature and pressure of fugacity, pressure temperature composition relationship; phase behaviour at low and elevated pressure, Raoult's law Henry's Law, Equilibrium constant; Activity coefficient, Gibbs-Duhem equation; Margules and Van Leer equations Chemical Reaction Equilibria; Standard free energy change and equilibrium constant, Evaluation of equilibrium constants. Effects of temperature and pressure on equilibrium constants; calculation of conversion; Gas phase reactions, Percentage conversion; Liquid phase reaction Heterogeneous reactions.

TCH 403 Separation Processes II (3 Units: LH 3; PH 45)

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

TCH 404 Plant Design I (4 Units: LH 60)

Presentation and discussion of real process design problems; sources of design data; process and engineering flow diagram; process outline charts incorporating method study and critical examination; mechanical design of process vessels and piping. Environmental considerations site considerations; process services. Costing of design Process. Formulation of feasibility report evaluation. Economics and safety consideration must be stresses.

TCH 405 Chemical Engineering Analysis (2 Units: LH 30)

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.

TCH 406 Particle Technology (2 Units: LH 30)

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.

TCH 407 Environmental Engineering (3 Units: LH 45)

Pollution and the environment definitions and inter-relationship; natural and manmade pollution; the economics of pollution. Air pollution; Gaseous and particulate pollutions and their sources; effects on weather vegetation materials and human health. Legislation relating to air pollution, methods of control of gaseous emission and destruction; cyclones inertia separators electrostatic precipitator bag filters. Wet washers etc. Dispersal from chimneys and method of calculating chimney height; Flare stacks, water pollution river pollution by industrial effluent, Legislation and standards for effluent discharge; Impurities in natural water and their effects, Brief survey of ecology and the effects of effluent on the ecosystems; Treatment processes including precipitation flocculation coagulation, sedimentation, clarification and colour removal. Principles of biological treatment processes; cost of treatment; treatment for water re-use, ion exchange cooling water treatment. Land pollution; Disposal of solid wastes by incinerator and dumping, possible future trends including conversion of solid wastes into useful material or energy. Treatment of other types of pollution; noise; Thermal and nuclear pollution.

TCH 501 Separation Processes III (3 Units: LH 30; PH 45)

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

TCH 502 Plant Design II (4 Units: LH 15; PH 135)

A design problem involving the study of a process. It should consist of preparation of flow sheet and heat and mass balances of the process and a detailed design of plant or unit operation equipment used in the process. Due consideration must be given to economics and safety. Each student is expected to submit and orally defend a bound copy of technological/engineering design project. A design project should consist of introduction, literature review, process design, detailed design of some of the units of the process, specification of the equipment required, specification of materials of construction, basic mechanical design and drawings, inclusion of process control, modern drawings of the process equipment including a good flow chart, economic and environmental consideration.

TCH 503 Process Control (4 Units: LH 60)

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.

TCH 504 Process Optimisation (3 Units: LH 45)

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.

TCH 505 Reservoir Engineering (3 Units: LH 45)

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

TCH 506 Loss Prevention in Process Industries (2 Units: LH 30)

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.

TCH 507 Chemical Reaction Engineering (4 Units: LH 45; PH 45)

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; Fluidized bed trickle bed and slurry reactors. Factors affecting choice of reactors characterization of catalysis; Rate controlling regimes in gas solid reactions catalyzed by porous catalysts effectiveness factor scale up procedure catalyst decay and reactivation.

**TCH 508 Coal Processing Technology (3 Units:
LH 45)**

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.

**TCH 509 Sugar Technology (3 Units:
LH 45)**

Description of the equipment 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.

**TCH 510 Detergent Technology (3 Units:
LH 45)**

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

**TCH 511 Fermentation Technology (3 Units:
LH 45)**

Introductory microbiology and biochemistry. Substrates. The fermentation process. Batch and continuous fermentation. Malting and brewing. Wine making. Enzymes in fermentation.

**TCH 512 Pulp and Paper Technology (3 Units:
LH 45)**

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

**TCH 513 Polymer Science and Technology (3 Units:
LH 45)**

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.

**TCH 514 Technology of Fossil Fuel Processing (3 Units:
LH 45)**

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.

TCH 515 Biochemical Engineering (3 Units: LH 45)

Introductory Biotechnology. Definition and principles of biotechnology; Areas of application in biotechnology. Methods of genetic modification of prokaryotic and eukaryotic organisms; to optimize biochemical characteristics and to stabilize cellular. Structure transformation transduction; conjugation and protoplasm fusion. Natural DNA recombination; advantages and method of induced phage virus bacterial plasmid or vector DNA mapping techniques; present and future prospect of utilization of created gene pools is selected topics of application areas e.g. Microbial enzyme technology, bioreactor design; practice of post harvest technology and agricultural waste recycling.

TCH 555 Chemical Engineering Research Project (6 Units: PH: 270)

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

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.

3.7 CIVIL ENGINEERING

Civil engineers plan, design, and supervise construction of many essential facilities and structures such as bridges, dams, roads, buildings etc. Included in the study of civil engineering are courses in environmental engineering that are directly related to the solution of hazardous waste and pollution problems, to providing potable and economical water supply systems, and to maintaining a safe environment.

Water resources engineering is related to hydraulic and hydrologic engineering, flood control, rainfall, and run off prediction and the transport inflows. Studies in geotechnical engineering address the bearing capacities of soils, settlement of foundations, and the design of both deep and shallow foundations. Courses in structural analysis and design are directed toward providing reliable and economical structures such as bridges, buildings, port facilities, dams, etc. In consequence of the above, the programme is structured in such a way that students will have opportunity to take courses that will provide a basic understanding of all areas of civil engineering practice, while they can concentrate in any of the following options in the final year.

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- a. Construction Engineering and Management (combining engineering and management skills to complete construction projects designed by other engineers and architects).
- b. Geotechnical Engineering (analysis of soils and rock in support of engineering projects/applications - building foundations, earthen structures, underground facilities, dams, tunnels, roads, etc.)
- c. Structural Engineering (design of all types of stationary structures - buildings, bridges, dams, etc.)
- d. Surveying (measure/map the earth's surface in support of engineering design and construction projects and for legal purposes - locating property lines, etc.)
- e. Transportation Engineering (design of all types of transportation facilities/systems – streets/highways, airports, railroads, other mass transit, harbours/ports, etc.).
- f. Water Resources and (control and use of water, focusing on flood control, irrigation, raw water supply, and hydroelectric power applications)
- g. Environmental Engineering(Air Pollution Control, Hazardous Waste Treatment and Disposal, Recycling and Solid Waste Disposal, Sanitary Engineering (municipal and industrial water and wastewater treatment)

Students gain a broad-based experience ranging from engineering analysis and design to laboratory testing and experimentation.

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DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.7.1 Course Structure

Course structure at 300-Level Civil Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 301	Fluid Mechanics	3	C	30	45
CEE 302	Strength of Structural Materials	3	C	30	45
CEE 303	Engineering Geology	3	R	30	45
CEE 304	Civil Engineering materials	3	C	30	45
CEE 305	Soil Mechanics I	3	C	30	45
CEE 306	Design of Structures I	3	C	30	45
CEE 307	Structural Mechanics I	3	C	45	0
CEE 308	Engineering Surveying & Photogrammetry I	3	C	30	45
CEE 309	Civil Engineering Drawing	2	R	15	45
CEE 310	Elements of Architecture	4	R	45	45
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
	Total	45			

Course structure at 400-Level Civil Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 401	Hydraulics and Hydrology	3	C	30	45
CEE 402	Civil Engineering Practice	3	R	30	45
CEE 403	Structural Mechanics II	3	C	30	45
CEE 404	Design of Structures II	3	C	30	45
CEE 405	Soil Mechanics II	3	C	30	45
CEE 406	Engineering Surveying & Photogrammetry II	3	R	30	45
CEE 407	Highway Engineering	3	R	30	45
GET 499	SIWES III	6	C	24 weeks	
	Total	27			

Course structure at 500-Level Civil Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 501	Structural Design	4	C	45	45
CEE 502	Geotechnical Engineering	3	R	30	45
CEE 503	Water Resources & Environmental Engineering	3	R	30	45
CEE 504	Highway & Transportation Engineering	3	E	30	45
CEE 505	Foundation Engineering	3	C	30	45
CEE 506	Construction Engineering	3	C	30	45
CEE 507	Hydraulics Design	3	C	30	45
CEE 508	Waste Management Engineering	3	E	30	45
CEE 509	Terotechnology	2	R	30	-
CEE 510	Building Services Engineering	3	E	30	45
CEE 599	Project	6	C	-	270
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
	Total	41			

3.7.2 Course Synopses

CEE 301 Fluid Mechanics (3 Units: LH 30; PH 45)

Fluid statics: Flootation and Stability. Dynamics of fluid flow - conservation equation of mass and momentum. Enter and Bernoulli equations. Introduction to incompressible viscous flow. Reynold's number. Dimensional analysis - Philosophy. Similitude. Buckingham P1 theorems. Applications. Hydraulic models. Flow measurements. Flow meters, errors in measurement

CEE 302 Strength of Structural Materials (3 Units: LH 30; PH 45)

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

CEE 303 Engineering Geology (3 Units: LH 30; PH 45)

Geology 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.

CEE 304 Civil Engineering Materials (3 Units: LH 30; PH 45)

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, bricks. etc. Applications to buildings, Roads and Bridges.

CEE 305 Soil Mechanics I (3 Units: LH 30; PH 45)

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 - see page and permeability. Laboratory work.

CEE 306 Design of Structures I (3 Units: LH 30; PH 45)

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.

**CEE 307 Structural Mechanics I (3 Units:
LH 45)**

Analysis of determinate structures. Beams, Trusses: structure 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.

**CEE 308 Engineering Surveying and Photogrammetry I (Units 3: LH 30;
PH 45)**

Chain Surveying Compass surveying - Methods: Contours and their uses. Traversing - methods and applications. Levelling - Geodetic levelling - errors and their adjustments. Applications. Tachometry - Methods: Substance heighting. Self adjusting and electromagnetic methods. Introduction to Photogrammetry.

**CEE 309 Civil Engineering Drawing (2 Units: LH 15;
PH 45)**

Symbols and conventions. Dimensions, notes, titles, working or construction drawing and relationship to specifications. Plans, Floors, Foundation, Framing and Roof plans. Sections and Details, wall section, building section and sectional elevations. Drawing and detailing of Civil Engineering structure e.g. bridges, dams, foundations, etc.

**CEE 310 Elements of Architecture (4 Units: LH 45;
PH 45)**

Introduction – Dimensional awareness, Graphical communication, relation to environments. Free hand drawing – form in terms of shades, light shadow. Common Curves. Orthographics; dimetrics, perspective projections. Applications. Elementary Designs.

**CEE 401 Hydraulics and Hydrology (3 Units: LH 30;
PH 45)**

Laminar and turbulent Flows. Boundary layer separation life 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 hydrographic data. Land Drainage and inland navigation problems.

**CEE 402 Civil Engineering Practice (3 Units: LH 30;
PH 45)**

Civil Engineering Works standard 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.

CEE 403 Structural Mechanics II (3 Units: LH 3; PH 45)

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.

CEE 404 Design of Structures II (3 Units: LH 30; PH 45)

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.

CEE 405 Soil Mechanics II (3 Units: LH 30; PH 45)

Mineralogy of soils, Soil structures. Compaction and soil stabilization. Site investigations. Laboratory and course work.

CEE 406 Engineering Surveying & Photogrammetry II (3 Units: LH 30; PH 45)

Further work on contours and contouring. Methods of contouring, contour interpolation and uses of contour plants and maps. Areas and volumes. Setting out of Engineering works. Elementary topographical surveying: Elements of Photogrammetry. Photogrammetric equipment and errors of measurements.

CEE 407 Highway Engineering (3 Units: LH 30; PH 45)

Soil engineering aspects of highways. Railways and airfields. Highway geometrics. Payment structure and design. Pavement materials and Laboratory tests.

CEE 501 Structural Design (4 Units: LH 45; PH 45)

Structural mechanics: 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.

Design of structures: 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.

CEE 502 Geotechnical Engineering (3 Units: LH 30; PH 45)

Stressed in soils. Consolidation and settlement. Shear strength of soils. Barths pressures. Bearing capacity of soils. Foundations: normal and deep foundations. Slope stability. Site investigations.

CEE 503 Water Resources and Environmental Engineering 7 (3 Units: LH 30; PH 45)

Water Resources: 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, silting basins, man holes and coastal hydraulic structures, etc: engineering economy in water resources planning.

Environment Engineering: 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.

CEE 504 Highway and Transportation Engineering (3 Units: LH 30; PH 45)

Highway planning and traffic surveys. Pavement design, construction and maintenance. Administration and finance of highways. Condition of all transportation media. Transportation planning and economics. Traffic management and design of traffic signals. Parking. Geometrics design. Construction methods. Construction materials and laboratory tests.

CEE 505 Foundation Engineering II (3 Units: LH 30; PH 45)

Site investigations; Field and laboratory measurements. Engineering property of 'soils' for design. Plastic Equilibrium Theory. Design of footings and rate; differential settlement, earth structures excavation, shallow and deep foundations, single piles, group action, coffer dams, bracing and strutting techniques. In-situ testing.

CEE 506 Construction Engineering (3 Units: LH 30; PH 45)

Construction practices and professional relations. Earth-works, equipment, capital outlay and operating cost; Form-work design, component assembly, improvement of productivity and construction practices, safety, project financing, insurance and bonding, contract terms. Solutions to job site and engineering problems in buildings and heavy construction in Nigeria

CEE 507 Hydraulics Design

(3 Units: LH 30;

PH 45)

Design of large scale hydraulic structures: dams, spillways, Stilling Basins. Design of culverts and channel transitions. Reservoir Design Studies. Design of irrigation projects

CEE 508 Waste Management Engineering

(3 Units: LH 30;

PH 45)

Quantity and quality of sewage, including important parameters for the determination of quantity and qualities. Sewage system planning, design, construction and maintenance. Sewage treatment processes, including various unit operations. Non-conventional sewage treatment processes including sewage farming, waste stabilization ponds, aerated lagoons and oxidation ditch. Sewage disposal methods including water-dependent and water-independent methods. Water pollution control, solid waste quantity and quality determination, collection, transportation and disposal methods. Institutional arrangements for management. Management of toxic and hazardous waste.

CEE 509 Terotechnology

(2 Units:

LH 30)

Salvaging of structures, repairs, maintenance and demolition. Evaluation of building performance.

CEE 510 Building Services Engineering

(3 Units: LH 30;

PH 45)

Engineering study of the materials and equipment used in mechanical and electrical services of buildings. Design of building services components; modern building operation; selection of necessary equipment. Specific topics like illumination of building, comfort, heat loss and heat gain, air conditioning and climate control, water supply and fire protection. Drainage systems, plumbing and sewage disposal, elevators, escalators, building acoustics.

CEE 599 Project

(6 Units:

PH 270)

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).

3.8 COMPUTER ENGINEERING

The Computer Engineering Programme is designed to prepare an engineer to work with all aspects of computers – not just software, not just hardware, but both. The software world includes high-level languages and complex programs, which are often required to solve problems. In the hardware world, designs also include many aspects of the physical world like temperature or noise, energy source and

characteristics (particularly in our country still witnessing equipment-damaging power surges) and often must include compromises between many opposing factors. The ability of a computer engineer to work in both worlds is what distinguishes him or her from a computer scientist (with little training with hardware) or an electrical engineer (with little training in software). Thus, the Computer Engineering Programme includes several courses in both Electrical and Electronic Engineering (such as circuits and electronics) and Computer Science (such as data structures and operating systems).

Graduates are expected to have a sound knowledge of the fundamentals in electrical or computer engineering that allows them to analyse and solve technical problems, to apply hardware and software tools to problem solution, and to create and evaluate technical products.

The primary areas of specialization are:

- a. Artificial Intelligence (developing computers that simulate human learning and reasoning abilities)
- b. Computer Architecture (designing new computer instruction sets, and combining electronic or optical components to yield powerful computing systems)
- c. Computer Design and Engineering (designing new computer circuits, microchips, and other electronic computer components)
- d. Computer Theory (investigating the fundamental theories of how computers solve problems, and applying the results to other areas of computer engineering)
- e. Information Technology (developing and managing information systems that support a business or other organization)
- f. Operating Systems and Networks (developing the basic software computers use to supervise themselves or to communicate with other computers)
- g. Robotics (designing computer-controlled robots for performing repetitive industrial tasks)
- h. Software Applications (applying computing software to solve problems outside the computer field - in education or medicine, for example).
- i. Software Engineering (generating computer programs)

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirement

3.8.1 Course Structure

Course structure at 300-Level Computer Engineering

Course Code	Course Title	Units	Status	LH	PH
CPE 300	Laboratory Courses	3	C	-	135
CPE 301	Computer Organisation & Architecture	3	C	45	-
CPE 302	Software Development Techniques	3	C	45	-
EEE 301	Analogue Electronic Circuit	3	C	45	-
EEE 302	Digital Electronic Circuit	3	C	45	-
EEE 303	Circuit Theory I	3	C	45	-
EEE 303	Communication Principles	3	R	45	-
EEE 304	Measurement & Instrumentation	3	C	45	-
EEE 305	Electrical Machines	3	C	45	-
EEE 307	Electromagnetic Fields & Waves I	3	C	45	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
	Total	45			

Course structure at 400-Level Computer Engineering

Course Code	Course Title	Units	Status	LH	PH
CPE 400	Laboratory Courses	2	C	-	90
CPE 401	Microprocessor System & Interfacing	3	C	45	-
CPE 402	Control System	3	R	45	-
CPE 403	Data Communication & Network	3	C	45	-
CPE 404	Assembly Language Programming	3	R	45	-
CPE 405	Computer Software Engineering	4	C	60	-
CPE 406	Prototyping Techniques	2	R	30	-
GET 499	SIWES III	6	C	24 weeks	
	Total	26			

Course structure at 500-Level Computer Engineering

Course Code	Course Title	Units	Status	LH	PH
CPE 501	Reliability and Maintainability	3	C	45	-
CPE 502	Embedded system design	3	C	45	-
CPE 504	Digital Signal Processing	3	C	45	-
CPE 505	Digital System design with VHDL	3	C	45	-
CPE 506	Artificial Neural Network	3	C	45	-
CPE 507	Cyberpreneurship&Cyberlaw	2	C	30	-
CPE 508	Computer Graphics & Animation	3	C	45	-
CPE 509	Computer Security Techniques I	3	C	45	-
CPE 510	Digital Image Processing	2	E	30	-
CPE 511	Fuzzy Logic & Programming	2	E	30	-
CPE 512	Robotic & Automation	2	E	30	-
CPE 513	Cryptography Principles & Applications	2	E	30	-
CPE 514	Design & Installation of Electrical & ICT services	3	E	45	-
CPE 515	Computer Security Techniques II	2	E	30	-
CPE 555	Project	6	C	-	270
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
	Total	47			

3.8.2 Course Synopses

CPE 301 Computer Organisation and Architecture (3 Units: LH 45)

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,).

CPE 302 Software Development Techniques (3 Units: LH 45)

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.

CPE 401 Microprocessor System and Interfacing (3 Units: LH45)

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.

CPE 402 Control System (3 Units: LH 45)

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.

**CPE 403 Data Communication and Network (3 Units:
LH 45)**

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.

**CPE 404 Assembly Language Programming (3 Units:
LH 45)**

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.

**CPE 405 Computer Software Engineering (4 Units:
LH 60)**

Introduction to software engineering fundamentals. Object oriented programming. Number representations. Data structure and algorithms, Abstraction, modules and objects. Designing for efficiency. Object oriented software design, implementation

and testing. Team software specification and management. Cross-platform tools and GUI development. Advanced software algorithms and architecture. Software engineering practice and methods.

CPE 406 Prototyping Techniques (2 Units: LH 30)

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.

CPE 501 Reliability and Maintainability (3 Units: LH 45)

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 reliability. 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.

CPE 502 Embedded System Design (3 Units: LH 45)

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.

**CPE 504 Digital Signal Processing
LH 45)**

(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.

**CPE 505 Digital System Design with VHDL
LH 45)**

(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 modelling, Register-Transfer level modelling, FSM with data path level modelling, Algorithmic level modelling. 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.

CPE 506 Neural Network & Programming (2 Units: LH 30)

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, and 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.

CPE 507 Cyberpreneurship & CyberLaw (2 Units: LH 30)

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.

CPE 508 Computer Graphics & Animations LH 45)

(3 Units:

Overview of 3D animation and its application and types. Coordinate system, vertex, faces and object. Concept of wireframe, surface and solid modelling. Construction planes and differences between object space and world space. Principles of making characters alive. Polygonal Modelling techniques: the Box, using Edit Mesh, Smoothing Techniques, Subdivision 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 modelling. Render options and file output.

CPE 509 Computer Security Techniques I LH 30)

(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, TCPEC], 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 .

**CPE 510 Digital Image Processing
LH30)**

(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.

**CPE 511Fuzzy Logic & Programming
LH 30)**

(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 modelling 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.

**CPE 512 Robotic & Automation
LH 30)**

(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.

CPE 513 Cryptography Principles & Applications

(2 Units:

LH 30)

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.

CPE 514 Design & Installation of Electrical & ICT services

(3 Units:

LH 45)

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. Earthing 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.

CPE 515 Computer Security Techniques II

(2 Units:

LH 30)

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, 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.

3.9 ELECTRICAL ENGINEERING

Electrical engineers are involved in channelling natural resources into uses for society such as heating, lighting, home appliances, consumer products, computing, sensing, control, and communication. They contribute to systems and devices for power, instrumentation, measurement, communication, management, manufacturing, transportation, etc. They are primarily concerned with the processes of generation, transmission, transformation, control, and utilization of energy or information. The curriculum exposes students to the breadth of electrical engineering and allows them to pursue electives in areas of circuits, electronics, power, communications-signal processing, controls, electromagnetics, optic/devices, and computer engineering.

The current trend in curriculum design for electrical engineering is to combine it with more elements of electronics engineering in view of the considerable overlap as can be appreciated from the programme on Electrical and Electronics Engineering presented in this BMAS Document.

Primary areas of specialization are:

- a. Communications (transmission and processing of information via various means - wires, cable, fiber optics, radio, satellite, etc.)
- b. Computer Engineering (see separate entry)
- c. Digital Systems (digital-based communication and control systems)
- d. Electric Power (generation, transmission, and distribution of electric power)
- e. Electronics (electronic devices and electrical circuits for producing, detecting, and controlling electrical signals for a wide variety of applications)
- f. Robotics and Control Systems (machines and systems that perform/control automated processes)

DETAILS OF UNDERGRADUATE COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

Please, forward your comment on any section of this document to the following email:
nucassessment@gmail.com
You can also call the following phone numbers: 08033145087, 08033201097
All comments should be received before 31st October, 2015

300 LEVEL

Common engineering courses as shown previously plus specific Departmental Requirements

DRAFT

3.9.1 Course Structure

Course structure at 300-Level Electrical Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 301	Analogue Electronic Circuits	3	C	45	-
EEE 302	Digital Electronic Circuits	3	C	45	-
EEE 303	Circuit Theory I	3	C	45	-
EEE 304	Measurements and Instrumentation	3	C	45	-
EEE 305	Electrical Machines	4	C	60	-
EEE 307	Electromagnetic Fields and Waves I	3	R	45	-
EEE 314	Physical Electronics	3	R	45	-
GST 311	Entrepreneurship	2	R	30	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
TEL 300	Laboratory Practicals	4	R	0	180
TEL 301	Control Theory	3	C	45	-
TEL 303	Communication Principles	3	C	45	-
	Total	45			

Course structure at 400-Level Electrical Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 401	Circuit Theory II	3	C	45	-
EEE 402	Electromagnetic Fields and Waves II	3	C	45	-
GET 499	SIWES III	6	C	24 weeks	
TEL 400	Laboratory Practicals	4	R	0	180
TEL 401	Electric Power Principles	3	C	45	-
TEL 402	Assembly Language Programming	3	R	45	-
TEL 403	Advanced Electronics	2	C	30	-
	Total	24			

Course structure at 500-Level Electrical Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 500	Control Engineering	3	C	45	-
EEE 501	Reliability Engineering	2	C	30	-
EEE 507	Advanced Computer Programming and Statistics	2	R	15	45
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
TEL 502	Electrical Services Design	2	C	30	-
TEL 501	Industrial Electronics Design	3	C	45	-
TEL 504	Advanced Circuit Theory	3	R	45	-
TEL 505	Power Electronics	2	C	30	-
TEL 506	Electric and Magnetic Field Theory	3	C	45	-
TEL 507	Electric Power Systems Engineering	2	C	30	-
TEL 508	High Voltage Insulation and Switchgear Technology	2	C	30	-
TEL 509	Power Systems Communication and Control	2	C	30	-
TEL 510	Electrical Energy Conversion and Storage	2	R	30	-
TEL 555	Project	6	C	-	270
	Total	39			

3.9.2 Course Synopses**TEL 301 Control Theory (3 Units: LH 45)**

Feedback concept, advantages, system classification, structures. Control system components - mechanical, electronic hydraulic, thermal, position control. Transient analysis of servo-mechanism, signal regulators compensation techniques. Series/parallel feedback controllers. System transfer functions signal flow graphs, stability, Routh-Hurwitz criteria.

TEL 302 Communication Principles (3 Units: LH 45)

Signal analysis. Fourier series and transforms, convolution integrals. Amplitude, frequency and phase modulation, PAM, PCM. Time and frequency division multiplexing. Basic information theory, entropy, channel capacity, coding.

**TEL 401 Electric Power Principles (3 Units:
LH 45)**

Types of power station, operation, auxiliaries, economics of operation - stations, substations power supply economics, tariffs. Power factor correction. Polyphase theory. DC, AC power distribution, network calculations, Overhead line conductors. Corona effect, voltage control, circuit breakers, load forecast, siting of generating plants.

**TEL 402 Assembly Language Programming (3 Units:
LH 45)**

Int. 8086, 8088 instruction sets. Language fields, delimiters Pseudo-operations. CPU registers, addressing modes. Flow charting, classification of instructions; Data transfer, Data manipulation, Transfer of control, input-output, machine control. Monadic and dyadic operations. Character-code data, code conversion. Subroutines, modular programming, debugging, testing, documentation. Engineering applications.

**TEL 403 Advanced Electronics (2 Units:
LH 30)**

Linear I.C. op-amp, linear and non-linear operations, logarithmic amplifiers, A/D and D/A converters, gyrators and negative impedance converters, the 555 timer structure and applications; four-quadrant multipliers, dynamic logic systems and RAM memory circuits, application of digital circuits to instrumentation.

**TEL 501 Industrial Electronics Design (3 Units:
LH 45)**

Industrial transducers, position, velocity, temperature and other regulatory systems. Electric arc furnaces; welding, heaters, selection of motors, motor control panels specification and design. Temperature control and PH measurement and control. Computer controlled systems configurations, specifications and design.

**TEL 502 Electrical Services Design (2 Units:
LH 30)**

Basic Electrical Installations. Distribution system. Regulations - IEE, NEC, Nigeria standards. Illumination. Cables - types, ratings, wirings system, earth protection. Auxilliary electrical systems - fire alarm, telephone, elevator circuits, proposals, contract document preparation. Design of electrical installations - domestic, industrial, commercial air conditioning.

**TEL 504 Advanced Circuit Theory (3 Units:
LH 45)**

Computer-Aided-Analysis/Design of Electric Networks. Component/Device modelling linear Networks - Equation formulation (Nodal method). Equation solution methods. Algorithm and program for automated solution. Operations count. Numerical inaccuracies, pivoting, sparsity. Sensitivity analysis. Non-linear networks - Taylor's Theorem, companion models.

**TEL 505 Power Electronics (3 Units:
LH 45)**

Rectification and smoothing techniques. Voltage and current regulation, regulator circuits, the thyristor or SCR and its applications, timing circuits, motor speed control, power translator and integrated circuits, welding and heating.

**TEL 506 Electric And Magnetic Field Theory (3 Units:
LH 45)**

Electric, magnetic field problems, solutions, electric fields of electrode configurations. Field distribution in air-gap Schwarz problems, Christoffed transformation, numerical analysis, Simulation Quasi-stationary magnetic fields, eddy currents, braking power.

**TEL 507 Electric Power System Engineering (2 Units:
LH 30)**

Power system modelling load-flow analysis, static flow equations, classification of system variables, generalized n-bus system, network model formulation, use of network analyzer and digital computer, optimum operating strategies. Fault analysis. Control strategy. System protection switchgear, circuit breakers.

**TEL 508 High Voltage Insulation and Switchgear Technology (2 Units:
LH 30)**

Electric field strength; Breakdown mechanisms, thermal breakdown, electro-chemical deterioration in solids, gaseous insulation, gas-gilled circuit breakers, solid insulation, high voltage, breakdown in atmosphere. Corona discharge. Switching impulse voltage, lightning protection.

**TEL 509 Power Systems Communication and Control (2 Units:
LH 30)**

Review of transmission line theory, high frequency communication on power lines. Carrier systems and power line carrier applications. Multiplexing. Telemetry, signal processing and data transmission. Control of power generation. Voltage control, system stability, automatic voltage regulators, regulating transformers.

**TEL 510 Electrical Energy Conversion and Storage (2 Units:
LH 30)**

Electromechanical energy conversion, sources of motive power. Waste heat recovery. Solar energy nuclear power. Other sources of energy. Wind, geothermal, primary and secondary cells, cars and heavy vehicle batteries, testing, fault diagnosis, repairs. Effect of environmental factors on battery life, small-scale power resources.

3.10 ELECTRICAL AND ELECTRONICS ENGINEERING

Preamble

Electrical and Electronic engineers are involved in channelling natural resources into various end-uses such as heating, lighting, home appliances, consumer products, computing, sensing, control, and communication. They contribute to systems and devices for power, instrumentation, measurement, communication, management, manufacturing, transportation, etc. They are primarily concerned with the processes of generation, transmission, transformation, control, and utilization of energy or information.

The curriculum exposes students to the breadth of electrical engineering and allows them to pursue electives in several areas including circuits, electronics, power systems, communications, signal processing, controls, electromagnetics, optic/devices, and computer engineering. In circuits and electronics, courses provide study of basic electrical devices—energy sources, resistors, inductors, capacitors, diodes, and transistors – and their interconnection in operational networks. Circuits design and analysis techniques are covered with both analog and digital applications. In power systems, courses emphasize the design and applications of motors, generators, transformers, distribution systems, high-voltage devices, and power electronics. In communications signal processing, courses include concepts required for the characterization and manipulation of information-bearing signals, modulation systems, wireless networks, image processing, and detection hardware.

In controls, courses emphasize the design and application of circuits and systems to automatically monitor and regulate devices, machines, and processes. Advanced technologies using digital control, intelligent processing, neural networks, and programmable logic controllers are included. In electromagnetics, courses provide instruction in the interaction, propagation, and transmission high-frequency waves and signals through space and in conductors. Topics include grounding and shielding, antennas, microwaves, and systems. In optics/devices, courses provide study of solid-state materials, electronic devices, and optoelectronics. Applications are micro-fabrication, telecommunications, computing, instrumentation, lasers and fibre optics, sensing, and smart technologies.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.10.1 Course Structure**Course structure at 300-Level Electrical and Electronics Engineering**

Course Code	Course Title	Units	Status	LH	PH
EEE 301	Analogue Electronic Circuits	3	C	45	-
EEE 302	Digital Electronic Circuits	3	C	45	-
EEE 303	Circuit Theory I	3	C	45	-
EEE 304	Measurements and Instrumentation	3	C	45	-
EEE 305	Electrical Machines	4	C	60	-
EEE 307	Electromagnetic Fields and Waves I	3	C	45	-
EEE 314	Physical Electronics	3	C	45	-
EEE 315	Linear Systems	3	C	45	-
EEE 316	Electromechanical System	3	C	45	-
EEE 320	Laboratory Practicals	4	C	-	180
GST 311	Entrepreneurship	2	R	30	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
	Total	47			

Course structure at 400-Level Electrical and Electronics Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 401	Circuit Theory II	3	C	45	-
EEE 402	Electromagnetic Fields and Waves II	3	R	45	-
EEE 403	Communication Principles	4	C	45	45
EEE 404	Electric Power Principles	3	R	45	-
EEE 405	Advanced Electronics	3	C	30	45
EEE 406	Control Theory	3	C	45	-
GET 499	SIWES III	6	C	24 weeks	
	Total	25			

Course structure at 500-Level Electrical and Electronics Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 506	Electrical services Design	2	C	30	-
EEE 502	Reliability Engineering	2	C	30	-
EEE 503	Control Engineering	3	C	45	-
EEE 504	Advanced Circuit Techniques	2	C	30	-
EEE 505	Electromechanical Devices Design	2	R	30	-
EEE 507	Advanced Computer Programming and Statistics	2	R	15	45
EEE 599	Final Year Project	6	C	-	270
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
	Total	24			

Course Code	Course Title	Units	Status	LH	PH
GROUPS OF ELECTIVES					
COMPUTERS & CONTROL OPTION					
EEE 511	Analogue and Digital Computers	2	E	30	-
EEE 512	Industrial Electronics Design	3	E	45	-
EEE 513	Microcomputer Hardware and Software Techniques	3	E	45	-
EEE 514	Power Electronics	3	E	45	-
EEE 515	Control Engineering II	3	E	30	45
EEE 516	Control Engineering III	3	E	30	45
COMMUNICATION AND ELECTRONICS OPTION					
EEE 521	Communication Systems Engineering	3	E	45	-
EEE 522	Telecommunication Engineering	2	E	30	-
EEE 523	Solid State Electronics	2	E	30	-
EEE 524	Digital Signal Processing	2	E	30	-
EEE 525	Digital Communications System	2	E	30	-
EEE 526	Electroacoustics	3	E	45	-
EEE 527	Telecommunication Services Design	2	E	30	-
EEE 528	High Frequency and Microwave Electronics	3	E	45	-
EEE 529	Broadcasting	2	E	15	45

POWER AND MACHINES OPTION					
EEE 531	Electric Power System Engineering	2	E	30	-
EEE 532	Power Systems Communication and Control	2	E	30	-
EEE 533	Switchgear and High Voltage Engineering	2	E	30	-
EEE 534	Advanced Circuit Theory	3	E	45	-
EEE 535	Electric and Magnetic Field Theory	3	E	45	-
EEE 536	Electric Devices	3	E	30	45
EEE 537	Electrical Energy Conversion and Storage	2	E	30	-

3.10.2 Course Synopses

EEE 301 Analogue Electronic Circuit (3 Units: LH 45)

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.

EEE 302 Digital Electronics Circuit (3 Units: LH 45)

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)

EEE 304 Measurements And Instrumentation (3 Units: LH 45)

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 impedance 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.

EEE 305 Electrical Machines (4 Units: LH 60)

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.

EEE 307 Electromagnetic Fields and Waves I (3 Units: LH 45)

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.

EEE 311 Electric Circuit Theory I (3 Units: LH 45)

Circuit elements, circuit theorems, applications. Network response to steps, ramp, impulses. Network functions, response to exponential, sinusoidal sources. Laplace transform, polezero analysis, network synthesis, resonance, two-point analysis, ladder network. Star-Delta transformation, T, P Networks.

EEE 314 Physical Electronics (3 Units: LH 45)

Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy bands 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.

EEE 315 Linear Systems (3 Units: LH 45)

Mathematical models of physical system. Analogous concepts in electrical, mechanical and thermal systems. Transfer functions. Block diagrams and signal flow graphs. Feedback control system: advantages. Transient response of systems. The root-locus methods. Frequency response of systems. Bode and polar plots. System stability. Bouth and Nyquist criteria. Introduction to analogue computer simulation.

EEE 316 Electromechanical System (3 Units: LH 45)

Magnetic circuits. Basic principles of relays and activators; Ideal transformer. Equivalent circuits and basic analysis of practical transformers. D.C. machine contraction, characteristics of D.C. generators. Excitation of D.C. machines. Torque-speed characteristics of D.C. motors. A.C. machines; production of rotating magnetic fields. Simple theory of three-phase induction motors; torque speed characteristics, three-phase induction motors Single-phase motors-applications. Selection of motors, for practical applications. Synchronous machines.

EEE 320 Laboratory Practicals (4 Units: PH 180)

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.

EEE 401 Electric Circuit Theory II (3 Units: LH 45)

Networks, Node, Loop Analysis. Non-linear circuit analysis. Network functions, Locus diagrams. Filters; design, operation, low, high, band pass. Butterworth, Chebychev filters. Active network synthesis and analysis.

**EEE 402 Electromagnetic Fields and Waves II (3 Units:
LH 45)**

Propagation of electromagnetic waves in free space and in material media. Dielectric, conductors and ionised media. Transmission line theory including wave-guides and resonators, the Smith charts. Radiating elements and antenna theory.

**EEE 403 Communication Principles (4 Units: LH45;
PH 45)**

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, clippers 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, sources and correction of errors in PCM and DM.

**EEE 406 Control Theory (3 Units:
LH 45)**

Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwitz 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.

**EEE 405 Advanced Electronics (3 Units: LH 30;
PH 45)**

Linear I.C. op-amp, linear and non-linear operations, logarithmic amplifiers, A/D and D/A converters, gyrators and negative impedance converters, the 555 timer structure and applications; four-quadrant multipliers, dynamic logic systems and RAM memory circuits, application of digital circuits to instrumentation.

**EEE 404 Electric Power Principles (3 Units:
LH 45)**

Types of power station, operation, auxiliaries, economics of operation - stations, substations power supply economics, tariffs. Power factor correction. Polyphase theory. DC, AC power distribution, network calculations, Overhead line conductors. Corona effect, voltage control, circuit breakers, load forecast, siting of generating plants.

**EEE 502 Reliability Engineering (2 Units:
LH 30)**

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.

**EEE 503 Control Engineering (3 Units:
LH45)**

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.

**EEE 504 Advanced Circuit Techniques (3 Units:
LH 45)**

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.

**EEE 505 Electromechanical Devices Design (2 Units:
LH 30)**

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

**EEE 506 Electrical Services Design (2 Units:
LH30)**

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.

**EEE 507 Advanced Computer Programming and Statistics (2 Units: LH 15;
PH 45)**

Elements of statistics; Distribution and experiments; law of large number, numerical iteration procedures; revision of FORTRAN IV and BASIC Application program in computer aided design of Electrical systems.

**EEE 599 Final Year Project (6 Units:
LH270)**

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.

GROUPS OF ELECTIVES

These will be chosen by students with the Coordinator's 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.

COMPUTERS AND CONTROL OPTION

EEE 511 Analogue & Digital Computers (2 Units: LH 30)

Analogue computation, electrical analogue of mechanical, electromechanical systems and servomechanisms. Analogue computer elements, potentiometers, operational amplifiers, multipliers, function generators, simulation of systems transfer functions. Digital computer CPU, peripherals, storage. Arithmetic processes. Hybrid computer systems, parallel, vector, RISC's workstations.

EEE 512 Industrial Electronics Design (2 Units: LH: 30)

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.

EEE 513 Micro-Computer Hardware And Software Techniques (3 Units: LH 45)

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.

EEE 514 Power Electronics And Devices (3 Units: LH45)

Switching characteristics of diodes, transistors, thyristors etc. analysis of diode circuit with reactive loads, 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.

EEE 515 Control Engineering II (3 Units: LH 30; PH 45)

Frequency analysis, Nyquist plots, criterion, relative stability, M - and N - circles, inverse Nyquist Plots. Bode diagrams, determination of transfer function from asymptotic plot. Nichols chart. Root locus plots. 3 - term (PID) controllers. Series and parallel compensation design. Design using Bode, Nichols and Root locus methods.

EEE 516 Control Engineering III (3 Units: LH 30; PH 45)

Digital control; concept of sampling, z - transform, inverse zero-order-hold, stability analysis. State variables of dynamic system, formulation of state vector differential equation, solution state equation, transition matrix, eigenvalues and eigenvectors, stability. Nonlinear control, common types and effects of nonlinearities, phase-plane and describing function analysis, closed loop response and stability.

COMMUNICATION AND ELECTRONICS OPTION

EEE 521 Communications Systems Engineering (3 Units: LH45)

Microwave frequencies and uses; microwave transmission in transmission lines and wave guides, microwave circuits; impedance 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 aperture antennae and the related 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.

EEE 522 Telecommunication Engineering (2 Units: LH30)

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.

EEE 523 Solid State Electronics (2 Units: LH 30)

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

**EEE 524 Digital Signal Processing (2 Units:
LH 30)**

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.

**EEE 525 Digital Communications System (2 Units:
LH 30)**

Block Diagram of digital communication system sampling theorem, Shannon 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.

**EEE 526 Electroacoustics (3 Units:
LH 45)**

Properties of sound. Microphones, loudspeakers studio equipment and stereophone. Disc recording the reproduction. Turntables, crystal, magnetic pick-ups, recording, reproduction. Acoustic design of buildings.

**EEE 527 Telecommunication Services Design (2 Units:
LH30)**

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

**EEE 528 High Frequency and Microwave Electronics (3 Units:
LH 45)**

A survey of microwave engineering, models in waveguides and resonators, passive components, reactive and resistive elements, directional couples and tees ferrite isolators and circulators active components. Klystrons, magnetrons, travelling wave tubes, parametric amplifiers and solid state sources, introduction to varactor. PIN, Gunn-effect diode photodiode, phototransistor.

EEE 529 Broadcasting (2 Units: LH 15; PH 45)

Elements of broadcasting system, studio equipment, microphones, sound, disc, magnetic tape recording, radio transmitters power amplifiers, FM systems, radiating antenna, television camera, synchronization circuits, video amplifiers. Scanning. TV standards, Channel allocation colour television ADTV.

POWER AND MACHINES OPTION

EEE 531 Power Systems Engineering (3 Units: LH 45)

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.

EEE 532 Power System Communication and Control (2Units : LH 30)

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

EEE 533 Switchgear and High Voltage Engineering (2 Units: LH 30)

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

EEE 534 Advanced Circuit Theory (2 Units: LH 30)

Computer-Aided-Analysis/Design of Electric Networks. Component/Device modelling linear Networks - Equation formulation (Nodal method). Equation solution methods. Algorithm and program for automated solution. Operations count. Numerical inaccuracies, pivoting, sparsity. Sensitivity analysis. Non-linear networks - Taylor's Theorem, companion models.

EEE 535 Electric and Magnetic Field Theory (3 Units: LH 30)

Electric, magnetic field problems, solutions electric fields of electrode configurations. Field distribution in air-gap, Schwarz-problems, Christoffed transformation, numerical analysis. Simulation. Quasi-stationary magnetic fields, eddy currents, breaking power.

**EEE 536 Electric Drives (3 Units: LH 30
PH 45)**

Historical development, types of motors shunt, series, compound wound DC, AC induction motors, repulsion, reluctance, hysteresis and synchronous motors. Speed- torque characteristics, speed-control of electric drives. Braking. Motor power rating selection. Protection, control of drive motors. Application of electric drives

**EEE 537 Electrical Energy Conversion and Storage (2 Units:
LH 30)**

Electromechanical energy conversion, sources of motive power. Waste heat recovery. Solar energy nuclear power. Other sources of energy. Wind, geothermal, primary and secondary cells, cars and heavy vehicle batteries, testing, fault diagnosis, repairs. Effect of environmental factors on battery life, small-scale power resources.

3.11 ELECTRONICS ENGINEERING

Electronic Engineering Technology is a technological field requiring the application of scientific and engineering knowledge and methods, combined with technical skills, in support of engineering activities. An electronic engineering technologist is a person who is knowledgeable in electronics theory and design and who understands state-of-the-art practices on digital and analog circuits and systems. Some of the areas of emphasis in the programme are: *Communications Systems*(involving analog and digital communications systems at the circuit and subsystem level); *Mechatronics* (electronic control of mechanical systems}; *Signal Processing* (analog signal processing (ASP) and digital signal processing (DSP); *Programming Environments and Java* (alternate programming environments such as command-line-oriented UNIX or Linux and Eclipse IDE); *Microprocessor Architecture* (internal architecture of the microprocessor using assembly language and/or high-level language to program the microprocessor and develop simple algorithms).

DETAILS OF UNDERGRADUATE COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.11.1 Course Structure**Course structure at 300-Level Electronics Engineering**

Course Code	Course Title	Units	Status	LH	PH
EEE 301	Analogue Electronic Circuits	3	C	45	-
EEE 302	Digital Electronic Circuits	3	C	45	-
EEE 303	Circuit Theory I	3	C	45	-
EEE 304	Measurements and Instrumentation	3	C	45	-
EEE 305	Electrical Machines	4	C	60	-
EEE 307	Electromagnetic Fields and Waves I	3	C	45	-
EEE 314	Physical Electronics	3	C	45	-
EEE 315	Linear Systems	3	C	45	-
EEE 316	Electromechanical System	3	C	45	-
ELE 300	Laboratory Practicals	4	C	-	180
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
	Total	47			

Course structure at 400-Level Electronics Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 401	Circuit Theory II	3	C	45	-
EEE 402	Electromagnetic Fields and Waves II	3	R	45	-
EEE 403	Communication Principles	4	C	45	45
EEE 406	Control Theory	3	R	45	-
ELE 401	Advanced Electronic Circuits	3	C	45	-
ELE 402	Electronics I Laboratory	1	C	-	45
ELE 403	Electronics II Laboratory	1	C	-	45
GET 499	SIWES III	6	C	24 weeks	

TEL 404	Electric Power Principles	3	C	45	-
	Total	27			

Course structure at 500-Level Electronics Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 502	Reliability Engineering	2	C	30	-
EEE 503	Control Engineering	3	C	45	-
EEE 504	Advanced Circuit Techniques	2	C	30	-
EEE 512	Industrial Electronics Design	3	C	45	-
EEE 513	Microcomputer Hardware & Software Techniques	3	C	45	-
EEE 513	Analogue and Digital Computers	2	R	30	-
EEE 522	Telecommunications Engineering	2	C	30	-
EEE 523	Solid State Electronics	2	C	30	-
EEE 524	Digital Signal Processing	2	E	30	-
EEE 525	Communications Systems Engineering	3	C	45	-
EEE 526	Electroacoustics	3	E	45	-
EEE 528	High Frequency and Microwave Electronics	3	C	45	-
ELE 501	Project	6	C	-	270
ELE 502	Power Electronics	3	C	45	-
ELE 503	Power Electronics Laboratory	2	C	-	90
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
	Total	46			

3.11.2 Course Synopses

ELE 401 Advanced Electronic Circuits LH 45)

(3 Units:

Application of feedback theory, oscillators and frequency standards, precision analog techniques, low-power circuit design, interfacing sensors, designing for high reliability, electronics for harsh environments.

ELE 402 Electronics I Laboratory PH 45)

(1 Unit:

Experiments in design with diodes, transistors, differential and operational amplifiers, and logic components

**ELE 403 Electronics II Laboratory
PH 45)**

(1 Unit:

Experiments in design with diodes, power transistors, integrated circuits, advanced bipolar and FET logic gates, flipflops and registers.

**ELE 502 Power Electronics
LH 45)**

(3 Units:

Power semiconductor devices in switching mode converter and control circuits, phase-controlled rectifiers, synchronous inverters, AC regulators, cyclo-convertors; self commutated inverters; and frequency changers; thermal analysis and protection. Applications to industry and HVDC.

**ELE 503 Power Electronics Laboratory
PH 90)**

(2 Units:

An introduction to power electronic circuits is presented. Students will construct several dc/dc, dc/ac and ac/dc converters. Various switching algorithms, including pulse width modulation, delta modulation, and hysteresis control will be developed to regulate and control the respective circuits.

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3.12 ENVIRONMENTAL ENGINEERING

Environmental engineers are concerned with minimizing the impact of human activities on the local, regional, and global environment and concurrently improving our standard of living. Towards preserving environmental and public wellbeing, the programme exposes students to a strong background in the fundamental earth sciences in order to understand complex environmental problems and then pose and design appropriate engineering solutions. As problem solvers for something as diverse as “the environment,” environmental engineers also need to understand the most current technologies used in practice and have a desire to maintain a high level of learning in this rapidly evolving and developing field. Environmental engineering cuts across all disciplines of sciences and social sciences in handling the following key areas of emphasis in the programme: Water and Wastewater Resources Engineering; Geo-Environmental Engineering; Air Pollution and Control; Environmental Chemistry and Processes; and Environmental Microbiology and Processes.

Primary areas of specialization are:

- a. Air Pollution Control
- b. Hazardous Waste Treatment and Disposal
- c. Natural Systems Modeling
- d. Recycling and Solid Waste Disposal
- e. Sanitary Engineering (municipal and industrial water and wastewater treatment)
- f. Water Resources (control and use of water, focusing on flood control, irrigation, raw water supply, and hydroelectric power applications)

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.12.1 Course Structure

Table 3.11.1: Course structure at 300-Level Environmental Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 301	Fluid Mechanics	3	R	30	45
CEE 302	Strength of Structural Materials	3	R	30	45
CEE 304	Civil Engineering materials	3	C	30	45
CEE 305	Soil Mechanics I	3	C	30	45
CEE 308	Engineering Surveying and Photogrammetry I	3	R	30	45
EVE 301	Introduction to Geochemistry	3	C	45	-
EVE 302	General Biology	3	C	45	-
EVE 303	Chemical Engineering Material & Energy Balances	3	C	30	45
EVE 304	Biological Fundamentals of Environmental Engineering	3	C	45	-
EVE 305	Fundamentals of Environmental Engineering and Science	3	C	30	45
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
	Total	45			

Course structure at 400-Level Environmental Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 405	Soil Mechanics II	3	E	30	45
CEE 406	Engineering Surveying & Photogrammetry II	3	E	30	45
EVE 401	Chemical Fundamentals of Environmental Engineering	3	C	45	-
EVE 402	Water and Wastewater Engineering	3	C	45	-
EVE 403	Introduction to Air Pollution	3	C	45	-
EVE 404	Air Pollution Control Methods	3	C	45	-
EVE 405	Hydraulic Engineering	3	C	30	45
EVE 406	Introduction to Physical Geology	3	R	30	45
GET 499	SIWES III	6	R	24 weeks	
	Total	30			

Course structure at 500-Level Environmental Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 502	Geotechnical Engineering	3	E	30	45
EVE 599	Project	6	C	-	270
EVE 501	Sanitary Engineering Design	3	C	30	45
EVE 502	Research in Environmental Engineering	1	C	15	-
EVE 503	Senior Design Project	3	C	45	-
EVE 504	Environmental Law and Regulations	3	R	45	-
EVE 505	Remediation of Contaminated Groundwater and Soil	3	C	30	45
EVE 506	Public Health Engineering	3	R	45	-
EVE 507	Waste Management Engineering	3	C	30	45
EVE 508	Environmental Systems Modelling	3	C	45	-
EVE 509	Water Resources and Environmental Engineering	3	C	30	45
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
	Total	39			

3.12.2 Course Synopses**EVE 301 Introduction to Geochemistry
LH 45)****(3 Units:**

Application of basic chemical principals towards investigations of element distributions in geologic systems. Emphasis on origin of elements in our Solar System, element distribution during planetary formation, phase equilibria, rock-water interactions, thermodynamic principles, environmental and isotope geochemistry.

**EVE 302 General Biology
LH 45)****(3 Units:**

A comprehensive study of the general principles of the biology of plants, animals, and protists including population biology and regulation mechanisms.

EVE 303 Chemical Engineering Material & Energy Balances**(3 Units: LH 30;
PH 45)**

The application of mathematics, physics and chemistry to industrial chemical processes. The use of equations of state, chemical reaction stoichiometry, and the conservation of mass and energy to solve chemical engineering problems.

EVE 304 Biological Fundamentals of Environmental Engineering (3 Units: LH 45)

Introduction to the function of organisms related to environmental engineering. The course focuses on both the application of organisms to removing contaminants and the effects of contaminants on organisms.

EVE 305 Fundamentals of Environmental Engineering and Science (3 Units: LH 30; PH 45)

Course discusses fundamental chemical, physical, and biological principles in environmental engineering and science. Topics include environmental phenomena, aquatic pollution and control, solid waste management, air pollution and control, radiological health, and water and wastewater treatment systems.

EVE 401 Chemical Fundamentals of Environmental Engineering (3 Units: LH 45)

Introduction to the key chemical and physical concepts integral to environmental systems and processes. This course provides a fundamental background in those chemical and environmental engineering principles that are common to all environmental engineering.

EVE 402 Water and Wastewater Engineering (3 Units: LH 45)

A study of the engineering design principles dealing with the quantity, quality and treatment of water, and the quantity, characteristics, treatment and disposal of wastewater.

EVE 403 Introduction to Air Pollution (3 Units: LH 45)

Introduction to the field of air pollution dealing with sources, effects, federal legislation, transport and dispersion and principles of engineering control.

EVE 404 Air Pollution Control Methods (3 Units: LH 45)

Study of the design principles and application of the state-of-the-art control techniques to gaseous and particulate emissions from fossil fuel combustion, industrial and transportation sources

EVE 405 Hydraulic Engineering (3 Units: LH 30; PH 45)

A study of applied hydraulics to design of systems used for collection or distribution of water. Emphasis on open channel flow, hydraulic machinery, design of supply systems, drainage systems, and hydraulic transients.

EVE 406 Introduction to Physical Geology (3 Units: LH 30; PH 45)

A study of Earth materials, surface features, internal structures and processes. Particular attention is paid to Earth resources, geological hazards, engineering and environmental problems.

EVE 501 Sanitary Engineering Design (3 Units: LH 30; PH 45)

Functional design of water and waste water treatment facilities.

EVE 502 Research in Environmental Engineering (1 Unit: LH 15)

Students will investigate cutting edge research in the environmental engineering field including experimental studies, current environmental policy changes, and international environmental issues. Investigation to include live research seminars, reading current literature, and/or laboratory experimentation.

EVE 503 Senior Design Project (3 Units: LH 45)

Open-ended design projects involving one or more areas of engineering. Planning design projects, philosophy of design, and application of engineering principles to design problems.

EVE 504 Environmental Law and Regulations (3 Units: LH 45)

This course provides comprehensive coverage of environmental laws and regulations dealing with air, water, wastewater, and other media. The primary focus is permitting, reporting, and compliance protocols. The course topics include Nigerian and international legal systems and judicial processes, liability, enforcement, Clean Air Act, Clean Water Act, Safe Drinking, Water Act, etc. Case studies will be emphasized.

EVE 505 Remediation of Contaminated Groundwater and Soil (3 Units: LH 30; PH 45)

Course covers current in-situ and ex-situ remediation technologies. Current literature and case studies are utilized to provide the focus for class discussions and projects.

EVE 506 Public Health Engineering (3 Units: LH 45)

A comprehensive course dealing with the environmental aspects of public health.

EVE 507 Waste Management Engineering (3 Units: LH 30; PH 45)

Quantity and quality of sewage, including important parameters for the determination of quantity and qualities. Sewage system planning, design, construction and maintenance. Sewage treatment processes, including various unit operations. Non-conventional sewage treatment processes including sewage farming, waste stabilization ponds, aerated lagoons and oxidation ditch. Sewage disposal methods including water-dependent and water-independent methods. Water pollution control, solid waste quantity and quality determination, collection, transportation and disposal methods. Institutional arrangements for management. Management of toxic and hazardous waste.

EVE 508 Environmental Systems Modelling (3 Units: LH 45)

Introductory course in modelling environmental systems. Course will focus on contaminant fate and transport in the environment. Models will be developed that will include physical, chemical and biological reactions and processes that impact this fate.

EVE 509 Water Resources and Environmental Engineering (3 Units: LH 30; PH 45)

Water Resources: 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, silting basins, man holes and coastal hydraulic structures, etc.: engineering economy in water resources planning.

Environment Engineering: 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.

EVE 599 Project (6 Units: PH 270)

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.

3.13 FOOD SCIENCE AND TECHNOLOGY

The need for manpower required for the preservation of many agricultural crops and development of products or processes that will provide nutritious and balanced diet to the people has been the concern of all involved in national development. The main objectives of the programme are to provide the course of instructions that will train the type of scientists and technologists capable of working effectively at the senior level in the food industry, food commodity research institutes and government or private establishments related to food. Students are expected to be exposed to the following areas:

- Evaluation of the chemical and physical properties of conventional and non-conventional sources of food.
- Use or adaptation of appropriate technology for the preservation of foods.
- Study of the nutritional and health implications of local/imported foods.
- Provision of technical and managerial skills to industry through extension services.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.13.1 Course Structure

Course structure at 300-Level Food Science and Technology

Course Code	Course Title	Units			
AGR 306	Animal or Crop Science	3			
FST 300	Laboratory Practicals	4			
FST 302	Introduction to Food Technology	2			
FST 303	Food Microbiology	3			

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FST 304	Food Chemistry	3	C		
FST 305	Fundamentals of Food Processing	4	C		
FST 306	Food Analysis	3	C		
FST 307	Principles of Nutrition	3	C		
FST 308	Post Harvest Physiology and Storage Technology	3	F		
GET 301	Engineering Mathematics III	3	F		
GET 303	Engineer-in-Society	2	F		
GET 304	Engineering Communication	2	F		
GET 399	SIWES II	3	C		12 weeks
GST 311	Entrepreneurship	2	F		
MEE 309	Thermodynamics	3	F		
MCB2 21	General Microbiology	3	C		
	Total	46			

Course structure at 400-Level Food Science and Technology

Course Code	Course Title	Units	Prerequisites		
FST 400	Laboratory Practicals	2	C		
FST 401	Food Process Engineering	4	C		
FST 402	Food Process Plant Design	4	C		
FST 403	Cereals Technology	3	F		

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FST 404	Brewing Science and Technology	3	C	
FST 405	Food Machinery	3	F	
GET 499	SIWES III	6	C	24 we eks
	Total	25		

Course structure at 500-Level Food Science and Technology

Course Code	Course Title	U n i t s	S t a t u s	
FST 500	Laboratory Practicals	4	C	
FST 501	Food Packaging	3	C	
FST 502	Fruits and Vegetables Processing	3	C	
FST 503	Meat Technology	3	C	
FST 504	Milk and Dairy Technology	3	C	
FST 505	Processing of Miscellaneous Food Commodities	3	C	
FST 506	Food Standard and Quality Control	3	C	
FST 555	Final Year Project	6	C	
GET 501	Engineering Management	3	F	
GET 502	Engineering Law	2	F	
	Total	33		

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3.13.2 Course Synopses

**FST 302 Introduction to Food Technology (2 Units:
LH 30)**

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.

**FST 303 Food Microbiology (3 Units:
LH 45)**

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

**FST 304 Food Chemistry (3 Units:
LH 45)**

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.

**FST 305 Fundamentals of Food Processing (3 Units:
LH 45)**

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

**FST 306 Food Analysis (3 Units:
LH 45)**

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

**FST 307 Principles of Human Nutrition (3 Units:
LH 45)**

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.

**FST 308 Post-Harvest Physiology and Storage Technology (3 Units:
LH 45)**

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.

FST 401 Food Process Engineering (4 Units: LH 45; PH 45)

Thermodynamics properties of food materials. Review of basic concepts of fluid flow; viscosity, compression, expansion and power requirements for pumping of fluids in the food industry. Pipe-line design. Application of the theory of heat, mass, momentum transfer in the analysis of the following unit operations: refrigeration, evaporation, psychometry, dehydration, gas absorption, distillation, extraction, filtration, sedimentation, centrifugation and crystallisation. Fuel utilisation in the food industry.

FST 402 Food Process Plant Design (4 Units: LH30; PH90)

Plant layout and design in the food industry. Technical feasibility study of food processing operations. Review of the economics of process design and optimisation techniques. Optimum design of food processing plants.

FST 403 Cereals Technology (3 Units: LH 45)

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

FST 404 Brewing Science and Technology (3 Units: LH 45)

Study of the history, production, packaging and chemistry of beer. Operations of malting, mashing, hop chemistry, boiling, maturation and storage of beer as well as fruit composition and quality of cider will be discussed. (3H,3C) I.

FST 405 Food Machinery (3 Units: LH 45)

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.

FST 501 Food Packaging (3 Units: LH45)

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

FST 502 Fruit and Vegetable Processing (3 Units: LH 45)

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

FST 503 Meat Technology (3 Units: LH 45)

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

FST 504 Milk and Dairy Technology (3 Units: LH 45)

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.

FST 505 Processing of Miscellaneous Food Commodities (3 Units: LH 45)

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

FST 506 Food Standards and Quality Control (3 Units: LH 45)

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

FST 510 Introduction to Tropical Crops (3 Units: LH 45)

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).

FST 511 Animal Husbandry and Production (3 Units: LH 45)

A broad treatment of the-breed types, world distribution, management, feeding and disease problems of farm live-stock.

3.14 INDUSTRIAL AND PRODUCTION ENGINEERING

Industrial and production engineering is the application of the principles of mathematics, physical and social sciences to the design, analysis, operation and control of man-machine work systems with maximum productivity as the primary goal. Man-machine work system includes manufacturing, mineral exploration and exploitation, agro-allied, construction, defence as well as service industries. Thus the programme seeks to combine knowledge of the physical laws that govern the behaviour of materials, machines and the environment with the behaviour of people as they interact with materials, machines and the environment in dynamic organizational operations. The programme has taken due cognizance of the emerging area of *Manufacturing Systems Engineering* which combines the principles of mechanical engineering, electronics, control systems, manufacturing technology, production management and software to formulate and improve manufacturing processes. Of importance is the use of computers to control various manufacturing processes, including factory automation, design and manufacture and awareness of the planning, control and management methods which are relevant to modern manufacturing systems.

Primary Areas of Specialization:

- a. Ergonomics / Human Factors Engineering (designing the workplace to better accommodate “human factors” - human abilities and behaviors - , thereby yielding more efficient operations and fewer accidents or injuries).
- b. Facility Design (aimed at operational efficiency)
- c. Management Decision Making / Operations Research (using statistics and other forms of data analysis to aid in making management decisions)
- d. Manufacturing Engineering (concerned with all aspects of manufacturing operations – materials, parts, equipment, facilities, labor, finished products, delivery, etc.).
- e. Quality Control (using sampling, statistical analysis and other techniques to assess and maintain the quality of products or services provided by a business or other organization)
- f. Work Design (defining jobs that individual workers do in performing the overall work of the organization, with the typical focus being on optimizing manufacturing operations).
- g. Worker Productivity (conducting time and motion studies, setting work performance standards, and proposing new/improved work methods)

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.14.1 Course Structure

Course structure at 300-Level Industrial and Production Engineering

Course Code	Course Title	Units	Status	LH	PH
EE E 316	Electromechanical System	3	E	4 5	-
GE T 301	Engineering Mathematics III	3	R	4 5	-
GE T 302	Engineering Mathematics IV	3	R	4 5	-
GE T 303	Engineer-in-Society	2	R	3 0	-
GE T 304	Engineering Communication	2	R	3 0	-
GE T 399	SIWES II	3	C	12 weeks	
GS T 311	Entrepreneurship	2	R	3 0	-
ME E 307	Theory of Machines I	3	C	3 0	-
ME E 308	Manufacturing Technology	3	C	4 5	-
ME E 309	Thermodynamics	3	C	4 5	-
ME E 310	Fluid Mechanics	2	C	3 0	-

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ME E 312	Workshop Practice	2	C	1 5	4 5
ME E 313	Metallurgy	2	C	3 0	-
ME E 321	Mechanics of Materials	3	C	4 5	-
ME E 322	Metrology	3	R	4 5	-
ME E 331	Engineering Drawing III	3	C	3 0	4 5
TI E 301	Operations Research	3	C	4 5	-
TI E 302	Machine Tools	3	C	3 0	4 5
TI E 303	Work Study	3	C	4 5	-
TI E 304	Laboratory Practicals	3	R	4 5	-
TI E 305	Engineering Probability and Statistics	3	R	4 5	-
	TOTAL UNIT	5 7			

Course structure at 400-Level Industrial and Production Engineering

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H
GE T 499	SIWES III	6	C	24 weeks	
TIE 401	Industrial Forecasting Technique	3	E	4 5	-

TIE 402	Engineering Economics	2	C	3 0	-
TIE 403	Project Planning and Control I	2	R	3 0	-
TIE 404	Work Systems Design	3	C	3 0	4 5
TIE 405	Production and Inventory Systems Design	3	C	4 5	-
TIE 406	Machine Tools and Transfer Machines	3	C	4 5	-
TIE 407	Industrial Quality Control	3	C	3 0	4 5
TIE 408	Tools and Fixtures Design	3	R	3 0	4 5
TIE 409	Laboratory Practicals	1	C	-	4 5
	TOTAL	2 9			

Course structure at 500-Level Industrial and Production Engineering

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H
GE T 501	Engineering Management	3	R	4 5	-
GE T 502	Engineering Law	2	R	3 0	-
ME E 508	Engineering Design Process	3	C	4 5	-
TI E 501	Computer Aided Manufacturing	3	R	4 5	-
TI E 502	Simulation in Systems Design	3	C	4 5	-
TI E 503	Project Planning and Control II	2	C	3 0	-

TI E 504	Facilities and Industrial Systems Design	4	C	4 5	4 5
TI E 505	Human Factors Engineering	3	C	3 0	4 5
TI E 506	Applied Stochastic Process	3	R	4 5	-
TI E 507	Maintenance Engineering	3	R	3 0	4 5
TI E 508	Value Engineering and Analysis	3	R	3 0	4 5
TI E 509	Manufacturing Information systems	3	R	4 5	-
TI E 510	Project	6	C	-	2 7 0
TI E 511	Laboratory Practicals	2	C	-	9 0
	TOTAL	4 3			

3.14.2 Course Synopses

TIE 301 Operations Research LH 45)

(3 Units:

Linear programming-graphical solution method, the simplex algorithm, duality theory and sensitivity analysis. Special LP problems. Computer packages for LP, PERT and CPM and Applications to maintenance and project control. Dynamic programming. Markov chains queuing theory and applications. Examples of Operations Research Applications to Engineering Problems

TIE 302 Machine Tools PH 45)

(3 Units: LH 30;

Review of standard machine tools: centre lathes, milling, shaping, drilling, cylindrical and surface grinding machines. Principles of machine tools for quantity production: Machine elements and considerations for rigidity. Kinetics of machine tools.

**TIE 303 Work Study (3 Units:
LH 45)**

Work Methods Analysis and Design including charting techniques, operations Analysis, Micromotion studies, principles of motion. Economy and workplace layout. Establishing Standard Procedures and Applications. Principles and Techniques of Work Measurement including time Study, Work Sampling, System of Predetermined Motion Time Data and Estimating Techniques.

**TIE 305 Engineering Probability and Statistics (3 Units:
LH 45)**

Estimating Engineering Quantities: Estimators Methods, Confidence Limits and Tolerance. Hypothesis testing; Statistical Inference and Engineering decision situations, operating characteristics curves, parametric and non-parametric tests of engineering data. Introduction to analysis of variance, regression and correlation analysis in industrial system modelling. Statistical computer routines.

**TIE 401 Industrial Forecasting Technique (3 Units:
LH 45)**

Forecasting in Industrial Operations. Time horizons and accuracy. Forecasting future business, product demand and technological changes. Intuitive and quantitative techniques. Input-output analysis. Moving averages and exponential smoothing. Application of regression, correlation and time series analysis. Computer routines. Forecast evaluation of Industrial Systems.

**TIE 402 Engineering Economics (2 Units:
LH 30)**

Economic analysis of engineering projects; value systems economic decisions on capital investments and choice of engineering alternatives; new projects, replacement and abandonment policies, risky decisions; corporate financial practices.

**TIE 403 Project Planning and Control I (2 Units:
LH 30)**

Project organisation and definition of objectives. Collecting, generating and analysis of project statistical data. Projects task elements identification techniques and diagramming, planning and progressing. Construction, fabrication or maintenance project scheduling and evaluation using CPM and PERT techniques. Feasibility studies to include technical and economic studies of projects.

**TIE 404 Work Systems Design (3 Units: LH 30;
PH 45)**

Elements and classification of Work-Systems Design Objectives and Parameters including Productivity measurement and improvement techniques. Design of operations including the use of jigs and fixtures in methods improvement; job description and evaluation, incentive and work control schemes. Working Posture

including lifting, pushing and pulling. Design of Industrial Work Stations using Anthropometric principles and data. Process design and introduction to modern techniques in work-systems design.

TIE 405 Production and Inventory Design (3 Units: LH 45)

Production systems design and control tasks, including planning, scheduling and machine loading. Work flow control. Material requirement planning and control. Inventory systems design. Applications of linear programming, critical path method and PERT in resource allocation.

TIE 406 Machine Tools and Transfer Machine (3 Units: LH 45)

Hydraulic/electrical copying/transmission in machines. Considerations for installing, testing and maintenance. In-line transfer machines, rotary, indexing transfer machines, drum type machines and automatic loading transfer methods. The economics and justification of transfer machines. Installation and testing of machines.

TIE 407 Industrial Quality Control (3 Units: LH 30; PH 45)

Engineering and cost factors affecting quality of products. Control charts for attributes. Control charts for variables. Use of control charts for establishing and maintain engineering specifications/tolerances. Sampling by attributes and variables. Continuous sapling. Economic considerations.

TIE 408 Tools and Fixtures Design (3 Units: LH 30; PH 45)

Differences between jigs and fixtures. Principles of locations, principles of clamping. Design features of jigs and fixtures and applications to design of drill jigs, milling, turning, grinding, boring and welding fixtures, metal cutting tool design, numerically-controlled tools design. Ergonomic considerations in jigs, fixtures and tool design, location and applications. The economics of machine tools design.

TIE 501 Computer Aided Manufacturing (3 Units: LH 45)

Trends in manufacturing technology. Computer aided manufacturing systems. Cases in facilities planning, group technology and process design. Numerical control, introduction to direct and adaptive control, elementary application of computers in material handling and production control including the integrated data base approach.

TIE 502 Simulation in Systems Design (3 Units: LH 45)

Introduction to modelling and simulation. Random Number generation and testing. Introduction to special simulation languages (GPSS, SIM-SCRIPT, etc.). Multiple comparison procedure in simulation. Case studies in process design, queuing, production/inventory systems, etc.

TIE 503 Project Planning and Control II (2 Units: LH 30)

Optimisation of large scale resource allocation. Scheduling and sequencing criteria including makespan, lateness, tardiness and mean flow time. One, two and three facility optimal scheduling, multi-facility heuristic scheduling and applications. Introduction to Technology Assessment.

TIE 504 Facilities and Industrial Systems Design (4 Units: LH 45; PH 45)

The facilities design function and economics. Product and process engineering. Flow analysis and design. Facilities layout, using manual and computer routines, plant and machine location from qualitative and quantitative consideration. Analytical methods. Packaging, storage and material handling system.

TIE 505 Human Factors Engineering (3 Units: LH 30; PH 45)

Human performance in man-machine systems. Human sensory, motor and information processes. Man-machine dynamics. Environmental effects on human performance.

TIE 506 Applied Stochastic Processes (3 Units: LH 45)

Examples of stochastic processes in Engineering. Classification of general stochastic processes. Markov chains (discrete time and continuous time) and applications. Renewal processes and applications – equipment replacement, signal counters, production inventory, queues in maintenance, etc. Other processes with engineering applications. Computational methods, and computer packages.

TIE 507 Maintenance Engineering (3 Units: LH 30; PH 45)

The maintenance function and maintainability of man-machine systems. Organisation for efficient maintenance. Maintenance consideration in Engineering Systems design. Failure and analysis, replacement theory, preventive and corrective maintenance. Maintenance analysis and economics. Policy formulation and implementation.

TIE 508 Value Engineering & Analysis (3 Units: LH 30; PH 45)

The concept of value, productivity, functionality, marketability, and their mutual relationship. Product and project analysis: Identification of alternative components, features and materials and their selection. Value systems design,

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analysis and evaluation. The value engineering and analysis problem, level of value engineering. Solution procedures to the value engineering problem. Value analysis and real-life applications. Product, project and system cost estimate and reduction.

TIE 509 Manufacturing Information Systems
LH 45)

(3 Units:

Definition of data, information, manufacturing, systems. Basic manufacturing functions, the respective information required to perform each function; generate information for each function. Basic manufacturing processes, information needed to carry out each process and application. Process output information with examples in the heat treatment of all the forming processes, all the conventional machining processes. Organisation of integrated input/output manufacturing information systems for the basic manufacturing.

DRAFT

3.15 INFORMATION AND COMMUNICATION TECHNOLOGY

The programme exposes students to the latest technology in areas including networking, telecommunications, enterprise-resource planning, human-computer interaction, E-commerce, and integrated business systems. Professionals in this field administer, maintain, and support computer systems and networks. Students are to be exposed to technology platforms that support business processes, managerial decision-making, and organizational communication.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.15.1 Course Structure

Course structure at 300-Level Information and Communication Technology

Course Code	Course Title	Units	Status	L H	P H
EE E 30 1	Analogue Electronic Circuit	3	R	4 5	-
EE E 30 2	Digital Electronic Circuit	3	R	4 5	-
EE E 30 3	Circuit Theory I	3	R	4 5	-
EE E 30 5	Electrical Machines	4	R	6 0	-

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GET301	Engineering Mathematics III	3	R	45	-
GET304	Engineering Communication	2	R	30	-
GET399	SIWES II	3	C	12 weeks	
GST311	Entrepreneurship	2	C	30	-
ICT301	Data-Base Design & Management	2	C	30	-
ICT303	Operating Systems	3	C	45	-
ICT304	Communication Principles	3	R	45	-
ICT305	Software Development Techniques	3	C	45	-
ICT306	Electromagnetic Fields & waves	3	R	45	-
ICT310	Computer Organisation & Architecture	3	C	45	-
ICT311	Laboratory Practicals	4	C	-	180

	TOTAL UNIT	4			
		4			

Course structure at 400-Level Information and Communication Technology

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H
EE E 40 6	Control System	3	R	4 5	-
GE T 49 9	SIWES III	6	C	24 weeks	
IC T 40 1	Cyberpreneurship&Cyberlaw	2	R	3 0	-
IC T 40 2	Satellite Communication	3	C	4 5	-
IC T 40 3	Computer Security Techniques	2	C	3 0	-
IC T 40 5	Data Communication System & Network	3	C	4 5	-
IC T 40 6	Internet Technology & Programming	3	C	4 5	-
IC T 40 7	Information System Analysis & Design	3	R	4 5	-
IC T	Mobile Communication and Network	3	R	4 5	-

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40 8					
IC T 41 1	Laboratory Practicals	2		-	9 0
			C		
	TOTAL	3 0			

Course structure at 500-Level Information and Communication Technology

Co ur se Co de	Course Title	U n it s	St at us	L H	P H
EE E 50 2	Reliability Engineering	3	R	4 5	-
EE E 52 4	Digital Signal Processing	3	C	4 5	-
G ET 50 1	Engineering Management	3	C	4 5	-
G ET 50 2	Engineering Law	2	C	3 0	-
IC T 50 3	Java Technology & Programming	3	R	4 5	-
IC T 50 4	Software Engineering	3	C	4 5	-
IC T 50 5	Artificial Neural Network	3	C	4 5	-

IC T 50 7	Introduction to EnterpriseResourcePla nningSystems	3	C	4 5	-
IC T 50 8	Antenna & Propagation	2	R	3 0	-
IC T 50 9	Computer Graphics & Animation	2	C	3 0	-
IC T 51 1	Project	6	C	-	2 7 0
IC T 51 3	Project Management	2	E	3 0	-
IC T 51 4	Communication Systems Engineering	2	E	3 0	-
IC T 51 5	Multimedia Technology & Programming	2	E	3 0	-
IC T 51 6	Random Process & Queue Theory	2	E	3 0	-
IC T 51 7	Data Structure & Algorithms	2	E	3 0	-
IC T 51 8	Design & Installation of Electrical & ICT Services	3	R	4 5	-
	TOTAL	4 6			

3.15.2 Course Synopses

**ICT 301 Database Design & Management (2 Units:
LH 30)**

Overview of Database systems: model, schema, instance. Database system vs. File systems. Data abstraction levels, database languages, system architecture. Classification of DBMS. Data modelling: 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.

**ICT 303 Operating Systems (3 Units:
LH 45)**

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, 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.

**ICT 304 Communication principles (3 Units:
LH 45)**

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,

clippers 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.

ICT 305 Software Development Techniques (2 Units: LH 30)

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.

ICT 306 Electromagnetic Fields & Waves (3 Units: LH 45)

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. Magnetostatics: 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 hysteresis, Hysteresis 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 .

ICT 310 Computer Organization and Architecture (3 Units: LH 45)

Introduction to basic concepts of computer organization and design: metrics for computer performance, computer arithmetic, Von Neuman architecture, instruction implementation, control unit, pipelining, memory systems hierarchy, cache memories and basic I/O controllers.

ICT 401 Cyberpreneurship&CyberLaw (2 Units: LH 30)

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.

ICT 402 Satellite Communication

(3 Units:

LH 45)

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 launching. 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-SS), sequence synchronous and sequence asynchronous DS-SS, random access DS-SS, link analysis, FH-SS systems, FH-SS, 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.

ICT 403 Computer Security Techniques

(2 Units:

LH 30)

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, 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.

ICT 405 Data Communication and Network Applications

(3 Units:

LH 45)

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.

ICT 407 Information System Analysis & Design (2 Units: LH 30)

System Development Life Circle: Strategy and planning system analysis, logical design, physical design, implementation maintenance. System Development Techniques and methodologies: by Process modelling, function decomposition diagramming, Entity-Relationship diagramming, data flow diagramming, and procedure modelling. Design and Layout of forms, screens, dialogues, 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.

ICT 408 Mobile Communication & Network (3 Units: LH 45)

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; signalling; 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.

ICT 503 JAVA Technology & Programming (2 Units: LH 30)

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, catching 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.

ICT 504 Software Engineering (3 Units: LH 45)

Development of methodologies useful in the software engineering classical life cycle. This includes: requirements, design, implementation, and testing phases. These methodologies are reinforced through utilization of a CASE tool and a group project.

ICT 505 Artificial Neural Network (2 Units: LH 30)

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.

ICT 507 Introduction to Enterprise Resource Planning Systems (3 Units: LH 45)

This course provides a technical overview of Enterprise Resource Planning Systems and their impact on organizations. Existing software package, such as SAP, should be used to illustrate the concepts, fundamentals, framework, general information technology context, the technological infrastructure, and integration of business enterprise-wide applications.

ICT 508 Antenna & Propagation (3 Units: LH 45)

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. Hertzian 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.

ICT 509 Computer Graphics & Animations (3 Units: LH 45)

Overview of 3D animation and its application and types. Coordinate system, vertex, faces and object. Concept of wireframe, surface and solid modelling. 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, Subdivision 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 modelling. Render options and file output.

ICT 513 Project Management (2 Units: LH 30)

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.

ICT 515 Multimedia Technology & Programming (2 Units: LH 30)

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 colour 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.

ICT 516 Random Processes & Queue Theory (2 Units: LH 30)

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. Queuing 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.

ICT 517 Data Structures & Algorithm

(2 Units:

LH 30)

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.

ICT 518 Design & Installation of Electrical & ICT services

(3 Units:

LH 45)

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. Earthing 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.

3.16 MARINE ENGINEERING

Marine Engineering courses deal with construction and maintenance of ships, other sailing vessels, ports and cargo facilities at waterfront. Marine engineers take complete charge of the engine room of a ship and the functioning of various devices like electric motors, steam engines, propulsive engines, etc. They also develop newer designs for the engines of sailing vessels and check the efficiency of existing equipment like gas or steam turbines, diesel or nuclear propulsion plants. New technologies like superconductivity, fuel cells and hydrodynamics are being explored in this field to make the vessels more efficient, thus supplying this field with even more interesting job propositions.

DETAILS OF COURSES

100 LEVEL

Common engineering courses such as

200 LEVEL

Common courses as shown previously

300 LEVEL

Common courses as shown previously plus specific Departmental requirements.

3.16.1 Course Structure

Course structure at 300-Level Marine Engineering

Course Code	Course Title				
EEE 305	Electrical Machines				
GET 301	Engineering Mathematics III				
GET 302	Engineering Mathematics IV				
GET 304	Engineering Communication				
GET 399	SIWES II				12 weeks
GST 311	Entrepreneurship				
MAR 301	Navigation and Meteorology				

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MAR 311	Marine Diesel Engines I				
MAR 312	Ship Power Plants I				
MAR 313	Ship Engines and Power Plants I				
MAR 314	Marine Steam and Gas Turbines				
MAR 315	Naval Architecture I				
MEE 307	Theory of machines I				
MEE 309	Thermodynamics				
MEE 310	Fluid Mechanics I				
MEE 313	Engineering Metallurgy				
MEE 321	Mechanics of Materials				
MEE 322	Metrology				
MEE 331	Engineering Drawing III				
	TOTAL				

Course structure at 400-Level Marine Engineering

Course Code	Course Title	Units	Status	
GET 499	SIWES III	6	C	24 week s
MAR 421	Ship Structures	3	C	
MAR 422	Ship Strength	3	C	
MAR 423	Shipyards Technology I	4	C	
MAR 424	Marine Auxiliary Machinery	4	C	

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MAR 425	Heat Transfer	3	R		
MAR 426	Ship Design I	4	C		
MAR 427	Naval Architecture II	2	C		
MEE 406	Machine Design I	3	R		
	TOTAL	3 2			

Course structure at 500-Level Marine Engineering

Course Code	Course Title		S t a t u s		
GET 501	Engineering Management	1	R		
GET 502	Engineering Law	2	R		
MAR 511	Marine Diesel Engines II	4	C		
MAR 512	Ship Power Plants II	4	C		
MAR 513	Running and Maintenance of Ship Power Plants	4	C		
MAR 516	Refrigeration and Air-conditioning	1	R		
MAR 517	Ship Automation	1	C		
MAR 521	Naval Architecture III	4	C		
MAR 522	Ship Propulsion	1	C		
MAR 523	Shipyards Technology II	1	C		
MAR 524	Ship Design II	4	C		
MAR 525	Ship Design and Construction	4	R		
MAR 526	Marine Operations	1	C		

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MAR 530	Project		C		
	TOTAL				

DRAFT

3.16.2 Course Synopses

MAR 301 Navigation and Meteorology (5 Units: LH 45; PH 90)

Introduction to seaman's skill. Ship nomenclature. Ship Equipment: deck gear and Machinery. Hold ceiling, bulk heading. Cargo protection. Anchor arrangements. Mooring and towing arrangements. Small boat handling with oars or engine. Mooring, anchoring, lowering and lifting of life boats. Use of life saving equipment. First Aid, Personal survival. Merchant ship departmental organisation and station bills. Bridge equipment. Navigational Aids. Signalling and communications. International convention. Weather: Types, impact and prediction. Climatology. Meteorological equipment and application in Navigation. Marine ecology. Practicals: Seamanship practice.

MAR 311 Marine Diesel Engines I (3 Units: LH 30; PH 45)

Theoretical and actual cycles. Types of engines. Cylinder arrangements. Fuels and combustion. Performance characteristics. Engine ratings. Efficiency. Design and Construction. Fuel oil injection pumps, injectors. Ship propulsion engine types: direct and geared drive. Practicals: laboratory exercises.

MAR 312 Ship Power Plants I (3 Units: LH 45)

Choice and factors affecting the choice of Power Plant type. Types of Plants. Ship main engines: types, configurations. Shaftline arrangement. Marine Steam Boilers: Principles of operation, Classification. Heat transfer: water tube, auxiliary, donkey and forced circulation boilers, controlled superheat and Reheat boilers. Components of a boiler, control, corrosion. Boilers materials, instrumentation and automatic control of Boilers, Application on ships, Boiler surveys. Classification Society rule, Waste heat recovery systems. Main engine systems: Sea, fresh water and lubricating Oil systems. General layout. Heat balance of power Plants. General purpose systems: bilge, ballast, water, fire fighting. Marine gear Boxes.

MAR 313 Ship Engines and Power Plants I (3 Units: LH 45)

Classification of ship power plants, application on various ships. Power plants in motor ships. Main engines, types, propulsion systems (direct coupled, geared electrical transmission). The main engine auxiliary machines and systems. Electric generating sets. Exhaust gas boiler. Evaporating plant. Steam turbines power plants steam-water Cycles: Rankine, superheat, reheat, regenerative. Steam boilers, steam turbines, condensers, steam extraction, feed-water heaters, feed pump, deaerators. Evaporators. Actual cycles of power plants. Fire fighting, bilge, ballast and other systems.

MAR 314 Marine Steam and Gas Turbines (3 Units: LH 45)

Principles of operation and classifications, Rankine Cycles, Reheat cycles Regenerative cycles, Reheat/Regenerative cycles, cycles efficiencies. Theory of steam expansion in cascade. Gas Turbine; principles of operation and classification, Brayton cycle, Heat exchange cycle, Reheat cycle, Intercooled cycle, Intercooler/Reheat/Heat Exchange cycle, cycle efficiencies, combined steam and gas turbine cycles. Turbomachinery theory: Expansion of fluids in nozzles. Expansion process in turbine stator blades, work done in turbine rotors, velocity and turbine, pressure, velocity and pressure-velocity compounding. Steam turbine construction: Governors, safety devices, glands, couplings, Astern turbines, Blades, rotors, Blades fixing, seals, casings, condensers. Gas turbine construction: Rotors, compressor blades, Intakes, combustors, turbines, exhausts.

MAR 315 Naval Architecture I (3 Units: LH 45)

Function of a ship; ship types; Principal terms; layout and profile of ships. Hydrostatic curves; ship calculations: Areas, volumes, moments, displacement, TPC, Forms, coefficient and Bonjean curves; centre of gravity. Buoyancy; stability; transverse and dynamical-Inclining experiment, calculations; GZ, and BM; Curves of stability; Free surface effect. Trim: Change in trim and draughts. Statutory Regulations; Classification societies requirements; IMO Regulations. Ship rolling; the Sea and ship motion. Practicals: drawing and laboratory.

MAR 421 Ship Structures (3 Units: LH 45)

Loads acting on ship structure. Types of ship structures. Framing systems. Classification Rules. Function of ship structural components. Double bottom. Single bottom, Shell plating. Frames. Decks. Bulkheads. Pillars. Girders. Hatch coatings. Machinery casings. Superstructures. Bossing and structs. Bilge keels and fenders.

MAR 422 Ship Strength (3 Units: LH 45)

Longitudinal bending moment and shear forces in still water: Wave bending moment. Total bending moment. Hogging and sagging. Dynamic forces. Local stresses. Torsion. Function of ship structure. Girder section modules and stress. Deflection of ships. Transversal strength. Thermal effects. Strength of structure components. Local strength. Fatigue. Local vibrations. Reducing of hull vibration.

MAR 423 Shipyard Technology I (4 Units: LH 45; PH 45)

Shipyard layout. Planning and scheduling of ship production. Shipyard management. Hull materials. Materials storage. Hull material fabrication. Lofting. Steel fabrication processes. Prefabrication of erection units. Cranes and transportation devices. Welding and welding machines. Inspection. Measurements methods and instruments. Classification society requirements.

MAR 424 Marine Auxiliary Machinery (4 Units: LH 45; PH 45)

Auxiliary systems. Pipes, fitting valves. Flow resistance in systems. Pumps – classification. Impeller; reciprocating and rotary types, principles of operation, velocity triangles, pump head, efficiency performance curves, construction. Priming, cavitation, performance curves, construction and maintenance principles. Blowers – types, performance. Distilling plants; types, components, efficiency, sealing, cleaning. Steam condensers, construction. Centrifugal separators: operation, ordinary and self-cleaning, rated and service capacity. Sewage treatment. Practicals: laboratory exercises.

MAR 425 Heat Transfer (3 Units: LH 45)

Heat transfer relationship: Convection, conduction and radiation. Laminar and turbulent flows. Heat transfer in shell-tube heat exchangers. Modes of heat flow. Log mean temperature difference. Pressure drop. Design calculations. Constructional details. Water and lubricating oil coolers. Water; fuel oil and lubrication oil heaters. Feed water heaters: low and high pressure. Steam surface condensers. Performance characteristics. Design considerations. Evaporation materials and maintenance. Heat transfer coefficients, pressure drops. Applications. Mass transfer: modes. Pre-requisites.

MAR 426 Ship Design I (4 Units: LH 45; PH 45)

Function of a ship. Designing process-criteria, requirements, classification societies rules, Government rules and regulations; load line, safety, ship proportions, Light ship mass and power estimation. Estimation of ship capacity; GRT, NRT, Grain. Bale, and measurement, Hydrostatic and stability. Hull form design. Layout of the ship. Crew and passenger accommodation. General arrangement. Specification, survey contracts.

MAR 427 Naval Architecture II (2 Units: LH 30)

Ship body line design and calculation: Ship's body plan drawings, Bonjeans diagram and hydrostatic curves calculations and plotting. Ship stability: Calculation and plotting of cross curves stability by conventional and computer methods. Ship subdivision and damaged stability: calculations and plotting of floodable length curves. SOLAS convention.

MAR 511 Marine Diesel Engines II (4 Units: LH 45; PH 45)

Engine performance: indicator, types of Indicator diagrams, Seavaging and supercharging. Turbocharging and turbochargers. Dual fuel systems. Operation of low-speed engines: Starting air system, Reversing mechanism. Control stand and instrumentation. Starting normal and stopping operations. Overload operation. Manoeuvring. Minimum speed. Operation in specific conditions. Typical operating

troubles. Running in services. Safety devices. Dynamics of crank gear. Vibration: Simple system, torsional, multi-cylinder crankshaft system; Balancing. Dampers, crankcase, explosion. Seavenge fire, precautions. Practicals: Laboratory. Pre-requisites: MAR 311.

MAR 512 Ship Power Plants II (4 Units: LH 45; PH 45)

Propulsion system; General configurations of conventional propulsion systems, Direct drive diesel engine system. Diesel steam turbine system, Direct Gas turbine system combined propulsion system such as CODAG, CODOG, COGS etc., Electric drives for Modern ships. Power plant Efficiency. Enhancement and Analysis: Energy balance analysis, Energy balance diagrams, flow diagrams of various types of power plants, overall efficiency determination, comparison of power plants types. Selection of main engines and propeller: Performance of main engines, Graphical presentation of engine performance, performance of propellers, graphical presentation of propellers performance, Main Engine/ propeller Matching. Design of power plant systems: Fuel oil systems, sea water cooling systems, lubricating oil systems, compressed air systems, steam systems, Exhaust gas system, Fresh water systems, Automatic control and alarm systems. Rules and Regulations guiding design of ship Power plants: Lloyds register rules and regulations, American bureau of shipping rules and regulations, Environmental protection required, power plants for special ship: Fishing vessels, tugs/pushers tankers and passengers ships.

MAR 513 Running and Maintenance of Ship Power Plants (4 Units: LH 45; PH 45)

Running, maintenance and repairs of main and auxiliary diesel engines. Operation; Operation; Fault detection, Overhauling, dismantling, measurements, checking, assembly. Defects, wear and damage. Repair methods. Testing of injectors, fuel pumps and valves. Adjustments. Overhauling of turbochargers. Inspection. Maintenance. Replacement of parts. Bolt tightening. Watch keeping. General safety in machinery spaces.

MAR 516 Refrigeration and Air-conditioning (3 Units: LH 45)

Refrigeration cycles and media. Systems. Compressors, evaporators, condensers, receivers, expansion valves. Brine System. Cold stores, refrigerated cargo holds, freezers. Design methods. Thermal insulation. Heating systems. Humidification. Ventilation of crew accommodation, cargo holds, engine and boiler rooms. Distribution and circulation of air. Air-conditioning design. Maintenance production.

MAR 517 Ship Automation (3 Units: LH 45)

Introduction, definitions. Regulation and automatic control, remote control. Control systems: Open-loop and close-loop. Components: Sensors, measuring instruments, controllers, correctors and actuators. Controller actions. Digital systems. Response of control system to step, Ramp and sine inputs. Automatic control of diesel engine. Speed governors. Alarm and protective systems. Steam boiler combustion control. Boiler water level control: single, two and three element systems. Data logging Centralized control. Bridge control. Control system of tankers.

MAR 521 Naval Architecture III (4 Units: LH 45; PH 45)

Resistance of ship. Components of resistance. Laws of comparison. Model tests. Resistance in restricted water, Resistance of small, fast ships. Methods of ship resistance calculations. Determination of engine power. Steering of ships. Types of rudders. Turning ability. End and side launching of a ship. Seaworthiness of a ship. Practicals: Laboratory: Tests for stability and resistance.

MAR 522 Ship Propulsion (3 Units: LH 45)

Fundamentals of ship propulsion. Ship resistance. Methods of ship Resistance calculations, the effect of hull form and water path. Propulsion devices. Geometry of screw propeller. Momentum theory of the screw. Axial and tangential losses. The propulsion coefficients. The influence of afterbody on wake distribution. Model tests and laws of comparison. Systematic screw-series. Hydrodynamic characteristics. Matching of propeller to the hull. Cavitation. Design of screw propellers. Performance curves. The screw propellers performance in different load conditions. Controllable pitch propellers. Calculations, design and drawing of screw propellers.

MAR 523 Shipyard Technology II (3 Units: LH 45)

Hull assembly on slipway. Slipway types and launching methods. Deflection of hull. Cutting, welding and riveting. Shipway arrangements. Machinery installation. Shafting and screw assembly. Boilers and auxiliary machines installation. Deck equipment. Masts, booms and cranes. Steering gears. Hatch covers. Mooring arrangements. Life saving equipment. Container fitting. Surface preparation and painting. Corrosion prevention. Superstructure outfitting. Fire-fighting arrangements. Inspection, tests and trials. Classification society requirements and certificates. Drydocking. Hull crack arresting methods.

MAR 524 Ship Design II (4 Units: LH 45; PH 45)

Specific characteristics and design of different types of ships: general cargo carriers, container ships, bulk carriers, tankers, fishing vessels, inland vessels, small crafts.

MAR 525 Ship Design and Construction (4 Units: LH 45; PH 45)

Basic concepts in ship design: rules based on design principles, classification societies rules and regulations, ship design processes. Introduction; classification of ships: Functions, cargo type, propulsion system. Characteristics of various types of ships. Determination of areas, moments, moments of inertia, volumes, Intact and damaged stability, determination of floodable length, Dynamic stability inclining experiment ship geometry, Hydrostatic curves. Ship structures: Structural arrangement of ships, Fundamentals of hull vibration. Displacement and form coefficients; Principal dimensions, Estimates of dead weight and lightship weights and speed. Loading lines: International convention of load lines and amendments. Computation: free boards, load line parameters. Ship construction; structural arrangements, framing systems, functions of ship structural components, double bottom, single bottom, shell plating, frames, Decks, Bulkheads, Pillars, Griders, Hatch Coaming, machinery Casings, superstructure Deck houses, foundation laws and storm structures, Bossings and struts, Bilge Keels and fenders, Hull assembly on shipway, shipway types and launching methods, shipway arrangements, surface preparation and painting, corrosion prevention, superstructure outfitting arrangements, inspection, tests, and trials classification society requirements, and certification.

MAR 526 Marine Operations (3 Units: LH 45)

Fuel, lubricant and water on ships: Classification, types physical and chemical properties, characteristics, tests and treatment. Confined space precaution, corrosion: General consideration; stimulating and inhibiting factors; Corrosion due to electrolysis; Corrosion oxidation of metal, pipes, boilers, structural work, season cracking of brass; minimizing methods. Marine pollution: Sources; effect on environment; preventive methods, IMO and Local regulations. Coastal Engineering: Dredging and sand filling mechanism and piping system; maintenance; design of breakwaters and jetties.

MAR 530 Project (6 Units: PH 270)

Students take individual projects of different ship power plants according to their interest and future employment. The work on project includes the elements of calculation, computation experimentation, design and manufacturing under the supervision of method(s) of staff.

Students Work Experience Programme(SIWES)

During the SIWES periods, students are attached to marine industries or shipping companies to gain experience in research, design, operation, production, industrial processes, social and environmental services and the maintenance of Ship's Hull, Ship's, power plants and machinery.

3.17 MATERIALS AND METALLURGICAL ENGINEERING

Recent advances in technology in all the spheres of human endeavour can be ascribed to advances in materials. It is now current to refer to 'materials engineering' instead of the traditional 'materials and metallurgical engineering' (as in the BMAS). Although metals still occupy a pride of place in the spectrum of materials in use in technology, the emergence of nanotechnology as an area of research in materials development has widened the scope of materials in use. Thus, the programme in materials engineering must incorporate nanotechnology from the point of teaching and research. Nanotechnology, or, as it is sometimes called, *molecular manufacturing*, is a branch of engineering that deals with the design and manufacture of extremely small electronic circuits and mechanical devices built at the molecular level of matter. It involves operations at the scale of 0.1 nanometre (nm or 10^{-12} m) to 100 nm. Nanotechnology is often discussed together with micro-electromechanical system (MEMS), a subject that usually includes nanotechnology but may also include technologies higher than the molecular level. Nanotechnology holds promise in the quest for ever-more-powerful computers and communications devices. It is also being used in the medical science. Current commercial applications include: *Sunscreens* which use nanosized zinc oxide particles to absorb and reflect UV rays; *Self cleaning windows* coated with nanomaterials which, when the sun shines on these windows, a chemical reaction is triggered which breaks down dirt; *Bouncy tennis balls* coated in nanosized material whose tiny particles form a molecular barrier that trap air molecules making the balls extra bouncy. The future possibilities of nanotechnology seem endless as it is applied in computer technology, environment and energy, and in health care and medicine.

Primary Areas of Specialization:

- a. Ceramic Materials
- b. Composite Materials (combining different materials to produce an advanced material)
- c. Electronic Materials (used in computers and other electronic devices)
- d. Materials Science (examining the structure and properties of various materials, with particular focus on material failure issues - fracture, fatigue, corrosion, etc.)
- e. Metallurgical Engineering (focusing on metallic alloys and specialty metals)
- f. Polymeric Materials (plastics, synthetic rubbers and fibers, films, etc.)

ETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.17.1 Course Structure

Course structure at 300-Level Materials and Metallurgical Engineering

Course Code	Course Title	Units	Status	Level	Prerequisites
GET301	Engineering Mathematics III	3	R	45	-
GET302	Engineering Mathematics IV	3	R	45	-
GET303	Engineer-in-Society	2	R	30	-
GET304	Engineering Communication	2	R	30	-
GET399	SIWES II	3	C	12 weeks	
GST311	Entrepreneurship	2	C	30	-
MEE308	Manufacturing Technology	2	R	30	-
MEE310	Fluid Mechanics	2	R	30	-
MEE315	Workshop Practice	2	R	15	45

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31 2					
M EE 33 1	Engineering Drawing III	3	C	3 0	4 5
M M E 30 1	Thermodynamics of Materials	3	C	4 5	-
M M E 30 2	Fundamentals of Foundry Processing	3	C	4 5	-
M M E 30 4	Chemistry of Materials	3	C	4 5	-
M M E 30 5	Engineering Materials: Structure and Properties	3	C	4 5	-
M M E 30 7	Laboratory Practicals	3	R	-	1 3 5
M TE 30 4	Mineral Processing	3	C	4 5	-
M TE 30 5	Metal Deformation Processes	2	R	3 0	-
M TE 30 6	Physical Metallurgy	2	C	3 0	-
M TE	Computer Application in Metallurgical Engineering	3	R	4 5	-

30					
9					
	TOTAL	4	9		

Course structure at 400-Level Materials and Metallurgical Engineering

Course Code	Course Title	Units	Status	L H	P H
GE T 49 9	SIWES III	6		24 weeks	
M M E 40 1	Synthesis, Processing, and Manufacturing of Materials	3	C	4 5	-
M M E 40 2	Hydrometallurgy and Chemical Processing	3	C	4 5	-
M M E 40 3	Engineering Materials Laboratory	2		3 0	-
M M E 40 4	Materials Engineering Design	2		3 0	-
M M E 40 5	Corrosion Science and Engineering	3		4 5	-
M M E 40 6	Chemical Metallurgy	3		4 5	-
			R		

M M E 40 7	Mechanical Behaviour of Materials	3		4 5	-
M M E 40 8	Laboratory Practicals	3		-	1 3 5
	TOTAL	2 8			

Course structure at 500-Level Materials and Metallurgical Engineering

Course Code	Course Title	Units	Status	L H	P H
GE T 50 1	Engineering Management	3	R	4 5	-
GE T 50 2	Engineering Law	2	R	3 0	-
M EE 50 8	Engineering Design Process	3	C	4 5	-
M M E 50 1	Analytical Methods for Materials	2	C	3 0	-
M M E 50 2	Thermodynamics and Phase Equilibria	3	C	4 5	-
M M E	Powder Technology	2	C	3 0	-

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50 3					
M M E 50 4	Polymer Materials Engineering	3	R	4 5	-
M M E 51 0	Project	6	C	-	2 7 0
M M E 51 4	Laboratory Practicals	3	R	-	1 3 5
M TE 50 6	Electrical Systems and Controls for Materials	3	R	3 0	4 5
M TE 50 7	Transport Phenomenon in Metallurgy	3	C	4 5	-
M TE 50 8	Steels and their Treatment	3	C	4 5	-
TC E 51 0	Glass Science and Engineering	3	E	4 5	-
TC E 51 1	Principles of Engineering Materials	3	R	4 5	-
	TOTAL	4 2			

3.17.2 Course Synopses

MME 301 Thermodynamics of Materials (3 Units: LH 45)

Thermochemistry applied to typical metallurgical reactions, graphical representations of equilibria, binary and ternary phase diagrams, heterogeneous equilibrium, behaviour of solutions, standard states, and electrochemical thermodynamics.

MME 302 Fundamentals of Foundry Processing (3 Units: LH 45)

Metal-casting principles including pattern design, moulding materials, moulding methods, sand testing, solidification, risering and gating of castings, casting design, and casting defects.

MME 304 Chemistry of Materials (3 Units: LH 45)

Basic Inorganic Chemistry of Materials. Topics will include chemical properties, structure and bonding of solids, energy, enthalpy, entropy, thermochemistry, kinetics and rate processes. Application of chemistry principles to materials engineering through flowsheeting, reactor design, materials/ metals processing and the environment.

MME 305 Engineering Materials: Structure and Properties (3 Units: LH 45)

Basic structure of ceramics, alloys, composites, metals, and polymers. Relationships between the structure of materials and their mechanical, electrical, magnetic, thermal, and chemical properties.

MME 401 Synthesis, Processing, and Manufacturing of Materials (3 Units: LH 45)

Detailed study of principal alloy, ceramic, and polymer systems. Evaluation of the effects of processing on selected physical and mechanical material properties. Overview of design fundamentals and examination of selected material/design case studies for manufacturing.

MME 402 Hydrometallurgy and Chemical Processing (3 Units: LH 45)

Current hydrometallurgical practice as applied to mineral processing, metal extraction, and recovery; recent developments in technology; thermodynamics and kinetics of hydrometallurgical processes; leaching and solvent extraction.

MME 403 Engineering Materials Laboratory (2 Units: LH 90)

Materials testing and evaluation, laboratory procedures and techniques, metallography, heat treatment, phase diagrams, hardenability, and mechanical testing.

MME 404 Materials Engineering Design (2 Units: LH 30)

Design of devices, components, processes or systems using physical, chemical, mechanical, economic, and ethical principles. Project planning and cost analysis. Application of computer-based design tools. Analysis of problems, design and development of solutions. Concepts of shared responsibility, teamwork, and communication. Oral and written presentations.

MME 405 Corrosion Science and Engineering (3 Units: LH 45)

The course is aimed at investigating the underlying fundamental causes of corrosion problems and failures. Emphasis is placed on the electrochemical reactions occurring and the tools and knowledge necessary for predicting corrosion, measuring corrosion rates, and combining these with prevention and materials selection.

MME 406 Chemical Metallurgy. (3 Units: LH 45)

Application of thermodynamics, fluid flow, and heat and mass transfer to the design and operation of chemical metallurgical processes; roasting, agglomerating, oxidation and reduction reactions, smelting, converting, and refining.

MME 407 Mechanical Behaviour of Materials (3 Units: LH 45)

Flow and fracture of solids; uniaxial stress-strain as a reference behaviour; theories of terminal stability under impact; monotonic, sustained (creep), and repeated (fatigue) loadings of solids under various states of stress.

MME 501 Analytical Methods for Materials (2 Units: LH 30)

Crystallography, physics of X-rays, diffraction by crystalline materials, applications of X-ray, electron and neutron diffraction, and spectrometric analysis of materials.

MME 502 Thermodynamics and Phase Equilibria (3 Units: LH 45)

Application of thermodynamic data to predict stable phases in aqueous and high-temperature systems. Construction and use of partial pressure diagrams, Eh-pH diagrams, temperature-composition diagrams in related mineral and metallurgical systems. Activities and equilibria in slag-metal and gas-metal systems.

MTE 503 Powder Metallurgy (2 Units: LH 30)

The course will cover the topic of powder metallurgy, describing the various types of powder processing and how these affect properties of the components made. Current issues in the subject area, from high production to nanomaterials, will be discussed.

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MME 504 Polymer Materials Engineering

(3 Units: LH 45)

Introduction to the manufacture, processing, and applications of organic polymeric materials. The chemistry of polymer manufacture, the molecular structure of polymers, and the structure-property relationships for thermoplastic and thermosetting polymers are covered.

DRAFT

3.18 MECHANICAL ENGINEERING

The programme is geared towards the practical applications of engineering sciences to the solution of problems regarding the manufacture and operation of industrial machines, processes and power production. Students are prepared for professional positions in design analysis, manufacture and the application of machines, processes and controls. Consequently, the programme includes Computer-Aided Mechanical Engineering (CAME), which integrates in-depth computing skills with traditional mechanical engineering topics. Skills such as programming in a variety of languages, use of internet resources, general purpose application tools, modelling and simulation techniques and associated software, computer in design and manufacturing, and the use of embedded computers for control and automation. The programme embraces traditional mechanical engineering topics such as applied mechanics, thermodynamics, materials science, stress analysis, engineering design and engineering management but will approach these from the modern ‘computer – orientated’ viewpoint by paying particular attention to such topics as computer-aided design, computer-aided manufacture, finite element analysis, computational fluid dynamics, robotic, control systems, simulation and computer programming languages, using wide number of state of the art computer-based engineering applications. Required courses in electronic engineering may be included. The overall focus of the programme is on machines, structures, devices, mechanical systems and energy conversion systems. Mechanical Engineering is often considered the broadest of engineering disciplines, with overlap into many of the other existing engineering disciplines, including Civil, Electrical, and Chemical Engineering.

Primary Areas of Specialization:

- a. Solid Mechanics (analyzing the behavior of solid bodies subjected to external loads, stress, and/or vibrations and using that information in the design and manufacture/construction of such bodies)
- b. Fluid Mechanics (analyzing the behavior of liquids and gases and using that knowledge in the design and development of machinery and systems that can and/or do influence that behavior – pumps, fans, turbines, piping systems, etc.)
- c. Thermodynamics (analyzing the conversion one form of energy into another and using that knowledge to design and develop energy conversion devices and systems – power plants, engines, Heating, Ventilation, and Air Conditioning (HVAC) systems, etc.)
- d. Mechanical Design (covering the full range of mechanical-based products and systems)

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.18.1 Course Structure

Course structure at 300-Level Mechanical Engineering

Course Code	Course Title				
EEE 305	Electrical Machines				
GET 301	Engineering Mathematics III				
GET 302	Engineering Mathematics IV				
GET 303	Engineer-in-Society				
GET 304	Engineering Communication				
GET 399	SIWES II				1 2 w e e k s
GST 311	Entrepreneurship				
MEE 307	Theory of Machines I				
MEE 308	Manufacturing Technology				
MEE 309	Thermodynamics				
MEE 310	Fluid Mechanics I				
MEE 312	Workshop Practice				
MEE 313	Engineering Metallurgy				

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MEE 315	Control Systems				
MEE 316	Laboratory Practicals				
MEE 321	Mechanics of Materials				
MEE 322	Metrology				
MEE 331	Engineering Drawing III				
	TOTAL				

Course structure at 400-Level Mechanical Engineering

Course Code	Course Title	Units	Status	L H	P H
GE T 49 9	SIWES III	6	C	24 weeks	
M EE 40 3	Applied Thermodynamics & Heat Transfer	4	C	4 5	4 5
M EE 40 4	Theory of Machines II	3	C	3 0	4 5
M EE 40 5	Fluid Mechanics II	3	C	3 0	4 5
M EE 40 6	Machine Design I	3	C	4 5	-
M EE 40 8	Advanced Mechanics of Materials	3	R	4 5	-

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ST A 30 5	Statistics for Physical Science and Engineering	3	R	4 5	-
	TOTAL	2 5			

Course structure at 500-Level Mechanical Engineering

Course Code	Course Title				
GET 501	Engineering Management				
GET 502	Engineering Law				
MEE 501	Applied Thermodynamics				
MEE 502	Fluid Dynamics				
MEE 503	Heat Transfer				
MEE 504	Machine Design II				
MEE 505	Project				
MEE 506	Laboratory Practicals				
MEE 507	Theory Elasticity				
MEE 508	Engineering Design Process				
MEE 509	Fracture of Structural Materials				
MEE 510	Plasticity				
MEE 511	Tribology				
MEE 512	Turbomachinery				

	TOTAL				
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3.18.2 Course Synopses

MEE 309 Thermodynamics (3 Units: LH 45)

Ideal air cycles. Introduction of Internal Combustion Engines; Reciprocating air compressors and other positive displacement compressors. Gas and vapour power cycles, refrigeration cycles, vapour compression units, principles of absorption refrigeration. Testing of various heat engine plants.

MEE 307 Theory of Machines I (3 Units: LH 45)

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.

MEE 310 Fluid Mechanics I (2 Units: LH 30)

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.

MEE 313 Engineering Metallurgy (2 Units: LH 30)

Introduction to the electric structure of atom and matter. Solid state crystallography. Relationship between structure and composition and the mechanical and thermal properties of materials of metals, alloys, plastics, ceramics, and natural products. Heat treatment: Annealing, normalizing, tempering and hardening. Metallic corrosion and protection. Manufacture and properties of high polymers. Thermoplastic and thermosetting resins.

MEE 331 Engineering Drawing III (3 Units: LH 30; PH 45)

Introduction to AutoCAD. Using AutoCAD to produce 2-D and 3-D drawing. Descriptive geometry. Limits and fits. Geometric tolerancing. Welding drawing and design. Redesigning of casts components using welded joints. Harder examples on exploded assembly drawing (e.g. a complete gear box in exploded assembly drawing). Pipe joints. Arrangement of engineering components to form a working plant (Assembly Drawing of a Plant). Revision.

MEE 308 Manufacturing Technology (2 Units: LH 30)

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

MEE 312 Workshop Practice (2 Units: LH 15; PH 45)

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

MEE 315 Control Systems (3 Units: LH 45)

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

MEE 321 Mechanics of Materials (3 Units: LH 45)

Deflection of beams; Revision of method of solution; shear stress distribution and deflection due to shear centre. Unsymmetrical bending. Strain energy methods; Application to thin members and indeterminate structures. Helical and leaf springs. Plastic bending of beams, buckling.

MEE 322 Metrology (3 Units: LH 45)

Theory and practice of high precision. Mechanical measurements under strict control conditions. Super micro-metry, comparator profilometry, collimators application in machine installations, etc. Tolerances and quality. Fits: Clearance, transition and interference fits.

MEE 403 Applied Thermodynamics & Heat Transfer (4 Units: LH 45; PH 45)

General thermodynamics relations. Kinetic theory of gas. Mixture of gases, psychrometry, air-conditioning and cooling towers. Introduction to heat transfer.

MEE 404 Theory of Machines II (3 Units: LH 30; PH 45)

Vibration of machinery; Free and forced vibration, damping, natural frequencies and critical speeds. Transverse vibrations of beams, whirling of shafts, torsional vibrations.

MEE 405 Fluid Mechanics II (3 Units: LH 30; PH 45)

Unsteady flow; Oscillation in U-tube; Surge tank; Water hammer. Open-channel flows. Introductory concepts of boundary layer and re-circulating flows, Mathematical derivation of Navier-stokes equations and its application.

**MEE 406 Machine Design I (3 Units:
LH 45)**

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

**MEE 408 Advanced Mechanics of Materials (3 Units:
LH 45)**

Thick cylinders; Compound cylinders. Rotating disks. Bending of flat plates. Beams on an elastic foundation. Membrane stresses in shells of revolution. Two-dimensional theory of elasticity. Elastoplastic problems, and limit theory.

**MEE 501 Applied Thermodynamics (3Units: LH 30;
PH 45)**

Availability of open closed system and heat reservoirs. Chemical reactions. Gibbs functions. Chemical equilibrium. Centrifugal and axial flow compressors. Turbine theory, velocity diagrams, degree of reaction, impulse, efficiency, reheat factor. Combustion and product analysis.

**MEE 502 Fluid Dynamics (3Units:
LH: 45)**

Mathematical theory of the motion of inviscid fluids. Steady compressible flow. Laminar and turbulent boundary layers, and wakes. Theory of turbulence models, isotropic wall and free turbulence.

**MEE 503 Heat Transfer (3 Units: LH 30;
PH 45)**

Conduction: Steady and unsteady conduction; Numerical methods. Convection; Free and forced convection for laminar and turbulent flows. Thermal radiation. Heat exchangers. Mass transfer processes. Solar energy application.

**MEE 504 Machine Design II (4 Units: LH 30;
PH 90)**

Creative Application of the design process to engineering problems with emphasis on the manufacture of complete systems to accomplish overall objectives of minimum weight, high efficiency while satisfying the design constraints. Use and evaluation of several CAD/CAM software packages. Students will gain experience with CAD/CAM software while carrying out an actual manufacturing design project.

**MEE 507 Theory Elasticity (4 Units: LH 45;
PH 45)**

Application of the theory of elasticity to two- and three-dimensional problems in engineering; Stress concentration round holes; Discs, wedges under point loading, etc. Experimental stress analysis, strain gauging, photo-elasticity and holography. Approximate methods; Finite element method.

**MEE 508 Engineering Design Process (2 Units:
LH 30)**

Introduction to elements of design process including strategic, planning, project, management, modelling, materials selection, engineering economics, safety, environmental issues and ethics.

**MEE 509 Fracture of Structural Materials (4 Units: LH 45;
PH 45)**

Conventional design concepts in relation to fractures; the mechanics of fracture. Designing and testing for fracture resistance. Microscopic aspect of fracture. Fracture of specific materials. Fatigue.

**MEE 510 Plasticity (2 Units:
LH 30)**

Fundamentals of plasticity; Stress and strain relations; Yield criteria. Various approximate methods applied to elastoplastic problems of bending of beams and torsion and bars. Plastic limit design.

**MEE 511 Tribology (2 Units:
LH 30)**

Theories of friction between metallic, non-metallic, dry and lubricated surfaces. Testing and properties of materials, solid and liquid lubricants. Theory of self-acting and pressurised bearing including Reynolds equation and solutions, dynamic loading, temperature, and pressure effects on viscosity. Elastohydrodynamic lubrication, gears and rolling contact bearings. Design of journal and thrust bearings.

**MEE 512 Turbomachinery (2 Units:
LH 30)**

Moment of momentum principles for turbines, compressors, pumps, fans. Performance characteristics of turbines, etc. Specific speed. Matching of pump and load. Cascade theory, including Mach number effects.

3.19 MECHATRONIC ENGINEERING

Mechatronics is an emerging area of engineering arising from the increasing integration of electronic intelligence into mechanical systems. This discipline is a hybrid between Mechanical and Electronics Engineering. Alternative names are: Mech-Electro Engineering, Electro-Mechanical Engineering. The name 'Mechatronics' seems to be the most popular description of the programme; hence its adoption in this document.

Examples of mechatronic devices are CNC machines, robotic manipulators, aircraft systems, cameras, video recorders, etc. Mechatronics involves the effective application of electronics and computing to simplify and enhance the performance and control of mechanical systems. It requires the study and application of principles of mechanics, electronics, control, microprocessors, software/information engineering and materials and their effective integration leading to the design of sensor-based computer controlled, intelligent mechanical products and systems. Thus, Mechatronics engineers have multidisciplinary skills in mechanical engineering, electronics and computing. Core mechatronics courses include electronics, microprocessors, software engineering, sensors and actuators, mechanical systems, control engineering and signal processing. Design and systems integration is an essential part of mechatronics and so the programme has placed great emphasis on design projects.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.19.1 Course Structure

Course structure at 300-Level Mechatronics Engineering

Course Code	Course Title	Units			
GET 301	Engineering Mathematics III	3			

Please, forward your comment on any section of this document to the following email:

nucassessment@gmail.com

You can also call the following phone numbers: 08033145087, 08033201097

All comments should be received before 31st October, 2015

GET 302	Engineering Mathematics IV	3			
GET 399	SIWES II	3			12 weeks
GST 311	Entrepreneurship	2			
MCT 301	Mechanical Engineering Design	2			
MCT 303	Materials Technology	2			
MCT 304	Signals and Systems	2			
MCT 305	Fluid Mechanics II	2			
MCT 306	Manufacturing Technology	3			
MCT 307	Computer Software Engineering I	2			
MCT 308	Electromechanical Devices	3			
MCT 309	Electronics I	3			
MCT 310	Computer Hardware Engineering	2			
MCT 311	Electromagnetic Theory	3			
MCT 313	Fluidics Laboratory	2			
MCT 314	Virtual Laboratory	2			
MCT 302	Heat and Mass Transfer	3			
MCT 312	Elect. Circuit Theory	2			
MEE 331	Engineering Drawing	2			
	TOTAL UNITS	46			

Course structure at 400-Level Mechatronics Engineering

Course Code	Course Title	Units			
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nucassessment@gmail.com

You can also call the following phone numbers: 08033145087, 08033201097

All comments should be received before 31st October, 2015

GET 304	Engineering Communication	2		
GET 499	SIWES III	6		24 weeks
MCT 401	Control Engineering I	3		
MCT 403	Computer Aided Manufacturing	2		
MCT 405	Sensors and Actuators	2		
MCT 407	Measurement and Instrumentation	2		
MCT 409	Digital Systems and PLCs	3		
MCT 411	Electronics II	3		
MCT 413	Group Project	2		
MCT 415	CAD/CAM/CNC Laboratory	2		
	TOTAL	27		

Course structure at 500-Level Mechatronics Engineering

Course Code	Course Title	Units		
GET 501	Engineering Management	3		
GET 502	Engineering Law	2		
MCT 501	Introduction to Robotics	2		
MCT 502	Automation and Robotics	3		
MCT 503	Digital Signal Modelling	3		
MCT 504	MEMS & VLSI	3		
MCT 505	Microcomputers and microprocessor systems	3		

MCT 506	Computer Software Engineering II	2		
MCT 507	Vibrations	2		
MCT 508	Systems Modelling and Simulation	3		
MCT 509	Control Engineering II	2		
MCT 510	Power Electronics & Drives	3		
MCT 511	Process Automation	2		
MCT 512	Full Automation Laboratory	2		
MCT 513	Partial Automation Laboratory	2		
MCT 599	Final Year Project	6		
	TOTAL	43		
	ELECTIVES			
MCT 516	Microcontrollers and embedded systems	2		
MCT 517	Machine Vision	2		
MCT 518	Computer Aided Product Modelling	2		
MCT 519	Micro-fabrication Technology	2		
MCT 520	Renewable Energy Resources	2		
MCT 521	Mobile Robotics	2		
MCT 522	Lean Production Mgt. & Ind. Logistics	2		
MCT 523	Control Engineering III	2		

3.19.2 Course Synopses

MCT 202 Introduction to Mechatronics Engineering LH 45)

(3 Units:

Introduction to mechatronics systems - Measurement Systems, Control Systems,

Microprocessor-based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement, Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Level. Temperature, Light Sensors – Selection of Sensors. Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and Pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – DC Motors – AC Motors – Stepper Motors.

MCT 301 Mechanical Engineering Design (2 Units: LH 30)

The design process, design concepts, sensors and actuators, computer vision, digital data acquisition and processing. The Analysis and Design of individual machine components; shafts, gears, chain linkages, bearing keys. Keyways, belts, clutches, etc.

Components assemblies and machine systems.

MCT 302 Heat and Mass Transfer (3 Units: LH 45)

Conduction: Steady and unsteady conduction; Numerical methods. Convection; Free and forced convection for laminar and turbulent flows. Thermal radiation. Heat exchangers. Mass transfer processes.

MCT 303 Materials Technology (2 Units: LH 30)

Metals: deformations, alloys, state diagrams, iron and non-iron alloys; Contact materials; damage of materials.

- Plastics: production and processing; characteristics and fields of applications.
- Magnetic materials: structure, characteristics and applications.
- Others: composite materials, ceramics, glasses, semiconductor materials.
- Testing of materials.
- Protection of the environment.
- Waste disposal and recycling.

MCT 304 Signals and Systems (2 Units: LH 30)

System modelling. Analog signals. Convolution and correlation. Fourier and Laplace Transforms. Random Processes. Sampled signals and systems. Discrete Fourier transforms. Z transforms, Analog and Digital filters. Control strategies; Open-loop, feed forward and feedback control systems. Stability, performance and sensitivity analyses. Lag and Lead compensation. Frequency domain design. PID controllers. Elements of nonlinear control.

MCT 305 Fluid Mechanics II (2

Units: LH 30)

Physical properties of fluids. Fluid statics. Fluid motion; conservation laws and mass, momentum and energy. Introduction of fluid friction energy equation in viscous flow. Laminar flow; steady flow in pipes, flow between parallel plates. Viscous flow theory and applications. Mechanical power systems and operations. Drive requirements for mechanical equipment. Thermal and hydraulic power systems. Introduction to heat exchangers.

MCT 306 Manufacturing Technology (3 Units: LH 30; PH 45)

Basic manufacturing industries and process including casting, forging, assembling, inspection/testing and certification, packaging, warehousing and forwarding. Metal working operations: shaping, planing, milling, drilling, turning, reaming, broaching, abrasive machining and chipless machining processes. Metal cutting tools and cutting fluids, cutting forces and power. Threads, gears, selection of materials, processing methods and equipment for manufacturing. Fabrication methods including welding, soldering, brazing, adhesive bonding and mechanical fastening. Quality control in manufacturing.

MCT 307 Computer Software Engineering I (2 Units: LH 30)

Introduction to software engineering fundamentals. Object oriented programming. Number representations. Data structure and algorithms, Abstraction, modules and objects. Designing for efficiency.

MCT 308 Electromechanical Devices (3 Units: LH 45)

Magnetic circuits and magnetic materials, Transformers, Electromechanical-energy-conversion principles; Rotating machines; Synchronous machines; Induction machines; DC machines; Variable Reluctance machines and Stepping motors; Introduction to Power electronics; speed and torque control.

MCT 309 Electronics I (3 Units: LH 45)

Audio and RF electronics; Biasing and stability. Actual circuit and noise. Tuned load and differential amplifiers. Oscillators, mixers, modulators and demodulators. Low noise amplifiers. Power amplifiers. Phase-locked loops.

MCT 310 Computer Hardware Engineering (2 Units: LH 15; PH 45)

Digital logic. Data representation. Digital components and signals. Combinational and sequential logic design and realization. Microprocessor system design and programming. Simple and complex programmable logic devices. Hardware description languages and introduction to VHDL. CPU design and field programmable gate arrays (FPGAs)

**MCT 311 Electromagnetic Theory (3 Units:
LH 45)**

Review of vector analysis. Electrostatic and magnetostatic. Simple boundary value problems. Field marking. Dielectric and magnetic media. Time varying fields and Maxwell's equations, plane waves. Phenomena of reflection, refraction, standing waves and transmission of energy.

**MCT 312 Electrical Circuit Theory (2 Units:
LH 30)**

Network theorems. Network topology, General network solutions. Network transformations. Time and frequency domain analysis of networks. Application of Fourier series in network analysis. Fourier and Laplace Transforms and their applications. Transfer function concepts. Two port networks and their parametric representations. Characteristic impedance. Two port network synthesis. Foster and Causer's methods of synthesis. Application of computers in the analysis of linear and nonlinear circuits.

**MCT 313 Laboratory (3 Units: PH
135)**

Fluidics Laboratory Experiments: transfer in the basic disciplines of Mechatronics like:

- Pneumatics/Electro-Pneumatics
- Hydraulics/Electro-Hydraulics
- Electrics/Electronics
- Sensorics
- AC-motors
- Open/Close loop Technology
- Process Automation
- Fieldbus Technology

**MCT 314 Laboratory (2 Units:
PH 90)**

Virtual Laboratory Experiments: transfer in the basics disciplines of Mechatronics like:

- Pneumatics/Electro-Pneumatics
- Hydraulics/Electro-Hydraulics
- Electrics/Electronics
- Sensorics
- AC-motors
- Open/Close loop Technology
- Process Automation
- Fieldbus Technology

**MCT 401 Control Engineering I (3 Units:
LH 45)**

Introduction; Concepts of feedback control. Mathematical model of physical

systems. Block diagrams. Reduction techniques. Block diagram algebra. Signal flow graphs. Mason's rule. Analysis and design in S-plane. Steady state and transient response to step and ramp input. Use of P+ I, P + D lag, lead and tachocompensators for improvement of overall response. Negative velocity and positive acceleration feedback. Error rate damping. Stability analysis; Routh's stability criterion. Frequency response methods using polar, Bode and Nichol's methods. Nyquist compensation. Design of system with lead, lag, lead-lag compensators in frequency domain. System identification from experimental data. Analog computing; basic computing element. Solutions of linear ODE. Simulation of simple transfer functions. D.C Bias design. Analysis and design of single stage and multiple stage amplifiers at low and high frequencies. Dealington pair, Cascoe amplifiers. Bootstrapping. Negative feedback concepts and feedback amplifiers.

MCT 403 Computer Aided Manufacturing (2 Units: LH 30)

In-depth study of some advanced technologies adopted by leading design and manufacturing industries worldwide. Exploring rapid product development and technologies aimed at reducing product development lead-time within a Design For Manufacture (DFM) context.

MCT 405 Sensors and Actuators (2 Units: LH 15; PH 45)

Electrical Actuators: Review of Electrical Motors and their types, Motor Equations, Drivers, and Control of DC Motors, Induction Motors, Synchronous Motors, and Stepper Motors.

Hydraulic Actuators: Pumps and its Different Types, Hydraulic Motors and Its Different Types, Valves and Its Different Types, Power Supplies, Cylinders, Accumulators, Intensifiers, Lifts, Couplings, Torque Converters. Hydraulic Circuit Design and Analysis.

Pneumatic Actuators: Compressors, Fluid Conditioners, Pneumatic Cylinders, Valves and Plugs, Basic Pneumatic Circuit Design & Analysis, Accumulator system Analysis

Motion Transducers: Potentiometer, Variable Inductance Transducers, Permanent Magnet Transducers, Variable Capacitance Transducers, Piezoelectric Transducers, and Proximity Transducers

Effort Sensors: Strain Gauges, Torque Sensors, Tactile Sensors

MCT 407 Measurement and Instrumentation (2 Units: LH 15; PH 45)

Errors in measurements, classification and functional analysis, performance of instruments systems, calibration. Control system components, amplifiers, sensing devices, pumps and controllers, error detectors and output elements, instrumentation methods; measurements and recording of dimensions, time, weight, frequency, temperature, pressure, etc. transducers, bridge and potentiometer methods. Synchros, Hall effects, photovoltaic and moving iron transducers. Instrument transformers, Pulse transformers, energy meters and

metering, information storage techniques, electronic instrumentation, digital technique, analog/digital signal processing. Survey of modern instrumentation components. Nonlinear computing elements.

MCT 409 Digital Systems and PLCs (3 Units: LH 45)

Digital representation of information and binary arithmetic. Position number system, binary coding of alpha numeric characters in the computer, simple error detecting and correcting codes. (parity bits, Hamming codes). Arithmetic in various radio systems, binary arithmetic in combination logic. Boolean algebra, switching function, truth tables, Karnaugh maps etc; Properties of switching functions; canonical forms, N and Nar designs; “don’t cares” minimization of multiple output switching functions; introductory minimization of multiple output switching functions; simple

combinational circuit design; encoders, decoders, multiplexer, serial and parallel half and full adders, etc. Hazards in combinational circuit and other design problems. Notion of feedback state and delay in logic circuit; basic difference synchronous sequential circuits; illustration of the use of state transition equations, diagrams, tables etc. in sequential logic by their use in defining the operation of synchronized or clocked flip flops (such as r.s, JKT etc. flip flops). Edge triggered and master flip-flops.

MCT 411 Electronics II (3 Units: LH 45)

Feedback oscillators and the Barkhausen criterion. Practical oscillator circuits; phase-shift, Wienbridge, Hartley, Colpitt, Crystal, etc. Frequency stability of oscillators. Ideal operational Amplifier. Connection as non-inverting and inverting amplifier. The

differential amplifier, transfer characteristics of the differential amplifier (Differential amplifier as a modulator and multiplier). Operational amplifier parameters (common-mode rejection ratio, offset voltages and currents etc.) Class A, AB, B and push-pull

power amplifiers. Analysis of power amplifiers and heat sinks. Thermal stabilization. Complementary and quasi-complementary output stages. Application of analogue integrated 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.

MCT 413 Group Project (2 Units: PH 90)

Identifying problem requirements. Generating and evaluating design concepts; design and fabrication. Design control software. Testing and debugging of systems. Documentation of design and results.

MCT 415 Laboratory CAD/CAM/CNC Experiments: (2 Units:

PH 90)

Planning and design of Mechatronic part systems

- CNC programming for Turn and Mill
- Production of Mechatronics part systems

MCT 501 Introduction to Robotics

(2 Units:

LH 30)

Automation and Robotics. Robot Classification. Robot Specifications. Direct Kinematics: Mathematical background. D-H representation. The Arm equation. Examples Inverse Kinematics: The inverse kinematics problem and its solution. Tool configuration. Examples of various robots. Introduction to Manipulator Dynamics: Lagrange's Equation, Lagrange-Euler Dynamic Model. Use of Sensors and Vision System in Robotic System.

MCT 502 Automation and Robotics

(3 Units:

LH 45)

Introduction to automation: Economics of Automation, Flow Lines, Mathematical Models, Storage Buffers, Partial Automation, Balancing, Group Technology and Flexible Manufacturing.

Programmable Logic Controllers

Introduction to PLCs, Advantages of PLCs, Ladder Logic Diagrams, Switching Logic. Components of PLC, PLC Operating Cycle, Additional Capabilities of a PLC, Latches, Design Cases (Deadman Switches, Conveyor, Accept/Reject Sorting), Addressing. PLC connection, PLC operation, Numbering, Event based logic, sequential logic design, Advanced ladder logic functions. PLC Programming, Structured text programming, Instruction list programming, Function block programming, Continuous control, PLC data communication, Human Machine Interfaces (HMI), Selecting a PLC.

CNC Machines

General information, Operation, Control panel descriptions, Tool function, Practical application of tool wear offset, feed function, spindle function, programming of CNC in absolute and incremental systems, program creation, preparatory functions, CNC Programming, Computer assisted part programming, Automatically programmed tools (APT Programming System), CAD/CAM approach to part programming, CAD/CAM application (turning problem, surface milling, machining of curved surfaces.)

MCT 503 Digital Signal Modelling

(3 Units:

LH 45)

The Concepts of sampling, quantization and aliasing. Discrete time signals and systems, discrete convolution, Z transforms, Z plane poles and zeros. Discrete Fourier transforms. Fast Fourier Transform. Concept of digital filtering, types of digital filters and properties. Digital transfer functions. One dimensional recursive and non recursive filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Computer techniques in filter synthesis. Realization of filters in hardware and software. Basic image processing concepts.

**MCT 504 MEMS and VLSI (3 Units:
LH 45)**

Basic micro electronic devices a brief review of the physics involved. Fabrication technology of microelectronic devices. IC fabrication technology (CMOS). Silicon crystal growth, epitaxy. Ion implantation, etching, chemical vapour deposition and photolithography. Silicon bulk and surface micromachining technology for micro systems or MEMS.

**MCT 505 Microcomputers and Microprocessor Systems (3 Units: LH 30;
PH 45)**

Hardwired logic contrasted with program logic. Microcomputer applications. Elements of microcomputer architecture; bus, microprocessor, memory, input-output, peripherals. Single chip and multichip micro computers. Overview of available microcomputer systems. Internal architecture; 3-bus concept, microprocessor operation. Microprocessor instruction set; instruction format, addressing modes; instructions execution. Comparison of available microprocessors. Machine language, assembly language and high level language programming. Synthesis of combinational logic circuits with ROMs and PLAs. Review of classical approach to sequential circuit design. The algorithmic state machine chart (ASM) method of representing sequential problems. Realization of sequential circuits using MSI and LSI. Register transfer languages.

**MCT 506 Computer Software Engineering II (2 Units:
LH 30)**

Object oriented software design, implementation and testing. Team software specification and management. Cross-platform tools and GUI development. Advanced software algorithms and architecture. Software engineering practice and methods.

**MCT 507 Vibrations (2 Units:
LH 30)**

Mechanical systems with one and several degrees of freedom, free, forced, and damped vibrations. Vibration problem solution by nodal analysis. Continuous systems, including exact and finite-element methods. Approximate methods of solution; Computer solutions: Vibration Isolation and absorption. Machine balancing.

**MCT 508 Systems Modelling and Simulation (3 Units:
LH 45)**

System identification and characteristic. System modelling. Installation considerations; generation of noise and its attenuation. Selection of equipment for particular applications. Review of currently available products. Control elements. System analysis and design; industrial application. Interfacing with programmable

logic controllers and computers.

MCT 509 Control Engineering II (2 Units:
LH 30)

Review of basic control theory. Analysis and design using Root's locus. System optimization using error criteria. Non linear systems. Describing and phase plane methods, multivariable systems, advanced analog and hybrid computing.

MCT 510 Power Electronics and Drives (3 Units:
LH 45)

Characteristics of semiconductor switches. Power conversion from AC to DC, DC to DC, DC to AC, AC to AC. Applications of SCR and other thyristor devices: motor control, control of drives, heating and lighting. Mechanical relays, solid state relays and stepping motors.

MCT 511 Process Automation (2 Units:
PH 90)

PLC programming higher functions
- PLC-programming analogue in/outputs
- 2-step controller
- Basics in closed loop control
- Closed loop temperature control
- Closed loop pressure control
- Closed loop flow control
- Closed loop level control

MCT 512 Laboratory (2 Units:
PH 90)

Full Automation Study fields:
- Material/signal flow in a networked system
- Installation and commissioning of a Mechatronics system
- Programming and communication in a Mechatronics system
- Maintenance and Trouble Shooting in a Mechatronics system

MCT 513 Laboratory (2 Units:
PH 90)

Partial Automation :- Factory Automation Factory Automation study fields:
- PLC programming level 1 - 3
- Industrial communication - Fieldbus
- DC/AC motor
- SCADA - Touch panel
- Assembly/disassembly or Mechatronics part systems

MCT 516 Microcomputers and Embedded Systems (2 Units: LH 30)

Microprocessor organization and interfacing: Memory interfacing. Hardware-software design of microprocessor systems. Introduction to Embedded Microcomputer Systems. Architectures of programmable digital signal processor. Programming for real-time performance. Design and implementation of data scrambler and interfaces to telecommunications.

MCT 517 Machine Vision (2 Units: LH 15; PH 45)

Advanced techniques and algorithms used in real-time computer vision and image processing design.

MCT 518 Computer Aided Product Modelling (2 Units: LH 30)

Geometric reasoning. Solid modelling, feature extraction, grasping, tolerancing.

MCT 519 Microfabrication Technology (2 Units: LH 15; PH 45)

Crystal growth, thermal oxidation, photolithography, etching, diffusion, ion implantation, film deposition, metallization, layout, process integration, IC manufacturing, MEMS, CAD tools for microfabrication (eg. SUPREM, PROLITH etc.). Future trends and challenges .

MCT 520 Renewable Energy Resources (2 Units: LH 30)

Possible future scenarios for energy from conventional to renewable sources. Energy conservation principles, energy distribution and system integration. Solar energy, hydro, wind and geothermal energies. Biofuels and biomass, energy storage options in form of hydrogen, batteries, liquid fuels, compressed gas by the use of heat exchangers.

MCT 521 Mobile Robotics (2 Units: LH 30)

Artificial intelligence programming techniques, basic problem solving techniques, knowledge acquisition and representation; artificial intelligent language (LISP and PROLOG). Computer interface, machine learning, natural language understanding, knowledge-based and expert systems, computer vision, robotics, relationship AI to software engineering and database methodology. Societal impact of AI and robotics. Machine vision and pattern recognition. Applications of identification trees, neural nets, genetics algorithms and other learning paradigms.

MCT 522 Lean Production Management and Industrial Logistics (2 Units: LH 30)

Material and information flows within a company, providing practical experience for all employees involved in lean production projects, inventory minimisation as

an important basis for increased productivity, the principle of pull production control, advantages compared to conventional production control methods, types and function of different pull production control methods, application of methods, Kanban – the classic pull principle, introduction to Value Stream Mapping (VSM). Lean manufacturing, flow production, throughput time and inventories while increasing flexibility, analysis of workplaces with the Standard Operation Sheet, adjusting the cycle times of individual workplaces, flow and takt time production, avoidance of material transport with linear and U layouts, • Structure and development of open-plan production, Line Back system, integration of logistic processes with kanban, flexible employee systems: relay and caravan systems, multimachine operation. Quality control.

**MCT 523 Control Engineering III (2 Units:
LH 30)**

MCT523 Types of systems nonlinearities, small perturbation methods, describing functions, phase plane analysis. Principles of sampled systems. Application of Z transforms. System performance and stability. State space analysis of controlled systems. On line computer control. Derivation of digital control algorithms. Microprocessor applications. Introduction to adaptive control; Hill climbing and model reference, adaptive systems. Lyapunov analysis. Stability in non linear systems. System identification and testing methods. Application of statistical correlation techniques.

**MCT 599 Final Year Project (6 Units:
PH 270)**

Undergraduate Project

3.20 METALLURGICAL ENGINEERING

Metallurgical engineering is a broad discipline that studies metals production and recycling, the manufacturing of components from metals and alloys, the processing and treatment of metals to achieve improved properties, and the design of metallic materials for specific applications. The field of metallurgical engineering starts with the production and recycling of metals such as aluminium, steel, copper, magnesium and titanium. Once these metals are made, metallurgical engineers design forming and processing techniques to transform these metals into useful shapes with the properties required for their application. Metallurgical engineers control the properties of metallic materials by altering the microscopic structure with alloying additions and special treatments. Thus they are able to develop products to meet specific needs such as corrosion-resistant stainless steels, ultra-light weight alloys for aircraft, wear-resistant alloys for engines, etc. In addition, investigating material failures and monitoring service life are tasks that are performed by metallurgists.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.20.1 Course Structure

Course structure at 300-Level Metallurgical Engineering

Course Code	Course Title	Units	Status	LH
GET 301	Engineering Mathematics III	3	R	45
GET 302	Engineering Mathematics IV	3	R	45
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	12 v
GST 311	Entrepreneurship	2	C	30

MEE 308	Manufacturing Technology	2	R	30
MEE 310	Fluid Mechanics I	2	R	30
MEE 312	Workshop Practice	2	R	15
MEE 331	Engineering Drawing III	3	R	30
MME 304	Chemistry of Materials	3	R	45
MTE 301	Metallurgical Thermodynamics	3	C	45
MTE 302	Metal Casting	3	C	45
MTE 303	Steelmaking	3	C	45
MTE 304	Mineral Processing	3	C	45
MTE 305	Metal Deformation Processes	2	R	30
MTE 306	Physical Metallurgy	2	C	30
MTE 307	Laboratory Practicals	3	R	-
MTE 309	Computer Application in Metallurgical Engineering	3	R	30
TOTAL		49		

Course structure at 400-Level Metallurgical Engineering

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	
MME 406	Chemical Metallurgy	3	R	45
MTE 401	Extractive Metallurgy	3	C	45
MTE 402	Process Metallurgy Application	3	C	45
MTE 403	Production Metallurgy	2	C	30
MTE 404	Mechanical Metallurgy	3	C	45
MTE 406	Metallurgical Process Design Principles	2	C	30

MTE 408	Corrosion and its Prevention	3	R	45
MTE 410	Laboratory Practicals	3	R	-
	TOTAL	28		

Course structure at 500-Level Metallurgical Engineering

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	R	45
GET 502	Engineering Law	2	R	30
MEE 508	Engineering Design Process	2	R	30
MTE 502	Metallurgical Failure Analysis	3	C	45
MTE 503	Material Selection, Fabrication, and Failure	3	C	45
MTE 504	Environmental Aspects of Metals Manufacturing	2	C	30
MTE 505	Microfabrication Materials and Processes	2	C	30
MTE 506	Electrical Systems and Controls for Materials	3	R	45
MTE 507	Transport Phenomenon in Metallurgy	3	C	45
MTE 508	Steels and their Treatment	3	C	45
MTE 509	Metal Coating Processes	3	C	45
MTE 510	Project	6	C	0
MTE 511	New Developments in Chemical Metallurgy	2	R	30
MTE 512	Laboratory Practicals	3	R	-
	TOTAL	40		

3.20.2 Course Synopses

**MTE 301 Metallurgical Thermodynamics
LH 45)**

(3 Units:

Thermodynamic laws and thermodynamic functions and their relation to problems of metallurgical interest, thermochemistry, thermophysics, and chemical or phase equilibria.

MTE 302 Metals Casting (3 Units: LH 45)

An advanced course in the materials and methods used in modern metals casting processes. Application of metallurgical principles to the casting of metals. Design of castings and metals casting mold features using commercial casting process simulation software.

MTE 303 Steelmaking (3 Units: LH 45)

Introduction to the fundamentals and unit processes used to turn impure iron and scrap into steel. Includes desulfurization, BOF and electric furnace operations, ladle metallurgy, casting, and stainless steel manufacture.

MTE 304 Mineral Processing(Mechanics and Design) (3 Units: LH 30; PH 45)

Mineral particle mechanics of comminution, sizing, classification, concentration, filtering and thickening. Mill and equipment selection and design including flowsheet development and plant assessment.

MTE 305 Metal Deformation Processes (3 Units: LH 45)

An introduction to metal deformation concepts followed by a study of various forming processes from both the analytical and applied viewpoints. Processes to include: forging, wire drawing, extrusion, rolling, sheet metal forming, and others.

MTE 306Physical Metallurgy (2 Units: LH 30)

Introduction to the principles of physical metallurgy. Topics include crystal structure, deformation, dislocations, point defects, diffusion, interfaces, nucleation theory, transformations, and growth.

MTE 309 Computer Application In Metallurgical Engineering (3 Units: LH 30; PH 45)

Introduction to the use of microcomputers for simulation, data analysis including statistics, data acquisition from laboratory instruments, and automatic process control systems. The course will provide instruction in programming and software usage, and the laboratory will enable students to fully utilize the potential of microcomputer in later courses.

MTE 401 Extractive Metallurgy (3 Units: LH 45)

Production and refining of metals by pyrometallurgy, hydrometallurgy, and electrometallurgy. Emphasis on heat and mass balance calculations for the unit processes of metals extraction. Introduction to the principles of combustion, heat utilization and recovery.

MTE 402 Process Metallurgy Applications (3 Units: LH 45)

Application of thermodynamics to process metallurgy. Equilibrium calculations with stoichiometry and heat balance restrictions, phase transformations, and solution thermodynamics. Use of thermodynamic software to solve complex equilibria in metallurgical applications.

MTE 403 Production Metallurgy (2 Units: LH 30)

Metal casting; Metal working and fabrication technology; Rolling; Extrusion; Forging; Wire drawing; other metal forming methods.

MTE 404 Mechanical Metallurgy (3 Units: LH 45)

Elastic and plastic behaviour of metallic single crystals and polycrystalline aggregates. Resulting changes in mechanical properties are considered. Included are applications to metal fabrication. Prerequisites

MTE 406 Metallurgical Process Design Principles (2 Units: LH 30)

Application of mass, component and energy balances for metallurgical design. The fundamentals of engineering economic analysis will be examined and experimental design techniques will be introduced. Students will be prepared for the selection and planning of the subsequent design project

MTE 408 Corrosion and its Prevention (3 Units: LH 45)

A study of the theories of corrosion and its application to corrosion and its prevention.

MTE 502 Metallurgical Failure Analysis (3 Units: LH 45)

Application of the principles of manufacturing and mechanical metallurgy for the analysis of failed components. Analytical techniques such as Scanning Electron Microscopy, Optical Metallography, and High Resolution Photography are used to characterize microstructure and fractographic features. In addition, appropriate methods to gather data, assimilate it, and draw conclusions from the data.

**MTE 503 Material Selection, Fabrication, and Failure (3 Units:
LH 45)**

Factors governing the selection of materials for specific needs, fabrication, heat treatment, surface treatment, and other aspects in the production of a satisfactory component. Failure analysis and remedies. Lecture plus assigned problems.

**MTE 504 Environmental Aspects of Metals Manufacturing (3 Units:
LH 45)**

Introduction to environmental aspects of metal extraction, melting, casting, forming, and finishing. Subjects include history of environmental movement and regulations permitting, risk analysis, disposal and recycling of metal manufacturing residues, environmental ethics, environmental technologies and case studies.

**MTE 505 Microfabrication Materials and Processes (3 Units:
LH 45)**

An overview course on the materials and processes used to fabricate integrated circuits, microelectromechanical systems (MEMS), interconnect substrates and other microelectronic components from starting material to final product. The emphasis will be on the influence of structure and processing on the electrical, mechanical, thermal, and optical properties.

**MTE 506 Electrical Systems and Controls for Materials (3 Units: LH 30;
PH 45)**

This course will cover analysis of alternating and direct current circuits as experienced in the materials industry. Current, voltage, and power relationships in single and three-phase electrical power systems. Introduction to continuous and batch instrumentation including programmable logic controllers (PLCs) and computer interfacing for materials applications.

**MTE 507 Transport Phenomena in Metallurgy (3 Units:
LH 45)**

Definition of viscosity, elements of laminar and turbulent flow, and overall mechanical energy balance. Thermal conductivity, steady and transient conduction problems, forced and natural convection, heat transfer, and radiative heat transfer. Definition of binary diffusivity, convection mass transfer, and mass transfer coefficient. The application of the principles covered in the design of specific metallurgical systems.

**MTE 508 Steels and their Treatment (3 Units:
LH 45)**

Industrially important ferrous alloys are described and classified. The selection of proper heat treatments to facilitate fabrication and to yield required service properties in steels suitable for various applications is considered.

**MTE 509 Metal Coating Processes (3 Units:
LH 45)**

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Introduction to the current technologies used to enhance metal performance, particularly corrosion resistance, by overlay coatings. Deposition processes are emphasized and the fundamentals of the behaviour of the films in high technology and electronic materials applications is discussed.

**MTE 511 New Developments in Chemical Metallurgy
LH 30)**

(2 Units:

Survey of selected modern processes for the production of metals, the treatment of wastes, and recycling of metal values. Processes are studied with respect to raw materials, chemical reactions, energy consumption, process intensity, yield and environmental impact.

DRAFT

3.21 MINING ENGINEERING

Mining engineering deals with location, extraction, and use of mineral resources and mineral policy. The mining engineer is concerned with all phases of mineral recovery, including exploration, evaluation, development, extraction, mineevaluation, reclamation, processing, and marketing of minerals. Appropriate courses have been developed in the key areas of explosives engineering, geology, mineral beneficiation, coalmine development and production, mining of metallic and aggregate minerals, mine systems design, mining economics and law, mine hygiene and safety, mine management, mine ventilation, rock mechanics, ground support, and reclamation.

Nigeria is rich in mineral resources thereby providing opportunities for mining engineers to enter a variety of segments of the mining industry: mine engineering, operations management, extraction or processing, base metals, precious metals, industrial minerals, quarry industry, explosives industry, construction or demolition, mining equipment suppliers and mining/geotechnical consulting firms. The overall focus of the programme is finding, extracting, and processing coal, metallic ores (such as copper, nickel, zinc, and gold) and other minerals (such as diamonds).

Primary Areas of Specialization:

- a. Identification and Estimation of Mineral Reserves
- b. Mine Design & Operation
- c. Mining Equipment Design & Operation
- d. Mineral Processing

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.21.1 Course Structure

Course structure at 300-Level Mining Engineering

Course Code	Course Title	Units			
EEE 305	Electrical Machines	4			
GET 301	Engineering Mathematics III	3			
GET 302	Engineering Mathematics IV	3			
GET 303	Engineer-in-Society	2			
GET 304	Engineering Communication	2			
GET 399	SIWES II	3			12 weeks
GST 311	Entrepreneurship	2			
MEE 308	Manufacturing Technology	2			
MEE 309	Thermodynamics	3			
MEE 310	Fluid Mechanics I	2			
MEE 312	Workshop Practice	2			
MEE 313	Engineering Metallurgy	2			
MEE 331	Engineering Drawing III	3			
MNE 301	Mine Surveying I	3			
MNE 302	Mining Systems I	3			
MNE 303	Laboratory Practicals	3			
MNE 349	Soil Mechanics	3			

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	TOTAL		4		

Course structure at 400-Level Mining Engineering

Course Code	Course Title	Units	Weeks	Prerequisites
GET 499	SIWES III	6	24 weeks	
MNE 401	Geology I	3		
MNE 402	Mining Systems II	3		
MNE 403	Mine Surveying II	3		
MNE 404	Drilling & Blasting	3		
MNE 405	Mining Process Design	2		
MNE 406	Plant Technology	3		
MNE 408	Laboratory Practicals	4		
	TOTAL	27		

Course structure at 500-Level Mining Engineering

Course Code	Course Title	Units			
GET 501	Engineering Management	3			
GET 502	Engineering Law	2			
MEE 508	Engineering Design Process	3			
MNE 501	Geology II	3			
MNE 502	Mining System II	3			
MNE 503	Mining Exploration & Evaluation	3			
MNE 504	Mining Process Design	2			
MNE 505	Mine Ventilation	3			
MNE 506	Mine Health and Safety	2			
MNE 507	Rock Mechanics	3			
MNE 508	Mineral Processing Technology	3			
MNE 509	Mine Power System	3			
MNE 511	Final Year Project	6			
MNE 514	Laboratory Practicals	3			
	TOTAL	42			

3.21.2 Course Synopses

**MNE 301 Mine Surveying I
(LH 45)**

(3 Units:

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.

**MNE 302 Mining Systems I
LH 45)**

(3 Units:

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.

**MNE 349 Soil Mechanics
PH 45)**

(3 Units: LH 30;

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

**MNE 401 Geology I
LH 45)**

(3 Units:

Elements of physical geology; Structural geology; Paleontology and Stratigraph; Mineralogy; Petrology; Geochemistry; Sedimentology; Geophysical prospecting methods, Photogeology; Hydro geology

**MNE 402 Mining Systems II
LH 45)**

(3 Units:

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.

**MNE 403 Mine Surveying II (3 Units:
LH 45)**

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 rocks/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.

**MNE 404 Drilling & Blasting (3 Units:
LH 45)**

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.

**MNE 405 Mining Process Design (2 Units:
LH30)**

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.

**MNE 406 Plant Technology (3 Units:
LH 45)**

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.

MNE 501 Geology II (3 Units: LH 45)

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.

MNE 502 Mining Systems (3 Units: LH 45)

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

MNE 503 Mining Exploration & Evaluation (3 Units: LH 45)

Mineral exploration and reserve estimation, statistical quality control, risk management, and engineering economy concepts applied to mineral deposits, including depreciation and depletion.

MNE 504 Mining Process Design (2 Units: LH 30)

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.

MNE 505 Mine Ventilation (3 Units: LH45)

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.

MNE 506 Mine Health and Safety (2 Units: LH 30)

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.

MNE 507 Rock mechanics (3 Units: LH 45)

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 ratio on failure; Empirical criteria of failure; Coulom-Navier criterion of failure of rocks; Griffith 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.

MNE 508 Mineral Processing and Technology (3 Units: LH 45)

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

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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. Communitation 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.

MNE 509 Mine Power System

(3 Units:

LH 45)

Comprehensive study of mine electrical power systems from theory to practice, covering the vital aspects that go into planning and designing a mine power system.

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3.22 OPERATIONS RESEARCH

Operations Research (OR) evolved from military applications into a full-scale, scientific discipline that is practised widely by analysts in industry, government, and the military. It is a decision support system. Technically, it is the development and application of mathematical models, statistical analyses, simulations, analytical reasoning, and common sense to the understanding and improvement of real-world operations. Improvement can be measured by the minimization of cost, maximization of efficiency, or optimization of other relevant measures of effectiveness. The programme introduces students to mathematical modelling ideas and computing technology to penetrate deeply into the analysis of important real-world problems.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.22.1 Course Structure

Course structure at 300-Level Operations Research

Course Code	Course Title	Units	Status	LH
GET 301	Engineering Mathematics III	3	R	45
GET 302	Engineering Mathematics IV	3	R	45
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	45
GST 311	Entrepreneurship	2	R	30
OPR 301	Introduction to Mathematical Programming	3	C	45
OPR 302	Methodology of Operations Research	2	C	30

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OPR 303	Decision Theory and Games	3	C	45
OPR 304	Structured Programming I	3	R	45
OPR 305	Macroergonomics and Organizational Behaviour in Human Systems Integration	2	C	30
OPR 306	Operations Research Practicals	3	C	45
OPR 307	Optimisation Techniques	3	R	45
OPR 308	Inventory Control	3	C	45
OPR 309	Laboratory and Field Course	3	R	45
OPR 310	Cost Estimation	3	R	45
OPR 314	Statistical Methods	2	E	30
OPR 315	Sample Survey Methods	2	E	30
OPR 317	Numerical Methods	2	E	30
OPR 319	Introduction to Operation Research	3	C	45
OPR 320	Operations Management	2	C	30
STA 305	Statistics for Physical Sciences and Engineering	3	R	45
	TOTAL	57		

Course structure at 400-Level Operations Research

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	24
OPR 401	Linear Programming and Extensions	3	C	45
OPR 404	Dynamic and Goal Programming	3	C	45
OPR 405	Forecasting and Estimation	3	C	45
OPR 406	Systems analysis	3	C	45
OPR 409	Mathematical Modelling	3	R	45

OPR 410	Statistical Theory of Quality Control	2	R	30
TOTAL		23		

500-Level Operations Research

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	R	45
GET 502	Engineering Law	2	R	30
OPR 501	Simulation Techniques	3	C	45
OPR 502	Management Information Systems	3	C	45
OPR 503	Applications of Operation Research	3	C	45
OPR 505	Stochastic Processes	3	C	45
OPR 506	Project	6	C	0
OPR 507	Reliability, Replacement and Maintenance	3	R	45
OPR 508	Mathematical Programming	3	R	45
OPR 509	Statistical Methods in Operations Research Application	3	C	45
OPR 510	Non-parametric Statistics	2	E	30
OPR 511	Multivariate Analysis	2	E	30
OPR 512	Econometrics	2	E	30
OPR 513	Sequential Methods in Statistics	2	E	30
OPR 514	Partial Differential Equations	2	E	30
TOTAL		42		

3.22.2 Course Synopses

**OPR 301 Introduction to Mathematical Programming
LH 45)**

(3 Units:

Brief introduction to several areas of mathematical programming; linear, nonlinear, integer, dynamic and goal programming. Emphasis is given to applications, models, computer implementation, and solutions, some algorithms.

OPR 302 Methodology of Operations Research (3 Units: LH 45)

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.

OPR 303 Decision Theory and Games (3 Units: LH 45)

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.

OPR 304 Structured Programming I (3 Units: LH 45)

Use of structured programming language such as QBASIC and VBASIC in problem solving operation research problems. Mainly laboratory based course.

OPR 305 Macroergonomics and Organizational Behaviour in Human Systems Integration (3 Units: LH 45)

This course systematically examines the application of macroergonomic concepts and organizational processes in orchestrating human systems integration (HSI) efforts in acquisition programs. The key concepts, principles, and theories of macroergonomics are defined and then applied to analyze organizational structures, policies, and processes that impact effective HSI efforts. Specific attention will be paid to leadership, organizational, group, and team behaviours as they impact HSI strategy, planning, program execution, and risk assessment.

OPR 306 Operations Research Practicals (3 Units: LH 45)

This course is designed to provide a forum where the theories, techniques models and methodology of 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.

**OPR 307 Optimisation Techniques (3 Units:
LH 45)**

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

**OPR 308 Inventory Control (3 Units:
LH 45)**

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.

**OPR 310 Cost Estimation (3 Units:
LH 45)**

This course provides a broad-based understanding of the cost analysis activities involved in the acquisition and support of industrial systems. It introduces operations research techniques fundamental to the field of cost estimation. The course covers time value of money, cost processes, data collection and sources, and economic analysis; it develops, uses, and analyzes cost estimating techniques commonly encountered in industry, including statistical and non-statistical cost estimating relationships, inflation indices, cost improvement curves, time phasing, wrap rates, and uncertainty analysis.

**OPR 314 Statistical Methods (3 Units:
LH 45)**

Analysis of variance, simple and multiple, linear and nonlinear regression, analysis of covariance. Use of MINITAB.

**OPR 315 Sample Survey Methods (3 Units:
LH 45)**

Statistical methods for the design and analysis of survey sampling. Fundamental survey designs. Methods of randomization specific to various survey designs. Estimation of population means, proportions, totals, variances, and mean squared errors. Design of questionnaires and organization of a survey.

**OPR 317 Numerical Methods (2 Units:
LH 30)**

An introduction to numerical methods including the study of iterative solutions of equations, interpolation, curve fitting, numerical differentiation and integration, and the solution of ordinary differential equations.

**OPR 319 Introduction to Operations Research (3 Units:
LH 45)**

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. Gantt's 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.

**OPR 320 Operations Management (2 Units:
LH 30)**

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.

**OPR 401 Linear Programming and Extensions (3 Units:
LH 45)**

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.

**OPR 404 Dynamic and Goal Programming (3 Units:
LH 45)**

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.

**OPR 405 Forecasting and Estimation (3 Units:
LH 45)**

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.

**OPR 406 Systems analysis (3 Units:
LH 45)**

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.

**OPR409 Mathematical Modelling (2 Units:
LH 30)**

A study of the process of translating real-world problems into mathematical models. Various methods of formulation and solution of models will be illustrated by practical examples.

**OPR 410 Statistical Theory of Quality Control (2 Units:
LH 30)**

Development of statistical concepts and theory underlying procedures used in quality control applications. Sampling inspection procedures, the sequential probability ratio test, continuous sampling procedures, process control procedures, and experimental design.

**OPR 501 Simulation Techniques (3 Units:
LH 45)**

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.

OPR 502 Management Information Systems (3 Units: LH 45)

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.

OPR 503 Applications of Operation Research (3 Units: LH 45)

The art and science of problem formulation. The operations research approach to problem solving. Mathematical modelling, 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.

OPR 505 Stochastic Processes (2 Units: LH 30)

Stochastic processes in statistical applications including Markov chains, Poisson processes, renewal processes, branching processes, random walks, martingales, Brownian motion and related stationary Gaussian processes.

OPR 506 Project (6 Units: PH 270)

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 four bound copies of his project (certified by the supervisor) to the Department.

OPR 507 Reliability, Replacement and Maintenance (3 Units:
LH 45)

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.

OPR 508 Mathematical Programming (3 Units:
LH 45)

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.

OPR 509 Statistical Methods in Operations Research Application (3 Units:
LH 45)

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.

OPR 510 Nonparametric Statistics (2 Units:
LH 30)

Statistical methodology based on ranks, empirical distributions, and runs. One and two sample tests, ANOVA, correlation, goodness of fit, and rank regression, R-estimates and confidence intervals. Comparisons with classical parametric methods. Emphasis on assumptions and interpretation.

OPR 511 Multivariate Analysis (2 Units:
LH 30)

Non-mathematical study of multivariate analysis. Multivariate analogs of univariate test and estimation procedures. Simultaneous inference procedures. Multivariate analysis of variance, repeated measures, inference for dispersion and association parameters, principal components analysis, discriminant analysis, cluster analysis.

OPR 512 Econometrics (2 Units:
LH 30)

Economic applications of mathematical and statistical techniques: regression, estimators, hypothesis testing, lagged variables, discrete variables, violations of assumptions, simultaneous equations.

OPR 513 Sequential Methods in Statistics (2 Units:
LH 30)

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Introduction to sequential tests, sequential probability ratio and other tests, approximation to OC and ASN function, tests for continuous parameter processes, sequential tests between three hypotheses, invariant tests, and sequential estimation.

**OPR 514 Partial Differential Equations
LH 45)**

(3 Units:

Bessel's equation and Legendre's equation, boundary value problems in curvilinear coordinate systems, Green's functions for ordinary and partial differential equations. Applications to problems of science and engineering will be given throughout the course.

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3.23 PETROCHEMICAL TECHNOLOGY

Petrochemical Technology is run in most institutions as an area of specialization in chemical engineering. Thus, the programme borrows a lot from chemical engineering and petroleum engineering programmes while concentrating on providing students with capability to meet the emerging needs of the modern petroleum refineries, chemical and petrochemical industries. The programme aims at products with capability to manage the modern petroleum refineries and petrochemical complexes.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.23.1 Course Structure

Course structure at 300-Level Petrochemical Technology

Course Code	Course Title	Units	Status	LH
GET 301	Engineering Mathematics III	3	R	45
GET 302	Engineering Mathematics IV	3	R	45
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	
GST 311	Entrepreneurship	2	R	30
MEE 310	Fluid Mechanics I	2	R	45
MEE 321	Mechanics of Materials	3	R	45
PCT 301	Industrial Studies I	2	R	30
PCT 302	Heat and Mass Transfer	4	C	45

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PCT 303	Engineering Analysis I	5	R	75
PCT 304	Drilling Fluids Technology	4	C	45
PCT 305	Drilling Technology I	3	C	45
PCT 306	Reservoir Engineering I	6	C	60
PCT 307	Petroleum Production Engineering I	3	C	45
PCT 309	Petroleum Geology	3	C	45
PCT 310	Petroleum Engineering Rock mechanics	3	C	45
	TOTAL	53		

Course structure at 400-Level Petrochemical Technology

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	2
PCT 401	Industrial Studies II	3	R	45
PCT 402	Applied Geophysics and Petroleum Exploration	2	C	30
PCT 403	Drilling Technology II	3	C	45
PCT 404	Reservoir Engineering II	3	C	45
PCT 405	Petroleum Production Engineering II	3	C	45
PCT 406	Well Logging	3	C	45
PCT 407	Oil Pollution Control	3	R	45
PCT 408	Laboratory Practicals	2	C	-
TIE 402	Engineering Economics	2	R	30
	TOTAL	30		

Course structure at 500-Level Petrochemical Technology

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Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	C	45
GET 502	Engineering Law	2	C	30
PCT 501	Drilling Technology III	3	C	45
PCT 502	Reservoir Engineering III	3	R	45
PCT 503	Petroleum Refining Technology	3	C	45
PCT 504	Petroleum Production Engineering III	3	C	45
PCT 505	Reservoir Modelling and Simulation	3	C	45
PCT 506	Enhanced Oil Recovery	2	C	30
PCT 507	Project	6	C	-
PCT 509	Petroleum Product Transport & Storage	2	C	30
PCT 510	Process Technology	3	R	45
PCT 511	Offshore Operations	2	R	30
PCT 512	Natural Gas Processing	3	R	45
PCT 513	Engineering Analysis II	3	R	45
PCT 514	Petroleum Economics	2	C	30
PCT 515	Multiple Phase Flow in Pipes	3	R	45
PCT 516	Laboratory Practicals	3	C	-
	TOTAL	49		

3.23.2 Course Synopses

PCT 301 Industrial Studies I
LH 30)

(2 Units:

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.

PCT 302 Heat and Mass Transfer (4 Units: LH 45; PH 45)

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.

PCT 303 Engineering Analysis I (3 Units: LH 45)

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.

PCT 304 Drilling Fluids Technology (4 Units: LH 45; PH 45)

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.

PCT 305 Drilling Technology I (3 Units: LH 45)

Techniques 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.

PCT 306 Reservoir Engineering I (6 Units: LH 60; PH 90)

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.

**PCT 307 Petroleum Production Engineering I (3 Units:
LH 45)**

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.

**PCT 309 Petroleum Geology (3 Units:
LH 45)**

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.

**PCT 310 Petroleum Engineering Rock Mechanics (3 Units:
LH 45)**

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.

**PCT 401 Industrial Studies III (3 Units:
LH 45)**

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.

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).

**PCT 402 Applied Geophysics and Petroleum Exploration (2 Units:
LH 30)**

The scope of geophysics; solid earth geophysics; the shape of the earth; geomagnetism; marine geophysics; isostasy. Geophysical instruments, field data processing, electrical, seismic, radiometric, etc). Geophysical logging of borehole. Geophysical prospecting and exploration.

**PCT 403 Drilling Technology II (3 Units:
LH 45)**

Pressure Control and Blowout Prevention: The need to control pressure; BOP valves; stack, choke line and choke manifold; choice of BOP system; control of 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 tools; objects lost in the hole; fishing methods.

Casing Design: Mechanical properties – tension, collapse and burst; designing a casing string.

**PCT 404 Reservoir Engineering II (3 Units:
LH 45)**

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.

**PCT 405 Petroleum Production Engineering II (3 Units:
LH 45)**

Surface completion: Gathering systems; service and cleaning systems; design and testing of flow lines. Emulsion problems; oil emulsions; emulsifying agents and demulsifiers; 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.

**PCT 406 Well Logging (3 Units:
LH 45)**

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.

**PCT 407 Oil Pollution and Control (3 Units:
LH 45)**

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.

**PCT 501 Drilling Technology III (3 Units:
LH 45)**

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.

**PCT 502 Reservoir Engineering III (3 Units:
LH 45)**

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.

**PCT 503 Petroleum Refining Technology (3 Units:
LH 45)**

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.

**PCT 504 Petroleum Production Engineering III (3 Units:
LH 45)**

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.

**PCT505 Reservoir Modelling and Simulation (3 Units:
LH 45)**

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.

**PCT 506 Enhanced Oil Recovery (3 Units:
LH 45)**

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.

**PCT 509 Petroleum Product Transport and Storage (3 Units:
LH 45)**

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.

**PCT 510 Process Technology (3 Units:
LH 45)**

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.

**PCT511Offshore Operation (2 Units:
LH 30)**

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.

**PCT 512 Natural Gas Processing (3 Units:
LH 45)**

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 liquefaction.

**PCT 513 Engineering Analysis II (3 Units:
LH 45)**

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.

**PCT 514 Petroleum Economics (2 Units:
LH 30)**

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.

**PCT 515 Multiple Phase Flow in Pipes (3 Units:
LH 45)**

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.

DRAFT

3.24 PETROLEUM ENGINEERING

The Petroleum Engineering curriculum is designed to provide the student with the strong foundation in science and engineering needed by petroleum and other related industries engaged in exploitation of natural gas resources from underground reservoir. The curriculum blends the natural sciences (mathematics, physics, chemistry and geology) and the engineering science (thermodynamics, mechanics, dynamics, hydraulics and strength of materials). The programme covers the fundamentals of petroleum engineering science and technology including the flow of fluids, separation processes, unit processes, inorganic and organic chemical equilibrium, and economics. The programme prepares students for engineering duties in the petroleum industry as well as the chemical process industry. The main focus is on the identification, extraction, storage, and transportation of crude oil and natural gas.

Primary Areas of Specialization:

- a. Identification and Estimation of Crude Oil and Natural Gas Reserves
- b. Land-Based Well Drilling Equipment/Facilities and Operations
- c. Offshore Well Drilling Equipment/Facilities and Operations
- d. Storage and Transportation Equipment/Facilities and Operations

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.24.1 Course Structure

Course structure at 300-Level Petroleum Engineering

Course Code	Course Title				
GET 301	Engineering Mathematics III				
GET 302	Engineering Mathematics IV				

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GET 303	Engineer-in-Society				
GET 304	Engineering Communication				
GET 399	SIWES II				12 we eks
GST 311	Entrepreneurship				
MEE 310	Fluid Mechanics I				
MEE 321	Mechanics of Materials				
PEE 301	Industrial Studies I				
PEE 303	Engineering Analysis I				
PEE 304	Drilling Fluids Technology				
PEE 305	Drilling Technology				
PEE 306	Reservoir Engineering I				
PEE 307	Petroleum Production Engineering I				
PEE 308	Petroleum Geology				
PEE 309	Heat and Mass Transfer				
PEE 310	Engineering Analysis II				
PEE 311	Petroleum Engineering Rock Mechanics				
PEE 312	Industrial Studies II				
	TOTAL				

Course structure at 400-Level Petroleum Engineering

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	

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PEE 401	Industrial Studies III	2	R	30
PEE 402	Applied Geophysics and Petroleum Exploration	2	C	30
PEE 403	Drilling Technology II	3	C	45
PEE 404	Reservoir Engineering II	3	C	45
PEE 405	Petroleum Production Engineering II	3	C	45
PEE 406	Well Logging	3	C	45
PEE 407	Oil Pollution and Control	3	R	45
PEE 408	Laboratory Practicals	3	C	0
TIE 402	Engineering Economics	2	R	30
	TOTAL	30		

Course structure at 500-Level Petroleum Engineering

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	R	45
GET 502	Engineering Law	2	R	30
PEE 501	Drilling Technology III	3	C	45
PEE 502	Reservoir Engineering III	3	C	45
PEE 503	Petroleum Refining Technology	3	C	45
PEE 504	Petroleum Production Engineering III	3	C	45
PEE 505	Reservoir Modelling and Simulation	3	C	45
PEE 506	Enhanced Oil Recovery	2	C	30
PEE 507	Project	6	C	-
PEE 509	Petroleum Product Transport & Storage	2	R	30

PEE 510	Process Technology	3	R	45
PEE 511	Offshore Operations	2	C	30
PEE 512	Natural Gas Processing	3	R	45
PEE 513	Petroleum Economics	2	R	30
PEE 514	Multiple Phase flow in Pipes	3	R	45
PEE 515	Laboratory Practicals	3	C	-
	TOTAL	46		

3.24.2 Course Synopses

PEE 301 Industrial Studies I LH 30)

(2 Units:

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.

PEE 303 Engineering Analysis I LH 45)

(3 Units:

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.

PEE 304 Drilling Fluids Technology PH 45)

(4 Units: LH 45;

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.

PEE 305 Drilling Technology I LH45)

(3 Units:

Techniques 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.

PEE 306 Reservoir Engineering I (6 Units: LH 60; PH 90)

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.

PEE 307 Petroleum Production Engineering I (3 Units: LH 45)

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.

PEE 308 Petroleum Geology (3 Units: LH 45)

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.

PEE 309 Heat and Mass Transfer (4 Units: LH 45; PH 45)

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.

PEE 310 Engineering Analysis II (3 Units: LH 45)

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.

PEE 311 Petroleum Engineering Rock Mechanics (3 Units: LH45)

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.

PEE 312 Industrial Studies II (2 Units: LH 30)

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.

PEE 401 Industrial Studies III (2 Units: LH30)

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).

PEE 402 Applied Geophysics and Petroleum Exploration (2 Units: LH30)

The scope of geophysics; solid earth geophysics; the shape of the earth; geomagnetism; marine geophysics; isostasy. Geophysical instruments, field data processing, electrical, seismic, radiometric, etc). Geophysical logging of borehole. Geophysical prospecting and exploration.

PEE 403 Drilling Technology II (3 Units: LH 45)

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.

PEE 404 Reservoir Engineering II (3 Units: LH 45)

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.

PEE 405 Petroleum Production Engineering II (3 Units: LH 45)

Surface completion: Gathering systems; service and cleaning systems; design and testing of flow lines. Emulsion problems; oil emulsions; emulsifying agents and demulsifiers; 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.

PEE 406 Well Logging (3 Units: LH 45)

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.

PEE 407 Oil Pollution and Control (3 Units: LH 45)

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.

PEE 501 Drilling Technology III (3 Units: LH 45)

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.

PEE 502 Reservoir Engineering III (3 Units: LH 45)

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.

PEE 503 Petroleum Refining Technology (3 Units: LH 45)

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.

PEE 504 Petroleum Production Engineering III (3 Units: LH 45)

Problem-well analysis: Work over techniques; well stimulation; fracturing and acidizing. 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.

PEE 505 Reservoir Modelling and Simulation (3 Units: LH 45)

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.

PEE 506 Enhanced Oil Recovery (3 Units: LH 45)

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.

PEE 509 Petroleum Product Transport and Storage (3 Units: LH 45)

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.

**PEE 510 Process Technology (3 Units:
LH45)**

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.

**PEE 511 Offshore Operation (2 Units:
LH 30)**

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; oil spill and oil removal.

**PEE 512 Natural Gas Processing (3 Units:
LH 45)**

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 liquefaction.

**PEE 513 Petroleum Economics (2 Units:
LH 30)**

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.

**PEE 514 Multiple Phase Flow in Pipes (3 Units:
LH 45)**

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.

3.25 PETROLEUM AND GAS ENGINEERING

The programme has been designed to equip the student with the fundamentals necessary to achieve lifelong professional growth as they enter both the private and public sectors as petroleum and natural gas engineers or to pursue further education at the graduate level. The programme is structured with emphasis on the fundamentals of mathematics and earth and engineering sciences which are integrated to the treatment of traditional petroleum and natural gas engineering topics. Graduates of the program are expected to perform in various facets of the petroleum industry including drilling, production, evaluation, transportation and storage.

DETAILS OF UNDERGRADUATE COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.25.1 Course Structure

Course structure at 300-Level Petroleum and Gas Engineering

Course Code	Course Title	Units	Status	LL
EEE 316	Electromechanical System	3	R	43
GET 301	Engineering Mathematics III	3	R	43
GET 302	Engineering Mathematics IV	3	R	43
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	
GST 311	Entrepreneurship	2	C	30
MEE 310	Fluid Mechanics I	2	R	30
MEE 321	Mechanics of Materials	3	R	43

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PGE 301	Transport Phenomena	4	C	45
PGE 302	Separation Process	3	C	30
PGE 303	Structural Geology	2	C	30
PGE 304	Petroleum Geology	2	C	30
PGE 305	Unit Operations in Natural Gas Engineering	2	C	30
PGE 307	Fluid flow Through Porous Medium	2	C	30
PGE 308	Formation Evaluation & Geophysical Methods	3	C	45
PGE 310	Basic Petroleum Reservoir Engineering	3	C	45
PGE 311	Drilling Methods	3	C	45
PGE 312	Petroleum Engineering Laboratory I	4	C	0
TCH 302	Chemical Engineering Thermodynamics I	2	C	30
	TOTAL	53		

Course structure at 400-Level Petroleum and Gas Engineering

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	45
MME 405	Corrosion Science and Engineering	3	R	45
PGE 403	Petroleum Reservoir Engineering	3	C	45
PGE 404	Petroleum Production Engineering	3	C	45
PGE 405	Pressure Build-up and Test Methods	2	C	30
PGE 406	Gas Processing Equipment	2	C	30
PGE 407	Gas Dynamics	3	C	45
PGE 408	Petroleum Engineering Laboratory II	3	C	0
PGE 409	Introduction to Well Logging & Interpretation	2	R	30

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TCH 404	Plant Design I	4	C	60
TIE 402	Engineering Economics	2	R	30
	TOTAL	33		

Course structure at 500-Level Petroleum and Gas Engineering

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	C	45
GET 502	Engineering Law	2	C	30
PEE 503	Petroleum Refining Technology	3	E	45
PGE 503	Absorption and Fractionation	3	C	45
PGE 504	Gas Transportation	2	C	30
PGE 506	Refrigeration and Liquefaction	3	R	45
PGE 507	Petroleum Economics	3	C	45
PGE 508	Gas Sweetening & Sulphur Recovery	2	C	30
PGE 509	Gas Process Control	2	C	30
PGE 510	Valves and Pipeline Design	2	R	30
PGE 511	Gas Process, Vessel & Equipment Design	2	R	30
PGE 512	Research Project	6	C	-
PGE 514	Environmental Pollution	3	E	45
PGE 515	Petrochemical Science & technology	3	E	45
PGE 516	Reservoir Modelling and Simulation	3	E	45
PGE 517	Petroleum Engineering Laboratory III	3	C	-
TCH 513	Polymer Science and Technology	3	E	45
	TOTAL	48		

3.25.2 Course Synopses

PGE 301 Transport Phenomena (4 Units: LH 45; PH 45)

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 vapours. Diffusion in liquids and solids.

PGE 302 Separation Processes (3 Units: LH30; PH45)

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

PGE 303 Structural Geology (3 Units: LH 45)

The Dynamic Earth. Model convection and plate movement. Rock cycle, Rocks and rock types Geologic symbols. Folding and faulting. Lithography Reservoir rocks. Traps stratigraphy.

PGE 304 Petroleum Geology (2 Units: LH 30)

Requirement for petroleum accumulation; plate tectonic. Origin of hydrocarbon, migration and trapping mechanisms. Reservoir rock properties. Depositional environment, petro-physical properties.

PGE 305 Unit Operations in Natural Gas Engineering (2 Units: LH 30)

Design of natural gas facilities-pressure losses in pipes. Pressure losses in armature and fittings. Pumps. Nozzle theory and mass transfer. Dehydration. Need for dehydration of gas; Dew point depression; Absorption with glycol and adsorption with solids; Sulphur removal; Scale problems. Control of gas quality. Adsorption facilities. Fractionation and heat exchange design. Storage.

PGE 307 Fluid Flow through Porous medium (2 Units: LH 30)

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. Poiseuille'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.

PGE 308 Formation evaluation and applied geophysical methods (3 Units: LH 45) Application of geophysical methods to formation evaluation.

PGE 310 Basic Petroleum Reservoir Engineering (3 Units: LH 45)

General composition of Petroleum. Fundamental properties of fluid permeated rocks. Properties of Porous media containing multiple fluid saturations. Fundamentals of the behaviour of hydrocarbon fluids. Determination and application of reservoir fluid properties. Properties of water. Data Evaluation for calculations. The material Balance.

PGE 311 Drilling Methods. (3 Units: LH 45)

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.

PGE 312 Petroleum Engineering Laboratory 1 (4 Units: PH 180)

Laboratory analysis of Reservoir rocks.

PGE 403 Petroleum Reservoir Engineering (3 Units: LH 45)

Study of Gas-condensate and under-saturated reservoirs including recovery methods. Oil reservoirs under simultaneous dissolved Gas drive, Gas cap drive and water drive. Water Influx.

PGE 404 Petroleum Production Engineering (3 Units: LH 45)

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.

PGE 405 Pressure Build-up and Test methods (2 Units: LH 30)

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 Heterogeneities on pressure behaviour.

**PGE 406 Gas Processing equipment (2 Units:
LH 30)**

Study of compressors, valves including valve mechanics pumps and other processing equipment.

**PGE 407 Gas Dynamics (3 Units:
LH 45)**

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 Ducts. Measurement methods. Frictionless flow effects of viscosity and conductivity.

**PGE 408 Petroleum Engineering Laboratory II (3 Units:
PH 135)**

Coring and core analysis. Porosity and permeability measurements. Liquid saturation measurements.

**PGE 409 Introduction to well logging and Interpretation (2 Units:
LH 30)**

Driller's logs, Sample logs, Mud logging. Electric Logging Radioactivity logging. Miscellaneous logging devices. Wire line logs. Well logging interpretation.

**PGE 503 Adsorption and Fractionation (2 Units:
LH 30)**

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.

**PGE 504 Gas Transportation (2 Units:
LH 30)**

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 and 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.

**PGE 506 Refrigeration and Liquefaction (2 Units:
LH 30)**

Basic principles of refrigeration and liquefaction application of First and Second Laws of Thermodynamics cycles. Refrigerants. Vapour compression systems and equipment. Multistage refrigeration cycles compression fundamentals. Introduction to cryogenic systems. Joule - Thompson effect. Expansion turbines. Equipment selection.

**PGE 507 Petroleum Economics (2 Units:
LH 30)**

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.

**PGE 508 Gas Sweetening and Sulphur recovery (2 Units:
LH 30)**

Gas purification and odourisation. Absorption processes. Use of DEA, Cuprous solution and Na_2CO_3 in gas purification. Extraction processes. Removal of H₂S from Liquefied gas. Sulphur recovery processes.

**PGE 509 Gas process Control (3 Units:
LH 45)**

Review of Mathematical Concepts process dynamics. Non-Linear systems. Lumoed parameters Feedback control and higher level control systems. Case studies. Multi-variable control systems.

**PGE 510 Valves and Pipeline Design (2 Units:
LH 30)**

Design of simple pipelines, pipes in series, in parallel, branched pipes and pipelines with continuous flow regime, design of valves.

**PGE 511 Gas Process, Vessel and Equipment Design (2 Units:
LH 30)**

Design of gas compressors and allied equipment.

**PGE 514 Environmental Pollution (3 Units:
LH 45)**

Causes of environmental pollution – oil pollution; blowout; pipeline and flow line 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.

**PGE 515 Petrochemical Science and Technology (3 Units:
LH 45)**

The petroleum oil industry and its relevance to the petrochemical industry. The non-oil fossil fuels and their relevance to the petrochemical industry. Petrochemical precursors. Socio-economic, socio-political and geographical

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implications of the petrochemical industry. Planning petrochemical industry for a developing country.

PGE 516 Petroleum Reservoir Modelling and Simulation (3 Units: LH 45)

Basic principles of Reservoir modelling. Modelling 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.

DRAFT

3.26 POLYMER ENGINEERING

Polymer engineering is generally an engineering field that designs, analyses, and/or modifies polymer materials. The discipline of Polymer Engineering involves studying relationships that exist between the structure and properties of polymeric materials, their structure and properties, product design and their applications etc. The programme covers aspects of petrochemical industry, polymerization, structure and characterization of polymers, properties of polymers, compounding and processing of polymers and description of major polymers, structure property relations and applications. The programme is aimed at producing competent and skilled graduates who wish to seek careers as engineers, scientists and managers in the polymer industries.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.26.1 Course Structure

Course structure at 300-Level Polymer Engineering

Course Code	Course Title	Units	Status	LP
GET 301	Engineering Mathematics III	3	R	45
GET 302	Engineering Mathematics IV	3	R	45
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	12
GST 311	Entrepreneurship	2	C	30
MEE 309	Thermodynamics	3	C	45
MEE 310	Fluid Mechanics I	2	C	30

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MEE 313	Engineering Metallurgy	2	R	30
MEE 321	Mechanics of Materials	3	R	45
PYE 301	Analytical Chemistry	4	R	45
PYE 303	Physical Chemistry	3	C	45
PYE 305	Science of Materials	3	R	45
PYE 306	Chemistry of Polymer	2	R	30
PYE 307	Polymer Process Engineering I	3	R	45
PYE 309	Polymer Engineering Laboratory I	3	R	15
PYE 310	Surface and Colloid Chemistry	2	R	30
TCH 301	Transport Phenomena I	4	C	45
TCH 302	Chemical Engineering Thermodynamics I	2	C	30
	TOTAL	51		

Course structure at 400-Level Polymer Engineering

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	
PYE 401	Polymer Structures & Properties	4	C	60
PYE 402	Polymer Reaction Engineering	2	C	30
PYE 403	Polymer Process Engineering II	3	C	45
PYE 404	Polymer Engineering Laboratory II	2	C	0
PYE 405	Process Instrumentation	2	C	30
TCH 404	Plant Design I	4	C	60
TIE 402	Engineering Economics	2	R	30

	TOTAL	25		

Course structure at 500-Level Polymer Engineering

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	C	45
GET 502	Engineering Law	2	C	30
PYE 501	Composites and Nanocomposites	3	C	45
PYE 502	Polymer Reactions and Degradation	2	C	30
PYE 503	Pulp and Paper Technology	3	R	45
PYE 504	Polymer Chain Properties and Solutions	2	C	30
PYE 505	Technology of Elastomers	3	C	45
PYE 506	Polymer Engineering Laboratory III	3	C	0
PYE 507	Project	6	C	0
PYE 508	Adhesive Technology	3	R	45
PYE 509	Industrial Applications of Polymetric Materials	2	C	30
PYE 510	Applied Polymer Chemistry	3	C	45
	TOTAL	35		

3.26.2 Course Synopses

PYE 301 Analytical Chemistry PH 45)

(Units 4: LH 45;

A study of analytical chemistry including separation techniques for chemical and biochemical analysis, atomic - molecular mass spectrometry, atomic - molecular

spectroscopy, surface analysis with electron spectroscopy, X-ray and mass spectrometry.

PYE 303 Physical Chemistry (Units 3: LH 45)

A study of kinetic theory, chemical kinetics, electromotive force and ionic equilibria.

PYE 305 Science of Materials (3 Units: LH 45)

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.

PYE 306 Chemistry of Polymers (2 Units: LH 30)

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.

PYE 307 Polymer Process Engineering I (3 Units: LH 45)

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.

PYE 309 Polymer Engineering Laboratory (3 Units: LH 15; PH 90)

Lectures and laboratory experiments dealing with polymerization reactions, solution properties and bulk or solid properties will be presented. Each student will prepare polymers and carry out all characterization experiments on actual samples.

PYE 310 Surface and Colloid Chemistry (2 Units: LH 30)

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.

PYE 401 Polymer Structure & Properties (2 Units: LH 30)

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. Crystallographic cells in polymers, single crystals, lamellae, fibrils, spherulite and globular crystals. Structure of amorphous polymers. The methods of investigation of polymers structures, such as optical microscopy, electron microscopy (SEM AND TEM), X-ray diffraction. Infrared spectroscopy and NMR spectroscopy, ESR and RAMAN spectroscopy.

PYE 402 Polymer Reaction Engineering (2 Units: LH 30)

Classification of polymerisation reactions. Methods of reactor operation and design equations. Temperature and pressure effects. Fluid mixing, Catalyst deactivation. Choice of reactors.

PYE 403 Polymer Process Engineering II (3 Units: LH 45)

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.

PYE 405 Process Instrumentation (2 Units: LH 30)

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

PYE 501 Composites and Nanocomposites (3 Units: LH 45)

Introduction to thermoset and thermoplastic composite materials, polymers, reinforcements, processing techniques, tooling, properties, and emerging nanocomposite materials with applications in various markets such as sports, automotive, marine, construction, aircraft, medical, and electronics.

PYE 502 Polymer Reactions and Degradation (2 Units: LH 30)

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.

PYE 503 Pulp and Paper Technology (3 Units:
LH 45)

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.

PYE 504 Polymer Chain Properties and Solutions (2 Units:
LH 30)

Configuration of polymer chains; optical activity, stereoregularity; conformation of dissolved polymer chains; irregularities; random chain, bonded chains; excluded volume, dimensions of freely jointed chain, bond angle restrictions, thermodynamics of polymer solution, lattice theory, entropy and heat of 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; polyelectrolytes viscosities.

PYE 505 Technology of Elastomers (3Units:
LH 45)

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, styrenebutadienerubbers, 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 density, swelling volume, sulphur cross-linkages, gel. Content and thermal analysis.

PYE 507 Project (6 Units:
PH 270)

Project work in selected areas under staff supervision.

PYE 508 Adhesive Technology (3Units:
LH 45)

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, ASTM tests on storage life, working life, coverage, blocking, tack curing rate; selected adhesive materials: Formaldehyde-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.

PYE 509 Industrial Applications of Polymeric Materials (2 Units: LH 30)

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.

PYE 510 Applied Polymer Chemistry (3 Units: LH 45)

A basic study of the organic chemistry of natural and synthetic high polymers, their inherent properties and their uses in plastic, fibre, rubber, resin, food, paper and soap industries.

3.27 PUBLIC HEALTH ENGINEERING

The programme is geared towards the exposure of students to the principles and practice of public health engineering, providing a bridge between the arena of public health policy and the practical application of engineering to improve public health. Students are introduced to the historical and current trends in water supply, sanitation, wastewater and solid waste management and key technologies and approaches. Public health engineers are trained to thinkwiththeclearnessandaccuracyofanengineer as they deploy scientific and technological principles to the present day practice of public health engineering which includes the key areas of: Water Engineering (involving the appropriate techniques for the collection, storage, treatment and distribution of potable water to urban areas); Wastewater Engineering (involving an introduction to the techniques necessary to design and operate a range of treatment processes using both low and high-cost options); Landfill Processes Design (providing a deeper understanding of the technologies of landfill and landform, and their role in the overall waste management process); Environmental Microbiology (providing the background necessary to understand the applications of biologically engineered systems to minimize environmental impacts and restore damaged environments.); and Solid Waste and Air Pollution.

DETAILS OF UNDERGRADUATE COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.27.1 Course Structure**Course structure at 300-Level Public Health Engineering**

Course Code	Course Title	Units	Status	LH
CEE 304	Civil Engineering Materials	3	R	30
GET 301	Engineering Mathematics III	3	R	45
GET 302	Engineering Mathematics IV	3	R	45
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	
GST 311	Entrepreneurship	2	R	30
MEE 310	Fluid Mechanics I	2	C	30
MEE 321	Mechanics of Materials	3	C	45
PHE 301	Structural Mechanics	4	R	60
PHE 302	Design of Structures	4	R	60
PHE 303	Public Health Engineering I	4	C	60
PHE 304	Engineering Geology	3	C	45
PHE 305	Engineering Surveying & Photogrammetry	4	C	60
PHE 306	Soil Mechanics	2	R	30
PHE 307	Laboratory Practicals	6	R	-

PHE 308	Hydraulics and Hydrology	4	C	60
TOTAL		54		

Course structure at 400-Level Public Health Engineering

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	
PHE 401	Public Health Engineering II	2	C	30
PHE 402	Industrial Waste Engineering	2	C	30
PHE 403	Quantity Surveying	2	C	30
PHE 404	Soil Mechanics and Foundations	3	R	45
PHE 405	Design of Hydraulic Structures	3	C	45
PHE 406	Laboratory Practicals	3	C	0
TIE 402	Engineering Economics	2	R	30
TOTAL		23		

Course structure at 500-Level Public Health Engineering

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	R	45
GET 502	Engineering Law	2	R	30
PHE 501	Project	6	C	0
PHE 502	Design of Treatment Plants	6	C	90
PHE 503	Units Operations and Processes	3	C	45
PHE 504	Solid Waste Engineering & Air Pollution	3	C	45

PHE 505	Bio-Engineering	3	C	45
PHE 506	Advanced Public Health Engineering	4	C	60
PHE 507	Laboratory Practicals	6	R	0
	TOTAL	36		

3.27.2 Course Synopses

PHE 301 Structural Mechanics (4 Units: LH 60)

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.

PHE 302 Design of Structures (4 Units: LH 60)

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.

PHE 303 Public Health Engineering I (4 Units: LH 60)

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.

PHE 304 Engineering Geology (3 Units: LH 45)

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.

**PHE 305 Engineering Surveying & Photogrammetry (4 Units:
LH 60)**

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.

**PHE 306 Soil Mechanics (2 Units:
LH 30)**

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

**PHE 307 Laboratory Practicals (6 Units:
PH 270)**

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

**PHE 308 Hydraulics and Hydrology (4 Units:
LH 60)**

Introduction, descriptive Hydrology: Hydrologic cycle, precipitation, evaporation and transpiration. Quantitative Hydrology: Hydrography, Volume runoff, storage routing. Groundwater: Occurrence, hydraulics, well, yield.

**PHE 401 Public Health Engineering II (2 Units:
LH 30)**

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.

**PHE 402 Industrial Waste Engineering (2 Units:
LH 30)**

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.

**PHE403 Quantity Surveying (3 Units:
LH 45)**

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.

PHE404 Soil Mechanics and Foundations

(3Units:

LH 45)

Soil Structures. Compaction and soil stabilisation, stability of slopes. Earth pressures, Retaining Walls. Concepts permeability, stress distribution, shear strength and pressure in relation to foundation engineering. Bearing capacity of soils. Shallow and Deep foundations. Pile foundations. Site Investigation.

PHE 405 Design of Hydraulic Structures

(3Units:

LH 45)

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) Catch basins

Introduction to multiple purpose designs involving flood control water supply, irrigation, recreation, drainage navigation and erosion control. Computer Aided design of Hydraulic structures

PHE 406 Laboratory Practicals

(3 Units:

PH 135)

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

PHE 501 Project

(6 Units:

PH 270)

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.

PHE502 Design of Treatment Plant Wastewater

(3Units:

LH 45)

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.

**PHE 503 Unit Operations and Process (4 Units:
LH 60)**

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.

**PHE504Solid Waste Engineering and Air Pollution (3Units:
LH 45)**

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.

**PHE 506 Advanced Public Health Engineering (4 Units:
LH 60)**

Water Related Tropical Diseases

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

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.

**PHE 507 Laboratory Practicals (6 Units:
PH 270)**

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

**PHE 510Bio-Engineering (3Units:
LH 45)**

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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.

DRAFT

3.28 REFRIGERATION AND AIR-CONDITIONING ENGINEERING

Air-conditioning and Refrigeration Engineering is run in most institutions as an area of specialization in mechanical engineering. Thus, the programme borrows a lot from mechanical engineering while concentrating on providing students with capability to meet the emerging needs of the modern air-conditioning and refrigeration systems including controlled atmosphere technology (CAT).

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.28.1 Course Structure

Course structure at 300-Level Refrigeration and Air-Conditioning Engineering

Course Code	Course Title	Units	Status	Level	Prerequisites
EE 305	Electrical Machines	4	C	60	-
GE 301	Engineering Mathematics III	3	R	45	-
GE 302	Engineering Mathematics IV	3	R	45	-
GE 303	Engineer-in-Society	2	R	30	-
GE 304	Engineering Communication	2	R	30	-

GE T 39 9	SIWES II	3	C	12 weeks	
GS T 31 1	Entrepreneurship	2	C	3 0	-
M EE 30 7	Theory of Machines I	3	R	4 5	-
M EE 30 8	Manufacturing Technology	2	R	3 0	-
M EE 30 9	Thermodynamics	2	C	3 0	-
M EE 31 0	Fluid Mechanics I	2	C	3 0	-
M EE 31 2	Workshop Practice	2	C	1 5	4 5
M EE 31 3	Engineering Metallurgy	2	R	3 0	-
M EE 32 1	Mechanics of Materials	3	C	4 5	-
M EE 33 1	Engineering Drawing III	3	C	3 0	4 5
RA E 30 1	Basic Refrigeration Systems	4	C	4 5	4 5
RA E	Psychrometry and Systems Design	3	C	4 5	-

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30 2					
RA E 30 5	Refrigeration and Air-conditioning Workshop Practice	2	C	3 0	-
RA E 30 6	Commercial HVAC Appliances units	4		4 5	4 5
ST A 30 5	Statistics for Physical Science and Engineering	3	E	4 5	-
	TOTAL	5 4			

Course structure at 400-Level Refrigeration and Air-Conditioning Engineering

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H
GE T 49 9	SIWES III	6	C	24 weeks	
M EE 40 3	Applied Thermodynamics & Heat Transfer	4	C	4 5	4 5
M EE 40 5	Fluid Mechanics II	3		3 0	4 5
M EE 40 6	Machine Design I	3		4 5	-
RA E 40 1	Properties and Characteristics of Refrigerants	3	C	4 5	-

RA E 40 2	HVAC Codes	1	C	1 5	-
RA E 40 3	Direct Digital Controls	3	R	3 0	4 5
RA E 40 4	Air Movement and Ventilation	4	C	4 5	4 5
RA E 40 5	HVACR Electricity	4	C	4 5	4 5
	TOTAL	3 1			

Course structure at 500-Level Refrigeration and Air-Conditioning Engineering

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H
GE T 50 1	Engineering Management	3	R	4 5	-
GE T 50 2	Engineering Law	3	R	4 5	-
M EE 50 1	Applied Thermodynamics	3	C	3 0	4 5
M EE 50 2	Fluid Dynamics	3	C	4 5	-
M EE	Heat Transfer	3	C	3 0	4 5

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50 3					
M EE 50 4	Machine Design II	4	E	3 0	9 0
M EE 50 7	Theory Elasticity	4	E	4 5	4 5
M EE 50 8	Engineering Design Process	2	C	3 0	-
RA E 50 3	Refrigeration and Air-conditioning Equipment Design and Manufacture	4	C	6 0	-
RA E 50 5	Project	6	C	0	2 7 0
RA E 50 7	Energy Auditing	4	C	6 0	-
RA E 50 8	Air Conditioning Split-Systems	4	C	4 5	4 5
RA E 50 9	Refrigeration Commercial Appliances	4	C	4 5	4 5
RA E 51 0	Refrigeration Small Appliances	4	C	4 5	4 5
	TOTAL	5 1			

3.28.2 Course Synopses

RAE 301 Basic Refrigeration Systems (4 Units: LH 45; PH 45)

This course introduces students to basic refrigeration theory and practice in Heating, Ventilation, Air-Conditioning and Refrigeration (HVACR). The function and operational characteristics of the mechanical refrigeration system including condensers, evaporators, compressors, refrigerant metering devices, sustainable energy sources and refrigerants are covered. The use and operation of service manifolds, leak detection, system evacuation and charging, test equipment, flaring, soldering and brazing skills are covered. NOTE: The student will be required to purchase basic hand tools that will be used in this and other refrigeration and air conditioning courses.

RAE 302 Psychrometry and System Design (3 Units: LH 45)

Load estimation
Basic Psychrometry
Idea Vapour power cycles
Cycle and systems design and analysis.

RAE 305 Refrigeration and Air-conditioning Workshop Practice (3 Units: LH 45)

Testing of Refrigeration Equipment
Testing of Air-conditioning Equipment
Fault detection
Scheduled maintenance
Other cooling techniques

RAE 306 Commercial HVAC Appliances units (4 Units: LH 45; PH 45)

This course covers intermediate principles, practices, operations, service and installation of commercial HVAC equipment through lectures, demonstrations, and lab experiences conducted on commercial HVAC equipment. The function and operational characteristics of various types of commercial HVAC equipment, its wiring, and safety procedures are studied. Electric controls including thermostats, defrost controls, relays, and contactors are studied, as well as capacitors, power distribution, motors, protective devices, system malfunction diagnosis, corrective procedures, and the refrigerants used in the commercial HVAC industry. This course also introduces hydronic heating, air mixing properties, installation and service, a basic understanding of load calculations, ducting, fan laws, and piping techniques for commercial HVAC equipment.

RAE 401 Properties and Characteristics of Refrigerants (3Units: LH 45)

Types and availability of refrigerants

Properties of various refrigerants
Selection of refrigerants.

**RAE 402 HVAC Codes (1 Unit:
LH 15)**

This course covers the function of HVAC Mechanical Codes including Building Officials and Code Administrators (BOCA) Mechanical Codes, National Fire Protection Association (NFPA) codes, National Fuel Gas Codes, ASHRAE Standard Mechanical Refrigeration Codes, and National Electrical Codes.

**RAE 403 Direct Digital Controls (3 Units: LH 30;
PH 45)**

This course covers basic commercial control principles and offers students experiences and practice in the selection, installation, operation, and servicing of pneumatic and electronic automation control systems and components used in commercial buildings. Special emphasis will be placed on direct digital control systems (DDC) including troubleshooting, maintenance, and retrofitting

**RAE 404 Air Movement and Ventilation (4 Units: LH 45;
PH 45)**

This course covers intermediate principles, practices, operations, and service of commercial HVAC equipment through the use of lectures, demonstrations, and lab experiences. The function and operational characteristics of various types of residential and commercial HVAC equipment, wiring, and safety procedures are studied, as well as proper methods and techniques involved in the design, sizing and balancing of complete ventilation systems. Electric controls including thermostats, sail switches, relays, contactors, flow switches, power distribution, motors, protective devices, system malfunction diagnosis, corrective procedures, and various fan systems used in the residential and commercial HVAC industry are covered. Air mixing properties, equipment servicing, a basic understanding of load calculations, ducting, fan laws, Indoor Air Quality (IAQ), and piping techniques for residential and commercial HVAC equipment are introduced.

**RAE 405 HVACR Electricity (4 Units: LH 45;
PH 45)**

This course introduces students to basic AC and DC circuitry, the laws of electricity, wiring of basic HVACR equipment, and safety procedures with an emphasis placed on sustainable energy sources through the use of lectures, demonstrations, and lab experiences. The function and operational characteristics of various types of electric controls including thermostats, defrost controls, relays, and contactors are studied, along with capacitors, power distribution, motors, and protective devices. This course introduces the National Electrical Code, the use of meters, schematics, wiring diagrams, electrical troubleshooting, electrical service procedures and electrical test equipment.

RAE 503 Refrigeration and Air-conditioning Equipment Design and Manufacture

(3 Units:

LH 45)

Refrigeration Equipment Design

Air-conditioning Equipment Design

Duct Design

Equipment Parts manufacture

Equipment Assembly.

RAE 507 Energy Auditing

(4 Units:

LH 60)

This course covers building energy auditing and associated heating and air-conditioning equipment. The concepts of heat flow, energy audit software, building science, building envelope, construction practices, material costs, moisture concerns, proper insulation techniques, energy pricing, energy modelling, and commercial and residential HVAC systems including equipment selection, layout, piping techniques, troubleshooting, codes, preventive maintenance, multiple systems, and system accessories are covered. The function and operational characteristics of building construction, building materials, various types of commercial and residential heating and air-conditioning equipment, wiring, and safety procedures are studied. Electric controls, thermostats, power distribution, and protective devices are studied, as well as equipment selection, layout, duct design, troubleshooting, and commercial and residential energy usage codes.

RAE 508 Air Conditioning Split-Systems

(4 Units: LH 45;

PH 45)

This course introduces students to the basic principles, practices, operations, service and installation of split-system residential and commercial cooling equipment, as well as industrial refrigeration equipment. The function and operational characteristics of various types of air conditioning and refrigeration equipment, the wiring of split-system equipment, and safety procedures are also studied. Students will be exposed to topics such as electric controls such as thermostats, defrost controls, relays, and contactors, as well as capacitors, power distribution, motors, protective devices, system malfunction diagnosis, corrective procedures, and the refrigerants used in the split-system industry.

RAE 509 Refrigeration Commercial Appliances

(4 Units: LH 45;

PH 45)

This course introduces students to the basic principles, practices, operations, service, and installation of commercial refrigeration appliances. Students will learn how the product is cooled, desired temperature maintained, and proper humidity conditions controlled. The function and operational characteristics of various types of electric controls including thermostats, defrost controls, relays, and protective devices are studied, as well as system malfunction diagnosis, corrective procedures, and the refrigerants used in the commercial refrigeration appliance industry. This

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course also covers a basic understanding of commercial refrigeration appliances, multiple systems, load calculations of commercial refrigeration appliances, system accessories, and piping techniques. This course reinforces the use and operation of electrical and mechanical test equipment, wiring diagrams and schematics, service manifolds, test equipment, flaring, soldering and brazing skills.

RAE 510 Refrigeration Small Appliances (4 Units: LH 45; PH 45)

This course introduces students to the service needs of the small refrigeration appliance industry. Through lectures, demonstrations, and lab experiences, students will learn how to service domestic refrigerators, freezers, and icemakers and to install and service water coolers, vending machines, and under-the-counter refrigeration units. The function and operational characteristics of various types of electric controls including thermostats, defrost controls, relays, and protective devices will be studied, as well as system malfunction diagnosis, corrective procedures, and the refrigerants used in the small refrigeration appliance industry.

DRAFT

3.29 STRUCTURAL ENGINEERING

Structural engineering is the branch of engineering concerned with the design and analysis of civil, mechanical, aerospace, marine, naval and offshore structures. Examples include bridges, dams, buildings, aircraft, spacecraft, ships, oil platforms, automobiles, and other transportation vehicles. The programme is designed based on the recognition of the fact that the field requires a thorough knowledge of the behaviour of solids (concrete, soils, rock, metals, plastics, and composite materials), fluid mechanics as it relates to structural loads, dynamics as it relates to structural response, mathematics for the generation of theoretical structural models and numerical analysis, and computer science for simulation purposes associated with computer-aided design, response analyses, and data acquisition. Basic understanding of materials behaviour and structural performance is enhanced by laboratory courses involving static and dynamic stress failure tests of structural models, and response of structural systems.

DETAILS OF UNDERGRADUATE COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.29.1 Course Structure

Course structure at 300-Level Structural Engineering

Course Code	Course Title	Units	Status	LH
CEE 304	Civil Engineering Materials	3	R	30
GET 301	Engineering Mathematics III	3	R	45
GET 302	Engineering Mathematics IV	3	R	45
GET 303	Engineer-in-Society	2	R	30
GET 304	Engineering Communication	2	R	30
GET 399	SIWES II	3	C	1
GST 311	Entrepreneurship	2	C	30

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MEE 321	Mechanics of Materials	3	C	45
STE 301	Thermodynamics and Acoustics	4	R	60
STE 302	Construction Technology	4	C	60
STE 303	Soil Mechanics & Engineering Geology	4	C	60
STE 304	Elements of Architecture	3	C	45
STE 305	Design of Structures	3	C	45
STE 306	Structural Mechanics I	3	C	45
STE 307	Engineering Surveying	3	R	45
STE 308	Laboratory Practicals	6	R	-
	TOTAL	51		

Course structure at 400-Level Structural Engineering

Course Code	Course Title	Units	Status	LH
GET 499	SIWES III	6	C	2
STE 401	Engineering Services(Water Resources)	2	R	30
STE 402	Building Construction Materials	2	C	30
STE 403	Structural Mechanics II	2	C	30
STE 404	Design of Structures	2	C	30
STE 405	Construction Technology	2	C	30
STE 406	Engineering Surveying & Photogrammetry	2	C	30
STE 407	Reinforced Concrete Design	3	C	30
STE 408	Analysis and Design of Wood Structures	3	R	45
STE 409	Laboratory Practical	2	C	-
TIE 402	Engineering Economics	2	E	30

	TOTAL	28		
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Course structure at 500-Level Structural Engineering

Course Code	Course Title	Units	Status	LH
GET 501	Engineering Management	3	R	45
GET 502	Engineering Law	2	R	30
STE 501	Advanced Steel Structures Design	3	C	45
STE 502	Services Engineering	3	R	45
STE 503	Building Construction & Management	3	C	45
STE 504	Quantity Surveying	2	C	30
STE 505	Building Maintenance	2	C	30
STE 506	Project	6	C	0
STE 507	Foundation Engineering	2	C	30
STE 508	Laboratory Practicals	6	R	-
STE 509	Low-Rise Building Analysis and Design	3	C	45
STE 510	Advanced Concrete Structures Design	3	C	45
STE 511	Pre-stressed Concrete Design	3	C	45
STE 512	Infrastructure Strengthening With Composites	3	C	45
STE 513	Smart Materials and Sensors	3	30	45
	TOTAL	47		

3.29.2 Course Synopses

**STE 301 Thermodynamics and Acoustics
LH 60)
Thermodynamics**

(4 Units:

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

Basic Principles of acoustics

Sources and effects of noise

Attenuation and control.

STE 302 Construction Technology (4 Units: LH 60)

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.

STE 303 Soil Mechanics and Engineering Geology (4 Units: LH60)

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.

STE 304 Elements of Architecture (3Units: LH 45)

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)

STE 305 Design of Structures (3Units: LH 45)

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)

STE 306 Structural Mechanics I (3Units : LH 45)

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.

**STE 307 Engineering Surveying (3Units:
LH 45)**

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.

**STE 308 Laboratory Practicals (6 Units:
PH 270)**

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

**STE 401 Engineering Services (Water Resources) (2 Units:
LH 30)**

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

**STE 402 Building Construction Materials (2 Units:
LH 30)**

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.

**STE 403 Structural Mechanics II (2 Units:
LH 30)**

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.

**STE 404 Design of Structures (2 Units:
LH 30)**

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)

**STE 405 Construction Technology (2Units:
LH 30)**

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.

STE 406 Engineering Surveying and Photogrammetry (3Units: LH 45)

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

STE 407 Reinforced Concrete Design (3 Units: LH 30; PH 45)

The analysis and design of reinforced concrete beams, slabs, columns, retaining walls and footings by the elastic and ultimate strength methods, including an introduction to the design of prestressed concrete. Introduction to use of computers as a design aid tool.

STE 408 Analysis and Design of Wood Structures (3 Units: LH 45)

A critical review of theory and practice in design of modern wood structures. Effect of plant origin and physical structure of wood on its mechanical strength; fasteners and their significance in design; development of design criteria and their application to plane and three dimensional structures.

STE 409 Laboratory Practicals (2 Units: PH 90)

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

STE 501 Advanced Steel Structures Design (3 Units: LH 45)

The design of structural steel systems into a final integrated structure. Plate girders, composite systems, stability, connections, rigid frames, single and multistory buildings, and similar type problems of interest to the student. Use of the computer as a tool to aid in the design will be emphasized.

STE 502 Services Engineering (3Units: LH 45)

Principles of air movement. Mechanical air supply system and fume extraction. Heat transmission and study of air/water vapour mixtures. Psychometry, air-conditioning and refrigerators. Design of mechanical services and systems including ducts. Designs, selection, stability and control.

**STE 503 Building Construction and Management (3Units:
LH 45)**

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.

**STE 504 Quantity Surveying (2Units:
LH 30)**

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.

**STE 505 Building Maintenance (2Units:
LH 30)**

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.

**STE 506 Project (6 Units:
PH 270)**

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).

**STE 507 Foundation Engineering (2Units:
LH 30)**

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.

**STE 508 Laboratory Practicals (6 Units:
PH 270)**

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

STE 509 Low-Rise Building Analysis and Design

(3 Units:

LH: 45)

Characterization of various design loads, load combinations, general methodology of structural designs against lateral loads, code-oriented design procedures, distribution of lateral loads in structural systems, application of the International Building Code in design of load-bearing wall systems, building frame system and moment-resisting frame systems.

STE 510 Advanced Concrete Structures Design

(3 Units:

LH 45)

The design of structural concrete systems into a final integrated structure. Two-way slabs, long columns, connections, and discontinuity regions, deflections and cracking of beams and slabs, ACI design criteria, and similar type problems of interest to the student. Use of the computer as a tool to aid in the design will be emphasized.

STE 511 Pre-stressed Concrete Design

(3 Units:

LH 45)

Behaviour of steel and concrete under sustained load. Analysis and design of pre-tensioned and post-tensioned reinforced concrete members and the combining of such members into an integral structure.

STE 512 Infrastructure Strengthening With Composites

(3 Units:

LH 45)

The course presents composite materials and includes principles of reinforcing and strengthening for flexure, shear, and ductility enhancement in buildings and bridges. It covers the design of existing members strengthened with externally bonded laminates and near surface mounted composites. Case studies are discussed.

STE 513 Smart Materials and Sensors

(3 Units: LH 30;

PH 45)

Smart structures with fibre reinforced polymer (FRP) composites and advanced sensors. Multidisciplinary topics include characterization, performance, and fabrication of composite structures; fibre optic, resistance, and piezoelectric systems for strain sensing; and applications of smart composite structures. Laboratory and team activities involve manufacturing, measurement systems, instrumented structures, and performance tests on a large-scale smart composite bridge.

3.30 SYSTEMS ENGINEERING

The systems engineering programme is designed to produce graduates with ability to identify, formulate, and solve operational, technical, and engineering problems in systems engineering and related disciplines using the techniques, skills, and tools of modern practice, including modelling and simulation. Graduates are to demonstrate

proficiency in the systems engineering process, including defining requirements, conducting functional analysis, designing and architecting a system, analysing it against requirements, allocation of requirements to sub-systems, conducting trade-off studies, determining the cost of the system, integrating human factors into the system, designing logistical supportability, and planning for its testing and evaluation. Of great relevance at this stage of the country is the development of competence in the planning and management of large systems engineering projects. Thus, students are exposed to core skills of systems analysis, to include deterministic and stochastic modelling of systems, optimization, decision analysis, risk analysis and economic models.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirement

3.30.1 Course Structure

Course structure at 300-Level Systems Engineering

Course Code	Course Title	Units	Status	Hours	Prerequisites
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-

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GE T 39 9	SIWES II	3	C	12 weeks	
GS T 31 1	Entrepreneurship	2	R	3 0	-
M EE 50 8	Engineering Design Process	2	E	3 0	-
ST A 30 5	Statistics for Physical Science and Engineering	3	C	4 5	-
SY E 30 1	Operational Methods I	2	R	3 0	-
SY E 30 2	Mathematical Modelling for AI systems	3	C	4 5	-
SY E 30 3	Special Analytical Techniques	3	C	4 5	-
SY E 30 4	Differential Equations	3	C	4 5	-
SY E 30 5	Operations Research I	3	C	4 5	-

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SY E 30 7	Elements of Game Theory	2	C	3 0	-
SY E 30 8	Rigid Body Dynamics	3	C	4 5	-
SY E 30 9	Control Theory	2	R	3 0	-
SY E 31 0	Programming Languages	2	R	3 0	-
SY E 31 1	Algorithms and Data Structure	3	C	4 5	-
SY E 31 3	Engineering Material & the Environment	1	R	1 5	-
SY E 31 4	Computer Systems and Architecture	4	R	6 0	-
	TOTAL	4 9			

Course structure at 400-Level Systems Engineering

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H

GE T 49 9	SIWES III	6	C	24 weeks	
SY E 40 1	Numerical Methods in Engineering	3	C	4 5	-
SY E 40 2	Operational Methods II	2	C	3 0	-
SY E 40 3	Operations Research III	3	C	4 5	-
SY E 40 5	Systems Simulations	2	C	3 0	-
SY E 40 6	Advanced Engineering Statistics (Stochastic Models)	2	R	3 0	-
SY E 40 7	Mechanics of the Continua	3	R	4 5	-
	TOTAL	2 1			

Course structure at 500-Level Systems Engineering

Co urs e Co de	Course Title	U ni ts	St at us	L H	P H
GE T 501	Engineering Management	3	R	4 5	-
GE T 502	Engineering Law	2	R	3 0	-

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SY E 501	Project in Systems Engineering	6	C	0	2 7 0
SY E 502	Engineering System Analysis	2	C	3 0	-
SY E 503	Artificial Intelligence	2	C	3 0	-
SY E 504	Automated Reasoning	2	C	3 0	-
SY E 505	Systems Reliability & Maintainability	2	C	3 0	-
SY E 506	Computer Graphics	2	R	3 0	-
SY E 507	Techniques of Planning & Scheduling	2	R	3 0	-
SY E 508	Image Processing	2	C	3 0	-
SY E 509	Facility Planning	2	C	3 0	-
SY E 510	Mechanics of Robotics System	3	C	4 5	-
SY E 511	Systems Animation	2	C	3 0	-
SY E 513	Manufacturing Systems Automation	3	R	4 5	-
SY E 514	Control of Robots and Human Arms	3	R	4 5	-
	TOTAL	38			

3.30.2 Course Synopses

SYE 301 Operational Methods I (2 Units: LH 30)

Fourier series: periodic functions; Dirichlet conditions; odd and even functions; half-range Fourier sine and cosine series. Parseval's identity. Differentiation and integration of Fourier series. Boundary value problems.

The Laplace transform and applications excluding the use of inversion integral and convolution theorem).

SYE 302 Mathematical Modelling For Artificial Intelligence Systems (3 Units: LH 45)

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.

SYE 303 Special Analytical Techniques (3 Units: LH 45)

Fuzzy set and logic Graph theory: Methods of fractiles; Genetic and evolutionary algorithms such as ant-colony algorithm etc.

SYE 304 Differential Equations (3 Units: LH 45)

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 Poisson equation. The Navier-Stokes equation, Maxwell equations of Electromagnetism.

SYE 305 Operations Research I (3 Units: LH 45)

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.

SYE 307 Elements of Games Theory (2 Units: LH 30)

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.

SYE 308 Rigid Body Dynamics (3 Units: LH 45)

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 of inertia. 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. Lagrange's and applications.

SYE 309 Control Theory (2 Units: LH 30)

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 Pontryagin maximum principle for optimal control.

SYE 310 Programming Languages (2 Units 2: LH 30)

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, matrices and arrays.

SYE 311 Algorithms and Data Structures (3 Units: LH 45)

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, sparse matrices, task 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.

SYE 313 Engineering Materials and the Environment (1 Unit: LH 15)

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. Recycling 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 relevance of flue gas (e.g. in the production of Carbon dioxide).

SYE 314 Computer Systems And Architecture (3 Units: LH 45)

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.

SYE 401 Numerical Methods in Engineering (3 Units: LH 45)

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.

SYE 402 Operational Methods II (2 Units: LH 30)

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.

SYE 403 Operations Research III (3 Units: LH 45)

Integer programming; dynamic programming; non-linear programming algorithms; direct search, gradient method, separable programming, complex optimisation method. Sequential unconstrained maximisation algorithm (SUMT).

SYE 405 Systems Simulation (2 Units: LH 30)

Discrete event simulation. Examples in different production and service systems. Principles and computer languages e.g. GPSS/H, SIMAN, etc. and Pro Model Analysis of Simulation data.

SYE 406 Advanced Engineering (Stochastic Models) (2 Units: LH 30)

Markov chains: The Poisson Process; Memoryless random variable. Replacement models, Continuous-time stochastic processes. General Queuing Systems. Renewal process.

SYE 407 Mechanics of The Continua (3 Units: LH 45)

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

SYE 502 Engineering Systems Analysis (2 Units: LH 30)

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.

SYE 503 Artificial Intelligence (2 Units: LH 30)

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.

SYE 504 Automated Reasoning (2 Units: LH 30)

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.

SYE 505 Systems Reliability and Maintainability (Units 3: LH 45)

Deterministic reliability. Arrhenius model. Failure mechanisms, screening. Statistical reliability: operational reliability, quantities, derived quantities. Failure distributions: negative exponential, Normal, Lognormal, Weibull and Gamma distributions. Life distribution measurements. Reliability models. Non-maintained systems. Maintained systems. Evaluation methods.

SYE 506 Computer Graphics (2 Units: LH 30)

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 modelling and object modelling; reflectance models and rendering, texture mapping; polyhedral representations. Procedural modelling.

SYE 507 Techniques of Planning and Scheduling (2 Units: LH 30)

Project definition and work breakdown structure, scheduling and control models and techniques such as AOA, AON, Bar charting, line of balanced and time & location. Allocation of resources. Optimal schedules. Documentation and reporting services. Time and cost control. Progress monitoring evaluation. Computer applications.

SYE 508 Image Processing (2 Units: LH 30)

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 hardware systems. Applications. Science analysis.

SYE 509 Facility Planning (2 Units: LH 30)

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

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SYE 510 Mechanics of Robotics Systems (3 Units: LH 45)

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.

SYE 511 Systems Animation (2 Units: LH 30)

Procedural modelling and animation. The use of animation software; the Proof Animation and others. Problems drawn from different systems models.

SYE 513 Manufacturing Systems Automation (3 Units: LH 45)

Computer assisted manufacturing systems: NC, CNC, DNC; robotics, materials, handling, group technology, flexible manufacturing systems, process planning and control Computer Integral Manufacturing (CLM).

SYE 514 Control of Robots and Human Arms (3 Units: LH 45)

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.

DRAFT

3.31 TELECOMMUNICATIONS ENGINEERING

The telecommunications industry is the fastest growing industry in Nigeria. There is no gainsaying the fact that the country has probably not gained maximally from the heavy investments in the liberalized sector due to limited local technical capability in the form of telecommunication engineers. There was no telecommunications engineering programme in the Nigerian university system at the onset of the current investments in the sector.

Telecommunications technologies are shaping the way in which we access news and information relevant to our lives, communicate with family and friends, but, most importantly their role in driving the so-called information/knowledge economy through technologies that underpin modern voice, multimedia and data communications. Telecommunications engineers are responsible for the design, construction, maintenance and evolution of systems from business data networks to global voice and data communications. Relevant technologies include: transmission systems such as optical fibre, satellites, cellular networks, Internet Protocol networks and digital television; digital representation of audio, video and other multimedia; and the control, design and analysis of massive communications networks.

Consequently, the programme is designed to expose students to telecommunications systems encompassing both hardware and software needed by professional engineers in telecommunications systems. Emphasis is placed on underlying principles and techniques so that graduates will be able to learn and apply new technologies as they emerge in the future. The early introduction to scientific and engineering foundation of computing, electronics, physics and mathematics prepares the ground for introduction to the specialised telecommunications engineering courses including telecommunications systems modelling, computer networks, voice telecommunications and emerging technologies including 3G video phones, high speed domestic broadband and network security.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.31.1 Course Structure

Course structure at 300-Level Telecommunications Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 301	Analogue Electronics Circuits	3	C	45	-
EEE 302	Digital Electronics Circuits	3	C	45	-
EEE 303	Circuit Theory I	3	C	45	-
EEE 304	Measurements and Instrumentation	3	C	45	-
EEE 305	Electrical Machines	2	C	30	-
EEE 314	Physical Electronics	3	C	45	-
EEE 315	Linear Systems	3	C	45	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
TEE 301	Electric Power Systems	2	R	30	-
TEE 302	Laboratory Practicals	6	R	0	270
	TOTAL	42			

Course structure at 400-Level Telecommunications Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 403	Communications Principles	4	C	45	45
EEE 406	Control Theory	3	R	45	-
GET 499	SIWES III	6	C	24 weeks	
TEE 402	Assembly Language Programming	4	C	60	-
TEE 401	Digital System Design with VHDL	3	C	45	-
TEE 403	Analog and Digital Telephony	3	R	45	-
TEE 404	Laboratory Practicals	3	C	30	135
TEE 405	Data Communications and Systems	4	C	60	-
	TOTAL	30			

Course structure at 500-Level Telecommunications Engineering

Course Code	Course Title	Units	Status	LH	PH
EEE 501	Advanced Circuit Design	2	C	30	-
EEE 512	Industrial Electronics Design	3	C	30	-
EEE 521	Communication Systems Engineering	3	C	30	-
EEE 523	Solid State Electronics	2	C	30	-
EEE 524	Digital Signal Processing	2	C	30	-
EEE 525	Digital Communication System	2	C	30	-

GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
TEE 503	Communication Theory	3	R	45	-
TEE 504	Telecommunications Systems Planning	2	C	30	-
TEE 506	Optical Communication System	2	C	30	-
TEE 507	Image and Data Transmission System	2	C	30	-
TEE 508	Laboratory Practicals	3	C	-	135
TEE 512	Project	6	C	-	270
	TOTAL	37			

3.31.2 Course Synopses

TEE 301 Electric Power Systems

(3 Units: LH 45)

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.

TEE 401 Digital System Design with VHDL

(3 Units: LH 45)

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 modelling, Register-Transfer level modelling, FSM with datapath level modelling, Algorithmic level modelling. 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.

TEE 402 Assembly Language Programming

(3 Units: LH 45)

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.

TEE 403 Analog and Digital Telephony (3 Units: LH 45)

This course is an introduction to modern telephone networks and interfaces. Telephone sets, the central office and the Public Switched Telephone Networks are discussed in detail. Private (PBX) and public switches both digital and analog are discussed, with emphasis on features, signaling and technology. Concludes with the transmission of audio signals through different networks. Laboratory experiments supplement the course and expose students to the fundamentals of telephony.

TEE 405 Data Communications and Systems (4 Units: LH 60)

Introduction to analog and digital communications systems, synchronous transmission of information and binary transmission. Multiplexing and various binary codes used in communication systems are explored. Distortion, noise and test equipment are discussed. Modems are analyzed. The RS232 interface, protocols, and line testing (loopback, analog, and digital) are covered. Laboratory exercises emphasize fault isolation and systems troubleshooting techniques. The protocol analyzer used for monitoring, troubleshooting and emulation.

TEE 503 Communication Electronics (3 Units: LH 45)

Theory and applications of modern electronics in communications. Filters, oscillators, transmitters, and receivers as applied to amplitude modulation and frequency-modulation transmission systems are discussed. Introduction to noise and its effect on communication electronics are given.

TEE 504 Telecommunication Systems Planning (2Units: LH 30)

FDT, Modulation Plan, High Order PCMCCITT Requirement Delta Modulation And ADPM, Different Type Systems Co-Operation Integrated Network, Network Planning

TEE 506 Optical Communication System (2 Units: LH 30)

Optical transmitting devices, LEDs optical receivers, optical fibres/types, features, joining, coupling/deep space communication system/capacity, reliability economy/application of PCM and A DPCM concepts.

TEE 507 Image and Data Transmission System (2Units: LH 30)

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.

3.32 TEXTILE AND POLYMER ENGINEERING

Textile engineering is the study of various scientific and technical principles underlying the processing and production of all kinds of textile fabric and yarns from textile fibres. The discipline involves extensive study of chemical and physical principles, which is then utilized for the detailed study and analysis of the behaviour of polymers involved in the formation of textile fibre. Students are prepared for entry into the textile industry, which involves design, manufacture, distribution, and sales of clothing and apparels. The programme seeks to inculcate in students ability for creative research, study, and exploration of new techniques for production and improvisation. Students undergo courses in other aspects of engineering, including mechanical, industrial, and chemical to equip them with the technical aspects of the field preparatory for advanced topics in textile production.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.32.1 Course Structure

Course structure at 300-Level Textile and Polymer Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	R	30	-
MEE 309	Thermodynamics	3	R	45	-
MEE 310	Fluid Mechanics I	2	R	30	-
MEE 313	Engineering Metallurgy	2	E	30	-
MEE 321	Mechanics of Materials	3	R	45	-
TPE 301	Analytical Chemistry	4	C	45	45
TPE 302	Physical Chemistry	3	C	45	-
TPE 305	Polymer and Fibre Chemistry	2	C	30	-
TPE 306	Polymer and Fibre Physics	2	C	30	-
TPE 307	Yarn Manufacture	3	R	45	-

TPE 308	Weaving Mechanisms	3	C	45	-
TPE 309	Experimental Polymer Science	2	C	30	-
TPE 311	Man-made Fibre Production	2	C	30	-
TPE 312	Chemical Processing of Textiles	2	C	30	-
TPE 313	Fabric Structure and Design	3	C	45	-
TPE 314	Analysis and Testing of Polymeric and Textiles	3	C	45	-
TPE 399	Laboratory Practicals	3	C	-	135
	TOTAL	57			

Course structure at 400-Level Textile and Polymer Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 499	SIWES III	6	C	24 weeks	
TPE 401	Polymer Processing Technology I	3	C	45	-
TPE 402	Quality Control in Polymer and Textile Processes	3	C	45	-
TPE 403	Properties of Bulk Polymers	3	C	45	-
TPE 404	Non-Woven Technology	3	C	45	-
TPE 405	Knitting Technology	3	C	45	-
TPE 406	Operations Research	3	R	45	-
TPE 407	Environmental Management	2	R	30	-
TPE 408	Laboratory Practicals	2	C	-	90
	TOTAL	28			

Course structure at 500-Level Textile and Polymer Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	R	45	0
GET 502	Engineering Law	2	R	30	0
TPE 501	Polymer and Fibre Science	3	C	45	0
TPE 502	Polymer Processing Technology II	3	C	45	0
TPE 503	Polymer Chain Properties and Solutions	2	C	30	0
TPE 504	Modern Yarn Production	3	C	45	0
TPE 505	Polymer Reactions and Degradation	2	C	30	0
TPE 506	Coloration and Finishing of Polymeric and Textiles	3	C	45	0
TPE 507	Technology of Elastomers	3	R	45	0
TPE 508	Complex Textiles and Design	3	C	45	0
TPE 509	Theory of Textile Structures	2	R	30	0
TPE 510	Research Project	6	C	0	270
TPE 511	Pulp and Paper Technology	3	R	45	0

TPE 512	Adhesive Technology	3	C	45	0
TPE 513	Laboratory Practicals	3	C	0	135
	TOTAL	44			

3.32.2 Course Synopses

TPE 301 Analytical Chemistry (4 Units: LH 45; PH 45)

A study of analytical chemistry including separation techniques for chemical and biochemical analysis, atomic - molecular mass spectrometry, atomic - molecular spectroscopy, surface analysis with electron spectroscopy, X-ray and mass spectrometry.

TPE 302 Physical Chemistry (3 Units: LH 45)

A study of kinetic theory, chemical kinetics, electromotive force and ionic equilibria.

TPE 305 Polymer and Fibre Chemistry (2Units: LH 30)

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-mollioplasts. 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.

TPE 306 Polymer and Fibre Physics (2 Units: LH 30)

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.

TPE 307 Yarn Manufacture (3 Units: LH 45)

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.

TPE 308 Weaving Mechanisms (3 Units: LH 45)

Yarn packages; various systems of yarn preparation. Details of non-automatic winding machines; precision winding. Beam and sectional warping processes and mechanisms. Automatic cheese, cone 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.

TPE 309 Experimental Polymer Science (2Units: LH 30)

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.

TPE 311 Man-made Fibre Production (2 Units: LH 30)

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.

TPE 312 Chemical Processing of Textiles (3 Units: LH 45)

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.

TPE 313 Fabric Structure and Design (3 Units: LH 45)

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 badfordcoards 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 piggy 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.

TPE 314 Analysis and Testing of Polymeric and Textiles (3Units: LH 45)

Introduction to testing of polymeric and textiles.

Properties of fibres yarns, fabrics and polymeric and their relevance in assessing the performance of the materials (Polymeric and textiles) during and after manufacture. Measurement of length, fineness, crimp and foreign matter content of fibres.

Measurement of dimensions of polymeric; 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.

TPE 401 Polymer processing Technology I (3Units: LH 45)

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 mulling 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 modelling 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, extrudate swell, entry losses; flow in tubes and channels, flow in dyes.

TPE 402 Quality Control in Polymer and Textile Processes (3Units: LH 45)

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 polymer 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.

TPE 403 Properties of Bulk Polymers (3Units: LH 45)

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 spectroscopy; X-ray diffraction analysis; thermal analysis; mass spectrometry; light and electron microscopy.

TPE 404 Non-Woven Technology (Units 3: LH 45)

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.

TPE 405 Knitting Technology (3 Units: LH 45)

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.

TPE 406 Operations Research I (3 Units: LH 45)

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.

TPE 407 Environmental Management (2 Units: LH 30)

Total quality assurance, waste management, effluent characterisation and treatment, regulations and guidelines for emissions.

TPE 501 Polymer and Fibre Science (3 Units: LH 45)

Polymer stereochemistry and co-ordination of polymerisation, polyethylene polymerisation. Structure and properties; polypropylene and other olefin polymers; modacrylics, 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.

TPE 502 Polymer Processing Technology II (3 Units: LH 45)

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.

TPE 503 Polymer Chain Properties and Solutions (2 Units: LH 30)

Configuration of polymer chains; optical activity, stereoregularity; conformation of dissolved polymer chains; irregularities; random chain, bonded chains; excluded volume, dimensions of freely jointed chain, bond angle restrictions, thermodynamics of polymer solution, lattice theory, entropy and heat of 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 cross-linked polymers; hydrodynamics of polymer solutions; polyelectrolytes viscosities.

TPE 504 Modern Yarn Production (3Units: LH 45)

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.

TPE 505 Polymer Reactions and Degradation (2 Units: LH 30)

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.

TPE 506 Colouration and Finishing of Polymeric and Textiles (3Units: LH 45)

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.

TPE 507 Technology of Elastomers (3 Units: LH 45)

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, polybutadiene 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 density, swelling volume, sulphur cross-linkages, gel. Content and thermal analysis.

TPE 508 Complex Textiles and Design (3Units: LH 45)

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.

TPE 509 Theory of Textile Structures (2 Units: LH 30)

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.

TPE 510 Research Project (6 Units: PH 270)

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.

TPE 511 Pulp and Paper Technology (3 Units: LH 45)

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.

TPE 512 Adhesive Technology (3Units: LH 45)

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 polymers, 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.

3.33 WATER RESOURCES ENGINEERING

The programme focuses on the use and management of land and water resources in rural and urban watersheds. Engineering science and ecological principles are applied to the study of hydrologic and hydraulic behaviour of watershed flow systems as input into the design of water management systems and strategies. Water management includes flood prevention, warning and control; drainage; design of natural channels; irrigation; and erosion prevention and control. Students are exposed to the basic operations of water supply for municipal, industrial and agricultural purposes. Courses have also been designed to identify potential point and diffused sources of pollutants towards the development of efficient, environmentally sustainable and economical methods to preserve high-quality water to sustain human life and water-dependent ecosystems.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.33.1 Course Structure

Course structure at 300-Level Water Resources Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 304	Civil Engineering Material	2	C	30	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	C	30	-
MEE 310	Fluid Mechanics I	2	R	30	-
MEE 321	Mechanics of Materials	3	C	45	-
PHE 303	Public Health Engineering	4	C	60	-
WRE 301	Structural Mechanics	3	R	45	-
WRE 302	Design of Structures	3	R	45	-
WRE 303	Hydraulics and Hydrology I	4	C	60	-
WRE 305	Engineering Surveying & Photogrammetry	4	C	60	-
WRE 306	Soil Mechanics	2	C	30	-
WRE 307	Laboratory Practicals	6	R	-	270

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nucassessment@gmail.com

You can also call the following phone numbers: 08033145087, 08033201097

All comments should be received before 31st October, 2015

WRE 308	Engineering Geology	3	C	45	-
WRE 309	Hydraulics and Hydrology II	3	C	45	-
	TOTAL	54			

Course structure at 400-Level Water Resources Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 499	SIWES III	6	C	24 weeks	
TIE 402	Engineering Economics	2	C	30	-
WRE 401	Soil Mechanics and Foundation	3	C	45	-
WRE 402	Design of Hydraulic Structures	4	C	60	-
WRE 403	Hydraulics and Hydrology III	3	C	45	-
WRE 404	Quantity Surveying	2	R	30	-
WRE 405	Laboratory Practicals	3	R	45	-
WRE 406	River Mechanics and Sediment Transport	3	C	45	-
	TOTAL	26			

Course structure at 500-Level Water Resources Engineering

Course Code	Course Title	Units	Status	LH	PH
CEE 503	Water Resources & Environmental Engineering	3	C	45	-
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
WRE 501	Project	6	C	0	270
WRE 503	Design of Treatment Plants	6	C	90	-
WRE 504	Hydro-Geology (Groundwater Hydrology)	3	C	45	-
WRE 505	Water and Waste Water Engineering	3	C	45	-
WRE 506	Pollution Control	3	C	45	-
WRE 507	Drainage and Irrigation Engineering	4	C	60	-
WRE 508	Systems Management (Operations Research)	3	R	45	-
WRE 509	Laboratory Practicals	6	R	-	270
WRE 510	Drainage and Irrigation	3	C	45	-
	TOTAL	45			

3.33.2 Course Synopses

WRE 301 Structural Mechanics (3Units: LH 45)

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.

WRE 302 Design of Structures (3Units: LH 45)

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.

WRE 303 Hydraulics and Hydrology I (4 Units: LH 60)

Introduction, descriptive hydrology: Hydrologic cycle, precipitation, evaporation and transpiration. Quantitative Hydrology: Hydrography, Volume runoff, storage routing. Groundwater: Occurrence, hydraulics, well, yield.

WRE 305 Engineering Surveying & Photogrammetry (4 Units: LH 60)

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.

WRE 306 Soil Mechanics (2 Units: LH 30)

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.

WRE 308 Engineering Geology (3Units: LH 45)

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.

WRE 309 Hydraulics and Hydrology II (3Units: LH 45)

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.

WRE 401 Soil Mechanics and Foundation (3Units: LH 45)

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.

WRE 402 Design of Hydraulic Structures (4 Units: LH 60)

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, molds, 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) Catch basins.

Introduction to multiple purpose designs involving flood control, water supply, irrigation, recreation, drainage navigation and erosion control.

Computer Aided Design of structures

WRE 403 Hydraulics and Hydrology III (3Units: LH 45)

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.

WRE 404 Quantity Surveying (2 Units: LH 30)

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.

WRE 405 Laboratory Practicals (3 Units: PH 135)

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

WRE 406 River Mechanics and Sediment Transport (3 Units: LH 45)

Formation of rivers and the laws governing river regulation and improvements, including navigation and flood protection. Principles governing sediment transport.

WRE 501 Project (6 Units: PH270)

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.

WRE 503 Design of Treatment Plants (6 Units: LH 90)

Wastewater

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

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.

WRE 504 Hydro-Geology (Groundwater Hydrology) (3 Units: LH 45)

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 modelling. Unsaturated Flow. Surface – Subsurface water relations. Computer Aided Design in Water Resources.

WRE 505 Water and Waste Water Engineering (3Units: LH 45)

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.

WRE 506 Pollution Control (3Units: LH 45)

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.

WRE 507 Drainage and Irrigation Engineering (4 Units: LH60)

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.

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You can also call the following phone numbers: 08033145087, 08033201097
All comments should be received before 31st October, 2015

WRE 508 Systems Management (Operations Research) (3Units: LH 45)

Basics of Operations Research: Introduction, Development of Operations Research. Art of modelling 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. Queuing Theory and applications.

WRE 509 Laboratory Practicals (6 Units: PH 270)

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

WRE 510 Irrigation and Drainage (3Units: LH 45)

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.

DRAFT

3.34 WOOD PRODUCTS ENGINEERING

The primary purpose of the programme is to prepare students for career in the wood products industry. The courses are packaged to prepare graduates for immediate employment in various aspects of wood products business management/marketing, process and product quality control, and research and development. Graduates will also have opportunities for involvement in the wider scope of the industry – from harvesting to the use of wood, fibre, and chemical products. Students are exposed to basic operations such as: roundwood processing to lumber and plywood; drying and protection of wood and fibre products; adhesives and coatings; reconstructed wood composites; paper manufacture; board products; construction and housing.

DETAILS OF COURSES

100 LEVEL

Common engineering courses

200 LEVEL

Common engineering courses

300 LEVEL

Common engineering courses as shown previously plus specific Departmental requirements

3.34.1 Course Structure

Course structure at 300-Level Wood Products Engineering

Course Code	Course Title	Units	Status	LH	PH
AGR 301	Soil Science	3	C	45	-
GET 301	Engineering Mathematics III	3	R	45	-
GET 302	Engineering Mathematics IV	3	R	45	-
GET 303	Engineer-in-Society	2	R	30	-
GET 304	Engineering Communication	2	R	30	-
GET 399	SIWES II	3	C	12 weeks	
GST 311	Entrepreneurship	2	C	30	-
MEE 307	Theory of Machines I	3	R	45	-
MEE 313	Engineering Metallurgy I	2	R	30	-
MEE 321	Mechanics of Materials	3	C	45	-
MEE 331	Engineering Drawing III	3	R	45	-
TAG 302	Land Surveying	3	E	45	-
TAG 303	Hydrology	3	C	45	-
TAG 304	Geology for Engineers	2	R	30	-
TAG 305	Hydraulics	2	C	30	-
WPE 301	Introduction to Wood Products Engineering	2	C	30	-

WPE 302	Silviculture	4	C	60	-
WPE 303	Basic Properties of Wood I	3	C	30	45
WPE 304	Basic Properties of Wood II	3	C	30	45
WPE 311	Laboratory Practicals	2	C	-	90
	TOTAL	53			

Course structure at 400-Level Wood Products Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 499	SIWES II	6	C	12 weeks	
TAG 403	Farm Structures and Environmental Control	3	R	45	-
TIE 402	Engineering Economics	2	R	30	-
WPE 401	Wood Deterioration and Preservation	3	C	30	45
WPE 402	Wood-Based Panel Products	3	C	30	45
WPE 403	Wood Physics	3	C	30	45
WPE 404	Wood Conversion Equipment and Processes I	3	C	30	45
WPE 405	Chemical Aspects of Wood	2	C	15	45
WPE 406	Laboratory Practicals	2	R	-	90
	TOTAL	27			

Course structure at 500-Level Wood Products Engineering

Course Code	Course Title	Units	Status	LH	PH
GET 501	Engineering Management	3	R	45	-
GET 502	Engineering Law	2	R	30	-
TAG 502	Soil and Water Conservation	3	R	45	-
TAG 503	Land Clearing and Development	2	R	30	-
TAG 510	Irrigation	3	R	45	-
WPE 501	Pulp and Paper Technology	3	C	30	45
WPE 502	Wood adhesives and Finishes	3	C	45	-
WPE 503	Quality Control and Marketing of Wood-Based Products	3	C	30	45
WPE 504	Wood Seasoning	3	C	30	45
WPE 505	Wood Structure I	3	C	30	45
WPE 506	Wood Structure II	3	C	30	45
WPE 507	Wood Conversion and Equipment Processes II	3	C	30	45
WPE 509	Laboratory Practicals	2	R	-	90
WPE 510	Final year Project	6	C	-	270
	TOTAL	42			

3.34.2 Course Synopses

WPE 301 Introduction to Wood Products Engineering (2 Units: LH 30)

Wood Products Industry in Nigeria. Job opportunities in Wood Products Engineering. Inter-relationship between Wood Products Engineering and other engineering fields and forestry.

WPE 302 Silviculture (4 Units: LH 60)

Forest reserves in Nigeria. Concept of ecosystem. Afforestation. 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.

WPE 303 Basic Properties of Wood I (3 Units: LH 30; PH 45)

Structure of tropical hardwoods and its influence on wood properties, gross characteristics of wood macro and microscopic features of hardwoods. Wood and water interactions. General consideration of physical and mechanical properties of wood. Identifications of Nigeria wood at the macroscopic level.

WPE 304 Basic Properties of Wood II (3 Units: LH 30; PH 45)

Anisotropic properties of wood; Standard tests and stress calculations, creep and relaxation. Non-destructive testing. Effect of density, moisture content and temperature on strength; Natural defects in wood and their effects on its properties; Wood deterioration and casual; Grading rules.

WPE 401 Wood Deterioration and Preservation (3 Units: LH30; PH45)

Deterioration of wood by fungi, insects, and marine borers. Types of decay organisms, decay, condition mechanisms, and consequences. Other agents of wood degradation; fire weathering, discolourations. Wood protection against deterioration; chemical used for wood preservation and techniques employed for applying wood preservation.

WPE 402 Wood-Based Panel Products (3 Units: LH 30; PH 45)

Production techniques and basic properties of plywood, blockboard, particle board and fibreboard. Methods of testing and deterioration of basic and grade strength of each product. Structural, grade plywood (marine grade) and particleboard. Uses of each product in construction. Deterioration of wood based panels in service and methods of their preservation.

WPE 403 Wood Physics (3 Units: LH30; PH 45)

Wood and fibre composites in terms of anisotropic elasticity; elasticity; rheology, fracture; mass, heat and charge transport; electrical and acoustic properties, thermodynamics, wood-fluid interactions.

WPE 404 Wood Conversion Equipment and Processes I (3 Units: LH30; PH 45)

Theory of cutting in relation to wood. Design and maintenance of saw and cutters. Sawmilling and resawing equipment including handsaw, frame saw (and gang frame saw), circular saw, planer, moulder, lathe, etc. Mill handling equipment; dust extraction from sawmills. Sawing patterns; Best Opening Face Mill layout, Production measurements in mills, mill efficiency.

WPE 405 Wood Conversion Equipment and Processes I (2 Units: LH 15; PH 45)

A survey of the chemical components of wood and bark; their distribution, isolation, structure, reactions and relationships with properties and uses.

WPE 501 Pulp and Paper Technology (3 Units: LH: 30; PH 45)

Technology of fundamental processes of the pulp and paper industry including wood procurement and preparation, chemical, semi-chemical and mechanical pulping, bleaching, refining; sheet forming, filing, sizing, colouring and coating; pulp and paper machinery variables. Complete tree utilization in the manufacture of pulp and paper; Air and water problems.

WPE 502 Wood Adhesives and Finishes (3Units: LH 45)

Wood Adhesives: adhesives theory, essential and desirable requirements for wood adhesives utilized for structural and non-structural purposes. Types and classifications of wood adhesives in wood processing, particularly for the production of glulam, scarf and finger joints.

WPE 503 Quality Control and Marketing of Wood-Based Products

(3 Units: LH 30; PH 45)

Product development and promotion. End-use pattern for wood products. Quality standards and quality control in lumber, panel products and pulp/paper industries. Determination of lumber target sizes, control and tolerance limits. Product inspection and certification. Marketing techniques, housing and warehousing hygiene. Distribution system for products and distribution costs.

WPE 504 Wood Seasoning (3 Units: LH 30; PH 45)

The relationship between wood structure and wood permeability moisture movement, and heat transfer; Thermodynamics of sorption; wood drying and defects; Drying schedules; Design of drying fans, vents, dehumidifier and heating elements in a kiln.

WPE 505 Wood Structure I (3 Units: LH 30; PH 45)

Basic theory of structures, including considerations of elastic deformation. General requirements for structural designs loading, standard (nominal) dimensions of structural timbers, grouping of timber species. Modification factors. Design of wooden beams: solid and built-up beams, glue-laminated beams, stress akin panel, and wooden floors. Elementary discussions on lateral stability of wooden beams.

Please, forward your comment on any section of this document to the following email:
nucassessment@gmail.com

You can also call the following phone numbers: 08033145087, 08033201097
All comments should be received before 31st October, 2015

WPE 506 Wood Structure II

(3 Units: LH 30;PH 45)

Design of wooden columns: Euler's theory and Perry Robertson's formula modification factors for 'short' columns and duration of load. Composite columns: spaced columns, glulam columns. Mechanical fasteners: nails staples, spikes, bolts, metal sheets for wooden tooth plate connectors, special brackets and hinges, load, slip characteristics and specifications on the uses of connectors in wood structures. Design and testing of wood trusses. Exterior structures including water-front structures.

WPE 507 Wood Conversion Equipment and Processes II

(3 Units: LH 30; PH 45)

Advanced techniques of wood sawing. Vibration and noise in sawmills and wood-working factories. Buckling of saw during wood conversion: causes and methods of prevention. Wood mill wastes and their utilization. Safety in wood conversion mills. Factory laws in relation to wood processing mills.

DRAFT

SECTION FOUR:

LABORATORY AND EQUIPMENT REQUIREMENT FOR ENGINEERING AND TECHNOLOGY PROGRAMMES

As to be expected from the common curriculum in the first two years of the programmes in this discipline, there are common laboratories to cater for the practical components of the foundation courses and some others. These common laboratories and facilities are expected to be operated centrally for the various departments while departmental laboratories are expected to be dedicated to the housing of equipment for the specialized areas of the programmes run in the department. The recommended high degree of centralization is dictated by the generally high cost of modern laboratory equipment and the need to utilize these equipment optimally. Consequently, the presentation herein is in two categories: one, centralized laboratory and technical facilities; and two, the department-based laboratories for the various programmes.

4.1 CENTRALIZED LABORATORY AND TECHNICAL FACILITIES

The common laboratories and technical facilities to be centrally established are the following:

- ✚ Technical Support Unit
- ✚ Drawing and Design Studio
- ✚ Computer Laboratory
- ✚ Fluid Mechanics Laboratory (including Wind Tunnel)
- ✚ Thermodynamics Laboratory
- ✚ Mechanics of Machines Laboratory
- ✚ Strength of Materials Laboratory (Mechanical Testing Laboratory)
- ✚ Materials Testing and Analysis Laboratory
- ✚ Electrical and Electronics Laboratory
- ✚ Library

4.1.1 Technical Support Unit

The Technical Support Unit (TSU) is to be established in the faculty to take care of some aspects of the practical training of students under the Workshop Practice set of courses that are to be presented later. The TSU is also to provide support for the fabrication of parts and components of designed engineering systems by staff and students. Towards this end, the Unit is expected to be equipped with the following facilities:

- ❖ Metal machine shop (to be equipped with a small dimensional metrology laboratory)
- ❖ Carpentry and wood machine section
- ❖ Electrical section
- ❖ Sheet metal fabricating and welding shop
- ❖ Central Stores

❖ Fitting Section

General Mechanical Workshop

Wood processing machines and equipment (for sawing, surface planing, thicknessing, mortising, wood turning, etc) comprising:

- Tenoning 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.

Wood Working Equipment:

- Band saw-table size – 700 x 980mm – 3HP
- Radial arm saw 3HP (with extra blades)
- Circular saw – blade diameter – 400mm with external blades
- Universal woodworker combined – 4HP seven works model
- Sing cylinder planner 4HP (Surface planner with extra blades)
- Vertical Mortiser – chain mortiser – 3HP with extra bits
- Router drilling machine – 3HP
- Combined tenoning and scribing 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, 16 mm
- Flat chisel – 6.4, 9.6, 12.7, 16 mm
- Bevel edge chisel – 6.4, 9.6, 12.7, 16 mm
- Round chisel 6.4, 9.6, 12.7, 16 mm
- Smooth plane – Jack Plane, plough plane
- Wood rasp
- Hand saw or panel saw
- Rip saw, cross cut
- C – Clamp
- F – Clamp
- Wood bench vice
- Jack plane

- Hand drilling machine/ratchet brazed bits
- Sanding machine – heavy duty
- Surface and thickness 100 – 150 mm 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 – 24 V, 20 A)
- Battery service equipment
- Spark plug tester and cleaner
- Hydraulic mobile crane 1.5 – 5 ton
- Wire rope winch – 1500 – 3000 kg
- 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 100 mm
- Electric two speed drill 23 mm
- Electric hand drill 13 mm
- Straight electric hand grinder 125 mm
- Angle electric hand grinder 230 mm

4.1.2 Drawing and Design Studio

Adequate space and drawing boards are to be provided based on the population of students to be served. Students are to take off with exposure to drawing board practice to handle diverse drawing assignments. Such exposure is highly required notwithstanding the emergence of software packages for drawing such as Microsoft Visio and AutoCAD.

4.1.3 Computer Laboratory

Students of engineering and technology are to be exposed to computing in all its facets so that they can utilize the expertise in the practical and analytical aspects of their training. The computer laboratory should be adequately equipped to ensure reasonable contact hours by students. Most importantly the laboratory is expected to install software packages such as AutoCAD for drawing and other specialized packages for virtual laboratory.

4.1.4 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 circuitry 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

4.1.5 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

4.1.6 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

4.1.7 Strength of Material 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.

4.1.8 Materials Laboratory

Materials laboratory is to be equipped with facilities to carry out:

Tests on metal and composite materials including:

- tensile & compressive (buckling)
- torsion
- toughness/impact test
- Bending & Creep
- Hardness
- Strain measurement
- Stress measurement
- Materials structure inspection

Suggested equipment are:

- Tensile and compressive testing machine
- Torsion testing machine
- Impact testing machine
- Creep testing machine
- Bending testing equipment
- Hardness Testing Machine
- Strain gauges and channels
- Photoelasticity equipment
- Electron Microscope
- X-ray Unit
- Radiography Test Unit
- High Power Metallurgical Microscope with camera unit
- Surface measuring Instruments
- Cathode ray oscilloscope (CRO)

4.1.9 Electrical and Electronics Laboratory

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.

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, 5 MHZ, 10 MHZ, 20 MHZ, 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) **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.

(vi) **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**

Suggested Experiments

(i) **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

(ii) **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

(iii) **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 astablemultivibrators)

Memory circuits and counters.

Software packages e.g. PSPICE, ELECTRONIC WORK-BENCH & SOFTWARE FOR PCB DESIGN

(iv) **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 impedance coils and chokes
- Transducers
- Piezoelectric, Photoelectric, thermo-electric, magnetoelectric variable impedance, 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.

(v) **Control Experiments:**

Operational

- Uses as adder/subtractor, scaler, integratorand differentiator amplifier.

Serve amplifier, servometer/tachogenerator: motor speed characteristics

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

(vi) **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

(vii) **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

4.1.10 Faculty Library

In most universities, there are university libraries in addition to faculty-based libraries. Faculty-based library for engineering and technology is to cater for the specialized needs of the different programmes run in the Faculty. Such library is to be equipped with electronic-based library facilities with access to the information superhighway.

4.2 SPECIALIZED PROGRAMME-BASED LABORATORY FACILITIES

4.2.1 AEROSPACE ENGINEERING LABORATORY

(a) **Non-Destructive Testing of materials including dye penetrate, eddy current, ultrasonic tests, X-ray and Thermography.**

Equipment

1. Eddy Current flaw detectors
2. Ultrasonic probes and associated analysis hardware/software
3. Ultrasonic calibration specimen
4. Dye penetrate
5. Thermography camera
6. Magnetic Particle testing

(b) **Computer Aided Design (CAD)**

Computation tool on Finite Elements such as CATIA; NASTRAN; ABAQUS; IDEAS;
MATLAB; ANSYS

(c) **Aircraft Flight Principles II**

Flight Simulator Laboratory, encompasses aircraft performance and flight mechanics calculations and demonstrations

Equipment

Flight simulator (computer based software or standalone simulator)

(d) **Aircraft aerodynamics & Thermo-fluids**

Use of scaled models in a wind tunnel. Comparison of the various experimental results with a CFD model, Summary of tasks include:

1. Estimation of lift and drag coefficients, lift and drag forces for various angles of attack
2. Observation of pressure distribution profile across an aerofoil
3. Identification of the onset of stall
4. CFD model of airfoil employed for case (1)
5. CFD simulations that replicates aerodynamic experimental tests for case (1).

Equipment

1. Wind tunnel (low speed, subsonic, supersonic)
2. Aerofoil sections; reference may be made to the suite of NACA (National Advisory Committee for Aeronautics) profiles.
3. Computation software on Fluid Dynamics such as FLUENT; ANSYS CFX; STAR-CD;OpenFOAM

(e) **Flight Control and dynamics**

Experimental study of techniques such as velocity control, position control, and velocity feedback, etc. Laboratory sessions may include:

1. Simple examples of open loop and feedback control systems;
2. Modelling: transfer functions and block diagrams
3. Control system performance in the frequency and time domain;
4. Modelling of overshoot, damping
5. Stability analysis
6. Analyse a feedback control system to determine its steady state
7. Analyse a feedback control system to determine its transient performance

Equipment

Control software for modelling and demonstration such as MATLAB

(f) **Avionics System Engineering**

Use of instrumentation and cockpit displays, flight control and autopilot systems, engine control, diagnostic systems, on-board navigation systems, satellite global positioning systems, radar systems, communications and air traffic control systems.

Equipment

Avionics display and fault diagnosis kit

4.2.2 AGRICULTURAL ENGINEERING LABORATORY

A: 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.

B: List of Major Equipment

- (i) **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.

(ii) **Irrigation and Drainage Laboratory:**

- General purpose Theodolite
- Liquid prismatic compass
- Surveyor's umbrella
- Stereoscope
- Nylon-coated steel tapes – 50 m
- Levelling staff
- Abney level
- Physical Survey Basic Set
- (Pocket Altimeter, range finder, automatic level set, double prismatic square, ranging Rods, land chains-30 m, 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

(iii) **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.

(iv) **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 mallet
- ✓ 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, 115 mm diameter x 180 mm deep
- Asphalt Equipment:
 - ✓ Thermometer
 - ✓ Laboratory Thermometer
 - ✓ Surface Thermometer
- General Equipment:
 - ✓ Distiller
 - ✓ Measuring tapes
 - ✓ Refrigerator
 - ✓ Strain Gauge Indicators
 - ✓ Sieve shakers
 - ✓ Set of sieves
 - ✓ Set of 200 mm diameter (various sizes)
 - ✓ Set of 300 mm diameter (various sizes)

- ✓ Set of 450 mm diameter (various sizes)
- ✓ Verniercallipers

(v) **Farm Mechanics Workshop:**

- Measuring Tools and Instruments:
 - ✓ Pocket rule with belt clip (235 m)
 - ✓ Steel measuring tape
 - ✓ Calliper rule
 - ✓ Procession external micrometer
 - ✓ Universal measuring instrument for depth measurement
 - ✓ Procession inside micrometer
 - ✓ Dial indicator
 - ✓ Outside spring calliper
 - ✓ Inside spring calliper
 - ✓ 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 – 2 mm
 - ✓ Soldering lead in rod.
- Workshop Hand Tools (Technicians):
 - ✓ Hacksaw frame
 - ✓ Hacksaw blades high speed steel
 - ✓ Tube cutter 3 – 32 mm; 3 – 16 mm
 - ✓ Steel wire brush
 - ✓ Clip plier for external clip
 - ✓ Clip plier for internal clip
 - ✓ Combination plier 160, 180 mm
 - ✓ Heavy duty diagonal cutter

- ✓ Constructed steel cutter 800 mm
- ✓ Universal grip plier 250 mm
- ✓ Welding grip plier 280 mm
- ✓ Riveting tool set
- ✓ Engineer hammer 200 g – 150 g
- ✓ Sledge hammer 1-2 kg
- ✓ Rubber hammer
- ✓ Clipping chisel 150 – 250 mm
- ✓ Welding hammer
- ✓ Standard ring spanners
- ✓ Combination spanner set
- ✓ Scrapper
- ✓ Hand gloves
- ✓ Centre punch set 120 x 12 mm
- ✓ Chisel set
- ✓ Flat file (150 – 300) mm
- ✓ Square file (150 – 300) mm
- ✓ Half round file 150 – 300 mm
- ✓ Round file 150 – 300mm
- ✓ Black smith tong 150 – 300 mm
- ✓ All steel vices 100 – 175 mm
- ✓ Pipe cutter 10 – 60mm; 42 – 10 mm
- ✓ Anvil with two horns – 100 kilos
- ✓ Technician tool box (empty).

(vi) **Machinery Maintenance Base:**

- Hydraulic trolley
- Wheel alignment gauge
- Electrical/Electronic kit
- Clutch alignment gauge
- Vacuum tester
- Battery charging equipment
- Injector repair machine
- Carburettor service kit
- Hydraulic press
- Vulcanising set
- Oxyacetylene equipment
- Nozzle testing outfit
- Tool Boxes
- Complete set of various maintenance kits.

4.2.3 AUTOMOTIVE ENGINEERING LABORATORY

A: **List of Laboratories**

- (i) IC Engines and Fuels Laboratory

- (ii) Automobile Systems and Vehicle Dynamics Laboratory
- (iii) Automobile Systems Maintenance and Testing Laboratory
- (iv) Automobile Workshop

B: List of Major Equipment/Experiments

- (i) **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.
- (ii) **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.
- (iii) **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

(iv) **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

4.2.4 BIOMEDICAL ENGINEERING/TECHNOLOGY

List of Laboratories/Workshops and Equipment/Instruments/Tools Expected

Biomechanics Laboratory

Equipment (Virtual Instruments, Sensors, and Biomechanics Lab)

1. Clevelab Virtual Instruments
2. Human Arm Model with Angle Sensors
3. Goniometer (probe + velcro straps)
4. Conductivity Sensor and Dissolved Oxygen
5. Respiration Rate Sensors
6. Bicycle ergometer

Tissue and Regeneration Medicine Laboratory Equipment (Cell Culture Lab)

1. Biosafety (Laminar Flow Hoods) Cabinet Type All with stands
2. Incubators
3. Inverted Microscopes with Digital Camera and PC + Cell counting sets
4. Orbital Shaker, Vortexer, Water Baths, pH meter, Micropipettes, Balance
5. NanoPure Water System, Autoclave Liquid N₂ Storage, Microplate Reader, and -80-Freezer
6. Refrigerated Microcentrifuges with Swing-bucket and Fixed-angle Rotors
7. Protein Electrophoresis System
8. Nucleic Acids Electrophoresis System
9. Power Supply for Electrophoresis
10. Cryotome
11. Low Temperature Freezers and Refrigerators
12. Lab Fluoroscopic Imaging Microscopes
13. Support equipment employed in cell culture and Analysis
14. Freeze Dry System
15. Protein Solution Particle size Analyze

Bioinstrumentation Laboratory Equipment

1. CFX96 Real Time PCR
2. Protein Electrophoresis System
3. UV/VIS Spectrophotometer with Nanovette
4. Nucleic Acids Electrophoresis System
5. Differential Scanning Calorimeter (DSC)
6. Nucleic Acids Electrophoresis System
7. Power Supply for Electrophoresis
8. Semi-Dry Blotting System with Power Supply
9. Impedance Analyzer System with PC
10. Wet Blotting System
11. Impedance Analyzer System with PC 1 2 . C02 Incubator
13. Molecular Imager
14. Digital voltmeter
15. Signal Generator
16. Multiple Input Oscilloscopes
17. Relevant Analysis Software and Hardware

Bioinformatics Laboratory Equipment

1. Server Computer
2. Workstations
3. Relevant Software

Biomedical Equipment Workshop Equipment

1. Milling Machine for Rapid Prototyping 2 . CNC Lathe Machine
3. Biomedical Equipment Maintenance Tools 4 . Universal Testing Machine
5. Drilling Machines

4.2.5 CERAMIC ENGINEERING LABORATORY

A: List of Laboratories










- (i) Glass Blowing Laboratory
- (ii) Ceramic Raw Materials Laboratory
- (iii) Heat Treatment Laboratory
- (iv) Ceramic Materials Testing Laboratory
- (v) Ceramic Production Laboratory

B: List of Major Equipment/Experiments

- (i) Glass Blowing Laboratory
- (ii) Ceramic Raw Materials Laboratory
- (iii) Heat Treatment Laboratory
- (iv) Ceramic Materials Testing Laboratory
- (v) Ceramic Production Laboratory

4.2.6 CHEMICAL ENGINEERING LABORATORY

A: List of Laboratories

- (i) Separation Process Laboratory
 -  Distillation
 -  Absorption
 -  Extraction
- (ii) Transport Phenomenon Laboratory
 -  Fluid Flow
 -  Heat Transfer
 -  Mass Transfer
- (ii) Reaction Engineering control Laboratory
 -  Kinetics
 -  Reactor Systems
 -  Process Control Systems

B: List of Major Equipment/Experiments

- Flow Measuring Apparatus
- Dryer
- Filtration 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

4.2.7 CIVIL ENGINEERING LABORATORY

A: List of Laboratories

- (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
 - (iii) Environmental Health Laboratory
- (e) **Highway & Transportation Engineering**
 - (i) Highway Materials Testing Laboratory
 - (ii) Pavement Laboratory.

B: List of Major Equipment/Experiments

- (a) **Structural Engineering Laboratory**
- (i) **Universal Testing Machine** with accessories for Tension, Compression, Transverse 180° cold Bend, Double Shear, Punching and Brunel Hardness Tests. Capacity – 10000 kN, Transverse Beam – 500 kN.
- (ii) **Proto-type Tests Facilities** for testing of proto-type in structural elements, i.e. Beams, Frames, Trusses, etc. Accessories for the purpose include 1000 kN, 250 kN 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 2500 kN.
- (iv) **Routine Testing and Demonstration Equipment:**
This includes Armfield Extensometers, arch frames, suspension bridge frame and pin-jointed framework.
- (v) **Concrete Batching and Making Equipment**
- Multi-flow mixers, 112 Dm³ (4 ft³) and 56 Dm³ (2 ft³) capacities 200-240 V
 - Test BS Sieves of various sizes
 - Semi-Automatic scale 25 kg capacity
 - Automatic scale 500 kg capacity
 - Standard moulds of various sizes and tamping rods
 - Vibrating table
- (vi) **Concrete Quality and Workability Equipment:**
- Slump cone apparatus to BS 1881 ASTM CI43
 - Compacting factor apparatus to BS 1881. (2 sizes)
 - VibroConsistometer to BS 1881
 - Vicat Apparatus
 - Air Enmetertainment
- (b) **Water Resources and Environmental Engineering Laboratory**
- Laminar/Turbulent pipe flow apparatus
 - Radial flow pump
 - Radial flow turbine

- Surges in pipes apparatus
- Surge Tower
- Water Hammer apparatus
- Evaporating dish
- Steam bath or infrared lamp
- Drying oven
- Desiccator
- Analytical balance
- Reagents – Sodium hydroxide in distilled Water, phosphate buffer solution, magnesium sulphate solution, calcium chloride solution, ferric chloride solution, acid and alkali solution, etc.
- Incubators
- Colony counter (Quebec)
- pH Meters
- Pipettes and Cylinders
- Petri dishes
- Sample bottles
- Burner
- Laboratory flow channel
- Fibre glass
- Thermometers
- Funnels
- Test Tubes

(c) **Geotechnical Engineering/Highway and Transportation Engineering Laboratory:**

- Tri-axial testing machine complete with transducers cells and accessories.
- Motorised direct/residual shear box machine complete with load rings, set of weights and accessories.
- CBR Testing machine complete with moulds, load ring gauges and accessories.
- Consolidation apparatus complete with cells, gauges and set of weights
- Laboratory vane test apparatus complete with set of springs and motorizing attachment.
- Large capacity floor-mounting electric ovens 40oC to 16oC.
- Hotplates with simerstat heat control unit 220–240 V,2000 W.
- Mettler top-loading balance with optical scale 100 g, Readability 0.01 g, capacity 1.3 kg.
- Graduated twine beam scale complete with two stainless steel pans 0 to 200 g x 10 g.
- Semi-automatic balances, 25 kg capacity complete with scoop and set of counter weights.
- Autographic unconfined compression apparatus complete with platens springs.

- Unconfined compression apparatus complete with platens and strain gauge mounting assembly and dial gauge.
- Automatic sieve shaker for up to 200 mm diameter sieve.
- BS sieves 212 mm to 8 mm and 200 mm diameters.
- Simple hand boring sampling augers complete with accessories.
- Portable drilling unit with two-stroke petrol engine and two pairs of handles complete with extension rods
- Atterberg limits determination apparatus complete with liquid limit device and accessories.
- High-speed stirrer complete with cup and baffle.
- Constant temperature bath complete with hydrometer jars, watt heater, thermostat, etc.
- CBR Marshall tester complete with breaking head stability mould and flow meter dial gauge.
- Compaction pedestal complete with hammer and mould body.
- Constant head permeability apparatus complete with cells and accessories.
- Standard proctor compaction mould, 1000 cm³ capacity complete with rammers and accessories.
- Geonor swelling test apparatus complete with cells and accessories.
- Riffle boxes complete with three rigid metal containers.
- Wax melting pot with thermostatic control up to 150°C range.
- Hand-operated extruder – screw type sample extruder for 38 mm dia. Complete with built-in sample tube supports.
- Procutor/core cutter extruder comprising a frame and a 15-kN hydraulic jack.
- Universal extruder comprising a frame and a 15-kN hydraulic jack.
- Bench-moulding mixer with three-speed gear box complete with stainless steel bowl 7.5 dm³ capacity.
- Long stem soil hydrometer graduated 0.995 to 1.030 g/ml.
- Sieving extractor complete with clamps and clamping ring for use with sieves of 200 mm dia.
- Minor centrifuge complete with 8-place angle head, 8 x 50 ml metal buckets and caps.
- Ductilometer for testing 4 specimens complete with briquette moulds and base plate.
- Flash and fire-points apparatus gas heated.

(d) **Geodetic Engineering and Photogrammetry Laboratory:**

- Theodolites
- Levels
- Compasses
- Umbrellas
- Protractors
- Steel tapes
- Engineer's chains

- Ranging rods
- Surveyor's scales
- Various graph paper
- French curves
- Log tables
- Planimeters
- Plumbulbs
- Arrows
- Field Books

4.2.8 COMPUTER ENGINEERING LABORATORY

A: List of Laboratories/Workshops

- (i) Microprocessor Laboratory
- (ii) Computer Laboratory
- (iii) Prototyping Workshop

B: List of Major Equipment

- Logic Analyser
- PCB Development Kits
- Digital Oscilloscope
- Microprocessor Development Kit (Intel)
- Microprocessor Development Kit (Motorola)
- Microcontroller Development Kit (Intel/Motorola)
- PIC Microcontroller Development Kit
- FPGA Development Kit
- Computer systems
- Multimedia Projector
- Overhead Transparency Projector
- Software Packages(MASM Assembler, Verilog, etc.)

4.2.9 FOOD SCIENCE AND TECHNOLOGY LABORATORY

A: List of Laboratories/Workshops

- (i) Food Microbiology/Fermentation Laboratory
- (ii) Food Processing/Preservation Laboratory
- (iii) Biochemistry/Nutrition Laboratory
- (iv) Food Chemistry/Analytical Laboratory
- (v) Workshop

B: List of Major Equipment

- (i) **Food Microbiology/Fermentation Laboratory:**
 - Microscopes

- Incubators
 - Fermenters
 - Stomacher
- (ii) **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
- (iii) **Biochemistry/Nutrition Laboratory**
- Flame analyser
 - Spectrophotometer
 - Animal cages
 - Kjehldhal auto analyser
- (iv) **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
 - BrabenderAmylograph

- BrabenderFrarinograph
- H.P.L.C.
- Gas Chromatography machine

4.2.10 INDUSTRIAL AND PRODUCTION ENGINEERING LABORATORY

A: List of Laboratories/Workshops

- (i) Machine Tools Laboratory
- (ii) Production Laboratory
- (iii) Foundry and Heat Treatment Laboratory
- (iv) Welding Shop
- (v) Metrology Laboratory
- (vi) Work Study and Systems Design Laboratory
- (vii) Manufacturing/Production Laboratory
- (viii) Ergonomics (Human Factors Engineering) Laboratory

B: List of Major Equipment/Experiments

(i) 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.

(ii) 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

(iii) **Foundry and Heat Treatment Laboratory:**

- Blacksmith Hearth
- Anvil
- Compressor and Exhaust Unit
- Drop hammer
- Pneumatic 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.

(iv) **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

- (v) **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

- (vi) **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

- (vii) **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

- (viii) **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.

4.2.11 INFORMATION AND COMMUNICATION TECHNOLOGY LABORATORY

A: **List of Laboratories/Workshops**

- (i) Microwave Laboratory

B: List of Major Equipment/Experiments

- (i) Experimental Ku VSAT system

4.2.12 MARINE ENGINEERING LABORATORY

A: List of Laboratories/Workshops

- (i) Fluid Dynamics Laboratory
- (ii) Marine Operations Laboratory
- (iii) Propulsion Systems Laboratory
- (iv) Naval Architecture Laboratory
- (v) Meteorology and Navigation Laboratory

B: List of Major Equipment/Experiments

- (i) **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
- (ii) **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
- (iii) **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
- (iv) **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.
- (v) **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.

4.2.13 MATERIALS AND METALLURGICAL ENGINEERING LABORATORY

A: List of Laboratories/Workshops

- (i) Production Laboratory
- (ii) Foundry and Heat Treatment Laboratory
- (iii) Welding Laboratory
- (iv) Physical Metallurgy Laboratory
- (v) Process Metallurgy Laboratory
- (vi) Materials Processing Laboratory
- (vii) Material Structure Inspection Laboratory
- (viii) Materials Testing Laboratory

B: List of Major Equipment/Experiments

- (i) **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

- (ii) **Foundry and Heat Treatment Laboratory:**
 - Blacksmith Hearth
 - Anvil
 - Compressor and Exhaust Unit
 - Drop hammer
 - Pneumatic 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.
- (iv) **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
- (iii) **Physical Metallurgy Laboratory**
- (iv) **Process Metallurgy Laboratory**
- (v) **Materials Processing Laboratory**
Mechanical Processing of materials
Chemical Processing of Materials.
- (vi) **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).
- (vii) **Materials Testing Laboratory**

4.2.14 MECHATRONICS ENGINEERING LABORATORY

Students registered for this programme must have taken courses and carried out extensive

laboratory experiments in the relevant foundation courses in engineering and technology. The laboratory experiments and equipment presented below are therefore driven by the following areas of study at the 300-500 Level:

- Mechanics
- Pneumatics
- Hydraulics
- Sensorics
- Controls
- Electrical/Electronics
- Robotics
- Factory automation technology (including planning & design, installation & commissioning, programming & communication, maintenance & trouble shooting.
- Process automation (the close-loop system to be considered includes: temperature control, pressure control, flow control, level control)
- CAD/CAM/CNC

The proposed mechatronics programme-driven laboratories to be established include the following

- ✚ Fluidics Laboratory (Pneumatics and Hydraulics)
- ✚ Virtual Mechatronics Laboratory (Knowledge to be acquired include- basic mechatronics technology, programming skills(CAD/CAD/CAM) and industrial robotics)
- ✚ Partial Automation Laboratory (Factory Automation & Process Automation)
- ✚ Full Automation Laboratory (Emphasis on packaging)

The equipment to be procured to equip each of the above laboratories are listed below:

Fluidics Laboratory

- Pneumatic training kits
- Sets of learn lines mobile along with software, workbook, solution book, decision and simulation Hand book
- Electro-pneumatics: Supplementary kits and software are required
- Sets of hydraulic kits - software, text book, work book inclusive

Virtual Laboratory

- Sets of WBT for knowledge in basic mechatronics technology and software
- Computers for Robotics software
- Sets of CAD/CAM/CNC simulators

Partial Automation Laboratory

- Sets of transfer system
- Sets of MPS-PA compact

Full Automation Laboratory

- Process Automation Manufacturing and packaging factory

CAD/CAM/CNC

- Programming and simulation software
- CNC-keyboard for each student's team
- CNC-machine Turn
- CNC-machine Mill
- CNC programming for Turn and Mill
- Production of Mechatronics part systems

Process Automation study fields:

- PLC programming higher functions
- PLC-programming analogue in/outputs
- 2-step controller
- Basics in closed loop control
- Closed loop temperature control
- Closed loop pressure control
- Closed loop flow control
- Closed loop level control

Fully Automation Study fields:

- Material/signal flow in a networked system
- Installation and commissioning of a mechatronics system
- Programming and communication in a mechatronics system
- Maintenance and Trouble Shooting in a mechatronics system

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4.2.15 MINING ENGINEERING LABORATORY

A: **List of Laboratories/Workshops**

- (i) Mine Surveying Facilities
- (ii) Mining Systems Laboratory
- (iii) Rock Mechanics Laboratory
- (iv) Mineral Processing Laboratory
- (v) Mine Ventilation Laboratory

B: **List of Major Equipment/Experiments**

4.2.16 OPERATIONS RESEARCH LABORATORY

A: **List of Laboratories/Workshops**

- (i) Operation Research Laboratory I
- (ii) Advance Operation Research Laboratory

B: **List of Major Equipment**

- (i) Computer Systems
- (ii) Multimedia Projector
- (iii) Overhead Transparency Projector
- (iv) Operation Research Software Packages




4.2.17 PETROCHEMICAL TECHNOLOGY LABORATORY

A: **List of Laboratories**



Drilling Laboratories

-  Mud Laboratories
-  Cement Laboratories

Reservoir Engineering Laboratory:

-  Fluid Properties
-  Flow in Porous Media
-  Petrophysics

Petroleum Production Engineering Laboratory

-  Flow Measurements
-  Fluid Quality

B: **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

4.2.18 PETROLEUM ENGINEERING LABORATORY

A: List of Laboratories

Drilling Laboratories

- ✚ Mud Laboratories
- ✚ Cement Laboratories

Reservoir Engineering Laboratory:

- ✚ Fluid Properties
- ✚ Flow in Porous Media
- ✚ Petrophysics

Petroleum Production Engineering Laboratory

- ✚ Flow Measurements
- ✚ Fluid Quality

B: 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

4.2.19 PETROLEUM AND GAS ENGINEERING LABORATORY

A: **List of Laboratories/Workshops**

Drilling Laboratories

- ✚ Mud Laboratories
- ✚ Cement Laboratories

Gas and Petroleum Reservoir Engineering Laboratory:

- ✚ Fluid Properties
- ✚ Flow in Porous Media
- ✚ Petro-physics

Gas and Petroleum Production Engineering Laboratory

- ✚ Flow Measurements
- ✚ Fluid Quality

B: **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

4.2.20 POLYMER ENGINEERING LABORATORY

A: **List of Laboratories**

Polymer Technology Laboratory

- Viscosity
- Normal Stresses

Polymer Processing Laboratory

- Continuous processes
- Batch processes
- Rubber Processing

Applied Polymer Chemistry Laboratory

- Polymer Synthesis
- Polymer Physical Chemistry

Polymer Structure And Properties

- Mechanical properties
- Polymer Physics and Characterisation

B: 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 Microscopes
- 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

4.2.21 PUBLIC HEALTH ENGINEERING LABORATORY

A: List of Laboratories

- (i) Sanitary chemistry Laboratory
- (ii) Sanitary Microbiology Laboratory
- (iii) Hydraulics and Hydrology Laboratories

B: List of Major Equipment

4.2.22 REFRIGERATION AND AIR-CONDITIONING ENGINEERING LABORATORY

A: List of Laboratories/Workshops

- (i) Refrigerant Testing Laboratory
- (ii) Refrigeration and Air-conditioning Systems Laboratory
- (iii) Refrigeration and Air-conditioning Workshop

B: List of Major Equipment/Experiments

(i) 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

(ii) 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

(iii) 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

4.2.23 STRUCTURAL ENGINEERING LABORATORY

A: List of Laboratories/Workshops

- (a) **Structural Engineering**
 - i. Civil Eng. Materials Laboratory
 - ii. Structures Laboratory:
 - iii. Routine Testing
 - iv. Models and Prototype Testing, e.g. Trusses, Columns; Beams and Frames.
 - v. 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

B: List of Major Equipment/Experiments

4.2.24 TEXTILE AND POLYMER ENGINEERING LABORATORY

A: List of Laboratories

- (i) Polymer Laboratory
- (ii) Textile Testing Laboratory
- (iii) Textile Production Laboratory
- (iv) Yarn Processing Laboratory

B: 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

Please, forward your comment on any section of this document to the following email:
nucassessment@gmail.com

You can also call the following phone numbers: 08033145087, 08033201097
All comments should be received before 31st October, 2015

- Fibre/Yarn Testing Machine
- Single Fibre Tester
- Fineness Maturity Tester
- Fibre Blender
- Combo Sorters
- Micro/Macro Project
- Student Microscopes
- Viscometer
- Fluidity Test Equipment

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