ALEX EKWUEME FEDERAL UNIVERSITY NDUFU ALIKE (AEFUNA)

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

DEPARTMENTAL HANDBOOK

2019

SECTION ONE:

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

Preamble

The proposed Department of Electrical and Electronic Engineering of the Alex Ekwueme Federal University Ndufu Alike is set up with the aim of establishing world-class programmes that are high quality cutting-edge producers of technology, manpower and research for the electrical and electronic industries. It aims to achieve this through an uncompromising approach towards knowledge acquisition for its teaching and technical staff and its systematic transfer to the students using the dynamic state-of-the-art methods of teaching, research and the latest analytical and industry standard equipment. In addition, the Department will do these in a friendly, forward-thinking environment that views the student as a customer, and makes itself a benefactor to its immediate community - Ebonyi State and Nigeria at large. Indeed, it will be a centre of excellence.

1.1 Electrical & Electronic Engineering Programme

1.1.1 Introduction

Electrical and Electronic Engineering programme will provide students with the analytical skills, design expertise and flexibility required to adapt to and master rapidly evolving technologies. The programme aims to achieve this through an uncompromising approach towards knowledge acquisition for its teaching and technical staff and its systematic transfer to students coupled with the adoption of dynamic state-of-the-art methods of teaching, researching as well as procurement of the latest analytical and industry standard equipment for training both the students and staff.

As with most engineering courses, core-engineering concepts are covered in earlier years of the two and three hundred levels. At four and five hundred levels, various fields/ specialized areas of Electrical and Electronic Engineering and other related topics are introduced. The progression paths taken by the students usually indicate that the majority prefer to take a B.Eng. degree and then gain employment experience. Many then anticipate returning to the University to study at M.Sc. or M. Eng. level, usually with scholarship backing, after a year or two of gaining experience. As a result the B.Eng. programme is designed to meet the demands of industry and to provide a vertically integrated programme of study leading from B.Eng. to M.Eng., and Ph.D.

1.1.2 Philosophy, Mission Statement, Vision Statement, Aims and Objectives

Philosophy

The philosophy of the Department is in line with the philosophy of the University. The University has as its philosophy, the production of graduates that will have the spirit of excellence, integrity and entrepreneurship imbibed in them. The philosophy of the University as well as that of the Department is guided by:

- The need to raise problem solvers for the nation through the production of highly skilled and motivated graduates.

- The need to pay particular attention to research activities that will address and impact positively on the lives of the people of Ebonyi State and Nigeria in general.

In addition to the above University philosophy, the Electrical & Electronics Engineering programme is, and will continue to be, designed to provide students with the analytical skills, design expertise and the flexibility required to adapt to and master rapidly evolving technologies.

Students will be highly motivated to cover the fundamental principles of the field such as digital and analogue electronics, power systems and control, communication networks, computer programming, mathematics, project management etc, so that they become competent high-level ICT-compliant Electrical and Electronic graduates at the end of their programme.

Extensive laboratory based practical work is and will continue to be fully integrated with lecture materials throughout their courses to help reinforce theory with experience for the students, thereby preparing the students to solve real world practical electrical electronics engineering problems.

Mission Statement

The mission and relevance of the University and hence, the Department of Electrical & Electronic Engineering is:

- To train top quality human resource that will propel the development of the country by equipping the graduates with the relevant knowledge and skills required in the market place in a globalized world.
- To take a leading role in fostering the economic development of Ebonyi State and the entire Nigerian society at large through specific education, training and outreach activities.

To educate Nigerians in modern engineering principles to prepare them for lifelong professional growth in a dynamic range of careers.

Vision Statement

The vision of the Department, which is in line with that of the University, is to become a vibrant centre of learning and research that will be reputable nationally and internationally and a hub for the economic transformation and development of the region through creative and innovative endeavours. The department also strives to be the leading Programme of Electrical and Electronics Engineering in Nigeria where the fundamentals and principles of science and technology are integrated into multi-disciplinary teaching and research programmes aimed at producing internationally competitive research as well as high-calibre, self-reliant graduates.

Aims

The Electrical and Electronic Engineering Programme is established to provide an outstanding Electrical and Electronic engineering education and value directed at training students with the state of-the- art- equipment and teaching methods that will enrich them with the scientific and technical/practical skills in an emerging knowledge-based society. We are committed to maintaining world-class standards teach and research while preserving our core values of scholarship, professionalism and integrity. We strive to maintain an ethos founded on harmony,

equity and a working environment where creativity and diversity are cherished. We firmly believe that our Programme will continue to find ways to improve the quality of life of all humankind.

Objectives

The objectives of the Department are in line with those of the University and the Faculty, which include the following:

- To provide access to University education for qualified candidates in all the fields of endeavour for which the University has mandate.
- To act as a centre for teaching, research and community service that will lead to the acceleration of economic and social development of the catchment areas in particular and the country in general.
- To develop and offer academic and professional Electrical and Electronics Engineering programmes leading to the award of university degrees and diplomas with the aim of producing mature graduates that will compete favourably with graduates from other world-class universities.
- To promote local and international cooperation through linkages in pursuit of research, staff and exchanges.
- To enhance and enable access to world-class research infrastructure and a collegial environment in which both senior and junior scholars can thrive.
- To ensure that curriculum content emphasizes emerging international dimensions in engineering education such as sustainability, nanotechnology, artificial intelligence and climate change adaptation technologies etc.

1.1.3 Learning Outcomes

The mission of Electrical & Electronic Engineering department at AEFUNA is to prepare our graduates to become professional engineers and leaders in the electrical & electronic engineering profession locally and globally. The pedagogy in our teaching and education is designed to enable them integrate fundamental scientific engineering principles coupled with rapid advances and developments in information and communication technology (ICT) to facilitate their problem-solving skills in a global knowledge-based economy. The curriculum and programme is designed to equip students with several learning outcomes that will enable them provide local, state, national and international leadership into the profession and other aspects of societal growth and development. These include:

Proficiency in problem solving through the application of engineering knowledge, mathematics and other analytical skills.

- Ability to design electrical & electronic engineering systems of various complexities, as well as theory components and processes, to meet clients' needs and specifications.
- An ability for collaborative team working

- Ability to understand and incorporate the concept of sustainability/sustainability footprints, sustainable development and sustainability rating appraisal/systems in Electrical & Electronic Engineering practice
- Good understanding of professional and ethical responsibilities in engineering practice
- An ability for effective oral and written communication
- Research, development and commercialization (R, D&C) skills as the main underpinning for societal growth and development

1.1.4 Attainment Level

It is our expectation to attain the highest academic level par excellence in the Electrical & Electronic Engineering department. More so, it is our expectation to be the preferred provider of research for our stakeholders by conducting multidisciplinary research in Electrical & Electronics Engineering Education and for industries in Nigeria using the state-of-the-art equipment and top-quality staff who will reflect the diversity of the industries.

1.2 Admission Requirements

1.2.1 UTME Requirements:

In addition to acceptable passes in UTME, the minimum academic requirement is credit level passes in at least five subjects at SSCE or GCE O' level or its equivalent in nationally recognized examination which must include English Language, Mathematics, Chemistry, Physics and any other Science subject in 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.

1.2.2 Direct Entry Requirements:

Candidates must meet the 'O' level requirements in (c)(i) above and obtain a minimum score at the University Post UTME examination.
Also, one of the following:

a. A 'Level GCE, HSC, JUBEB or IJMB with good passes in Mathematics, Physics and Chemistry
b. National diploma (ND) in Electrical Electronics Engineering with minimum of upper credit from a recognized NBTE accredited Polytechnic. Candidates who meet these requirements are admitted into 200 levels.
c. Higher national diploma (HND) in Electrical Electronics Engineering with a minimum of upper credit from a recognized NBTE accredited Polytechnic. Candidates who meet these requirements are admitted into 300 levels.

Direct entry students are required to register and pass the following lower level courses:

(i) For DE 200 level students; four (4) credit units of general studies are required of them in GST 101 and GST 102
(ii) For DE 300 level students, they shall be required to register and pass GST 105 and GST 104 in addition to the normal courses they are to register.

1.2.3 Remedial/Pre-degree Programme of the University (AEFUNA):

Students who pass Remedial/Pre-degree programme may be absorbed into 100 level after duly satisfying the general requirements of the University as in (1) above.

It should be generally noted that for entry into the next level, 100 level is the qualifying year. At this level, Electrical & Electronic Engineering students take courses in Mathematics, Physics, Chemistry and General Studies run by the Faculty of Science and Technology, Faculty of Humanities and Social Sciences.

For students to proceed from 100 level to 200 level and to remain in the Faculty, a Cumulative Grade Point Average (CGPA) of at least 2.0 is required. In addition, he/she must obtain 12 credits of Mathematics, 10 credits of Physics including at least two theory courses, 8 credits of Chemistry. He/she must also obtain 10 credits of General Studies. Note also that all the 200 level students of the Faculty offer the same common courses while at 300 level, students will begin to offer core courses and elective courses peculiar to their various Departments/Programmes.

1.3 Duration of Study

The Bachelor of Engineering in Electrical & Electronics Engineering is designed to last for a minimum of five (5) years for a UTME (100-500) level candidate, four (4) years for a DE (A 'level, JUBEB, IJMB and ND candidates) and three (3) years for a HND candidate with a maximum of 7½ years, 6years and 4½years respectively. The programme is organized in such a way that all Engineering students from Civil, Chemical/Petroleum, Electrical/Electronics, Mechanical and Mechatronics Engineering are to offer the same basic science courses in their 100 level and basic Engineering courses in their 200 level so that they are equipped with the basic general engineering knowledge for further integration. The 300 to 500 level courses are tailored to cover contemporary courses in Electrical & Electronics Engineering.

1.3.1 Matriculation

This is the formal admission of a student to the membership of a University after registration and signing by the student of the Declaration of Obedience. Note, only matriculated students are entitled to become candidates for degrees. No student can be admitted to a first degree programme until he or she has completed full-time attendance for at least three University sessions. Exceptions may be made in specified circumstances on the authority of the AEFUNA Senate.

1.4 Requirements for Graduation

To graduate from the Faculty of Engineering and Technology of AEFUNA, the students must meet the minimum requirement as stipulated by the student's Department in addition to passing all the required Faculty common Engineering and Technology courses (FET) from 100 – 500 levels.

1.4.1 Programme Structure for Graduation

The programme structure includes Period of Formal Studies in the University; Industrial Training; Planned Visit; and Projects. This structure is made up of four parts namely

i. **100 – 200 Levels:** General Studies, Basic Sciences and General Engineering and Technology Courses. General Studies and Basic Science Courses are normally taught by Lecturers from other Faculties.

ii. **300 – 500 Levels:** Core Programme Courses/Elective Courses

iii. (a) Student's Work Experience Programme (SWEP) – 3 months
(b) Student's Industrial Work Experience Scheme (SIWES) – 9 months.
Note, SWEP and SIWES are required and graded but not used for computation of final degree result.

The student is expected to go for one-year industrial training, which is an integral part of the five-year degree programme. This is made up of ten (10) weeks of Student's Work Experience Programme (SWEP) at the end of 200 level which is done in the University, twelve (12) weeks of Student Industrial Work Experience Scheme I (SIWES I) which is done in an industry at the end of 300 level, and twenty-four (24) weeks of Student's Industrial Work Experience Scheme II (SIWES II) during the second semester 400 level, i.e. at the end of the student's first semester 400 level examinations.

However, an academically weak student may be advised to defer SIWES II until he/she clears all his/her carry-over (failed) courses and such a student must satisfy the SIWES requirements before proceeding to 500 level.

1.4.2 Examination Regulations

The setting, conduct, evaluation schemes, moderation schemes - internal and external for degree examination and the issuance of results are as in the "Approved Senate Regulations Governing the Conduct of Examinations" and the "General Academic Regulations for Degree Courses." The relevant details are set out below:

A. General Academic Regulations for Degree Courses:

i. The unit of a course shall be the semester, one semester unit being when a class meets one hour every week for the semester or three or four hours every week in the laboratory for the semester or the equivalent in workshop or field work time. The size of a course shall, as much as possible, be a maximum of three units and its duration shall be one semester except for projects and design courses, which may carry more than three units and may last more than one semester.

ii. A **Core course (C)** is one which must be registered for and passed by a student to get a degree and is counted toward the classification of his/her degree.

iii. An **Elective course (E)** is either compulsory or optional. All elective courses taken are used in final computation for the degree classification. There are compulsory electives which implies that every student must offer the course before graduation; and the optional elective implies that a student may or may not offer the course provided such a student has taken the required units of elective courses for graduation.

iv. An **Optional course (O)** is one which a student can take based on interest and may count towards the minimum credit unit required for graduation

v. A University **Required course (R)** is a compulsory course prescribed by the University which must be passed before a student can graduate. It would also be counted towards the computation and classification of the student's degree.

vi. An **Audited course (A)** is one, which the student attends without writing the examination in it.

vii. **Pre-requisite course (P)** is one in which the students must pass before proceeding to the higher course

viii. **Co-prerequisite course (CP)** is one that may be taken in parallel with the course for which it is specified.

B. Students' Work Load:

The maximum numbers of units a student can register for is 24 units per semester. The minimum numbers of units a student can register for is 16 units per semester.

C. Computation of Results:

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.

The following terminologies and abbreviations are commonly used in the computation of Grade Point Average (GPA)

i. **Total Load Units (TLU):** This is the total numbers of course units carried by a student in a particular semester. It is the summation of the load units on all courses carried during the semester. Take for example, a student who is taking 6 courses of 3 units each has a TLU of 18 for the semester.

ii. **Cumulative Load Unit (CLU):** This is the summation of the total load units over all the semester from the beginning to date. A student who is prone to repeating courses will finish (if he/she does not drop out) with a higher CLU than his non-repeating colleagues, and will most likely require a longer time to complete the requirements for the award of a degree.

iii. **Total Credit Points (TCP):** These are the sum of the product of course units and ratings in each course for the entire semester. Take for example, a student who took four (4) courses of 3 units each. Suppose the grades he obtained in the four courses are A, B, C, and D, respectively. The TCP of the student is calculated as (3 x 5.0) + (3 x 4.0) + (3 x 3.0) + (3 x 2.0) = 15 + 12 + 9 + 6 = 42.

iv. **Cumulative Credit Point (CCP):** This is the summation of the Total Credit Points over all semesters from the beginning to date.

v. **Grade Point Average (GPA):** This is the Total Credit Points (TCP) divided by the Total Load Units (TLU). Take for example, consider the student's score referred to in section C(iii). His TCP is 42.0 and his TLU is 12, his GPA is therefore 42/12 = 3.50. The highest possible GPA that can be earned is 5.0 and that is when a student has earned a grade of "A" in every course during the semester. The lowest GPA obtainable is 0.0.

vi. **Cumulative Grade Point Average (CGPA):** This is not the summation of GPAs for all semesters. Rather, it is the summation of TCP for all the semesters to date, divided by the summation of TLU for the said semesters. Like the GPA, CGPAs obtainable range from 0.0 to 5.0. In effect, CGPA = CCP/CLU.

D. Qualification for Examination

Examination are normally conducted within the regulations stipulated by Senate from time to time. To sit for an examination, a candidate must be duly registered for the course and subsequently for the examination in that course. In addition, a candidate must have satisfied the requirements of 75 percent attendance in lectures, 75 percent participation in practical laboratory exercises. In addition, depending on the requirements for the course, class assignments, SWEP, SIWES, and fieldwork shall be recorded by a student in order to qualify to sit for a semester's examination. Lecturers are required to keep attendance for each course. The student shall be made to be aware of these requirements and shall be informed on an on-going basis during the course on how he/she is doing in the course with respect to attendance.

1.4.3 Course Credit System (CCS)

In AEFUNA, we practice course credit system; therefore, all Engineering and Technology Programmes are run on a Course Credit System, that is, a modularized system commonly referred to as Course Unit System. Going by this system, therefore, all courses are 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. In that case, credit weights are attached to each course. *Note, one credit is equivalent to one hour per week per semester of 15 weeks of lectures or 2 hours of tutorials or 3 hours per week of laboratory/studio work per semester of 15 weeks.*

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.

1.4.4 Grading System (GS)

The Alex Ekwueme Federal University Ndufu-Alike, Nigeria, operates a five (5) point grading system. Examination carries 70 percent while the continuous assessment (which is made up of class attendance/quiz/test/assignment/mini-project) all at the discretion of the course lecturer carries 30 percent giving a total of 100 per cent.

Apparently, a student must have at least 75 per cent attendance in lectures before he/she is qualified to sit for any examination in the Faculty. The overall grading system and the class of graduation degree are as given in the tables below.

Table 1.1: Overall Grading System

Grade	**Point**	**Range of Score (%)**	Remark
A	5.0	70 and above	Excellent Pass
B	4.0	60 – 69	Very Good Pass
C	3.0	50 – 59	Good Pass
D	2.0	45 – 49	Fair Pass
E	1.0	40 – 44	Pass
F	0.0	0 – 39	Failed

1.4.5 Degree Classification

The following regulations shall govern the conditions for the award of an 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 core 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 1.2. It is important to note that the CGPA shall be calculated and expressed correct to two decimal places.

Table 1.2: Class of Graduation Degree

S/N	**Class of Degree**	**CGPA**
1.	First Class	4.50 – 5.0
2.	Second Class Upper Division	3.50 – 4.49
3.	Second Class Lower Division	2.50 – 3.49
4.	Third Class	1.50 – 2.49
5.	Pass	1.00 – 1.49
6.	Failure (withdrawal)	Less than 1.00

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.

1.4.6 Probation (PR)

A student whose CGPA is below 1.50, but greater than 1.00 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 provided that: the maximum of 18 credit units per semester is not exceeded. The minimum number of credit units that can be registered in any semester is 15.

1.4.7 Withdrawal (WD)

A candidate whose Cumulative Grade Point Average is still below 1.00 at the end of a particular year of probation should be required to withdraw from the University. However, in order to minimize waste of human resources, consideration can be given to withdrawal from programme of study and possible transfer to other programmes within the University but outside the Faculty of Engineering and Technology.

1.5 Evaluation

1.5.1 Techniques of Students Assessment

(a) **Practical**

By the nature of the Electrical & Electronic Engineering programme, laboratory practical is very important in the training of the graduates. To reflect this importance of practical work, a minimum of 9 hours per week or 135 hours per semester (equivalent to 3 credit units) is spent on students' laboratory practical. 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 section 2, 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 based on the evaluation of their performance in written examination (which tests theory) and their performance in the laboratory work (based on actual conduct of experiments and their reports).

(b) **Tutorials**

There is one hour of tutorial for every four hours of lecture. Thus, a 3-unit course of 45 hours per semester attracts about 10 hours of tutorials.

(c) **Continuous Assessment**

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

(d) **Examinations**

In addition to continuous assessment, final examinations are normally given for every course at the end of each semester. All courses are graded out of a maximum of 100 marks comprising:

Final Examination: 70%
Continuous Assessment (Quizzes, Homework, Tests, Practical): 30%

Description of Students Status on Semester/Session Results

1. Dean's List (DL)
2. In Good Standing (IGS)
3. Deficient (DEF)
4. Probation (PR)
5. Withdrawal (WD)

Note

i. Any student that is able to make GPA or CGPA of 4.0 and above shall be deemed to be in the Dean's list of exceptionally good students so as to encourage such a student.

ii. A student shall be deemed to be in good standing if he/she had earned a GPA/CGPA/ of 2.0 and above; and had not failed any course(s).

SECTION TWO:

FACULTY COMMON COURSE STRUCTURES, SYNOPSES AND CREDIT REQUIREMENTS

Section 2 gives the various Faculty Common Course Structures, Synopses and Credit Requirements for 100 and 200 Levels.

2.1 Faculty Common Courses Structures 100 – 200 Levels

100 LEVEL COURSES

Table 2.1: First Semester: 100 Level Courses

S/N	COURSE CODE	COURSE TITLE	LH	T	PH	CU	CH	S
1.	MTH 101	Elementary Mathematics I	2	1	0	3	3	C
2.	MTH 103	Vector, Geometry & Dynamics	2	1	0	3	3	C
3.	STA 101	Probability and Statistics	2	0	0	2	2	C
4.	CHM 101	General Chemistry I	2	1	0	3	3	C
5.	CHM 107	Practical Chemistry I	0	0	1	1	1	C
6.	PHY 101	General Physics I	2	1	0	3	3	C
7.	PHY 107	Practical Physics I	0	0	1	1	1	C
8.	FET 101	Introduction to Engineering	1	0	0	1	1	R
9.	GST 101	Use of English I	2	0	0	2	2	R
10.	GST 103	Use of Library, Study and ICT	2	0	0	2	2	R
11.	GST 105	Nigerian Peoples and Culture	2	0	0	2	2	R
TOTAL			**17**	**4**	**2**	**23**	**23**	

Table 2.2: Second Semester: 100 Level Courses

S/N	COURSE CODE	COURSE TITLE	LH	T	PH	CU	CH	S
1.	MTH 102	Elementary Mathematics II	2	1	0	3	3	C
2.	MTH 104	Elementary Mathematics III	2	1	0	3	3	C
3.	CHM 102	General Chemistry II	2	1	0	3	3	C
4.	CHM 108	Practical Chemistry II	0	0	1	1	1	C

5.	PHY 102	General Physics II	2	1	0	3	3	C
6.	PHY 108	Practical Physics II	0	0	1	1	1	C
7.	PHY 122	General Physics III	2	1	0	3	3	C
8.	FET 102	Technical Drawing I	2	0	0	2	2	C
9.	GST 102	Use of English II	2	0	0	2	2	R
10.	GST 104	Logic, Philosophy & Human Existence	2	0	0	2	2	R
TOTAL			**16**	**5**	**2**	**23**	**23**	

Note:
A student is expected to obtain a **minimum CGPA of 1.50** to enable him/her proceed to 200 level.

200 LEVEL COURSES

Table 2.3: First Semester: 200 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 201	Engineering Mathematics I	MTH 101	2	1	0	3	3	C
2.	FET 203	Engineer-in-Society		1	0	0	1	1	C
3.	MME 205	Engineering Materials		2	0	0	2	2	C
4.	MME 209	Engineering Drawing I		1	0	1	2	2	C
5.	MME 213	General Engineering Laboratory I		0	0	1	1	1	C
6.	MME 217	Workshop Practice I		0	0	1	1	1	C
7.	CSC 201	Computer Programming		2	1	0	3	3	C
8.	CVE 201	Strength of Materials		2	0	0	2	2	C
9.	EEE 215	Basic Electrical Engineering I		2	1	0	3	3	C
10.	GST 201	Communication in French		2	0	0	2	2	R
11.	ENT 201	Introduction to Entrepreneurial Studies		2	0	0	2	2	R
12.	LEP 201	Fundamentals in Speed Reading and Writing Skills		0	0	0	0	0	R
TOTAL				**16**	**4**	**2**	**22**	**22**	

Table 2.4: Second Semester: 200 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S

1.	FET 222	Engineering Mathematics II	MTH 102	2	1	0	3	3	C
2.	MME 208	Engineering Thermodynamics		2	1	0	3	3	C
3.	MME 224	Engineering Drawing II	MME 209	1	0	1	2	2	C
4.	MME 226	Workshop Practice II		0	0	1	1	1	C
5.	MME 228	General Engineering Lab II		0	0	1	1	1	C
6.	MME 230	Applied Mechanics		2	1	0	3	3	C
7.	CHE 228	Engineering Chemistry		2	0	0	2	2	C
8.	CVE 202	Fundamentals of Fluid Mechanics		2	0	0	2	2	C
9.	EEE 224	Basic Electrical Engineering II		2	1	0	3	3	C
10.	LEP 202	Advances in Speed Reading and Writing Skills		0	0	0	0	0	R
11.	FET 226	Students' Work Experience Programme I (SWEP I) for 4 Weeks during holiday		0	0	2	2	2	C
TOTAL				**14**	**6**	**2**	**22**	**22**	

NB: LH = Lecture Hours per week; T = Tutorial duration per week; PH = Practical Hours per week; CU = Credit Unit; CH = Credit Hour; S = Status

2.2 Direct Entry Programme (200 Level)

Table 2.5: Direct Entry Programme: 200 Level Courses – First Semester

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 201	Engineering Mathematics I	MTH 101	2	1	0	3	3	C
2.	FET 203	Engineer-in-Society		1	0	0	1	1	C
3.	MME 205	Engineering Materials		2	0	0	2	2	C
4.	MME 209	Engineering Drawing I		2	0	0	2	2	C
5.	MME 213	General Engineering Laboratory I		0	0	1	1	1	C
6.	MME 217	Workshop Practice I		0	0	1	1	1	C
7.	CSC 201	Computer Programming		2	1	0	3	3	C
8.	CVE 201	Strength of Materials		2	0	0	2	2	C
9.	EEE 215	Basic Electrical Engineering I		2	1	0	3	3	C
10.	GST 101	Use of English I		2	0	0	2	2	R
11.	GST 201	Communication in French		2	0	0	2	2	R

12.	ENT 201	Introduction to Entrepreneurial Studies		2	0	0	2	2	R
13.	LEP 201	Fundamentals in Speed Reading and Writing Skills		0	0	0	0	0	R
TOTAL				**18**	**4**	**2**	**24**	**24**	

Table 2.6: Direct Entry Programme: 200 Level Courses – Second Semester

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 222	Engineering Mathematics II	MTH 102	2	1	0	3	3	C
2.	MME 208	Engineering Thermodynamics		2	1	0	3	3	C
3.	MME 224	Engineering Drawing II	MME 209	2	0	0	2	2	C
4.	MME 226	Workshop Practice II		0	0	1	1	1	C
5.	MME 228	General Engineering Lab II		0	0	1	1	1	C
6.	MME 230	Applied Mechanics		2	1	0	3	3	C
7.	CHE 228	Engineering Chemistry		2	0	0	2	2	C
8.	CVE 202	Fundamentals of Fluid Mechanics		2	1	0	3	3	C
9.	EEE 224	Basic Electrical Engineering II		2	1	0	3	3	C
10.	LEP 202	Advances in Speed Reading and Writing Skills		0	0	0	0	0	R
11.	GST 102	Use of English II		2	0	0	2	2	R
12.	FET 226	Students' Work Experience Programme I (SWEP I) for 4 Weeks during holiday		0	0	0	2	2	C
TOTAL				**16**	**6**	**2**	**24**	**24**	

Note: Any direct entry candidate that has evidence of having done and passed any of the above listed courses should present it for consideration and acceptance while others can apply for extra credit unit to accommodate the total credit as required.

2.3 Faculty Common Course Synopses

Presented below are the synopses of all the courses presented in Tables 2.1 to 2.6. The Units of each course has been indicated.

100 Level Courses

MTH 101 Elementary Mathematics I (3 Credit Units)
(Algebra and Trigonometry)

Elementary set theory, subsets, union, intersection, complements, and 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 103 Vector, Geometry & Dynamics (3 Credit Units)
Geometric representation of vectors in 1- 3 dimensions, components, direction cosines. Addition, Scalar, multiplication of vectors, linear independence. Scalar and vectors products of two vectors. Differentiation and integration of vectors with respect to scalar variable. Two-dimensional co-ordinate geometry, Straight lines, circles, parabola, ellipse, hyperbola. Tangents, normals, Kinematics of a particle. Components of velocity and acceleration of a particle moving in a plane. Force, momentum, laws of motion under gravity, projectiles, resisted vertical motion. Angular momentum. Simple harmonic motion, elastic string, simple pendulum, impulse. Impact of two smooth spheres and of a sphere on a smooth surface.

STA 101 Probability and Statistics (1 Credit Unit)
Permutation and Combination. Concepts and principles of Probability. Types and distribution of random variables; the binomial. Probability and distribution Functions. Basic distributions: Bernoulli, Binomial, Elementary principles of probability. Poisson, hypergeometric: normal distributions: Expectations and moments of random variables: Probability of sampling from tables or random numbers: selected applications. Generation of Statistical events from set-theory and combinatorial methods.

CHM 101 General Chemistry I (3 Credit Units)
Matter, atoms, molecules, chemical reactions and chemical equations. Laws of chemical combination and stoichiometry. Atomic structure, electronic configuration in elements, theory of valences, chemical bonding, including covalent, ionic, metallic and hydrogen bonding. The periodic classification of elements and the periodic table, blocks, rows, and groups of elements. General features of the chemistry of s-, p-, d-, and f-blocks of elements. Modern electronic theory of atoms; Isotopes – origin, detection, concentration and separation. Natural and artificial radioactivity, stability of nuclides, fission and fusion of elements. Measurement of radioactivity and calculations involving radioactive reactions. Chemical bonding; Properties of gases and the gas laws. The kinetic theory of gases, deviations from the ideal gas equation, the van der Waal equation, liquefaction of gases and the Joule-Thompson effect. Solutions, definition of terms, colligative properties of solutions –lowering of vapour pressure, Raoul's law, elevation of boiling point, lowering of freezing point and osmotic pressure. Kinetics – rates of chemical reactions, homogeneous and heterogeneous equilibria and Thermodynamics; factors affecting rates, activation energy, transition state and chemical catalysis. Chemical equilibria –reversibility of chemical reactions, factors affecting chemical equilibrium, solubility and solubility product, common ion effect. Electrochemistry as an equilibrium process. Heat changes in chemical reactions, heats of reaction and laws of thermo-chemistry.

CHM 107 Practical Chemistry I (1 Credit Unit)

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.

PHY 101 General Physics I (3 Credit Units)
(Mechanics, Thermal Physics and Waves)
Units and dimensions. Elements of vector algebra. Kinematics, linear and circular motion. Laws of mechanics and gravitation, simple applications, motion of planets. Conservation laws. Energy, momentum & work. Simple Harmonic Motion. Simple and compound pendulums. Elasticity, moduli of elasticity, bending moments. Fluid mechanics. Temperature and its measurement. Heat capacity, specific heat, latent heat, critical points. Calorimetry. Heat transfer; conduction, convection, radiation. Light wave: reflection, refraction, diffraction and dispersion, colors. Longitudinal and transverse waves. Vibrations in solids. Sound waves in solid, liquids, gases. Pitch, intensity and quality of sound. Electromagnetic (EM) radiation, wave properties, Doppler effect, and Kirchhoff's law.

PHY 107 Practical Physics I (1 Credit Unit)
Selected Experiments from PHY 101 and PHY 102.
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.

PHY 122 General Physics III (Electricity and Magnetism) (3 Credit Units)
Electric Field and Electric potential, Field of force, Electric Field, electric charge, magnetic field nuclear field, Electrostatics Coulomb's law, electric field, potential energy relations, Gauss theorem , Equilibrium potentials, capacitance, Parallel plate and practical forms of capacitors, capacitors in series and parallel, energy stored, dielectrics, action of dielectric charging and discharging a capacitor. Conductors and electric currents, magnetic field and induction, electromagnetic oscillations and waves, applications, A. C. circuits.

FET 101 Introduction to Engineering (1 Credit Unit)
Engineering: What is Engineering; Various fields of Engineering; Functions of Engineering. Dimensions and Units. Conventions in the Methods of Analyses and Measurements. Ideal gas laws, Equation of State and its Deviations; Dalton's law, Henry's Law and Raoul's Law, Antoine equation. What is thermodynamics and laws of thermodynamics?

GST 101: Use of English I (2 Credit Units)
Objectives
GST 101 is designed and taught as a developmental course to first year students that would empower them to efficiently contend with grammatical and linguistic barriers militating against them and their set goals. The use of English course contains additional valuable skills to language proficiency.

Course Outline

1. Man, society and language: Meaning and definition of language; language and man, characteristic & Usefulness of language to man and society and other functions of language, etc.

2. English language and the Nigerian society: English as a world language; Origin of English language and the uses of the language in Nigeria; Problem of learning English as a second language; l2 Varieties of English language in Nigeria, e.g. Pidgin, etc.

3. Study and listening skills: Lectures and their nature; Note-taking, Effective listening & study skills, obstacles to effective listening skills.

4. Reading skills: Types of reading; the process of reading; Reading deficiencies; Techniques for Effective reading; other methods of study reading.

5. Vocabulary development: The Dictionary and its uses; Kinds of vocabulary; Origin of some root words; How to develop good vocabulary & diction.

6. Varieties of the English language such as formal and non-formal/informal, literal & literary, British & American, etc.

7. Element of Meaning; levels of meaning: Denotation & Connotation, etc.

8. Elements of Grammar & Parts of Speech (Preliminary teaching)

GST 103: Use of Library, ICT and Study Skills (2 Credit Units)

Course Objectives

The objective of this course is to equip the students with the techniques of information search and retrieval, the knowledge of using an academic library and information center as well as the study skill and introductory research techniques for carrying out class assignment and undertaking independent studies. There is also the need to let students gain vital knowledge of the resources and services available in an academic library, which is fundamentally different from the school library that he is familiar with from his primary and secondary school days. This difference is evident in the resources content, organisational context, operational characteristics, infrastructural or structural complexities.

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 105 Nigerian Peoples and Culture (2 Credit Units)

The concept of culture. Study of Nigerian history, culture and arts in pre-colonial times. Social beliefs and the Nigerian's perception of his world. Culture areas of Nigeria and their characteristics. Evolution of Nigeria as political unit. Indigene/settler phenomenon. Concepts of trade, economic self-reliance and social justice. Individual and national development, norms and values. Negative attitudes and conducts (cultism and related vices). Re-orientation of moral and national values as well as moral obligations of citizens. Environmental problems. At the end of the course, students should be able to define and discuss the concept and processes of culture, norms and values in our tradition.

MTH 102 Elementary Mathematics II (Calculus) (3 Credit Units)
Functions of Real Variables: Graph, Limits and Concepts of Continuity. Techniques of Differentiation of Algebraic and Trigonometric Functions, Higher Order Derivatives, Maxima and Minimal, Leibnitz Rule, Application of Differentiation. Integration as Inverse of Differentiation, Methods of Integration, Definite Integra. Application to Areas, Volumes, Moment of Inertial. Approximate Integration: Trapezoidal and Simpson's Rule, Taylor's and McLaurin's Theorems, partial Differentiation and Implicit Differentiation.

MTH 104 Elementary Mathematics III (3 Credit Units)
Vectors: Algebra of Vectors; Coplanar Forces; Their resolution into components, equilibrium conditions moments and couples, parallel forces; friction; centroids and centers of gravity of particles and rigid bodies; equivalence of sets of coplanar forces. Kinematics and rectilinear motion of a particle, vertical motion under gravity, projection; relative motion. Dynamic of a particle. Newton's laws of motion; motion of connected particles.

CHM 102 General Chemistry II (3 Credit Units)
Brief historical survey of the development and importance of organic chemistry. The carbon atom and bonding in organic compounds, sp^3, sp^2, and sp hybridization and their structural and optical implications of isomerism. Functional groups, homologous series, classification of organic compounds, isolation, purification and derivatization of organic compounds, qualitative and quantitative analyses of organic compounds. IUPAC (systematic) nomenclature of organic compounds. Structural determination in organic chemistry. Electronic theory in organic chemistry. Saturated and unsaturated hydrocarbons. Periodic table and periodicity of properties. Valence forces, structure of solids. The chemistry of selected metals and non-metals.

CHM 108 Practical Chemistry II (1 Credit Unit)
Practical chemistry class deriving from CHM102. Use of different types of balance for weighing. Volumetric analysis. Acid-base titrations requiring the use of one or more indicators – partition coefficient. Qualitative inorganic and organic analysis. Redox reactions – Chromatography. Determination of heat of neutralization, rate of reaction, activation energy of reaction, solubility of a sparingly soluble salt (e.g. Ca salts)

PHY 102 General Physics II (3 Credit Units)
(Electricity, Magnetism and Modern Physics)

Electrostatics; Coulomb's law, Gauss's law; simple applications. Electric field, Electrostatic potential. Energy in electric field. Capacitance. Insulators, conductors, dielectrics; polarization. Electric current. Ohm's law, circuit analysis. Thermoelectricity. Magnetic effects of current, Ampere's law, Applications. Permanent magnetism, earth's magnetic field. Faraday's law of electromagnetic induction. Maxwell's equations, Alternating currents, AC circuits, Basic electronics, digital logic, elementary circuits. Measuring devices. Motion of a charged particle in electric and magnetic fields, Hall Effect. Atomic and Nuclear structure, Nuclear fission and fusion, Nuclear reactor.

PHY 108 Practical Physics II (1 Credit Unit)
Students will carry out laboratory experiments covering the main aspects of PHY 102 after having being introduced to quantitative measurement techniques, the treatment errors and graphical analysis.

FET 102 Technical Drawing I (1 Credit Unit)
Drawing Tools: Description, Uses and Maintenance, Line Work: Definition of points, lines and planes, Types of lines (Description, Uses), Dimensioning: Examples like arrowheads, solid dots and crosses; of straight lines, of circles, inadequate space dimensioning, Common Errors in line drawings, Lettering, Drawing Sheets Format, Border Lines and Title Block. Plane Geometry: Angles (Types and their construction), Triangles (Types and their construction), Quadrilaterals (Types and their construction), Polygons (Types and their construction), Circle and It's Parts, Inscribing and Circumscribing Circles, Tangents (Internal and External), Ellipse (Different Methods of construction), Plane and Diagonal Scales. Orthographic Projection: Basic Introduction: Description, Plan, Elevations, 1st Angle Projection, 3rd Angle Projection, Sectioning, Exercises.

GST 102: Use of English II (2 Credit Units)

Course Outline

A. Oral English
B. Parts of Speech (direct and indirect speeches)
C. Sentences (parts and types)
D. Phrase and Clauses
E. Speech Writing
F. Essay and Comprehension (paragraphs-qualities outline)
G. Technical Writing (minutes, reports, scientific writing)

A. ORAL ENGLISH
a. Definition of Sound
b. Organs of Speech
c. Differentiating Sound from letters of the Alphabet
d. Differentiating Sound in English (Consonant, Vowels)
e. Places and Manner of Articulation

f. Transcription, Plural Markers and Past Tense Markers
g. Syllable, Stress and Intonation in English

B. PARTS OF SPEECH

a. Types (Lexical and Grammatical Types)
b. Noun, Pronoun
c. Verbs, Adverbs, Adjectives
d. Preposition, Conjunctions

C. PHRASES AND CLAUSES

a. Phrase, Types and functions
b. Clause, types and functions

D. SENTENCES

a. Definition of a sentence
b. Elements of a sentence
c. Types of sentences
d. Functions of the English sentence

E. SPEECH WRITING

a. Qualities of a good speech
b. Structure and outline of a good speech
c. Speech presentation
d. Elocution and appearance
e. Direct and Indirect Speech

F. ESSAYS AND COMPREHENSION

a. Types of Essays (Narrative, Descriptive, Expository, Argumentative, Persuasive)
b. Features of Essay (Titles, Paragraphs, Conclusions)
c. Formats of Essays (Content, Organisation, Mechanical Accuracy, Expression)
d. Comprehension Passages and their features
e. Figurative Expressions and Figures of Speech
f. Developing a Paragraph (topic sentence, thesis statement, linking and transitional paragraphs)

G. LETTER WRITING AND TECHNICAL WRITING

a. Types and uses of Letters (Formal and Informal Letters)
b. Features of letters
c. Reports Writing (Uses, types and classifications of report)
d. Memo (Types, uses and layout of memo)
e. Minutes (Purposes, style/methods of writing minutes)
f. Scientific Writing

GST 104 – LOGIC AND PHILOSOPHY OF SCIENCE (2 Credit Units)

PART A - PHILOSOPHY

Objectives
The course Philosophy and Logic generally introduces the students to the origin of knowledge; sources of knowledge, methods of arriving at valid knowledge, and history of philosophical theories from the ancient to the contemporary period. It helps them to develop a critical attitude and thinking towards their various course of study. It helps them with the tools for evaluating and critically examining theories and policies in their courses of study for better understanding. Finally, it provides a holistic view about reality as against fragmented views about the world as well as improving their reasoning power.

PART B- LOGIC

1. **LOGIC**: Meaning and nature of Logic
   Why we study logic, components of an argument, types of sentences, types of argument, laws of thought.

2. **DEFINITION AND THEIR PURPOSES**
   Kinds of definitions- stipulate, lexical précising, theoretical, persuasive. Functions and purposes of definition.

3. **LOGICAL OPERATORS IN SYLLOGISTIC LOGIC**

4. **FALLACIES IN REASONING**
   Kinds of fallacies
   Material fallacies and linguistic fallacies.

200 Level Courses

FET 201- Engineering Mathematics I (3 Credit Units)
Calculus and relevant theories. Differentiation, integration. Taylor and Maclaurin's Series and equations. Elements of Linear Algebra. Determinants. Properties and evaluation of Matrices, non-singular matrices. Ranks of matrices and their evaluation, symmetric and skew symmetric matrices. Differential Equation. First and simple case of second order Application to Engineering systems. Co-ordinate systems. Rectangular cylindrical, spherical co-ordinate systems.

FET 203 Engineer-in-Society (1 Credit Unit)
Science, Technology and Development: Ethical concepts of development. Indicators of development, and the role of science and technology. The contribution of the Government to the process of development and the Nigerian experience in the process of economic development (Nigerian Five Year Development Plans, successes and setbacks). Limits of growth, appropriate technology and a new world of science and technology. Science, Technology and Society: The inter-relationship of social ethics and values, and science and technology. Societal needs and

resources in the genesis and development of science and technology. Social problems, impact assessment, and control of science and technology. Responsibilities of engineers. Science, Technology and Environment: Disruption or enhancement of environmental quality through harmful or sound science and technology in relation to air, space, water, land, populations, agriculture, industry, wild life, human settlements, culture, education, etc. Ethics and Professionalism: Theistic and secular concepts of personal, social and professional ethics. Codes of conduct of engineers. Motivation, control, responsibility, rewards and accountability of engineers and development of an ethical engineering professionalism. Council of Engineers and Engineering Societies.

MME 205 Engineering Materials (3 Credit Units)
Introduction to electronic configuration, atomic structures, inter-atomic bonding mechanisms, crystals 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.
(i) Alloy theory – Application to industrial alloys – steel in particular.
(ii) Engineering Properties – Their control, Hot and cold working, heat treatment, etc. Creep, fatigue and fracture. Corrosion and corrosion control.
(iii) Non-metallic materials – glass, rubber, concrete, plastics, wood and ceramics.
(iv) Elastic and plastic deformations: Defects in metals.

MME 209 Engineering Drawing I (2 Credit Units)
Revision of multi-view representation. Harder examples on two and three view representation (1st and 3rd angles). Harder examples on isomeric drawing to include simple pictorial assembly drawing in isomeric. Harder examples on oblique drawing (Cavalier, Cabinet and Angles other than 45 degrees). Dimensioning. Sections and Convections. Auxiliary views. Representation and specification of threads. Bolted joints. Keys and cottered joints. Conventional representation.

MME 213 General Engineering Laboratory I (2 Credit Units)
Laboratory tests based on all theoretical courses taken in MME 205, MME 217 and EEE 215.

MME 217 Workshop Practice I (Credit Unit)
Introduction to general metals and to machine tools. Processes and operations of various machine tools. Practices, measurements and gauges. Steel rule, micrometer, Vernier caliper, etc. Metal joining processes, oxygen cutting, gas and arc welding, industrial welding processes and inspection of elements. Metal forming and fabrication with emphasis on sheet metal and structural steel. Heat treatment of steels hardening, tempering, normalizing, case hardening. Heat treatment safety.

CSC 201 Computer Programming (2 Credit Units)
Introduction to problem solving methods and algorithm development, designing, coding, debugging and documenting programmes using techniques of a good programming language style, programming language and programming algorithm development. A widely used programming language should be used in teaching the above. E.g. Java. Introduction to high level programming language. Exercises in solving engineering problems using flowchart and pseudo-code.

CVE 201 Strength of Materials (3 Credit Units)
(i) Force equilibrium – free body diagrams, forces, moments, equilibrium of simple structures and machine parts. Kinematics of particles and rigid bodies.
(ii) Concept of stress, strain; Tensile test. Young's moduli and other strength factors.
(iii) Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems. Hoop stresses in cylinders and rings.
(iv) Bending moment, shear force and axial force diagrams for simple cases, Simple torsion and application.

EEE 215 Basic Electrical Engineering I (3 Credit Units)
Basic circuit elements, D.C. Circuit, Kirchhoff laws. Time domain and frequency domain analysis of A.C. circuits. Field theory; coulomb's law, Gauss's law, Bio – Savart law, Ampere's law, Lenz's law Lorentz's law, Analogue electronic. Conductors, Insulators, and Semiconductors. Semiconductor devices, electronics signal amplification. Introduction to machines and machine designs; Transistor characteristics, devices and circuits; Electrical and electrical power measurement.

GST 201 Communication in French (2 Credit Units)
Introduction to French, Alphabets and numeracy for effective communication (written and oral), Conjugation and simple sentence construction based on communication approach, Sentence construction, Comprehension and reading of simple texts.

ENT 201: Introduction to Entrepreneurial Studies I (2 Credit Units)
Objectives
This course is designed to acquaint students with the skills and practice of business so that at the end of the course students will be able not only to discuss the theory and practice of entrepreneurship but also to identify and evaluate new venture opportunities in terms of planning, implementation and launching of new business venture.

Course Outline
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.
The historical and Economic Role of Entrepreneurship. Theory and practice of Entrepreneurship. Starting and managing a new enterprise. Characteristics of entrepreneurs. The identification and evaluation of new venture opportunities: resource utilization, strategy development and successful planning, implementing and launching of new business venture. Analyses of case studies and development of detailed business plan for starting and owning an enterprise.

LEP 201 Fundamentals in Speed Reading and Writing Skills
Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass

communication process. Effective reading skills-extracting main ideas and reading for specific information through speed-reading. Written communication: principles of technical writing.

FET 222 Engineering Mathematics II (3 Credit Units)
Complex Analysis. Elements of complex algebra, elementary complex numbers, Trigonometric, exponential and logarithmic functions, real number, sequences and series. Vectors; Vector algebra in general involving elements, differentiation and integration with great emphasis on application to engineering systems. Scalar and Vector products of 3 or more Vectors. Elements of linear algebra. Calculus – Elementary differentiation with relevant theorems. Differential equations – exact equations. Methods for second order equations. Partial differential equation. Simple cases – Applications.
Numerical Analysis. Errors and Error Propagation, roots of non-linear equations. Newton-Raphson and bisection methods, solutions of systems of linear equations. Gaussian, Gauss-Seidel. Gauss-Jordan, Interpolation: Lagrangian and Finite Differences. Use of MATLAB language in numerical analysis.

MME 208 Engineering Thermodynamics (3 Credit Units)
Introduction to thermodynamics, definitions and laws. The ideal gas, heat and work. Energy resources and heat sources. First and second laws of Thermodynamics. The steady flow energy equation. Properties of substances. Definition of a pure substance, phase changes, relation between properties. Introduction to heat transfer, conduction, convection and radiation. Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

MME 224 Engineering Drawing II (2 Credit Units)
Cams. Integration of solids. Development of surfaces. Detail drawing. Belts, Chains, Gears. Bearing and lubrication arrangement. Couplings brakes, Flexible shafts, Universal joints, etc. assembly drawings. Revisions. Introduction to Computer Aided Drafting: Electronic drawing packages: principle and use in engineering design. Simulation packages: principle and use in engineering.

MME 226 Workshop Practice II (2 Credit Units)
Elementary introduction to types and organisation of engineering workshop, covering jobbing, batch, mass production. Engineering materials: their uses and properties. Safety in workshop and general principles of working. Bench work and fitting: Hand tools, instruments. Carpentry: Hand tools, materials, types of joints, processing of timber. Blacksmith: Hand tools and working principles. Joints and fastenings: bolt, rivet, welding, brazing, soldering Measurement and marking; for uniformity circulatory, concentricity, etc. Standard measuring tools used in workshops; Welding, brazing and soldering; Principles, classification, power source. General principles of working of standard metal cutting machine tools. Invited lectures from professionals.

MME 228 General Engineering Laboratory II (3 Credit Units)
Relevant experiments to illustrate topics covered in courses which include MME 208 (Engineering Thermodynamics), EEE 215 (Basic Electrical Engineering I), MME 205 and MME 217 (Workshop Practice I).

MME 230 Applied Mechanics (3 Credit Units)
Forces, moments, couples. Equilibrium of simple structures. First and second moments of area; centroids. Kinematics of rigid bodies in plane motion. Applications of Newton's laws of motion. Kinetic energy and momentum analysis. Hooke's law, stresses and strains due to loading and temperature. The stress circle, deflection, deflection of beams. Shear forces and bending moments, analytical and graphical methods for structures. Design and analysis of communication towers, standards, and regulations.

CVE 202 Fundamentals of Fluid Mechanics (2 Credit Units)
(i) Elements of fluid statics; density; pressure, surface tension, viscosity, compressibility etc.

(ii) Hydrostatic: Variation of pressure with position in a fluid, equilibrium of a fluid of constant density, measurement of pressure, barometer, manometer, the Bourdon gauge, thrust on plane and curved surface, buoyancy, stability of floating and submerged bodies. Principles of fluid motion: Continuity, Bernoulli's equation, energy transformation in constant density fluid, energy correction factor, stream lines, pressure variation perpendicular to streamlines, flow through sharp edge orifice, pitot tube, venturi meter, nozzle and orifice meter, notches and sharp crested weirs.

(iii) Introduction to fluid dynamics – conservation laws. Momentum equations: momentum equation for steady flow, momentum correction factor, application of the momentum equation, force caused by a jet striking a surface, force caused by flow round a pipe bend, force at a surface force at a nozzle and reaction of a jet.

EEE 224 Basic Electrical Engineering II (3 Credit Units)
Further Treatment in D.C. Circuits: D.C. Steady state responses, Transients in 1^{st} order circuits. Analysis by Superposition, Thevenin Norton and Reciprocity principles. Further Treatment in A.C. Circuits: A.C. circuit elements, voltage and phasors, inductive/capacitive reactance, impedances impedance, conductance, susceptance and admittance. Complex j-operator notations and its application in A.C. circuits. Introduction to electrical machines: Transformers: Constructional features, types, connections (single and Three phases) and application. D.C Machines-types simple treatment and applications. A.C Machines-Single descriptive treatment of induction machines (single and 3- phase), and synchronous machines. Measurement and Instrumentation: General principle of measuring instruments. (Torque and restraining spring relationship). Types of instruments; Ammeters, voltmeters, wattmeters watt.-hour meters. Transducers and Bridge measurements. Cathode ray oscilloscope and its applications. Introduction to Digital Electronics: Binary numbers, binary arithmetic logic gates OR, AND, NOT. Boolean algebra and identities. Simple truth tables and Karnangh maps.

FET 226: SWEP I (2Credit Units) – 4 WEEKS DURING HOLIDAY
On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (4 weeks during the long vacation following 200 level).

SECTION THREE:

SEMESTER COURSES STRUCTURES AND SYNOPSES FOR ELECTRICAL & ELECTRONIC ENGINEERING DEGREE PROGRAMME FROM 300 – 500 LEVELS

3.1 Electrical & Electronic Engineering Course Structures

300 LEVEL COURSES

Table 3.1: First Semester – 300 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 311	Engineering Mathematics III	FET 201	2	1	0	3	3	C
2.	FET 303	Engineering Economics		2	1	0	3	3	C
3.	EEE 301	Communication Principles		2	1	0	3	3	C
4.	EEE 311	Electrical Machines I		2	0	0	2	2	C
5.	EEE 331	Analogue Electronics Circuits I	EEE 224	2	1	0	3	3	C
6.	EEE 341	Physical Electronics	PHY 102	2	1	0	3	3	C
7.	EEE 351	Circuit Theory I	EEE 215/224	2	1	0	3	3	C
8.	EEE 391	Laboratory Practical I		0	0	2	2	2	C
9.	ENT 301	Introduction to Entrepreneurial Studies		2	0	0	2	2	R
TOTAL				**16**	**6**	**3**	**24**	**24**	

Table 3.2: Second Semester – 300 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 322	Engineering Mathematics IV	FET 222/311	2	1	0	3	3	C
2.	FET 324	Engineering for Sustainable Development I		1	0	0	1	1	R
3.	EEE 312	Electrical Machines II	EEE 311	2	0	0	2	2	C

4.	EEE 322	Electromagnetic Fields and Waves I		2	1	0	3	3	C
5.	EEE 332	Digital Electronics Circuits II	EEE 215/331	2	1	0	3	3	C
6.	EEE 352	Circuit Theory II	EEE 351	2	1	0	3	3	C
7.	EEE 362	Measurement and Instrumentation		2	1	0	3	3	C
8.	EEE 392	Laboratory Practical II	EEE 391	0	0	2	2	2	C
9.	FET 390	Students' Work Experience Programme II (SWEP II) for 4 Weeks during holiday	FET 226	0	0	2	2	2	C
TOTAL				**13**	**5**	**4**	**22**	**22**	

400 LEVEL COURSES

Table 3.3: First Semester – 400 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 403	Engineering Communication and Technical Writing		1	0	0	1	1	C
2.	FET 435	Engineering Project, Costing/ Evaluation		2	0	0	2	2	C
3.	FET 437	Engineering for Sustainable Development II		1	0	0	1	1	R
4.	EEE 421	Electric Power Principles		2	1	0	3	3	C
5.	EEE 423	Assembly Language Programming		2	1	0	3	3	C
6.	EEE 425	Control Theory		2	1	0	3	3	C
7.	EEE 431	Data Communications & Networks	EEE 301	2	1	0	3	3	C
8.	EEE 441	Electromagnetic Field and Waves II	EEE 341	2	1	0	3	3	C
9.	EEE 493	Laboratory Practice III	EEE 391/392	0	0	2	2	2	C
TOTAL				**14**	**5**	**2**	**21**	**21**	

Table 3.4: Second Semester – 400 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 490	Students' Industrial Work Experience Scheme (26 Weeks)	EEE 392/493	0	0	6	6	-	C
TOTAL				**0**	**0**	**6**	**6**	**-**	

500 LEVEL COURSES

Table 3.5: First Semester – 500 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 503	Engineering Management & Law I		2	0	0	2	2	R
2.	EEE 517	Advanced Computer Programming and Statistics		2	1	0	3	3	R
3.	EEE 519	Electrical Services Design	EEE 391 & EEE 392	2	0	0	2	2	C
4.	EEE 536	Research Methods/Seminar		0	0	0	2	2	C
5.	EEE 591	Final Year Research Project I		0	0	0	3	3	C
TOTAL				**6**	**1**	**0**	**12**	**12**	

GROUPS OF ELECTIVES FOR 500 LEVEL FIRST SEMESTER

Table 3.5.1: Power System and Machines Option for 1st Semester

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	EEE 501	Digital Signal Processing		2	1	0	3	3	E
2.	EEE 511	Electromechanical Devices Design		2	0	0	2	2	E
3.	EEE 513	Switchgear And High Voltage Engineering		2	0	0	2	2	E
4.	EEE 515	Power Systems Communication & Control		2	0	0	2	2	E
5.	EEE 533	Power System Engineering (System Analysis, Planning & Protection)		2	1	0	3	3	E
6.	EEE 551	Modern Control Engineering		2	1	0	3	3	E

Table 3.5.2: Electronics & Telecommunications Option for 1st Semester

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	EEE 501	Digital Signal Processing		2	1	0	3	3	E

2.	EEE 503	Microcomputer Hardware and Software Techniques		2	1	0	3	3	E
3.	EEE 505	Telecommunications Engineering		2	0	0	2	2	E
4.	EEE 507	Satellite Communications		2	0	0	2	2	E
5.	EEE 553	Digital Communications Systems		2	1	0	3	3	E
6.	EEE 583	Solid State Electronics		2	0	0	2	2	E

Table 3.6: Second Semester – 500 Level Courses

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	FET 504	Engineering Management & Law II		2	0	0	2	2	R
2.	EEE 524	Control Engineering		2	1	0	3	3	C
3.	EEE 532	Reliability & Maintainability of (Electrical & Electronic Components and Systems)		2	0	0	2	2	C
4.	EEE 534	Advanced Circuit Techniques		2	0	0	2	2	C
5.	EEE 594	Final Year Research Project II		0	0	0	3	3	C
TOTAL				**8**	**1**	**0**	**12**	**12**	

GROUPS OF ELECTIVES FOR 500 LEVEL SECOND SEMESTER

Table 3.6.1: Power System and Machines Option for 2nd Semester

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	EEE 522	Power Electronics		2	1	0	3	3	E
2.	EEE 552	Computer Application in Power Systems		2	0	0	2	2	E
3.	EEE 562	Electrical Power Systems Engineering		2	0	0	2	2	C
4.	EEE 574	Electrical Energy Conversion and Storage		2	0	0	2	2	E

Table 3.6.2: Electronics & Telecommunications Option for 2nd Semester

S/N	COURSE CODE	COURSE TITLE	Pre-Requisite	LH	T	PH	CU	CH	S
1.	EEE 526	Telecommunications Services Design		2	0	0	2	2	E

2.	EEE 528	Communication Systems Engineering		2	1	0	3	3	E
3.	EEE 546	Broadcasting & Internet Technology		2	0	0	2	2	E
4.	EEE 558	Mobile & Personal Communication Systems		2	0	0	2	2	E
5.	EEE 564	Digital Programmable Systems		2	1	0	3	3	C
6.	EEE 572	Industrial Electronic Design		2	0	0	2	2	E

3.2 Electrical & Electronic Engineering Courses Synopses

Presented below are the synopses of all the courses presented in Tables 3.1 to 3.6.2. The credit unit of each course has been indicated.

300 Level Courses

FET 311 Engineering Mathematics III (3 Credit Units)
Linear Algebra – Elements of Matrices, determinants, inverse of matrix, theory of linear equations. Eigen-values and Eigen-vectors. Matrix Transformation. Fourier series – Euler coefficients, even and odd functions, sine and cosine functions, simple applications. Gamma, Beta functions. Fourier Transformation. Laplace Transformation. Differential equations of Second Order – series solutions. Legendre and Bessel functions and their properties. Linear equations with constant coefficients, general solutions, complementary and particular solutions, variable coefficient linear equations. Engineering Applications.
Probability and Statistics concept, density and distribution function, moments and moment generating functions, standard distributions, regression and correlation. Vector Calculus. Gradient of a scalar point function. Divergence and curl of a vector, second order derivatives.

FET 303 Engineering Economics (3 Credit Units)
Breakeven analysis: Linear models, including dumping and production above normal capacity, non-linear models. Time value of money: Reasons for changing interest, simple interest, compound interest, nominal and effective interest rates, cash flow diagrams. Compound interest formulas and factors: Derivation of p/f, f/p, A/p, p/A, f/A and gradient series factors {p/G, etc}, deferred annuities; capital recovery; continuous compounding. Basic method of evaluating a single proposal: present worth, annual worth, future worth, internal rate of return, pay-out period, etc. Decision making among alternative proposals: present worth annual worth, future worth, internal rate of return, pay-out period, etc.
Depreciation: concept and reason for depreciation of assets, depreciation as an expense; depreciation methods (straight line, sum –of-the-years digit, declining balance); switching between depreciation methods. Equipment replacement analysis: reasons for replacement of assets (economic advantage, technological obsolescence, expensive maintenance, etc.), basic replacement models, dynamic replacement model. After-tax economic analysis: effects of taxes on economic analyses.

EEE 301 Communication Principles (2 Credit Units)
Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, bandwidth 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.

EEE 311 Electrical Machines I (2 Credit Units)
Introduction of electro-mechanical energy conversion; rotating magnetic fields; performance and methods of speed control of DC machines; power transformer; parallel operation of single – phase transformer; Synchronous machine operation and performance); parallel operation of synchronous generators; generators; single – phase induction motors; reluctance motors; hysteresis motors; faults on machines.

EEE 331 Analogue Electronics Circuits I (3 Credit Units)
Review of single-stage transistor amplifiers using BJTS and FETs Equivalent circuit and calculation of current gain, voltage gain, power gain, input and output 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 341 Physical Electronics (3 Credit Units)
Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

EEE 351 Circuit Theory I (3 Credit Units)
Review of Kirchhoff's Laws; Steady – state and transient state analysis; Review of Laplace transforms: - Direct and inverse transformation, Application of Laplace transformation to RL, RC, RLC circuit of 1 and 2 Loop. Initial and final value theorems; Review of Fourier transformation to circuit analysis. Delta–Wye transformation, Superposition theorem; Reciprocity; Thevenin's and Norton's theorems; Maximum power transfer theorem.

EEE 391/392 Laboratory Practical I & II (6 Credit Units)

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.

GST 301 Introduction to Entrepreneurial Studies (2 Credit Units)
Generating Entrepreneurial ideas and translating same with action, Fundamental changes that stimulate entrepreneurship, Entrepreneurship Equation, Components of Entrepreneurial ventures, Elements of entrepreneurship / The Entrepreneurial process and Entrepreneurial Windows, Contributors of Entrepreneurship, The Sources and Approaches to the study of Entrepreneurship, Salaried employment Vs Entrepreneurship, Youths Entrepreneurship, Female Entrepreneurship and Productivity. Biological studies of management giants/ business thinkers in Nigeria, Africa and Europe. Marketing Practice and Entrepreneurship Evolution of marketing, Roles of marketing, Five divisions of marketing, Responsibilities in marketing, Marketing and Sales, Relevance of Entrepreneurship and SMEs and Introduction to International Trade, Definitions of SME‘s, Advantages and disadvantages, Contributions of SME are to economic development, Institutions and programmers‘ in support of SME‘s, Risk Management, Profit Maximization, Definition of International Trade, Drivers of the current international business operations, Forces that make international business environment, International business environment model, Documentary credit in international trade.

FET 322 Engineering Mathematics IV (3 Credit Units)
Advanced topic in Differentiation and Integration of Complex functions. Cauchy-Riemann and related functions, conformal mapping. Partial Differential equations and applications. Line and Multiple Integrals. Advanced Numerical Analysis numerical solutions to ODE, finite differences. Numerical Iterations. Runge-Kutta, Euler, Predictor-corrector methods. Computer Aided Design.

FET 324 Engineering for Sustainable Development I (1 Credit Unit)
Engineering, Science, Technology and Development: Ethical concepts of development. Indicators of development, and the role of Engineering and Technology. The contribution of the Government to the process of development and the Nigerian experience in the process of economic development (Nigerian Five Year Development Plans, successes and setbacks). Limits of growth, appropriate technology and a new world of Engineering, Science and Technology. Engineering, Science, Technology and Society: The inter-relationship of social ethics and values, and science and technology. Engineering and Technology in the society and service of man. Renewable and non-renewable resources. Man and his energy resources.

EEE 312 Electrical Machines II (2 Credit Units)

Electromechanical energy conversion, emf equations, Synchronous machines, 3-phase alternator. Instability, mathematical representation of characteristics, polar diagram. Synchronous motor: construction, characteristics, circuit diagram. Induction motor: construction, characteristics, torque/slip relations, speed control, induction generator, single-phase induction motor. Applications.

EEE 322 Electromagnetic Fields and Waves I (3 Credit Units)
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 332 Digital Electronics Circuits II (3 Credit Units)
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 352 Circuit Theory II (3 Credit Units)
Foster-Cauer synthesis. 1-port network-synthesis. Active filters. Approximation to nonlinear characteristics of nonlinear resistive circuits. Harmonic analysis techniques. Sensitivity analysis. Use of computer simulation packages is strongly recommended. Introduction to CAD (PSpice, MATLAB & SIMULINK, NI Multisim)

EEE 362 Measurements and Instrumentation (3 Credit Units)
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 voltmeters; 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 analyzers, 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.

FET 390 Students Work Experience Programme II (SWEP II) (2 Credit Units)
On the job experience in industry chosen for practical working experience but not necessarily limited to the student's major (4 weeks during the long vacation following 300 level).

400 Level Courses

FET 403 Engineering Communication & Technical Writing (1 Credit Unit)
Introduction to principle of effective communication with attention to the importance of emphasis, emotive content and style; principles of technical writing, organisation and presentation of technical reports, feasibility studies, technical correspondence. Oral presentation of technical ideals; technical aid in presentation, organisation of practical application.

FET 435 Project Management, Costing and Evaluation (2 Credit Units)
Management Concepts. Project organization, teams, methods and tools for project management. Organization constraints on development. Project Planning Objectives, Resources, Project Estimation, Cost Factors, Decomposition Techniques, Estimation Models. Risk Strategies, Risk Identification, Risk Projection, Risk Monitoring and Management. Work Breakdown Structure, Task Allocation/Effort Distribution. Network Diagrams, PERT and Critical Path Method, Gantt Chart. Scheduling Strategies. Project Tracking, Controlling Progress. Quality measurement. Linear Programming and PERT/CPM applications. System Engineering, Software Development Process, Software Life Cycle, Software Metrics and Measurement.

FET 437 Engineering for Sustainable Development II (1 Credit Unit)
Societal needs and resources in the genesis and development of Engineering, Science and Technology. Social problems, impact assessment, and control of Engineering and Technology. Responsibilities of Engineers. Science, Technology and Environment: Disruption or enhancement of environmental quality through harmful or sound Engineering, Science and Technology in relation to air, space, water, land, populations, agriculture, industry, wild life, human settlements, culture, education, etc. Environmental effects of chemical plastics, Textiles, Wastes and other materials, Chemical and radiochemical hazards. Possible remedies to the environmental effects. Elements of environmental studies.

EEE 421 Electric Power Principles (3 Credit Units)
Introduction to power systems and sources of electric energy, structure of electric system, load characteristics, electric energy transmission and distribution, line impedance, representation and per unit systems, relationship between currents and voltage; regulation of voltage, transmitted power and losses; construction of overhead lines and underground cables; power system equipment: standard and safety.

EEE 423 Assembly Language Programming (3 Credit Units)
Introduction: Language level of abstraction and effect on machine, characteristics of machine code, advantages, justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: Programming model as resources available to programmer, addressing modes, instruction format, instruction set-arithmetic, logical, string, branching, program control, machine control, input/output , etc;

assembler directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service routine. Interfacing of assembly language to C. Intel 80x87 floating-point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

EEE 425 Control Theory (3 Credit Units)
Introduction: definition, examples of control systems. Open-loop and closed-loop control systems. Review of Laplace and inverse Laplace transforms. System modeling: 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.

EEE 431 Data Communications & Networks (3 Credit Units)
Introduction to Data communications: the Development of Data Communications; types and sources of data, simple communications network, transmission definitions, one way transmission, half duplex transmission, transmission codes, transmission modes, parallel transmission, serial transmission, bit synchronization, character synchronization, character synchronization, synchronous transmission, asynchronous transmission, efficiency of transmission, error detection methods and data compression.
Protocols: Introduction to network protocol. Seven Layer ISO-OSI standard protocols and network architecture. Transport protocols, session services protocols, and other protocols. Institute of Electrical and Electronics Engineering 802 standards. Error control and Data Compression: Forward Error Control; error detection methods; parity checking; linear block codes, cyclic redundancy checking; feedback error control, data compression, Huffman coding and dynamic Huffman coding. Local Area Networks: medium access control techniques – Ethernet, token bus and token ring; LAN standards; fibre distributed data interface, metropolitan area network. Peer-to-peer, Client Server. Client-Server Requirements: GUI design standards, interface independence, platform independence, transaction processing, connectivity, reliability, backup and recovery mechanisms. Information Network Software; Features and benefits of major recovery mechanisms. Information Network Software: features and benefits of major Network Operating Systems. Network OS: (e.g. Novell NetWare, UNIX/LINUX, OS/2 & Windows 10). TCP/IP and Network OS. INTERNET: Definition, architecture, services, Internet addressing. Internet protocol, IPv4, IPv6. Internet programming, Intranet. System administration and security issues.

EEE 441 Electromagnetic Field and Waves II (3 Credit Units)
Propagation of electromagnetic waves in free space and in material media. Dielectric, conductors and ionized media. Transmission line theory including wave-guides and resonators, the Smith Chart. Radiating elements and antenna theory.

EEE 493 Laboratory Practical III (2 Credit Units)
Laboratory experiments/investigations based on all theoretical courses taken in the Semester.

FET 490 Students Industrial Work Experience Scheme III (SIWES III) (6 Credit Units)

500 Level Core Courses

FET 503 Engineering Management & Law I (2 Credit Units)
Engineering profession: Professional ethics and conduct. Law: Definition and specification; Applications of business law to engineering; Patents and inventions, trademarks and copyrights; Contracts and contract documents; Engineering business – types, the structure and functions of organisations: Professional problems – legal responsibilities, professional liability, role of engineer in law suits.

EEE 517 Advanced Computer Programming and Statistics (3 Credit Units)
Elements statistics: Distribution and experiments: Law of large number; Numerical iteration procedures, Revision of FORTRAN and BASIC in Engineering. Application programme in computer aided design of Electrical and Electronic systems (such as MATLAB & SIMULINK, PSpice, NI Multisim).

EEE 519 Electrical Services Design (2 Credit Units)
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 591 Final Year Research Project (3 Credit Units)
This course lasts for one academic session along with the normal 500 level courses. 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 (**EEE 536**). The original individual student project will be related to a prescribed electrical engineering problem involving literature review, identification, definition and

formulation of the problem, theoretical investigations, modelling simulation, analysis and design. Each student must attend Engineering Seminars, **EEE 536**.

FET 504 Engineering Management and Law II (2 Credit Units)
Management: Organisational structure and behaviour; engineer to engineer manager transition; Managerial functions, principles and techniques of planning, forecasting, organising technical activities; project selection and management; leadership, styles of leadership and management. Techniques in engineering management – motivated, appraisal, participative and control techniques.

EEE 524 Control Engineering (3 Credit Units)
State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realization of systems having specified transfer function, applications to circuit synthesis and signal processing.

EEE 532 Reliability & Maintainability Engineering (2 Credit Units)
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 534 Advanced Circuit Techniques (3 Credit Units)
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, OrCAD, NI Multisim, Proteus, Visio technical etc., should be encouraged.

EEE 594 Final Year Research Project II (3 Credit Units)
Second phase of investigations involving the implementation of the designed model, debugging, calibration, testing, data collection and analysis, and presentation of a comprehensive written report of the investigations.

500 Level Electives

EEE 501 Digital Signal Processing (3 Credit 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.

EEE 511 Electromechanical Devices Design (2 Credit Units)
Design of transformers, principles of AC and DC machine design, introduction to parks equations.

EEE 513 Switchgear and High Voltage Engineering (2 Credit Units)
Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightening protection, Electric cables and condensers.

EEE 515 Power Systems Communication and Control (2 Credit Units)
Review of transmission line theory. High frequency communication on power lines carrier systems and power line carrier applications. Multiplexing, Telemetering, Signal processing and data transmission. Control of power generation, voltage control, system stability, automatic voltage regulators, regulating transformers.

EEE 533 Power Systems Engineering (3 Credit Units)
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 551 Modern Control Engineering (3 Credit Units)
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. System response and stability. Finite word length effect. Digital 3-term PID design. Introduction to Neural Network. Introduction to Fuzzy control system. Introduction to mechatronics and robotics.

EEE 503 Microcomputer Hardware & Software Techniques
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 an available microprocessor application.

EEE 505 Telecommunications Engineering (3 Credit Units)
Cable telegraphy and telephony characteristics, cross talk, equation, Pole-lines, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, and repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

EEE 507 Satellite Communications (2 Credit Units)
Satellite frequency bands, services, transmission and multiplexing schemes, trans-multiplexing, multiple access schemes. Satellite orbit, satellite motion, paths, geostationary satellites, non-geostationary constellations, satellite subsystems, and satellite 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: compounded FDM-FM-FDMA, SSB-AM-FDMA, amplitude and phase nonlinearities, optimized carrier to noise and intermodulation ratio; TDMA : frame structure, burst structure, frame efficiency, super-frame structure, frame acquisition and synchronization, satellite position determination, TDMA equipment, advanced TDMA satellite systems; CDMA : direct sequence CDMA (DS-CDMA), sequence synchronous and sequence asynchronous DS-CDMA, random access DS-CDMA, link analysis, FH-SS systems, FH-CDMA, acquisition and synchronization.
Demand assignment multiple access (DAMA): types of demand assignments, DAMA characteristics, real time frame reconfiguration, DAMA interfaces, SCPC DAMA, SPADE, digital speech interpolation. Message transmission by FDMA: M/G/1 queue, message transmission by TDMA: pure ALOHA- satellite packet switching, slotted ALOHA, packet reservation, tree algorithm. Advantages and disadvantages of multibeam satellites, interconnection by transponder hopping, interconnection by on-board switching (SS/TDMA), interconnection by beam scanning, ISL: GEO-LEO, GEO-GEO, LEO-LEO, RF and optical links. VSAT networks: VSAT technologies, network configurations, multi-access and networking, network error control, polling VSAT networks.

EEE 553 Digital Communications System (2 Credit Units)
Block Diagram of digital communication system sampling theorem, Shannon's 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 583 Solid State Electronics (2 Credit Units)
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 characterization: controlled and surface-controlled devices.

EEE 522 Power Electronics and Devices (3 Credit Units)
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 552 Computer Application in Power Systems (2 Credit Units)
Revision of linear algebra and numerical methods. Iterative method. Newton Raphson methods. Gauss elimination method, Gauss-Seidel method. Euler method, Runge Kutta 4^{th} order method. Node admittance matrix. Load flow analysis. State estimation. Load forecasting technique. Time series, Kalman filter. MATLAB applications in power systems.

EEE 562 Electrical Power Systems Engineering (2 Credit Units)
Power system modelling load-flow analysis, static flow equations, classification of system variables, generalized n-bus system, network model formulation, use of network analyser and digital computer, optimum operating strategies. Fault analysis. Control strategy. System protection switchgear, circuit breaker.

EEE 574 Electrical Energy Conversion and Storage (2 Credit Units)
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 sources.

EEE 526 Telecommunication Services Design (2 Credit Units)
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 Communication Systems Engineering (3 Credit Units)
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. Radio-wave 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 546 Broadcasting & Internet Technology

Elements of broadcasting system. Studio: Design, acoustic, and equipment. Broadcasting regulations. Frequency spectrum: allocation, assignment, and licensing. Regulatory bodies. Design, configuration, and services of CATV, MATV, MMDS systems. Multipath problems. Polarization, field strength, and footprint. Transmitter power rating, beam-width, interference and minimum separation. Frequency spectrum management of digital and analogue broadcasting. Antenna design and installation for radio, television, and satellite. Antenna support: Mast, Tower, High Altitude design and application. Digital Audio Broadcasting. Analogue television standards: Digital Television standards: MPEG, DVB, channel coding techniques. HDTV. Digital television/Monitor set: LCD, and Plasma technology. Internet Technology: The Internet, definition and services. Internet architecture, OSI layers, TCP/IP, Internet addressing, IPv4, IPv6. Internet broadcasting: principles, components, standards, and applications.

EEE 558 Mobile & Personal Communication Systems

Evolution and examples of mobile radio communications. Basic cellular system, Frequency reuse, Roaming, Hand-off strategies, Co-channel interference, Traffic and Grade of service. System capacity and improvement. Propagation path loss, multipath propagation problem, Raleigh fading, Rician distribution. Doppler effect. Field strength prediction models. Standards and overview of analogue and digital cellular systems: AMPS, TACS, GSM, WCDMA, CT2, PCN, DECT, PHS. Frequency management and channel assignment. GSM: Architecture, elements, and standard interfaces. Third Generation Wireless Standards. Paging & SMS services and technologies. Call Processing. Signaling; Roaming and mobility management; Route optimization.

EEE 564 Digital Programmable Systems (3 Credit Units)

Aims

To provide students with a sound understanding of the structured design and implementation of digital electronic systems as application-specific logic circuits.

Students will be exposed to the principles of digital electronic systems design and implementation using hardware description language (HDL) based approaches. They will learn methods for systematically designing combinational and sequential circuits that satisfy their functional specifications using state-of-the-art ECAD facilities and design flows. Theoretical knowledge will be complemented by practical skills gained through a design case study involving laboratory experience in the design, simulation and synthesis of a relatively simple system and its implementation as an FPGA circuit.

Content

Introduction and fundamentals

Introduction of VHDL and description of digital systems. Digital system design flow based on VHDL programming. Finite State Machine. Sequential circuits design. Structured Design: Design constructs, Design Levels, Geometry-based interchange formats, Computer aided electronic system design tools, Schematic circuit capture, Hardware description languages, Design process . Introduction to VHDL: language, design. Concurrent VHDL, Sequential VHDL, Advanced features of VHDL. Structural level modeling, Register-Transfer level modeling, FSM with

datapath level modeling, Algorithmic level modeling. Introduction of ASIC,.FPGA Design. Paradigm, FPGA synthesis, FPGA/CPLD Architectures. VHDL synthesis, optimization and mapping, constraints, technology library, delay calculation, synthesis tool, synthesis directives. Computer aided design of logic circuits.

VHDL basic concepts
VHDL data objects, data types and operators. Event, signal, waveform and delay. Discrete event simulation in VHDL.

Modeling system behavior
Description of entity-architecture pair, concurrent signal assignment, modeling combinational logic circuit. Process construct, attributes of signals, Wait statement, modeling sequential logic circuit, modeling finite state machine.

Modeling system structure
Component declaration and instantiation. Hierarchy and abstraction of structural model. Generics and Generate construct for modeling regular structure. Configuration and component binding.

Test bench, subprogram and text-based I/O
Test bench design and Assert statement. Functions and procedures, packages and libraries. File based input and output.

EEE 572 Industrial Electronics Design
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.

SECTION FOUR:

LABORATORY AND EQUIPMENT REQUIREMENT FOR ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME

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 this 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. In this handbook, we are interested in just Electrical and Electronic Engineering programme laboratory facilities.

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

The Central Electrical and Electronics Laboratory with technical facilities is shown below.

4.1.1 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 Laboratory

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 organizations. 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 and electronics workshop.

(b) Experiments

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 astable multi-vibrators)
Memory circuits and counters.
Software packages e.g. PSPICE, NI MULTISIM & SOFTWARE FOR PCB DESIGN

(iv) Measurements and Instrumentation:

Electrical components:

- Resistors
- Tolerance, power rating, colour coding, and 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, magneto-electric variable impedance, thermos-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 Amplifier
Uses as adder/substractor, scaler, integrator and 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. MATLAB & SIMULINK, MAPLESOFT MAPLE, 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, 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

Below is the list of what we already have in the Department:

ELECTRICITY AND TELECOMMUNICATIONS LAB

1. TPS – 3321: Electricity & Semiconductors Trainer System -----(12 units).

FINAL YEAR PROJECT LAB

1. TPS – 3090: 8051 Student Training and Project Development ---(10 units).
2. TPS – 3098: Altera PLD Student and Project ----(10 units).

4.2 Specialization-Based Laboratory Facilities

The list of Specialization-Based Laboratories for Electrical and Electronic Engineering include:

- Control and Instrumentation Laboratory
- Electronics Laboratory
- Microprocessor and Digital System Laboratory
- Computer Engineering Laboratory (Hardware and Software)
- Communication Laboratory
- Energy Laboratory
- Electric Power/Machine Laboratory

Below is the list of equipment that the Department already has.

LIST OF EQUIPMENT AVAILABLE IN POWER AND MACHINE LABORATORY

S/N	NAME OF EQUIPMENT	MODEL	SERIAL NO.	MANUFACTURER	QTY
1	Transformer trainer (Single Phase & 3-Phase)	XPO-TT		Anshuman	1
•	**Accompanying Modules***				
1a	Input 2-Phase DOL Starter Panel	EMT1	1208033	Tech PVT. Ltd.	1
1b	AC Secondary Voltmeter Panel	EMT2	1208007	Tech PVT. Ltd.	1
1c	Dual Range AC Ammeter Panel	EMT3	1208008	Tech PVT. Ltd.	1
1d	FWD-OFF-REV. Switch Panel	EMT4A	1208032	Tech PVT. Ltd.	1
1e	Milliohm Meter Panel (VI Method)	EMT6C	1208006	Tech PVT. Ltd.	1

1f	Lamp Load Panel	EMT7	1208009	Tech PVT. Ltd.	1
1g	AC Load Resistor Panel	EMT14A	1208030		1
1h	DC Load Resistor Panel	EMT14B	1208030		1
1i	230V/200V/200VA Single Phase Transformer Panel	EMT15G	1208012		1
1j	230V/200V/300VA Single Phase Transformer	EMT15F	1208013		1
1k	1-Phase A.C Input Panel	EMT16A	1208034		1
1l	Integrated A.C (1 Phase) Measurement Panel	EMT20F	1208031		1
1m	Three Phase Dimmer		1811013		1
1n	Three Phase Transformer Panel	EMT15H	1208006		1
1o	AC Load Inductive Panel	EMT15A	1812030		1
1p	FWD/REV, Star-Delta Starter Panel	EMT4	1812049		1
2	D.C Shunt Machine (Motor)	DM120-22055			1
3	D.C Series Machine	XC.100.100-126S	1205.8617	TESCA TECH. PVT. LTD.	1
4	D.C Compound Machine	DM120-220C		MCP LAB. ELECTRON	1
5	A.C Squirrel Cage Induction	IA3-100S-02	TR1205.1809	TESCA TECH. PVT. LTD.	1
6	Three-Phase Synchronous Motor	TM150-220S		MCP LAB. ELECTRON	1
7	Single Phase Start & Run Capacitors Motor	SM120-220SR		MCP LAB. ELECTRON	1
8	Electrical Machine Trainer	ED-5300		ED CO., LTD.	1
8a	Field Rheostat	ED-5300	5301	ED CO., LTD.	1
8b	Starting Rheostat	ED-5300	5302	ED CO., LTD.	1
8c	AC/DC Machine Load Unit	ED-5300	5303	ED CO., LTD.	1
8d	Three-Phase Load Unit	ED-5300	5304	ED CO., LTD.	1
8e	Variable R-C-L Load Unit	ED-5300	5305	ED CO., LTD.	1
8f	AC/DC Power Supply	ED-5300	5306	ED CO., LTD.	1
8g	AC Volt/Ampere Meter	ED-5300	5307	ED CO., LTD.	1
8h	DC Volt/Ampere Meter	ED-5300	5308	ED CO., LTD.	1
8i	DC Milliammeter	ED-5300	5309	ED CO., LTD.	1
8j	AC/DC Machine Field Frame	ED-5300	5310	ED CO., LTD.	2
8k	Auto Driving Unit	ED-5300	5311	ED CO., LTD.	1
8l	Pole Changing Unit	ED-5300	5312	ED CO., LTD.	1
8m	DC Machine Board	ED-5300	5313	ED CO., LTD.	1

8n	Three-Phase Machine Board	ED-5300	5314	ED CO., LTD.	1
8o	Rotary Convertor Board	ED-5300	5315	ED CO., LTD.	1
8p	Compound Motor Board	ED-5300	5316	ED CO., LTD.	1
8q	Speed Control of Induction Motor Board	ED-5300	5317	ED CO., LTD.	1
8r	Repulsion Motor Board	ED-5300	5318	ED CO., LTD.	1
8s	Split-Phase Motor Board	ED-5300	5319	ED CO., LTD.	1
9					
9a	A Type Rotor of Disc Slot		A01	ED CO., LTD.	1
9b	B type Rotor of Disc Slot		A02	ED CO., LTD.	1
9c	2 Pole Rotor		A03	ED CO., LTD.	1
9d	3 Pole Rotor		A04	ED CO., LTD.	1
9e	Winding Rotor		A05	ED CO., LTD.	1
9f	Sport Style Rotor		A06	ED CO., LTD.	1
9g	Needle Rotor		A07	ED CO., LTD.	1
9h	Circle Permanent Magnet		A08	ED CO., LTD.	2
9i	Wide Magnetic pole for Permanent Magnet		A09	ED CO., LTD.	2
9j	Wide Magnetic Pole for the Field Coil		A10	ED CO., LTD.	5
9k	Narrow Magnetic Pole for the Field Coil		A11	ED CO., LTD.	6
9l	Polarized Magnetic Pole for the Field Coil		A12	ED CO., LTD.	2
9m	Field Coil/300 Turns		A13	ED CO., LTD.	6
9n	Field Coil/700 Turns		A14	ED CO., LTD.	2
9o	Field Coil/1700 Turns		A15	ED CO., LTD.	2
9p	A Type Brush Holder Set		A16	ED CO., LTD.	1
9q	B Type Brush Holder Set		A17	ED CO., LTD.	1
9r	C Type Brush Holder Set		A18	ED CO., LTD.	1
10	Electronic toolbox				1
11	Power Factor Meter Power Factor Meter	JL – 08; JL – 05		MCP LAB. ELECTRONICS	2
12a	Resistive Load (Single Phase)	SRL – 1000		MCP LAB. ELECTRONICS	1
12b	Resistive Load (3 Phase)	TRL - 3000		MCP LAB. ELECTRONICS	1
13a	Inductive Load (Single Phase)	SIL - 1000		MCP LAB. ELECTRONICS	1
13b	Inductive Load (3 Phase)	TIL - 3000		MCP LAB. ELECTRONICS	1
14	Capacitive Load (Single Phase) Capacitive Load (3 Phase)	SCL – 1000 TCL 3000		MCP LAB. ELECTRONICS MCP LAB. ELECTRONICS	1

16	DC Voltmeter (Digital) DC Voltmeter (Digital) DC Voltmeter (Digital) DC Voltmeter (Digital) DC Voltmeter (Digital)	DV – 101 DV – 101 DV – 101 DV – 101 DV - 101	1.376951 1.376962 1.376942 1.376949 1.376966	LUTRON LUTRON LUTRON LUTRON LUTRON	5
17	DC Ammeter (Digital) DC Ammeter (Digital) DC Ammeter (Digital) DC Ammeter (Digital) DC Ammeter (Digital)	AA – 104 AA – 104 AA – 104 AA – 104 AA – 104	1.160660 1.160657 1.160650 1.160678 1.160647	LUTRON LUTRON LUTRON LUTRON LUTRON	5
18	Digital Multimeter (Clamp) Digital Multimeter			2 2	
19	Ward Leonard DC Machine (220Ω/2.8A Rheostat)	NV7036A	111101	NMS TECH. PVT. LTD.	1
20	Single Phase AC Automatic Voltage Regulator	SVC – C5KVA	1704HB160038	VINTECH	
21	Three Phase AC Automatic Voltage Regulator	SVC – C5KVA	1704HB160038	VINTECH	1
22	3 Phase Vriac 10A				1

LIST OF EQUIPMENT AVAILABLE IN ENERGY LABORATORY

S/N	EQUIPMENT NAME		MANUFCTURER	QTY
1.	TPS – 3720: Solar Energy Training System		Skill -G	2
2.	TPS – 3730: Wind Energy Training System		Skill - G	2

LIST OF EQUIPMENT AVAILABLE IN BASIC ELECTRICITY LABORATORY

S/N	EQQUIPMENT NAME	MODEL	SERIAL NO.	MANUF.	QTY
1	Decade Resistance Box	RBOX – 408	I.335886	LUTRON	2
2	Decade Capacitance Box	CBOX – 406	I.325568	LUTRON	2
3	Decade Inductance Box	LBOX – 405	I.328288	LUTRON	2
4	Centre-Tapped Transformer Voltage-Type Current-Type Shunt-Type	 F4 – 101 F4 – 201 F4 – 301		 MCP LAB. ELECTRONICS MCP LAB. ELECTRONICS MCP LAB. ELECTRONICS	 2 2 2

5	Function Generator Function Generator	FG – 2003 LW – 1641	20110939 0457649	LUTRON LW	1 1
6	Analogue Multimeter Digital Multimeter (Clamp) Digital Multimeter			SANNUO	5 5 5
7	**Two channel Oscilloscope with probes** 50mhz Oscilloscope 40mhz Oscilloscope 20MHZ Oscilloscope				 2 2 6
8	Single Phase AC Automatic Voltage Regulator	SVC – C5KVA	1704HB160038	VINTECH	1
9	Fixed Frequency Oscillator			LAB AIDS	1
10	Electronic Toolbox				1
11	Low voltage Power supply unit (0-30v/1A)				1
12	AC Power Supply unit 250/4.5A output				1
13	TPS 3321 Trainer		SKILL G		6
14	DC Power Supply 24/2A				1

LIST OF EQUIPMENT AVAILABLE IN COMMUNICATIONS LABORATORY

S/N	EQUIPMENT NAME	MODEL	SERIAL NO.	MANUFACTURER	Qty
1	TPS – 3421: Analogue Communication Training System	SKILL – G			12
2	TPS – 3431: Digital Communication Training System	SKILL –G			12
3	TPS – 3714: Communication System	SKILL - G			10
4	TPS – 3481: Optical Communication Trainer	SKILL G			12
5	**Two channel Oscilloscope with probes** Digital Oscilloscope				 3

	50mhz Oscilloscope 40mhz Oscilloscope 100Mhz Oscilloscope Function Generator Digital Mutimeter				2 2 2 2 5
6	Communication System Trainer (Amplitude MOD-DEMOD)	XPO-COM (CM6)	1201114	ANSHUMAN	1
7	Communication System Trainer (Frequency MOD-DEMOD Panel)	XPO-COM (CM7)	1201110	ANSHUMAN	1
8	Fiber Optics Trainers (With Accessories)	ST 2502	12111675	TECH-BOOK	1
9	Digital Circuits Development Platform (With Accessories)	ST 2611	01123158	TECH-BOOK	1
10	Error Detection & Correction Cyclic Codes (With Accessories)	ST 2120	111134	TECH-BOOK	1
11	PCM Generation & Demodulation Using Codec Chip (With Accessories)	ST 2123	111166	TECH-BOOK	1
12	Optical Fiber Communication	ST 2501	11111056	TECH-BOOK	1
13	TDM Pulse Code Demodulator & Receiver	ST 2154	0112133	TECH-BOOK	1
14	Digital Communication Trainer	ST 2155	0112104	TECH-BOOK	1
15	Analog Digital Lab	ST 2613	01121397	TECH-BOOK	1
16	Analog Circuits Development Platform	ST 2612	07112271	TECH-BOOK	1
17	Digital Communication Trainer	ST 2157	02122166	TECH-BOOK	1
18	Digital Communication Trainer	ST 2156	0112142	TECH-BOOK	1
19	Digital Communication Trainer	ST 2156	0112152	TECH-BOOK	1
20	Digital Communication Trainer	ST 2151	0112107	TECH-BOOK	1
21	TDM Pulse Code Modulation Transmitter	ST 2153	0112148	TECH-BOOK	1
22	PAM-PPM-PWM Modulation – Demodulation Technique	ST 2110	12111551	TECH-BOOK	1
23	Multiplexer/Demultiplexer-Coder/Decoder Trainer	ST 2503	1111489	TECH-BOOK	1
24	Two Channel CDMA Trainer	ST 2117	061188	SCIENTECH	1

25	Differential Pulse Code Modulation/Demodulation Trainer	ST 2113	0212139	TECH-BOOK	1
26	MSK Modulation/Demodulation Trainer	ST 2116	111123	TECH-BOOK	1

LIST OF EQUIPMENT AVAILABLE IN ELECTRONICS LABORATORY

S/N	EQUIPMENT NAME	QTY
1	TPS – 3321 Training System	6
2	TPS – 3371: Analog, Digital & Hardware Electronics Training System	5
3	TPS – 3712: Modern Technology & Electronics System	10
4	Digital Transistor Tester	2
5	Analogue Multimeter with Probe	5
6	Digital Multimeter with Probe	6
7	Electronic Tool Box	4
8	Function Generator	2
9	DC Power Supply ± DC @	1
10	0.5A 15v DC @ 1.5A	2
11	AC Milliameter 0 - 1000 mA	5
12	AC Milivoltmeter 0 - 1000 mV	5
13	**Two channel Oscilloscope with probes** Digital Oscilloscope 50mhz Oscilloscope 40mhz Oscilloscope 20mhz Oscilloscope Function Generator	 2 2 5 5 2
14	Power Supply Units	
	- AC Power Supply, Input	1
	Voltage 220v; Output	
	Voltage O - 250 AC.	
15	- DC Power Supply Unit	1
	Excitation Voltage24v/2A, 220v/0.5A	
16	Analogue Multimeter Digital Multimeter (Clamp) Digital Multimeter	5 5 5

LIST OF EQUIPMENT AVAILABLE IN MICROPROCESSOR AND DIGITAL SYSTEMS LABORATORY

S/N	EQUIPMENT NAME	QTY
1	TPS - 3351 Digital Electronics Training System	12
2	TPS – 3371 Analog , Digital & Hardware Electronics Trainig system	5
3.	TPS – 3491: Analogue-Digital Signal Conversion Training System	12

LIST OF EQUIPMENT AVAILABLE IN COMPUTER ENGINEERING LABORATORY

S/N	EQUIPMENT NAME	QTY
1	TPS 3200 Hardware & Peripheral Trainer	10
2	TPS - 3719 Technology and the Computer Trainer	10
1.	APPLIC – 12: 8051/8032 Microcontroller Module	10
2.	APPLIC – 18: 8088 Microprocessor Module	10

LIST OF EQUIPMENT AVAILABLE IN INTRUMENTATION AND CONTROL LAB.

S/N	EQUIPMENT NAME	QTY
1	Thermocouple Demonstration Set- Up using K-Type Transducer	1
2	RTD Demonstration Set-Up using PT - I 00 Type	1
3	Thermistor Demonstration Setup	1
4	Characteristics of a Solid - State Sensor, using LM - 35	1
5	Study of Strain Gauge Trainer Module	1
6	Study of Linear Variable Differential Transformer	1
7	Displacement Measurement Module	1
8	Temperature Measurement Module	1
9	Load Measurement Module	1
10	Pressure Measurement Module	1
11	Torque Measurement Module	1
12	Maxwell Impedance Bridge	1
13	Wien Bridge for frequency measurement	1

14	LCR Bridge	1
15	Electric Installation Measurement Trainer	1
16	Multi- function Meter	1
17	ACA clamp linkage Tester	1
18	Analogue Multimeter Digital Multimeter (Clamp) Digital Multimeter	5 5 5
20	Electronic Tool box	1