# DEPARTMENT OF ELECTRONIC AND ELECTRICAL ENGINEERING

**VISION**

“To attain excellence in teaching, research and technological development in every aspect of Electronic and Electrical Engineering”.

# MISSION

Our mission is to advance knowledge and educate students in science, engineering and technology, to turn out highly proficient graduates to serve the nation and the world in the 21st century. We are dedicated to providing students with quality education through thorough academic training and persistent intellectual motivation to stimulate creativity and innovations for the betterment of the society and the entire human race.

**INTRODUCTION**

The Department started from the inception of the university as one of the departments in the faculty of Engineering and technology. It aims at producing high level man-power in the field of Electronic and Electrical Engineering. Graduate Engineers of the departmental programme are trained to be self-reliant and competent in the basic maintenance of electrical industry in Nigeria and abroad.

Some of the graduates of the department are trained to be self-employed and be able to start small scale industries in the areas of communications, Electronic, control Engineering and Electrical power systems, such industries are expected to grow into large ones over some years.

# AIM AND OBJECTIVES

The main objective of the undergraduate programme in the department is to produce graduates who will be well qualified to:

1. Initiate and carry out engineering design and fabrication of electronic and electrical equipment and systems.
2. Pursue research and developmental work in the field of electronic and electrical engineering and
3. Engage in industrial management in such a way as to become self- reliant within a few years of graduation.

In the pursuit of these objectives, the academic curriculum is amalgamated with industrial training programme leading to the award of a bachelor degree. The department has been structured in a way to refine and build students with related engineering principles and enable young graduates demonstrate the versatility of electricity to work readily,

efficiently.

# PHILOSOPHY

Upon admission, the students, from the very outset the students are given advanced edge of their high school sciences concentration called basic courses and are fundamentally equipped with sciences of Physics, Chemistry, Mathematics and Biology. General studies also equip them with ability to communicate effectively, syntactically fit to operate within the structures of the society and future managerial positions. The curriculum is concentrically carved to focus on engineering from the second to the fifth year of the programme. It is designed to furnish prospective engineers with concepts, theories and the principles of electronic and electrical engineering.

Sessional breaks of year II and III students are devoted for workshop experience while the whole of the second semester of the fourth year is devoted to industrial training. In the fifth year, the students specialize on either. Electrical power systems and machines, Electronic engineering or communication. Advanced core courses are also inculcated at 500 level as electives.

# ADMISSION REQUIREMENTS

The minimum requirements for admission are five 'O' level credits in the SSCE or GCE Ordinary level which should include English, Mathematics, Physics and Chemistry. Candidate in the following categories may also be considered individually on their own merit expected from appropriate lower level courses.

* 1. Holders of two GCE 'A' levels in Mathematics and Physics
  2. Holders of the HND or OND (upper credit) in Electrical Engineering from recognized institution.
  3. Others with non-orthodox attestations of competence in Electrical engineering, Electronics, Telecommunications, Physics and Mathematics.

# DEGREE OFFERED

The undergraduate programme in the department leads to the award of a B.Tech degree (Honours) in Electronic and Electrical Engineering.

# PROGRAMME WORKLOAD ON STUDENTS

The programme workload on students include period of formal studies in the university, industrial training, planned visit and projects. This comprises:

1. 9 semesters of course work consisting of lectures, tutorials and practicals and assigned projects.
2. 1 full semester plus 2 long vacation periods of industrial attachment

**TOTAL NUMBER OF UNITS REQUIRED FOR GRADUATION**

To be eligible for the degree of B. Tech in Electronic and Electrical Engineering, a candidate must satisfactorily complete a minimum of 196 units which are made up as shown below. In addition, a minimum of 40 weeks of students' Industrial work experience scheme (SIWES) during the long vacations of years II and III plus the second semester of Year IV must be satisfactorily completed by a candidate to qualify for the award of a degree. Compulsory courses

University requirements

Basic Sciences 33 units

General studies 13 units

Computer studies 1 unit

Faculty / Department requirements 135 units

Electives

Restricted electives 14 units

Grand total 196 units

# HISTORY OF THE PROGRAMME/SUB-DISCIPLINE/DISCIPLINE

The Bachelor of Technology (B. Tech) programme in Electronic and Electrical Engineering started in 1990/91 session. The main objectives of the programme are teaching and Research in the field of Electronic and Electrical Engineering.

The Department started with (thirty-one) 31 students in 1990/91 and has grown to about Nine hundred and sixty two (962) in the current academic session 2012/2013. Till date 2325 (two thousand, three hundred and twenty five) students have graduated with B. Tech in the Department.

1. ***THE ORGANOGRAM***



Laboratory Assistants & Attendants

Technical

Assistant

Clerk & Office Assistants

Typist

Student

Graduate/ Teaching Assistants

Lecturers

Technologists & Technical Officers

Secretary

Chief Technologist

Student Advisor

Head of Department

1. Regular Departmental meetings are held by the HOD with the Senior Staff in the Department to deliberate on academic and other matters in relation to the Department and take appropriate decisions. Staff members represent the Department on various committees in the Faculty/University and report back to the HOD from time to time.
2. The University has a good policy on staff development and quite a number of staff in this Department have benefitted from this policy. Teaching and Graduate Assistants have enjoyed study leave with pay to pursue higher degrees in some local Universities. Technical and Administrative staff have also been sponsored for in–house training courses in Management Science, Word Processing and Computer Studies.
3. Promotion of staff is in accordance with the laid down University guidelines.

**Student's Welfare**

1. All academic problems such as wrong results, incorrect computation of GPA, etc. that cannot be solved by the student adviser are reported to the HOD for further necessary action. There is also a Departmental Student Association through which collective grievances are brought to the attention of the HOD for resolution.
2. Department operates a staff advisory system with one academic staff member being appointed for each student level i.e. 100 level student has an adviser and the same with the four other levels.

**Examinations**

One academic staff member is appointed each year by the HOD to serve as the Examinations Officer. This Officer and the HOD oversee the examination matters and also represent the department on the Faculty Examinations committee. Course examination questions are set by the course lecturers and handed over along with the solutions and marking scheme to the HOD who is the Chief Examiner, for moderation and other necessary processing. The students' answer scripts are given to the course lecturers for grading. These lecturers submit the students' grades together with the answer booklet to the HOD who in turn works with the Departmental examinations officer for the collation and processing of the results. The results are presentedto the department board of examinaland to the Faculty Board of Examiners for ratification before being considered by the Committee of Deans and Senate for final approval. The results are

officially released only after the Senate has approved them.

**Academic Atmosphere**

Academic Staff members maintain regular office hours during which students are free to consult on or discuss their problems. The Department runs regular seminars for staff and students on academic fields, I. T. Practical experience acquired by the students, and project writing methodology.

# PROGRAMME / WORK LOAD BY STUDENTS

The programme workload by students includes periods of formal studies in the University, Industrial Training, planned visit and projects. This comprises of;

I. 9 Semesters of course work consisting of lectures, tutorials, practicals and assigned projects.

ii 1 full semester plus 2 long vacation periods of industrial attachment.

**COURSE OUTLINE AND CONTENT OF ALL COURSES IN THE DEPARTMENTAL PROGRAMME**

**100 LEVEL HARMATTAN SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **COURSE CODE** | **COURSE TITLE** | **PRE- REQ.** | **HOURS** | | | **UNITS** |
| L | T | P |
| MTH 101 | Elementary Mathematics I |  | 4 | 1 | 0 | 5 |
| CHM 101 | Introductory Chemistry I | 3 | 1 | 0 | 4 |
| CHM 191 | Experimental Chemistry I | 0 | 0 | 3 | 1 |
| PHY 101 | General Physics I | 3 | 1 | 0 | 4 |
| PHY 103 | Experimental Physics I | 0 | 0 | 3 | 1 |
| GNS 101 | Use of English I | 2 | 0 | 0 | 2 |
| FAA 101 | Fundamentals of Drawing | 2 | 0 | 0 | 2 |
| BIO 101 | General Biology I | 2 | 1 | 0 | 3 |
| BIO 103 | Experimental Biology I | 0 | 0 | 3 | 1 |
| LIB 101 | Use of Library | 1 | 0 | 0 | 0 |
| **Total Number of Units** | | | | | | **23** |

**100 LEVEL RAIN SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **COURSE**  **CODE** | **COURSE TITLE** | **PRE-REQ.** | **HOURS** | | | **UNITS** |
| L | T | P |
| MTH 102 | Elementary Mathematics II |  | 4 | 1 | 0 | 5 |
| CHM 102 | Introductory Chemistry II | 3 | 1 | 0 | 4 |
| CHM 192 | Experimental Chemistry II | 0 | 0 | 3 | 1 |
| PHY 102 | General Physics II | 3 | 1 | 0 | 4 |
| PHY 104 | Experimental Physics II | 0 | 0 | 3 | 1 |
| GNS 102 | Use of English II | 2 | 0 | 0 | 2 |
| GNS 104 | Science and Technology in Africa Through | 2 | 0 | 0 | 2 |
| CSE 100 | the Ages | 1 | 0 | 0 | 1 |
| BIO 102 | Introduction to Computer Technology | 2 | 1 | 0 | 3 |
| BIO 104 | General Biology II | 0 | 0 | 3 | 1 |
|  | Experimental Biology II |  |  |  |  |
| **Total Number of Units** | | | | | | **24** |

**200 LEVEL HARMATTAN SEMESTER**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **COURSE CODE** | **COURSETITLE** | **PRE-REQ.** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE231 | Engineering Analysis I | MTH101/102 | 3 | 1 | 0 | 4 |
| CSE201 | Basic Computer Programming | CSE100 | 2 | 1 | 0 | 3 |
| EEE201 | Basic Electrical Engineering I | PHY101/102 | 2 | 1 | 0 | 3 |
| EEE203 | Basic Electrical Engineering | PHY 103 / | 0 | 0 | 3 | 1 |
|  | Lab I | 104 |  |  |  |  |
| MEE 201 | Engineering Drawing I |  | 1 | 0 | 3 | 2 |
| MEE 203 | Workshop Technology I |  | 1 | 0 | 3 | 2 |
| MEE 205 | Engineering Materials I |  | 2 | 1 | 0 | 3 |
| MEE 207 | Fluid Mechanics |  | 2 | 0 | 0 | 2 |
| MEE 209 | Fluid Mechanics Lab. |  | 0 | 0 | 3 | 1 |
| MGS 201 | Technology and Society |  | 1 | 0 | 0 | 1 |
| GNS 209 | Elements of Administrative |  |  |  |  |  |
|  | Science/Citizenship Education |  | 2 | 0 | 0 | 2 |
| **Total Number of Units** | | | | | | **24** |

**200 LEV EL RAIN SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE CODE** | **COURSE TITLE** | **PRE-REQ.** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE 232 | Engineering Analysis II Introduction to Computer  Basic Electrical Engineering II  Basic Electrical Engineering Lab II Electrical Engineering Material Engineering Drawing II  Workshop Technology II Strength of Materials Strength of Materials Lab. Elementary Modern Physics  Family Marriage System & Kinship Structure in comparative  perspective | EEE 231 | 2 | 1 | 0 | 3 |
| CSE 204 |  | 2 | 0 | 0 | 2 |
| EEE 204 | EEE 201 | 2 | 0 | 0 | 2 |
| EEE 206 | EEE 203 | 0 | 0 | 3 | 1 |
| EEE 208 |  | 2 | 0 | 0 | 2 |
| MEE 202 |  | 1 | 0 | 3 | 2 |
| MEE 204 |  | 1 | 0 | 3 | 2 |
| MEE 214 |  | 2 | 0 | 0 | 2 |
| MEE 216 | PHY | 0 | 0 | 3 | 1 |
| PHY 202 | 101/202 | 3 | 0 | 0 | 3 |
| GNS 208 |  |  |  |  |  |
|  |  | 2 | 0 | 0 | 2 |
| **Total Number of Units** | | | | | | **22** |

**FET – 200 (SWEP) 2 (Units)**

**300 LEVEL HARMATTAN SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE**  **CODE** | **COURSE TITLE** | **PRE-REQ**. | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE301 | Electromagnetic Fields and Waves | EEE 201 | 2 | 1 | 0 | 3 |
| EEE303 | Electric Circuit Theory I | EEE201 | 2 | 0 | 0 | 2 |
| EEE305 | Electronic Engineering I | EEE204 | 2 | 1 | 0 | 3 |
| EEE307 | Electrical Machines I | EEE 201 | 2 | 1 | 0 | 3 |
| EEE309 | Electrical Engineering Lab | EEE 206 | 0 | 0 | 3 | 1 |
| EEE311 | Signal & Systems Analysis | EEE 201 | 2 | 0 | 0 | 2 |
| CSE331 | Engineering Statistics |  | 2 | 1 | 0 | 3 |
| MEE211 | Engineering Thermodynamics I |  | 2 | 0 | 0 | 2 |
| MEE213 | Engineering Mechanics |  | 2 | 1 | 0 | 3 |
| **Total Number of Units** | | | | | | **22** |

**300 LEVEL RAIN SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE**  **CODE** | **COURSE TITLE** | **PRE-REQ.** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE302 | Digital Electronics | EEE204 | 2 | 1 | 0 | 3 |
| EEE304 | Electric Circuit Theory II | EEE303 | 2 | 0 | 0 | 2 |
| EEE306 | Electronic Engineering II | EEE305 | 2 | 0 | 0 | 2 |
| EEE316 | Electrical Machines II |  | 2 | 1 | 0 | 3 |
| EEE310 | Electronic Eng./Lab . |  | 0 | 0 | 6 | 2 |
| EEE312 | Measurement and Instrumentation |  | 2 | 0 | 0 | 2 |
| EEE314 | Acoustics Systems |  | 2 | 0 | 0 | 2 |
| EEE332 | Engineering Analysis III | EEE232 | 2 | 1 | 0 | 3 |
| MEE300 | Mechanical Maintenance and Repairs |  | 2 | 0 | 0 | 2 |
| **Total Number of Units** | | | | | | **21** |

**FET – 300 (SWEP) 2 (Units)**

**400 LEVEL HARMATTAN SEMESTER**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE**  **CODE** | **COURSE TITLE** | **PRE-REQ.** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE401 | Electrical Maintenance and Repair of |  | 2 | 0 | 0 | 2 |
|  | Equipment |  | 2 | 1 | 0 | 3 |
| EEE403 | Communication Principles |  | 2 | 1 | 0 | 3 |
| EEE405 | Control Engineering Principles |  | 2 | 1 | 0 | 3 |
| EEE407 | Electrical Power Principles |  | 2 | 0 | 0 | 2 |
| EEE409 | Physical Electronics |  | 2 | 0 | 0 | 2 |
| EEE415 | Power Electronics |  | 0 | 0 | 3 | 3 |
| EEE413 | Engineering Laboratory | EEE302 | 3 | 0 | 0 | 3 |
| CSE417 | Microprocessor System Design |  | 2 | 0 | 0 | 2 |
| CVE401 | Project Methodology |  |  |  |  |  |
| **Total Number of Units** | | | | | | **23** |

**400 LEVEL RAIN SEMESTER**

**FET 400 Student Industrial Work Experience Scheme (SIWES) 6 Units**

**500 LEVEL HARMATTAN SEMESTER**

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| **COURSE**  **CODE** | **COURSE TITLE** | **PRE-REQ.** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE501 | Assigned Project I |  | 0 | 0 | 9 | 3 |
| EEE503 | Industrial Electronics | EEE306 | 2 | 0 | 0 | 2 |
| EEE505 | Network Synthesis | EEE304 | 2 | 0 | 0 | 2 |
| EEE507 | Electronic/Electrical | EEE312 | 2 | 0 | 0 | 2 |
|  | Instrumentation |  | 2 | 0 | 0 | 2 |
| MGS511 | Industrial Economics |  | 1 | 0 | 0 | 1 |
| MGS513 | Principles of Management |  | 1 | 0 | 0 | 1 |
| MGS515 | Principles of Accounting |  | 2 | 0 | 0 | 2 |
| CHE519 | Invention and Patents |  |  |  |  | 6 |
|  | Departmental Electives |  |  |  |  |  |
| Total Number of Units | | | | | | 21 |

**500 RAIN SEMESTER**

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| **COURSE**  **CODE** | **COURSE TITLE** | **PRE- REQ.** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE502 | Assigned Project II.  Electrical Services Design. Current Trends in Electronic and Electrical Engineering.  Application of EM Principles. Technology Policy and Law Faculty – Wide Elective  Departmental Elective. |  | 0 | 0 | 9 | 3 |
| EEE504 |  | 2 | 0 | 0 | 2 |
| EEE506 |  |  |  |  |  |
|  |  | 2 | 0 | 0 | 2 |
| EEE508 | EEE301 | 2 | 1 | 0 | 3 |
| MGS540 |  | 2 | 0 | 0 | 2 |
|  |  |  |  |  | 2 |
|  |  |  |  |  | 6 |
|  |  |  |  |  | -------- |
|  |  |  |  |  | 20 |

1. **Departmental Electives**: **HARMATTAN Any Two From: 1. Electric Power Systems Option**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| COURSE  CODE | COURSE TITLE | PRE-REQ. | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE511 EEE513 EEE515 | Power Systems Engineering I Electric Energy Utilization.  High Voltage Engineering and  Switch Gear Technology | EEE407 EEE407 | 2  2  2 | 1  1  1 | 0  0  0 | 3  3  3 |

1. **Communication Option**

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| --- | --- | --- | --- | --- | --- | --- |
| COUR SE  CODE | COURSE TITLE | PR E-R EQ. | HOUR S | | | **UNIT S** |
| L | T | P |
| EEE 521 | Telecommunication Systems | EEE40 3 | 2 | 1 | 0 | 3 |
| EEE 523 | Engineerin g I | EEE30 1 | 2 | 1 | 0 | 3 |
| EEE 525 | Radio an d TV Engineering |  |  |  |  |  |
|  | Info rmation and Statistical Co mmunication Theory |  | 2 | 1 | 0 | 3 |

1. **Electronic Engineering Option**

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| **COURSE**  **CODE** | **COURSE TITLE** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE 531 | Solid State Electronics I | 2 | 1 | 0 | 3 |
| EEE 533  EEE 535 | Electronics Engineering III  Microelectronic Technology | 2  2 | 1  1 | 0  0 | 3  3 |

1. **Departmental Electives**: **RAIN Any Two From:**
2. **Electric Power System Option**

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| --- | --- | --- | --- | --- | --- | --- |
| **COURSE**  **CODE** | **COURSE TITLE** | **PRE- REQ** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE512 EEE516 EEE514 | Power Systems Engineering II Electrical Machines III  Power Systems Communication and  Control of Electrical Machines | EEE 511  EEE 511 | 2  2  2 | 1  1  1 | 0  0  0 | 3  3  3 |

1. **Communication Option**

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| **COURSE**  **CODE** | **COURSE TITLE PRE-REQ** | | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE522 | Telecommunication Systems Engineering II | EEE 403 | 2 | 1 | 0 | 3 |
| EEE526 | Microwave Engineering | EEE 521 | 2 | 1 | 0 | 3 |
| EEE524 | Digital communication Principles and System | EEE 403 | 2 | 1 | 0 | 3 |

1. **Electronic Engineering Option**

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| **COURSE**  **CODE** | **COURSE TITLE** | **HOURS** | | | **UNITS** |
| L | T | P |
| EEE 532 | Solid State Electronics II | 2 | 1 | 0 | 3 |
| EEE534  EEE536 | Quantum Electronics  Electronic Devices: Design and Fabrication | 2  2 | 1  1 | 0  0 | 3  3 |

1. **FACULTY-WIDE ELECTIVE COURSE – ANY ONE FROM:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **COURSE**  **CODE** | **COURSE TITLE** | **HOURS** | | | **UNITS** |
| **L** | **T** | **P** |
| EEE500 | Electrical Installation | 2 | 0 | 0 | 2 |
| CSE500 | Computer Models of Physical and Engineering Systems | 2 | 0 | 0 | 2 |
| CVE550 | Elements of Civil Engineering Practice | 2 | 0 | 0 | 2 |
| FSE500 | Elements of Food Processing and Preservation | 2 | 0 | 0 | 2 |
| MEE552 | Engineering Risk-Benefit Analysis | 2 | 0 | 0 | 2 |
| MGS500 | Entrepreneurship | 2 | 0 | 0 | 2 |

**2.2**. **DESCRIPTION OF COURSES EEE 200 – Applied Electricity (2-1-0)**

Terminal description and applications of resistors, capacitors, inductors, and transformers. Circuit analysis using Kirchoff's voltage law (KVL), kirchoff's current. Law (KCL), and superposition theorem. Periodic waveforms and their effective values. Power and energy in electric circuits, single time constant circuits. Concept of impedance and admittance. Elementary treatment of resonant circuits and their applications. Brief discussion of vacuum diode and triodes, tetrode and pentodes, their characteristics and applications. Elementary treatment of semiconductor devices like the junction diode, zener diode and bipolar transistor, their characteristics and their applications, e.g. p-n junction as a rectifier, the zener diode as a regulator and the transistor as an amplifier; concept of biasing. Brief mention of other semiconductor devices such as the light Emitting Diode (LED), Field Effect Transistor (FET), and integrated Circuits (IC's) and their uses. Introduction to logic gates and their applications. Introduction to electrical machines. Direct current (DC) generators and motors.

# EEE 201 – Basic Electrical Engineering I (2-1-0)

Brief history of electrical engineering. Review of basic electrostatics, Terminal and physical and physical description of electric circuit elements: resistors, capacitors, inductors, mutual inductors, transformers, voltage and current sources. Network theorem; Kirchoff's voltage law (KVL),

Kirchoff's current law (KCL, Thevenin, Norton and superposition theorems. Power and energy in electric circuits. Equivalences. Periodic waveforms and their effective values. Transient and steady state response of electric networks. Single time constant circuits, concepts of impedance and admittance. Elementary treatment of resonant circuits.

Review of magnetic fields of currents in space. Magnetic flux and flux density. Brief discussion of magnetic circuits. Transformers: their features and applications: polyphase systems. Introduction to electrical machines: Direct Current (DC) motors and generators Electric lamps and illumination.

# EEE 202 – Applied Electricity Laboratory (0-0-3)

This course consists of experiments designed to familiarize the students with the use of electrical measuring instruments such as ammeters, voltmeters, ohmmeters and oscilloscopes. The experiments will also acquaint the students with the use of power supplies, sinewave oscillators and pulse generators such as power and signal sources. Simple experiments will also be performed using diodes.

# EEE 203 – Basic Electrical Laboratory I (0-0-3)

This course consists of experiments designed to familiarize the students with the use of electrical measuring instruments like ammeters, voltmeters, ohmmeters, fluxmeters, oscilloscopes and bridges for direct current (d.c.) as well as alternating current (a.c.) circuits. The experiments will also acquaint the students with the use of power and signal sources like power supplies, sinewave oscillators and pulse generators.

# EEE 204 – Basic Electrical Engineering II (2-1-0)

Brief discussion of vacuum devices especially diode, triode, tetrode and pentode, their theory, characteristics and applications; concept of biasing. Rectification and smoothing circuits. Elementary treatment of semiconductor devices such as p-n junction diode, zener diode and the bipolar transistor, their characteristics and their applications, e.g. p-n junction as a rectifier, the Zener diode as a regulator and the transistor as an amplifier. Brief discussion of other semiconductor devices like varactor diode, light emitting diode (LED), Field Effect Transistor (FET), Unijunction Transistor (U.I.T.) and Integrated Circuits (IC's). Introduction to logic gates and digital circuits: AND gate, OR GATE, NAND gate, NOR gate, and EXCLUSIVE OR gate, their characteristics, realization and applications.

# EEE 206 – Basic Electrical Engineering Laboratory II (0-0-3)

This course is designed to familiarize the students with the characteristics and the use of simple electronic devices such as diodes, transistors and integrated circuits in various applications. Simple experiments are also to be carried out

on logic gates to determine their TRUTH tables. Students will be expected to design, construct and test some simple circuits of their choice.

# EEE 208 – Electrical Engineering Materials (2-0-0)

Atomic structure and bonding in solids, bond strength and properties. Electrons in solids; metallic conductors, insulators and semiconductors. Dielectric properties- permittivity, polarization, frequency response, Electrical properties - conductivity, resistivity, breakdown piezo-electric and ferroelectric effects Magnet properties - atomic moment, permeability hysteresis Thermal and optical propertiss of materials. Introduction to transducers.

# EEE 231 – Engineering Analysis I (3-1-0)

Principles of Differential Calculus, Applications to plane, curves, tangent, normals and curvature. Sequence and series Talylor's and Maclaurin's series; to include functions of several variables Maxima, Minimal and Saddle point. Approximate solution of equations. Principles of integral calculus. Numerical integrations. First and second order differential equations. Multiple integration; line, surface and volume integral. Partial Differential equation and applications to Engineering problems. Introduction to Fourier series analysis. Fourier transforms. Laplace transforms and simple applications to Engineering. Integral functions: Gamma, Beta, Error and Elliptic function.

# EEE232 – Engineering Analysis I (2-1-0)

Vector, Scalars, Vectors and Scalar Fields. Products of two, three or more vectors. Vectors differentiation and integration. Gradient, divergence, curl and their physical significance. Three dimentional coordinate geometry of lines and planes. Introduction to complex numbers. Elementary functions of complex variable. Determinants and their properties. Solution of a set of linear equations, Crammer's rule. Matrices and their properties; characteristics functions, Eigen values and eigen vectors. Introduction to linear programming.

# EEE 301 – Electromagnetic Field and Waves (2-1-0)

Review of scalar and vector fields. Static electric fields in free space. Gauss' Law. Poisson and Laplace equations. Steady magnetic fields of currents in space. Ampere's circuital law. Field distributions in material media. Boundary conditions. Time varying fields, Maxwell's equations in differential and integral forms, their interpretation and physical significance. Plane Transient and steady solution of transmission line problems.

# EEE 302 – Digital Electronics (2-1-0)

Nonsinusoidal oscillators, switching, timing and wave shaping circuits. Introduction to basic logic functions, AND, OR NOT, NAND, NOR and EXCLUSIVE-OR. Boolean algebra and analysis including FLIP-FLOP for different configurations (NMOS, CMOS, DTL, RTL, TTL, etc.), Sequential circuits, registers and counters. Introduction to microprocessors – architecture, memory and 1/0 devices.

# EEE 303 – Electric Circuit Theory I (2-0-0)

Network graph theory and its applications to node, mesh, loop and cutest analysis of linear networks. Transient Circuit Analysis: natural and forced response, AC and DC sources, Analysis of two port networks using z,y,h and t- parameters. Use of symmetrical components in the solution of unbalanced three-phase networks including analysis of symmetrical faults. Computer aided circuit analysis.

# EEE 304 – Electric Circuit Theory Ii (2-0-0)

Synthesis of 2 element (LC and RC) one port networks. Poles, zeros and frequency response of electrical networks. General properties of positive real rational functions. Partial and continued fraction expansion. Foster and Cauer forms.

Synthesis of 2-port networks. Cauer reactance theorem. Constant resistance ladders. Relationships between real and imaginary parts of some functions. Computer aided design of networks.

# EEE 305 – Electronic Engineering I (2-1-0)

Characteristics, models and equivalent circuits of vacuum devices, (diode, triode, tetrode and pentode). Frequency behaviour of triodes and pentodes. Crystal structure, electron and energy band schemes. Properties of semiconductors. Carrier transport, generation and recombination in semiconductors. Characteristics, models and equivalent circuits of junction – effect devices (junction diodes, zener diode, bipolar transistor) and field- effect devices (FFET, MOSFET). Frequency behaviour of these devices.

# EEE306 – Electronic Engineering II (2-1-0)

Amplifiers – voltage, current and power amplification, stability of operating point. Noise and distortion. Feedback amplifiers. Sinusoidal Oscillators. Introduction to operational amplifiers circuits. Regulation. Multistage

amplifiers, interstage coupling and frequency, response. Introduction to pulse techniques.

# EEE 307 – Electrical Machines I (2-1-0)

Principles of electromechanical energy conversion. D.C. Machines: design, construction and characteristics of dc machines, emf equations, armature reaction, efficiency. Performance and speed control of series, shunt, and compound dc machines. Industrial applications of dc machines. Transformer: elements of a t ransformer, f lux l inkages, winding/lvoltage/current ratios of transformers, leakage inductances, ideal transformer, circuit model of the iron-core transformer, impedances of a transformer, transformer losses, voltage regulation, 3-phase transformers and their connections in power systems. Auto-transformers and their applications. Transformer testing.

# EEE 308 - Electromechanical Energy Conversion, Devices and Machines (3-1-0)

Synchronous machines, rotating magnetic fields, emf equation, 3-phase alternators, winding factors, equivalent circuits, phasor diagram for cylindrical rotor. Steady-state performance, characteristic features of salient synchronous machines. Industrial applications of synchronous machines as generators and motors. Induction machines, wound rotor, squirrel case rotor constructions and characteristics, circuit diagram of induction motors. Torque/slip relation. Losses, power flow, and efficiency of induction motors. Speed control of induction motors, protection of machines. Methods of starting machines, Industrial applications of induction machines. Single-phase machines: universal motor, shaded-pole motor, single-phase induction: motor split phase motors, capacitor-start motors, two – value capacitor motors PSC motors, repulsion motors. Circuit model of single-phase induction motors. Industrial and domestic application of single-phase motors.

# EEE 309 – Electronic Engineering Laboratory (0-0-3)

The experiments in this course are designed to educate the students in the laboratory/practical aspects of the lecture courses EEE303, EEE305, and EEE311. Thus, students will be required to investigate the characteristics and uses of vacuum devices and semiconductor devices including diodes, bipolar junction transistors and field transistors (FET).

# EEE 310 -Electronic Engineering/Machines Laboratory (0-0-6)

This course covers the laboratory/practical aspects of the lecture courses EEE304, EEE306 and EEE307. Experiments will focus on the design, construction and performance evaluation of various types of electronic amplifiers, electromechanical energy conversion devices and machines.

# EEE 311 – Signal and System Analysis (2-0-0)

Classification of signals and systems, signal operations and singularity functions. Analysis of linear time-invariant systems. Convolution and correlation. Transform methods – Laplace, Fourier, Discreet and Fast Fourier transform. Introduction to non-linear systems.

**EEE 312 -Electrical Measurement and Instrumentation (2-0-0)** Measurement fundamentals, units and standards. Grounding, Shielding and noise. Moving coil and moving iron instruments. Electrostatic voltmeters. AC and DC bridges, Recording Measurement of non-electrical quantities – Transducers.

# EEE 314 – Acoustic Systems (2-0-0)

Principles and Properties of sound, simple acoustic systems. Acoustic transducer e.g. microjphone. Linear systems and Natural modes. Loud Speakers: Properties, types, responses and distribution patterns. Electro- acoustic recording and reproduction ultrasonic system, Transducers for untra-sonic system. Magnetic applications of magnetic materials, Ferro and Ferri magnetics, Magnetic circuit and shielding, Magnetic recording techniques e.g. Tape recording including electro acoustic and video tape recording. Units of recording level. Microphones and types.

# EEE 316 - Electrical Machine II (2-1-0)

Synchronous machines, rotating magnetic fields, emf equation, 3-phase alternators, winding factors, equivalent circuits, phasor diagram for cylindrical rotor. Steady-state performance, characteristic features of salient synchronous machines. Industrial applications of synchronous machines as generators and motors. Induction machines, wound rotor, squirrel case rotor constructions and characteristics, circuit diagram of induction motors. Torque/slip relation. Losses, power flow, and efficiency of induction motors. Speed control of induction motors, protection of machines. Methods of starting machines, Industrial applications of induction machines.

# EEE 332 – Engineering Analysis III (2-1-0)

Solution of linear and non linear equations, system of equations. Finite differences, functions of complex variables. Differentiation and integration

of complex functions, Cauchy – and Riemmann's equations, applications to Laplace and fourier transformers. Introduction to non-linear differential equation. Power series solution of Differential equations. The Euler method; Runge-Kutta methods; introduction to optimization methods

**EEE 401 – Electrical Maintenance and Repairs of Equipment (2-0-0)** Electrical tools and equipment for maintenance and repairs. Maintenance – Purpose, types and procedure. Ground rules of Appliance repair. Troubleshooting small appliances, Electrical safety. Maintenance of plants, Repairs of electrical motor, radio receiver and other major electrical equipment. Case studies from the Electrical Repairs Unit.

# EEE 403 – Communication Principles (2-1-0)

Block diagram description of a communication system. Classification of communication systems. Modulation types and their characteristics: AM (DSBTC, DSBSC, SSB, VSB), angle (FM, PM) and pulse (OAM, PWM,

PFM) Demodulation – types, principles and circuits. Comparison of modulation systems, concept of noise figure. Sampling principles and techniques. PCM and Delta Modulation. Multiplexing – FDM, TDM, WDM Shift keying techniques (Amplitude, Frequency and Phase). Introduction to coding.

# EEE 405 – Control Engineering Principles (2-1-0)

Introduction to control systems engineering. Differential equation and transfer function. Models of typical electrical, mechanical, thermal and fluid systems. Block and signal flow diagrams. Feedback system representation and basic stability concepts. Poles and Zeros, Root locus, Bode, Nyquist and Nichols plot. Closed loop performance analysis using frequency response, introduction to control system synthesis.

# EEE 407 – Electrical Power Principles (2-1-0)

Principles and methods of electrical energy generation employing steam, water, wind, gas and magnetohydrodynamic (MHD) sources. Other types of power sources – nuclear, solar, thermoelectric, photovolataic cells, fossil fuels, storage battery. Power systems layout and representation, components modeling per unit representation, grounding and distribution. Transmission lines and cables parameters and steady state analysis. Load flow calculation

– methods applicable to small reactance. Calculation of faults on small

networks using network reduction and similar techniques. General theory of power system protection and instrumentation.

# EEE 409 – Physical Electronics (2-0-0)

Conduction processes in solids – Atomic Structure. Probability distributions and the Schroedinger equation – wave mechanics and quantum mechanics – Pauli exclusion principle and Heisenberg uncertainty principle, Crystal structure. Charge carrier concentrations in semiconductors. Introduction to microwave semiconductor devices such klystron, magnetron, varistors, tunnel diode, impatt diode etc., Gunn diode, LED, LCD, and other optical devices. Integrated circuit (IC), principles and fabrication of semiconductor devices.

# EEE 413 – Engineering Laboratory (0-0-9)

The experiments in this course are designed to complement the theoretical aspect of courses EEE403, EEE405,EEE407,EEE409, and EEE302 in preparation for the SIWES in the following semester and long vacation. Thus, they consist of laboratory experiments on modulation, sampling, multiplexing, feedback control measurement of cable parameters, impulse test on insulators, etc.

# EEE 415 – Power Electronics (2-0-0)

Introduction to power semiconductor components. Circuits with switches and diodes. Power semiconductor switches: operation of the thyristor, controlled half wave rectifiers. Thyristor data sheets (component selection). AC voltage controllers, controlled rectifiers, DC-to-DC converters (choppers). Inverters: Reduction of output voltage harmonic in inverters. AC and DC motor drives, AC-AC converters. Regulated power supplies, principles of uninterruptible power supplies. Power supplies to electro- thermal process.

# EEE 500 – Electrical Installation (2-0-0)

National Electric Power Authority (NEPA) and Electricity Supply Regulations. Systems of supply, single Phase 2-wire, single phase 3-wire, Three phase3-wire, Three phase 4-wire. Consumer circuits – Internal distribution and protection. Identification of component parts, conductors and cables – conductor materials, insulation materials, cable selection. Joints and Joining Wiring system and accessories including lampholders, fuses,

distribution boards, and miniature circuit breakers. Earthing – definition, regulation, electrodes. Testing an installation, illuminating and electric heating. Electric signaling systems installation – single stroke electric bell, continuous ringing bell, burglar alarms and fire alarms. Intercommunication telephone system wiring.

# EEE 503 – Industrial Electronic (2-0-0)

Role of electronics in industries. Power supply and control systems. Solid state and switching devices, Photo-electric devices and controls, Counters. Data Display and Recording. Electric heaters and welders, Radiation Inspection and Detection. Industrial Radio, Industrial Television and Industrial Computers.

# EEE 504 – Electrical Services Design (2-0-0)

Design of electrical installation for domestic and industrial houses; codes and regulations. Design of transmission lines: short transmission lines, medium transmission lines and long transmission lines. Design of line compensators, selection of insulation for voltage types. Installation procedure of power transformers, synchronous generators, and motors, induction motors. Guides for selection of transformers, generators, motors switches, circuit breakers and relays. Starters Design and method of power distribution in the urban centers. Design of high voltage substations, selection of power equipment for substations. Design of towers and freeways.

# EEE 505 – Network Synthesis (2-0-0)

Introductory filter concept: passive, Active, others. Realisability of driving point impedance. Synthesis of two-terminal passive network: Foster form realization, Cauer form realization, minimum phase and non minimum phase network. Approximation methods; sensitivity, frequency transformations (low-pass to high-pass to band-pass).

# EEE 506 – Current Trends in Electronic and Electrical Engineering (2- 0-0)

This one unit course will examine the state-of-the art and topical issues in selected areas of electronic and electrical engineering such as communications, electric power systems, control systems and electronics. The areas(s) selected may vary from year to year. Three phase systems and modeling of power elements. Load flow studies: Gauss-Seidel and Newton- Raphson load flow interactive methods. Control of voltage level and

frequency, real and reactive power flow. Fault studies: Analysis of balanced and unbalanced faults, power system stability studies; steady state and transient stability; equal area criterion, the swing curve.

# EEE 507 – Electronic/Electrical Instrumentation (2-0-0)

Basic electrical and electronic measuring techniques, electrical transducers; industrial transducers and measurement systems. Opto-electronic and related systems. Digital electronic measuring systems. Data logging; A to D, and D to A conversion, types and applications. Introduction to the design of electronic equipments, specifications including environmental factors such as vibration, humidity and temperature. Tolerance and safety measures, reliability and testing. Duplication of least reliable parts (standby). Ergonomics, aesthetics and economics. Miniature and Microminiature construction using printed circuits and integrated circuits Maintenability. Computer design methods.

# EEE 508 -Application of Electromagnetic Principles (2-1-0)

Review of transmission line theory. Use of Smith chart, Single and double- stub matching on lines; quarter wave line as an impedance transformer. Propagation in common waveguides. Attenuation in guides. Guide termination, Antennas. Introduction to radiowave propagation in the Medium Frequency and High Frequency bands High Frequency communication on power lines.

# EEE 511 – Power Systems Engineering I (2-1-0)

Three-phase systems and modeling of power elements Transmission lines: representation of transmission lines; short, medium and long transmission lines, equivalent circuit of a long line, power flow through a transmission line, reactive compensation of transmission lines, transmission line transients. Transient analysis: traveling waves and reflections. D.C. transmission systems: justification and disadvantages of high voltage direct current (h.v. etc) operation features, review of current technologies. Lightning arresters. Network calculations. Load flow studies: Gauss-seidel and Newton – Raphson load flow interactive method(s) Economic operation of power systems. (Control of voltage level and frequency, real and reactive power flow).

# EEE 512 – Power Systems Engineering II (2-1-0)

Fault studies: analysis of symmetrical 3-phase faults, symmetrical components, unsymmetrical faults. Power systems stability studies. Power systems protection: Operating principle and constructional features of relays,

operating mechanisms. Relay protection of power lines, analysis and dynamics of pole alternator. Over-voltage and insulation coordination. Types and selection of circuit breakers. Systems planning, energy and power resources of all forms on a national, continental and world-wide scale. Load forecasting, planned development of generation, transmission, and loads. Specification of energy systems equipment, siting of stations, station management, maintenance routine.

# EEE 513 – Electrical Energy Utilisation (2-1-0)

Lighting system design for industrial and commercial building General and special factory drives. Electric heating space air-conditioning, electrical welding, electrolysis and its industrial applications. Grounding, power improvement, uninterruptible power supply (UPS). Regulations installations and operation of electrical equipment; metering and tariffs systems.

**EEE 514 -Power Systems Communication and Control (2-0-0)** Review of transmission line theory; high frequency (HF) communications on power lines. Carrier systems and power-line carrier operation. Multiplexing. Telemetering, Signal processing and Data Transmission. Control of power generation. Voltage control. Frequency control; System stability. Automatic voltage regulators (AVR). Regulating transformers.

# EEE 515– High Voltage Engineering and Switchgear Technology (2-1- 0)

Generation of high A.C., D.C. and impulse voltages. High Voltage (h.v.) measuring methods. Fundamental processes in electrical discharges. Propagation surges in h.v. transmission lines and in transformer coils. Lightning surges. Protection of transmission lines and substation from lightning strokes. Earthing, Arrestors, Protection of transformers. Switching over-voltages. Interruption of short circuits, interruption of capacitive circuits; current chopping. Means of reducing overvoltages. Insulation coordination. Switchgear construction, oil switches are extinction and devices.

# EEE 516 – Electrical Machines (2-1-0)

Transient and steady analysis of poly-phase induction motors; equivalent circuits; characteristics and speed control Synchronous machines: steady

state analysis, saliency and d-q axis analysis, Matrices equations. Synchronous machines transients: Sudden 3-phase short circuit, transformation to d- and q axes, operational circuit impedance and time constant, model for transient analysis. Synchronous phenomena and sustained oscillators in synchronous machines. Induction machine dynamics and transients: performance during both sudden changes in load and 3-phase fault, models for dynamic analysis, effect of rotor resistance. Paralleling of synchronous machines. Elements of electrical machine design. Output equation, main dimensions of transformers.

# EEE 521- Telecommunication System Engineering I (2-1-0)

Introduction to telephony, Principles of automatic telephony and switching. Strowger, and Crossbar exchanges, Electronic Switching systems. Stored programme control exchanges; Traffic consideration. Transmission standards, telephone network structure, Telegraphy, Telex and Facsmile transmission codes. Data Transmission, Frequency Division Multiplex (FDM) and Time Division Multiplex (TDM) Systems. Introduction to satellite communication systems. Multiple access methods. Earth stations for international telephony and television.

# EEE 522-Telecommunication Systems Engineering II (2-1-0)

Types of telecommunication systems and their basic engineering features. Voice Frequency (VF) and Coaxial Cable System Principles. Submarine System, Transmission hierarchies Fundamentals of optical fibre communication systems including electro-optical and acousto-optical devices for transmission and reception. Splices and connectors. Characteristics of radio transmitters and receivers. Medium wave (MW), High Frequency (HF), Very High Frequency (VHF) and Ultra High Frequency (UHF) point-to-point radio systems. Principles of cellular mobile radio, Noise and its effect on Comparison of telecommunication systems.

# EEE 523 – Radio and Television Engineering (2-1-0)

Propagation mechanisms for ground, sky and tropospheric waves. Propagation characteristics at microwave frequencies. Design of radio transmitters and receivers, Design of microwave line-of-sight radio link systems. Monophonic and stereophonic broadcasting. Practical radio antenna systems: Low Frequency (LF), Medium wave (MW), High Voltage (HV) and Very High Voltage (VHV) antennas. Introduction to Television Engineering, Black and White Television Broadcasting; Color Television Systems. NTSC, PAL, SECAM, Special features of TV transmitters and receivers. Cable

Television systems, Closed Circuit TV Systems. Design of TV antennas. Introduction to Radar System Engineering.

**EEE 524 - Digital Communication Principles and Systems (2-1-0)** Digital conversion of analogue signals: Sampling, aliasing, quantizing and coding principles and techniques. Line codes, Digital to analogue conversion principle and systems. Pulse and Data communication systems: analysis and response of linear and non linear networks; switching theory; Noise immunity and regenerative circuits. Digital modulation techniques: ASK, FSK, PSK, QPSK, QAM,. Digital transmission on analogue networks. Fundamentals of digital signal processing. Time and frequency domain analysis of discrete time waveforms. The Z transform and its attributes. Poles and Zeros. Discrete Fourier Transform and its fast implementation (FFT). Elements of digital filter design; introduction to image processing.

# EEE 525 – Information and Statistical Communication T h e o r y (2-1-0)

Review of probability theory and statistics. Introduction to stochastic processes; Correlation and power spectral density. Statistical characterization of noise and communication channels. Performance of communication systems (AM, FM, digital) in the presence of noise.Measure of information, entropy, information rate and channel capacity. Shannon thorem, source and channel coding. Error control coding. Trading of bandwidth and S/N ratio.

# EEE 526 – Microwave Engineering (2-1-0)

Review of plane wave propagation in free space, lossy media and metallic films. Transmission lines and waveguides, passive microwave components

– cavity resonators, waveguide Tees, directional couplers, ferrite isolators and circulators. Active microwave components – klystrons, magnetrons, traveling wave tubes, parametric amplifiers. Introduction to solid state microwave devices including varactor, PIN, and gunn-effect diodes, photo- diodes, phototransistor and microwave integrated circuits (IC's). Measurements at microwave frequencies.

# EEE 531 – Solid State Electronics I (2-1-0)

This course covers those elements of solid-state theory required to understand modern solid state devices. Topics include: Schroedinger

equation, harmonic oscillator, pertubation theory, classical and quantum distribution functions, density of states; thermodynamical functions, relation to statistical mechanics; energy band model, lattice vibration and phonons; semiconductor; donor-acceptor statistics, transport properties.

# EEE 532 – Solid State Electronics II (2-1-0)

One dimensional diffusion analysis of diodes, photocells and transistors under the assumption of low-level injection. Introduction to superconductivity, electron tunneling and properties of barriers between superconductors.

# EEE 533 – Electronic Engineering III (2-1-0)

Design of multistage amplifiers. Coupling and high frequency effects. Operational amplifiers – their characteristics and applications. Waveform generators. Multipliers; A/D and D/A converters. Sample and hold circuits. IF and RF amplifiers – small signal analysis. Large signal equivalent circuit of transistors. Power amplifiers. Negative resistance devices and applications.

# EEE534 – Quantum Electronics (2-1-0)

Review of wave mechanics, operator formalism and their physical interpretation. Theory of eight functions, solution in one and three dimensions, square well potentials and potential barriers. The linear harmonic oscillator, spherically symmetric potentials. Angular momentum and magnetic moments. Many electron atoms and Pauli exclusion principle. Time independent perturbation theory. Radiation interaction with crystalline solids emission and stimulated emission processes. Application to semiconductor physics.

# EEE535 – Microelectronic Technology (2-1-0)

Fundamentals of monolithic and hydbrid circuits design. Multiphase integrated cirucuit. Diodes and transistors for monolithic circuits, passive components for IC. Assembly processing and IC packaging. Introduction to the design and implementation of Very Large Scale Integrated (VLSI) circuits.

**EEE536 – Electronic Devices: Design and Fabrication (2-1-0)** Operation, design and fabrication of vacuum and solid state electronic devices. Thermoinic devices, p-n junctions, LED's bipolar and field-effect transistors, MOS devices and charge-coupled devices.

**CSE 201 - Basic Computer Programming 3 Units 2-0-3**

Structured programming principles. Keywords and standard identifiers, structure of a programming language. I/O statements. Control structures, Arrays, sub programming, records files, sets, enumerated and sub-range data. Use Pascal.

**CSE 204 - Introduction to Programming Applications 2 Units 1-0-3**

(a) Systems analysis and design concepts. Standard Software Engineering documentation of programs. Linked list and pointer structure. (b) Laboratory problems: Each student picks on two professional problems relevant to one of Architecture, Agriculture, Science or Engineering and submits well documented computer solutions to the problems. May be examined by a written or oral examination. Pascal Language should be used, emphasis should be on record and file structures.

**CSE 331 ENGINEERING STATISTICS 3 UNITS 2-1-0**

Introduction to statistics; Measures of dispersion: mean, median, mode, geometric mean, harmonic mean for grouped and ungrouped data. Correlation and regression analysis; Probability theory: Definition, axioms, Normal, binomial, poison distributions, mathematical expectations, probability density function; Elementary sampling theory; Test of hypothesis and significance: Chi-square, F-test, T-test: Analysis of variance; Introduction to SPSS.