FACULTY OF ENGINEERING

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

<table>
<thead>
<tr>
<th>100 Level</th>
<th>Course Title</th>
<th>Lecture/Lab.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mathematics</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>Physics*</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Chemistry*</td>
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<tr>
<td></td>
<td>General Studies</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Total</td>
<td></td>
<td>38</td>
</tr>
</tbody>
</table>

*Include laboratory practicals

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

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

<table>
<thead>
<tr>
<th>200 Level</th>
<th>Course Title</th>
<th>Lecture/Lab.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Engineering Mathematics</td>
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<td></td>
<td>Computers &amp; Computing</td>
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<td></td>
<td>IT in Engineering</td>
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<tr>
<td></td>
<td>Engineering Drawing</td>
<td></td>
<td>2</td>
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<tr>
<td></td>
<td>Applied Mechanics</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Strength of Materials</td>
<td></td>
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</tr>
<tr>
<td></td>
<td>Thermodynamics</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Material Science</td>
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<tr>
<td></td>
<td>Fluid Mechanics</td>
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<tr>
<td></td>
<td>Basic Electrical Engineering</td>
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<tr>
<td></td>
<td>Manufacturing Tech./Workshop Practice</td>
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<td>Engineer – in – Society</td>
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<tr>
<td></td>
<td>Laboratory Practicals</td>
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<td></td>
<td>Programme elective</td>
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<tr>
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</tr>
</tbody>
</table>

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

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

This view is further strengthened by the fact that an appreciable number of engineering students have rural backgrounds which limit their perception of engineering and the sub-disciplines therein. It is believed that after the second year, the wide engineering horizon would have been sufficiently illuminated for such students, who are now better placed, to make a choice. In addition, a broad-based programme at these foundation levels becomes an asset to its beneficiaries in the future when they are invariably required to play managerial, supervisory and/or executive roles in engineering areas that may not be strictly their areas of specialisation.
100 AND 200 LEVELS COMMON COURSE DESCRIPTIONS

100 Level
Elementary Mathematics I: (3 Credit Units)
(Algebra and Trigonometry)

Elementary Mathematics II: (3 Credit units)
(Vectors, Geometry and Dynamics)

Mathematics III and IV: (6 Credit units)
General Physics I: (3 Credit units)
(Mechanics)
Space and Time, frames of reference, Units and dimension, Kinematics; Fundamental Laws of Mechanics, statics and dynamics; Galilean invariance; Universal gravitation; work and energy; rotational dynamics and angular momentum; conservation laws.

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

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

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

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

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

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

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

**200 Level**

**Engineering Mathematics** (6 Credits)
Complex analysis – Elements of complex algebra, trigonometric, exponential and
logarithmic functions. Real number, sequences and series.
(a) Vectors – Elements, differentiation and integration.
(b) Elements of linear algebra.
(c) Calculus – Elementary differentiation. Relevant theorems.
   Partial differential equation. Simple cases – Applications.
(e) Numerical Analysis – linear equations, non-linear equations. Finite difference
   operators: Introduction to linear programming.

**Computers & Computing** (2 Credits)
Program design using pseudo-code/flowchart. Extensive examples and exercises in
solving engineering problems using pseudo-code/flowchart. **Computer programming
using structure BASIC such as QBASIC**: symbols, keywords, identifiers, datatypes,
operators, statements, flow of control, arrays, and functions. Extensive examples and
exercises in solving engineering problems using QBASIC. **Use of Visual programming
such as Visual BASIC** in solving engineering problems. **15hrs (Teaching &
Demonstrations), 30hrs (Practicals)**

**IT in Engineering** (2 Credits)
Identification of PC parts and peripheral devices: functions, applications, and how
to use them. Safety precautions and preventive maintenance of PC. **Filing system**:
directory, sub-directory, file, path, and how to locate them. **Word processing**:
principle of operation, applications, demonstrations, and practical hand-on exercises in
word processing using a popular word processing package. **Internet**: available services,
principle of operation, applications, demonstrations, and hand-on exercises in e-mail,
and www. **Spreadsheet**: principle of operation, applications, demonstration, and
practical hands-on exercises in use of spreadsheets to solve problems. **Database
Management package**: principle of operation, applications, demonstrations and
practical hands-on exercises in use of DBMS package in solving problems. **Report
Presentation Software Packages**: principle of operation, applications, demonstrations,
and practical hands-on exercises in use of a popular report presentation package (such as PowerPoint). **Mini-project** to test proficiency in use of software packages. **15hrs (Teaching &
Demonstrations), 30hrs (Practicals)**
**Engineering Drawing** (2 Credits)
(i) Use of draughting instruments, lettering, dimensioning, layout.
(iii) Projections – lines, planes and simple solids. Orthographic and projections, simple examples Threaded fastness.
(iv) Pictoral/Freehand Sketching.

**Applied Mechanics** 3 Credits
Statics Laws of statics, system of forces and their properties, Simple problems, Friction.
(ii) Kinematics of rigid body – velocity and acceleration diagrams for simple problems.
(iii) Kinetics of rigid bodies – Two dimensional motion of rigid bodies, energy and momentum, Mass, Moment of inertia, Simple problems.
(iv) Simple harmonic motions.

**Strength of Materials** 2 Credits
(i) Force equilibrium – free body diagrams.
(ii) Concept of stress, strain; Tensile test. Young’s moduli and other strength factors.
(iii) Axially loaded bars, composite bars, temperature stresses and simple indeterminate problems. Hoop stresses in cylinders and rings.
(iv) Bending moment, shear force and axial force diagrams for simple cases, Simple torsion and application.

**Thermodynamics** 2 Credits
(i) Basic concepts, definitions and laws.
(iii) The first Law of thermodynamics, applications to open and closed systems.
(iv) The steady State flow equation (Bernoulli’s Equation) and applications.
(v) Second law of thermodynamics and Heat Cycles.

**Materials Science** 2 Credits
Atomic and molecular structure, crystals, Metallic states, Defects in crystals, conductors, semi-conductors and insulators.
(i) Alloy theory – Application to industrial alloys – steel in particular.
(ii) Engineering Properties – Their control, Hot and cold working, heat treatment, etc. Creep, fatigue and fracture. Corrosion and corrosion control.
(iii) Non-metallic materials – glass, rubber, concrete, plastics, wood and ceramics.
(iv) Elastic and plastic deformations: Defects in metals.

**Fluid Mechanics** 2 Credits
(i) Elements of fluid statics; density; pressure, surface tension, viscosity, compressibility etc.
(ii) Hydrostatic forces on submerged surfaces due to incompressible fluid.
(iii) Introduction to fluid dynamics – conservation laws.
(iv) Introduction to viscous flow.

**Chemistry** 2 Credits
Thermo-chemistry, electro-chemistry, kinetic theory, gas laws, transition metals, introductory organic and inorganic chemistry.
Basic Electrical Engineering 3 Credits
(i) Circuits – elements, DC and AC circuits, Basic circuit laws and theorems.
    Resonance, power, power factors, 3-phase circuits.
(ii) Introduction to machines and machine designs.
(iii) Physics of devices – Discharge devices, semi-conductors, diode and transistors.
(iv) Transistor characteristics, devices and circuits.
(v) Electrical and electrical power measurements.

Manufacturing Technology/Workshop Practice 2 Credits
Elementary introduction to types and organisation of engineering Workshop, covering jobbing, batch, mass production.
(i) Engineering materials: their uses and properties.
(ii) Safety in workshop and general principles of working. Bench work and fitting: Hand tools, instruments.
(iv) Blacksmith: Hand tools and working principles. Joints and fastenings: Bolt, rivet, welding, brazing, soldering, measurement and marking: for uniformity, circulatory, concentricity, etc.
(vi) General principles of working of standard metal cutting machine tools.
(viii) Invited lectures from Professionals

Engineer-In-Society 1 Credit Philosophy of Science
(i) History of Engineering and Technology
(ii) Safety in Engineering and Introduction to Risk Analysis
(iii) The Role of Engineers in Nation Building
(iv) Invited Lectures from Professionals.

Laboratory Practicals 6 Credits
All courses share the laboratory schedules to suit; sometimes alternate weeks.
## B. ENG. CIVIL ENGINEERING

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Lecture/Lab. Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Course Title</strong></td>
<td></td>
</tr>
<tr>
<td>(a) Course Summary</td>
<td></td>
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<tr>
<td>(i) Core Courses</td>
<td></td>
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<tr>
<td>Engineering Mathematics/Analysis</td>
<td>15</td>
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<tr>
<td>Engineering/Construction Drawing</td>
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<tr>
<td>(ii) Structural Engineering</td>
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<tr>
<td>Structural Analysis</td>
<td>(7) 15</td>
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<tr>
<td>Design of Structures</td>
<td>(7) 15</td>
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<td>Civil Eng. Materials</td>
<td>(3) 12</td>
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<td>Strength of Materials</td>
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<tr>
<td>(iii) Geotechnical Engineering</td>
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<tr>
<td>Soil Mechanics</td>
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<tr>
<td>Foundation Engineering</td>
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<tr>
<td>Geology</td>
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<tr>
<td>Highways Engineering</td>
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<tr>
<td>Transportation Engineering</td>
<td>(2) 6</td>
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<tr>
<td>(iv) Water Resources &amp; Environmental Eng.</td>
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<tr>
<td>Fluid Mechanics</td>
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<tr>
<td>Hydraulics</td>
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<tr>
<td>Hydrology</td>
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<td>Public Health</td>
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<tr>
<td>Geodetic Eng. &amp; Photogrammetry</td>
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<tr>
<td>Civil Engineering Practice</td>
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<td>Engineer-in-Society</td>
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<td>Project</td>
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<td>(v) Laboratory/Design Practicals</td>
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<td>(vi) Auxiliary Courses</td>
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<td>Applied Mechanics</td>
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<td>Materials Science</td>
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<td>Manufacturing Technology</td>
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<tr>
<td>Electrical Engineering</td>
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<tr>
<td>Management and Economics</td>
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<td>Computers &amp; Computing</td>
<td>3</td>
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<td>Technical Communications</td>
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<td>(vii) Basic Science Courses</td>
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<td>Mathematics</td>
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<td>Physics</td>
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<td>Chemistry</td>
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<td>(viii) General Studies</td>
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<tr>
<td>(ix) Entrepreneurial Studies</td>
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<tr>
<td>(x) Optional/Electives</td>
<td>6</td>
</tr>
</tbody>
</table>

Total: 63 units
Compulsory Options/Electives from:
- Advanced Structural Analysis
- Geotechnical Engineering
- Water Resources & Environmental Eng.
- Highways & Transportation Engineering
- Building/Construction Engineering

| Total | 193 |

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

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

Sub-Total: **45**

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

Sub-Total: **23**

**500 Level**
- Management and Economics: 6
- Structural Analysis II: 2
- Design Structures III: 2
- Geotechnical Engineering: 3
- Water Resources & Environmental Engineering: 4
- Highway Engineering: 2
- Transportation Engineering: 2
- Laboratory/Design: 6
- Safety Engineering: 2
- Project: 6
- One Optional Course (See below): 6
Optional Courses
Advanced Structural Analysis
Highway & Transportation Engineering
Water Resources & Environmental Engineering
Construction Engineering
Geotechnical Engineering
Drainage and Irrigation Engineering
Total

2
40

65
COURSE DESCRIPTIONS

300 Level

(i) **Mathematics**  
6 Credits

(ii) **Fluid Mechanics**  
3 Credits

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

(iv) **Engineering Geology**  
3 Credits

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

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

(vii) **Soil Mechanics**  
3 Credits

(viii) **Design of Structures I**  
3 Credits
(ix) **Structural Mechanics** 3 Credits
Analysis of determinate structures, Beams, Trusses; Structure Theorems.
Graphical methods: Application to simple determinate trusses. Williot Mohr diagram.
Deflection of statistically determinate structures. Unit load, moment area methods.
Strain Energy Methods. Introduction to statistically indeterminate structures.

(x) **Engineering Surveying & Photogrammetry** 3 Credits
Chain Surveying. Compass surveying – Methods; Contours and their uses. Traversing –
methods and applications. Levelling – Geodetic leveling – errors and their adjustment
Applications. Tacheometry – Methods; Substance heighting, self adjusting and
electromagnetic methods. Introduction to Photogrammetry.

(xi) **Hydraulics** 2 Credits
Simulation of complex flow fields using sources, sinks uniform flows and doublets and
combinations of vortices. Steady and unsteady flows in open channels. Dimension
analysis and similitude. Hydraulic modeling techniques, Pipe network analysis, Design of
reticulation systems. Unsteady flows in pipes with special emphasis on water hammer
and the use of surge tanks.

(xii) **Hydrology** 2 Credits
The hydrologic cycle. Precipitation, infiltration, evaporation, groundwater, surface run-
off, floods and droughts. Physical and statistical analysis related to hydrologic
processes. Flood routing techniques. Hydrologic systems analysis. Hydrography
analysis. Unit hydrograph theory. Occurrence and distribution of water in nature.
Hydrogeology, Fundamentals of flows in porous media. Equations governing flows in
aquifer. Exact and approximate solutions. Flows in layered aquifer systems.

(xiii) **Laboratory Practicals** 6 Credits
All courses share the laboratory schedules to suit; sometimes in alternate weeks.

400 LEVEL

(i) **Engineering Mathematics** 3 Credits
Complex variables – advanced topics, differentiation and integration of complex
functions. Cauchy – Riemann equations: Related theorems. Laplace and Fourier
transforms – Applications.
elements of probability, density and distribution functions, moments, standard
distribution, etc. Statistics – Regression and correlation – Large sampling theory.
Test hypothesis and quality control.

(ii) **Drainage and Irrigation Engineering** 2 Credits
Analysis and design of surface and combined drainage systems, collectors, storages and
pumps. Methods of overflow protection of large areas. Analysis and design of
irrigation systems. Soil-plan-water relationships. Water supplies, water delivery
systems and water distribution systems.

(iii) **Civil Engineering Practice** 2 Credits
Civil Engineering Work Standards and measurements. Contracts and sub-contracts.
Works construction and supervision. Job planning and control – Programme Charts –
Bar charts. Critical path methods, etc. Construction machinery and equipment.
Applications/Case study-dams, foundations, bridges, highways, industrial buildings,
sewage works.
(iv) **Structural Analysis I** 3 Credits

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

(vi) **Soil Mechanics** 2 Credits

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

(viii) **Highway Engineering** 2 Credits

(ix) **Technical Communications** 2 Credits
Oral communication: Public speaking skills with effective use of visual aids and statistical and technical information. Principles of effective communication in interpersonal and mass communication process. Effective reading skills- extracting main ideas and reading for specific information through speed reading. Written communication: principles of technical writing. Project report presentation. 15 hrs (Teaching & demonstrations), 30hrs (Practicals).

(x) **Laboratory/Design Practicals** 3 Credits
All courses share the Laboratory schedules to suit; sometimes in alternate weeks.

500 Level

(i) **Management and Economics** 4 Credits
programming as an aid to decision making policies under risk and uncertainties.
Transport and Materials Handling: Selection of transport media for finished goods, raw materials and equipment. Faculty layout and location.

(ii) Structural Analysis II 2 Credits

(iii) Design of Structures III 2 Credits

(iv) Geotechnical Engineering 4 Credits

(v) Water Resources and Environmental Engineering 4 Credits

Environmental Engineering 2 Credits
The work of the Sanitary Engineer. Water Supply, Treatment and Design. Waste Water Collection, Treatment, Disposal and Design. Solid waste Collection, treatment, disposal and design of systems. Air Pollution and Control.

(vi) Highway Engineering 2 Credits

(vii) Transportation Engineering 2 Credits

(viii) Laboratory/Design 6 Credits
Courses (ii) – (vii) should carry Laboratory/Design works while (i) carry case Study/Feasibility Report assignments.

(ix) Project 6 Credits
For proper guidance of the students, Projects will depend on the available academic staff expertise and interest but the projects should be preferably of investigatory nature. Preferably, students should be advised to choose projects in the same area as their. Optional course. (See below)

(x) Optional Course 6 Credits
The Option Course is to be taken from the following: Advanced Structural Engineering. Highway and Transportation Engineering. Water Resources and Environmental Engineering. Building/Construction Technology. Geotechnical Engineering. The Options should aim at standards normally higher than the Bachelor’s degree but below Master’s degree expectations and calling for an in-depth study in the above areas.
### B. ENG. COMPUTER ENGINEERING

#### Lecture/Lab. Units

<table>
<thead>
<tr>
<th>Course Summary</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(a)</strong></td>
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</tr>
<tr>
<td><strong>(i)</strong> Humanities</td>
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<tr>
<td>General Studies</td>
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<tr>
<td><strong>(ii)</strong> Basic Sciences</td>
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<tr>
<td>Mathematics</td>
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<tr>
<td>Physics</td>
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</tr>
<tr>
<td>Chemistry</td>
<td>8</td>
</tr>
<tr>
<td><strong>Total</strong></td>
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</tr>
<tr>
<td><strong>(iii)</strong> Entrepreneurial Studies</td>
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<tr>
<td><strong>(iv)</strong> Basic Engineering Courses</td>
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<tr>
<td>Engineering Mathematics</td>
<td>6</td>
</tr>
<tr>
<td>Computers &amp; Computing</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Applied Mechanics</td>
<td>4</td>
</tr>
<tr>
<td>Strength of Materials</td>
<td>2</td>
</tr>
<tr>
<td>Material Science</td>
<td>3</td>
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<tr>
<td>Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Basic Electrical Engineering</td>
<td>6</td>
</tr>
<tr>
<td>Manufacturing Techniques/Workshop Practice</td>
<td>2</td>
</tr>
<tr>
<td>Engineer-in-Society</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>36</strong></td>
</tr>
<tr>
<td><strong>(v)</strong> Core Courses</td>
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<tr>
<td>Engineering Mathematics</td>
<td>12</td>
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<tr>
<td>Embedded system design</td>
<td>3</td>
</tr>
<tr>
<td>Analogue Electronic Circuits</td>
<td>3</td>
</tr>
<tr>
<td>Digital Electronic Circuits</td>
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</tr>
<tr>
<td>Measurements and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>Circuit Theory</td>
<td>6</td>
</tr>
<tr>
<td>Digital System design with VHDL</td>
<td>3</td>
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<tr>
<td>Control System</td>
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<tr>
<td>Communication Principles</td>
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</tr>
<tr>
<td>Electrical Machines</td>
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</tr>
<tr>
<td>Software Engineering</td>
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<td>Computer Programming</td>
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<tr>
<td>Assembly Language Programming</td>
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<tr>
<td>Software Development Techniques</td>
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<tr>
<td>Microprocessor system &amp; Interfacing</td>
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</tr>
<tr>
<td>Laboratory Practicals</td>
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<tr>
<td>Artificial Neural Network</td>
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<tr>
<td>Computer Graphics &amp; Animations</td>
<td>3</td>
</tr>
<tr>
<td>Computer Organisation &amp; Architecture</td>
<td>3</td>
</tr>
<tr>
<td>Cyberpreneurship &amp; Cyberlaw</td>
<td>2</td>
</tr>
<tr>
<td>Computer Security Techniques</td>
<td>3</td>
</tr>
<tr>
<td>Data Communication &amp; Network</td>
<td>3</td>
</tr>
<tr>
<td>Prototyping Techniques</td>
<td>2</td>
</tr>
<tr>
<td>Digital Signal Processing</td>
<td>3</td>
</tr>
<tr>
<td>Reliability &amp; Maintainability</td>
<td>3</td>
</tr>
<tr>
<td>Project</td>
<td>6</td>
</tr>
<tr>
<td>Electives</td>
<td>4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>98</strong></td>
</tr>
</tbody>
</table>

70
### Break-Down Of Courses Into Levels Of Study:

#### Core Courses 300 Level
- Engineering Mathematics: 3
- Electromagnetic Fields & waves: 3
- Computer Organisation & Architecture: 4
- Entrepreneurial Studies: 3
- Circuit Theory: 3
- Analogue Electronic Circuit: 3
- Digital Electronic Circuit: 3
- Communication Principles: 3
- Measurement & Instrumentation: 3
- Electrical Machines: 3
- Laboratory Courses: 3
- Software Development Techniques: 40

**Total**

#### Core Courses 400 Level
- Technical Communications: 3
- Microprocessor System & Interfacing: 3
- Control System: 3
- Data Communication & Network: 3
- Assembly Language Programming: 3
- Object Oriented Design & Programming: 2
- Laboratory Course: 2
- Prototyping Techniques: 6
- SIWES (Industrial Training): 27

**Total**

#### Core Courses 500 Level
- Reliability and Maintainability: 3
- Embedded system design: 3
- Software Engineering: 3
- Digital Signal Processing: 3
- Digital System design with VHDL: 3
- Artificial Neural Network: 2
- Cyberpreneurship & Cyberlaw: 3

**Electives (2):**
- Robotic & automation: 2
- Digital Image Processing: 2
- Digital Speech Processing: 34
- Fuzzy logic & Programming
- Cryptography Principles & Applications

**Total**
COURSE DESCRIPTIONS

300 Level

Computer Organisation and Architecture 3 Units
Computer Fundamentals: Development history of computer hardware and software. Hardwired vs stored program concept. Von-Neuman architecture. Harvard architecture: principle of operation, advantages, disadvantages. Single address machine. Contemporary computers. Computer system: block diagram, functions, examples, dataflow, control line. Computer Arithmetic: integer arithmetic (addition, subtraction, multiplication, division), floating-point representation (IEEE), floating-point arithmetic. Arithmetic and logic unit (ALU). Introduction to CISC and RISC architecture: principle of operation, merits, demerits. Storage and Input/Output Systems: Computer function (fetch and execute cycles), interrupts, interconnection structures (Bus structure and bus types), Overview of memory system, memory chip organization and error correction, cache memory, memory storage devices. Overview of I/O, programmed and interrupt-driven I/Os, DMA, I/O channel and I/O processor. Control Unit: Micro-operations, control of the CPU, hardwired implementation, control unit operation, micro-instruction sequencing and execution, micro-programmed control. Use INTEL family, and MOTOROLA family as case study of a CISC computer system. Instruction Set and Register: Machine instruction characteristics, types of operands and operations, instruction functions, addressing modes, instruction formats, register organization, instruction pipelining. High performance computer systems: Techniques to achieve high performance, pipelining, storage hierarchy, units with function dedicated for I/O. RISC, introduction to superscalar processor, parallel processor. Use popular RISC processor (e.g. i960, Motorola PowerPC) as case study. Operating System: Overview of operating system, dimension and type of operating system, high level scheduling, short-term scheduling, I/O scheduling, memory management, virtual memory, UNIX/LINUX operating system: architecture, commands, programming; window based operating systems (MS windows, X-window).

Software Development Techniques 3 Units
Software development life cycle. Top-Down design. Program, design using pseudo-code, flowchart. Flowchart ANSI symbols and usage. Extensive examples, and exercises using pseudo-code/flowchart to solve practical problems in engineering. Debugging and documentation techniques. Programming using a structural language such as C: Symbols, keywords, identifiers, data types, operators, various statements, operator precedence, type conversion, conditional and control structures, function, recursive functions. Arrays: 1-D, and multi-dimensional arrays, passing elements or whole array to a function. Simple sorting and searching on arrays, pointers, strings, dynamic memory allocation. Structures and Unions: Structure declaration and definition, accessing structures, array of structures, pointers and structures, union declaration, enumerated variables. File Handling: Concept of a file, files and streams, standard file handling functions, binary files, random access files. Advanced Topics: Command line parameters, pointers to functions, creation of header files, stacks, linked lists, bitwise manipulation. Software development in C in MS Windows, UNIX/LINUX environments, header file, preprocessor directives, make, makefile. Static and dynamic linking libraries. Extensive examples, and exercises programming in C to solve practical problems in engineering. Exercises are to be done in the Computer Laboratory.

Analogue Electronic Circuit (3)
See Electrical and Electronics Engineering.

Digital Electronic Circuit (3)
See Electrical and Electronics Engineering.
Communication Principles  3
See Electrical and Electronics Engineering.

Electrical Machine  3
See Electrical and Electronics Engineering.

Electromagnetic Field & Waves
See Electrical and Electronics Engineering.

400 Level

Control System  3 Units

Data Communication and Network  3 Units

Prototyping Techniques  2 Units
Introduction: Grounding, ground plane, digital ground, analogue ground, power decoupling, inductance and capacitive effects, feedthrough capacitors. Soldering techniques for pass-through and surface mount components, desoldering.

**Microprocessor System and Interfacing** 3 Units
A basic microprocessor system: the CPU, memory, I/O, and buses subsystems, basic operation of a microprocessor system: fetch and execute cycle, the architecture of some typical 8-bit, 16-bit microprocessors (INTEL, MOTOROLA) and their features. Programming model in real mode: registers, memory, addressing modes. Organisation of the interrupt system, interrupt vectors, and external interrupts, implementation of single and multiple interrupts in real mode. Programming model in protected mode: registers, memory management and address translation, descriptor and page tables, system control instructions, multitasking and memory protection, addressing modes, and interrupt system. Memory interfacing and address decoding. I/O interfacing: memory mapped i/o, isolated i/o, bus timing, i/o instructions. Peripheral devices interfacing: 8255 PPI/6821 PIA, 8251 USART/6821 UART, DMA, Timer/Counter chips, etc. Instruction set. Assembly language Programming of INTEL and MOTOROLA microprocessors. Discussion of a typical system e.g. IBM PC, Apple Macintosh.

**Assembly Language Programming** 3 Units
Introduction: Language level of abstraction and effect on machine, characteristics of machine code, advantages, justifications of machine code programming, instruction set and dependency on underlying processor. Intel 8086 microprocessor assembly language programming: Programming model as resources available to programmer, addressing modes, instruction format, instruction set- arithmetic, logical, string, branching, program control, machine control, input/output, etc; assembler directives, hand-assembling, additional 80x86/Pentium instructions. Modular programming. Interrupt and service routine. Interfacing of assembly language to C. Intel 80x87 floating point programming. Introduction to MMX and SSE programming. Motorola 680x0 assembly language programming. Extensive practical engineering problems solving in assembly language using MASM for Intel, and cross-assembler for Motorola.

**500 Level**

**Cyberpreneurship & Media Law** 2 Units
Digital System Design with VHDL 3 Units

Digital Signal Processing 3 Units
Introduction: Advantages of digital over analogue signal processing, problems of digitization, overview of application of DSP, basic elements of DSP system. Digital Processing of analogue signals: Sampling of analogue signals, sampling theorem, aliasing, quantization, noise, and coding, types and selection of ADC/DAC, Sigma-delta ADC. Analytical tools: z-transform, properties, transfer function, inverse z-transform, z-plane poles and zeros, analysis of linear time-invariant in z-domain, system stability. Discrete Fourier Analysis: Discrete Fourier Transform and properties, inverse DFT, truncated fourier transform, windowing, FFT algorithms. Discrete Time Signals & systems: Discrete time sequences (signals), classification and determination of discrete time system, discrete time i/o description (difference equation), solution of difference equations, convolution, correlation, impulse response. Digital Filters: Definition and types. FIR filters: Transfer function, characteristics, applications, design methods, Gibb's effect and elimination, fir filter realisation. IIR filter: Transfer function, characteristics, applications, overview of analogue filter design techniques, design methods-conversion from analogue to digital filter design techniques, IIR filter realization. Structure of Discrete Time System: Block diagram representation of constant coefficient difference equations, IIR and FIR systems and their basic structures, stability of discrete time systems. Software implementation of dsp algorithms. DSP Microprocessors: Architecture, fixed point vs floating point DSP, Finite word length effects. DSP chips: interfacing and programming. Practical application of DSP in audio, and video.

Reliability and Maintainability 3 Units
Introduction to reliability, maintainability, reliability specification and metrics. Application to computer hardware system, communication equipment, power systems, electronic components. Basic maintenance types, and procedures of computer and digital communication system. Fault troubleshooting techniques. QoS and time of availability of data communication. Quality control techniques. Design for higher reliability, fault tolerance. Software Reliability: software reliability specification, software reliability Metrics, fault avoidance, fault tolerance, programming for reliability, software safety and hazard analysis. Comparison of hardware and software reliability. Software Quality and Assurance: definition of software quality, software quality factors, quality control, cost of quality, quality assurance. SQA activities, formal technical reviews, software quality metrics, statistical quality assurance. ISO 9000 Requirements and Certification, ISO 9000-3 for software quality process, process documentation, quality audit. Capability Maturity Model: Software Engineering Institute, levels of maturity, key process areas, Comparison between ISO 9000 Standards and CMM. Ensuring Quality and Reliability:
verification and validation, measurement tracking and feedback mechanism, total quality
management, risk management.

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

**Neural Network & Programming** 2 Units
Neural Network: Definition of artificial neural network. Similarities of neural network with
human brain. Classification of ANN. Terminologies: input/output sets, weights, bias or
threshold, supervised learning, network training, Convergence process, single layer vs.
multilayer perception, Forward and Backward propagation, gradient descent rule. Back­
propagation neural network, Variable term used in back propagation neural network:
learning rate, momentum, hidden nodes, sigmoid activation function. Back propagation
algorithm of ANN. Design of ANN model, training sets for ANN, test sets for ANN,
network testing and performance. Engineering applications. ANN programming.

**Computer Security Techniques** 2 Units
Introduction: Overview of computer security, attacks and services, control of hardware
Malicious programs. Types of viruses. Antivirus approaches. Worm propagation and
countermeasures: access control, intrusion detection and firewalls. Disaster Recovery:
Recovery requirements, policy, strategy, technical team. Execution of recovery plans.
Documentation and backup system. Loss estimation. Developing Secure Computer
Verification, Bell and LaPadulla Model, Clark-Wilson Model, Goguen-Meseguer, TCSEC],
Discretionary Access Requirements, Mandatory Access Requirements, User
Authentication, Access and Information Flow Control, Auditing and Intrusion Detection,
Damage Control and Assessment, Microcomputer Security. Entropy, perfect secrecy,
unicity distance, complexity theory, NP completeness, number theory. Cryptographic
System, Public Key Systems, digital signatures. Network and Telecommunication
Security: Fundamentals, Issue, Objective and Threats, Security Services, Distributed
System Security, The Trusted Network Interpretation, TNI Security Services, AIS

**Digital Image Processing** 2 Units

**Fuzzy Logic & Programming** 2 Units

**Robotic & Automation** 2 Units

**Cryptography Principles & Applications** 2 Units
Design & Installation of Electrical & ICT services 3 Units

Computer Security Techniques 2 Units

Computer Graphics & Animations 3 Units

Cyberpreneurship & Media Law 2 Units
B. ENG. MECHANICAL ENGINEERING

Course Summary

(i) Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory of Machines</td>
<td>6</td>
</tr>
<tr>
<td>Workshop Practice</td>
<td>6</td>
</tr>
<tr>
<td>Auto Workshop</td>
<td>3</td>
</tr>
<tr>
<td>Engineering Drawing</td>
<td>4</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>8</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>8</td>
</tr>
<tr>
<td>Mechanical Design</td>
<td>7</td>
</tr>
<tr>
<td>Science and Engineering of Materials and</td>
<td></td>
</tr>
<tr>
<td>Metallurgy</td>
<td>6</td>
</tr>
<tr>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td>Manufacturing Technology</td>
<td>2</td>
</tr>
<tr>
<td>Engineering Materials, Selection and</td>
<td></td>
</tr>
<tr>
<td>}</td>
<td>3</td>
</tr>
<tr>
<td>Economics</td>
<td>1</td>
</tr>
<tr>
<td>Engineer-in-Society</td>
<td>2</td>
</tr>
<tr>
<td>Technology Policy and Development</td>
<td>2</td>
</tr>
<tr>
<td>Technical Communications</td>
<td>3</td>
</tr>
<tr>
<td>Advanced CAD/CAM</td>
<td>6</td>
</tr>
<tr>
<td>Project</td>
<td>67</td>
</tr>
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</table>

Sub-Total: 80

(ii) Other Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Electrical and Electronics Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Basic Civil Engineering</td>
<td>3</td>
</tr>
<tr>
<td>Law and Management Courses</td>
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Sub-Total: 20

(iii) Basic Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>10</td>
</tr>
<tr>
<td>Chemistry</td>
<td>10</td>
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<tr>
<td>Physics</td>
<td>6</td>
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<tr>
<td>Computers &amp; Computing</td>
<td>46</td>
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</tbody>
</table>

Sub-Total: 4

(iv) Entrepreneurial Studies

(v) Humanities

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>General Studies</td>
<td>12</td>
</tr>
<tr>
<td>Electives</td>
<td>28</td>
</tr>
</tbody>
</table>

Sub-Total: 16

Ground Total: 161
(b) Break-Down Of Courses Into Levels Of Study

### 300 Level
- Engineering Mathematics: 2
- Computers & Computing: 3
- Theory of Machines I: 2
- Manufacturing Technology: 2
- Thermodynamics: 2
- Fluid Mechanics: 2
- Engineering Drawing: 2
- Workshop Practice: 2
- Engineering Metallurgy I: 1
- Engineer-in-Society: 4
- Elect. & Electronics Engineering: 2
- Civil Engineering: 3
- Control Systems: 6
- Laboratory Practicals: 2
- Foundation Course in Entrepreneurial Studies: 41

**Total**

### 400 Level
- Theory of Machines II: 3
- Auto Workshop Practice: 2
- Thermodynamics: 2
- Fluid Mechanics: 3
- Mechanical Engineering Design I: 2
- Engineering Communication: 2
- Technology Policy and Development: 2
- Engineering Statistics: 2
- Introduction to Entrepreneurship Studies: 3
- Laboratory Practicals: 23

**Total**

### 500 Level
- Thermodynamics: 2
- Fluid Mechanics: 2
- Engineering Metallurgy II: 4
- Mechanical Engineering Design II: 3
- Engineering Materials Selection, and Economics: 6
- Project: 3
- Law and Management: 12
- Electives: 3
- Advanced CAD/CAM: 3
- Laboratory Practicals: 40

**Total**
COURSE DESCRIPTIONS

Core Course Descriptions Common to 300, 400 and 500 Levels

(i) Thermodynamics 6 Credits
Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(ii) Theory of Machines 2 Credits
Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton’s Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(iii) Fluid Mechanics 6 Credits
Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) Science and Engineering of Materials and Metallurgy 3 Credits
Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) Engineering Drawing 2 Credits
Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) Mechanical Engineering Design 7 Credits
Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production matching; Optimisation in design.

(vii) Manufacturing Technology 2 Credits
Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) Workshop Practice 2 Credits
Workshop setting; Types of workshop equipment, machines and materials; Use of instruments, Machine operation practice; Safety procedures in workshops.

(ix) Control Systems 3 Credits
Control Engineering concepts; Transfer function; Differential Equation of control Systems; Transducers; Automatic control methods.

(x) Engineering Statistics 2 Credits
### Course Summary

#### (i) Humanities
- General Studies: 16

#### (ii) Basic Sciences
- Mathematics: 12
- Physics: 10
- Chemistry: 8
- **Sub-Total**: 36

#### (iii) Entrepreneurial Studies
- 4

#### (iv) Basic Engineering Courses
- Engineering Mathematics: 12
- Computers & Computing: 3
- Engineering Drawing: 4
- Applied Mechanics: 4
- Strength of Materials: 2
- Material Science: 3
- Thermodynamics: 2
- Fluid Mechanics: 2
- Basic Electrical Engineering: 6
- Manufacturing Technology/Workshop Practice: 2
- Engineer-in-Society: 1
- **Sub-Total**: 41

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

#### (vi) Options
- A choice of 20 Credits from any of the following courses:
  - Electromechanical Devices Design: 2
  - Electrical Services Design: 2
  - Power Electronics and Drives: 3
Power Systems Engineering (Systems Analysis, Planning and Protection) 2
Power Systems Communication and Control 2
Switchgear and High Voltage Engineering 2
Industrial Electronics Design
Micro-Computer Hardware and Software Techniques 3
Communications Systems 2
Telecommunication Engineering 2
Analogue and Digital Computer 2
Solid State Electronics 2
Digital Signal Processing 2
Telecommunication Services Design 2
Digital communication systems 2
Special topics in Engineering Technology in Electrical Engineering
Total 174

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

<table>
<thead>
<tr>
<th>Lecture/Lab.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering Mathematics</td>
<td>6</td>
</tr>
<tr>
<td>Numerical Methods</td>
<td>4</td>
</tr>
<tr>
<td>Electromagnetic Fields and Waves</td>
<td>6</td>
</tr>
<tr>
<td>Circuit Theory</td>
<td>6</td>
</tr>
<tr>
<td>Electronic Circuit (Analogue &amp; Digital)</td>
<td>6</td>
</tr>
<tr>
<td>Physical Electronics</td>
<td>3</td>
</tr>
<tr>
<td>Measurements and Instrumentation</td>
<td>3</td>
</tr>
<tr>
<td>Control Theory</td>
<td>3</td>
</tr>
<tr>
<td>Communication Principles</td>
<td>3</td>
</tr>
<tr>
<td>Electric Power Principles</td>
<td>3</td>
</tr>
<tr>
<td>Electromechanical Devices and Machines</td>
<td>4</td>
</tr>
<tr>
<td>Laboratory Practicals</td>
<td>9</td>
</tr>
<tr>
<td>Foundation Course in Entrepreneurial Studies</td>
<td>2</td>
</tr>
<tr>
<td>Introduction to Entrepreneurship Studies</td>
<td>2</td>
</tr>
<tr>
<td>Sub-Total</td>
<td>60</td>
</tr>
</tbody>
</table>

500 Level
Reliability & Maintainability of Electrical & Electronic Components and Systems 2
Advanced Computer Programming and Statistics 3
Control Engineering 2
Advanced Circuit Techniques 4
Project 6
Electives 20
Total 84

Options
A choice of 16 Credits from any of the following courses 2
Electromechanical Devices Design 2
Electrical Services Design 3
Power Electronics and Drives
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Systems Engineering (Systems Analysis, Planning and Protection)</td>
<td>3</td>
</tr>
<tr>
<td>Power Systems Communication &amp; Control</td>
<td>2</td>
</tr>
<tr>
<td>Switchgear and High Voltage Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Industrial Electronic Design</td>
<td>3</td>
</tr>
<tr>
<td>Micro-Computer Hardware and Software</td>
<td>3</td>
</tr>
<tr>
<td>Techniques</td>
<td>2</td>
</tr>
<tr>
<td>Communications Systems</td>
<td>2</td>
</tr>
<tr>
<td>Telecommunication Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Analogue and Digital Computer</td>
<td>2</td>
</tr>
<tr>
<td>Solid State Electronics</td>
<td>2</td>
</tr>
<tr>
<td>Digital Signal Processing</td>
<td>2</td>
</tr>
<tr>
<td>Digital communications system</td>
<td>2</td>
</tr>
<tr>
<td>Special Topics</td>
<td></td>
</tr>
<tr>
<td>Telecommunication Services Design</td>
<td></td>
</tr>
</tbody>
</table>

85
COURSE DESCRIPTIONS

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

(i) **Engineering Mathematics**  
4 Credits  

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

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

(iv) **Circuit Theory**  
6 Credits  
Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer's methods of Synthesis, 2-port network synthesis, active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.

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

(vi) **Digital Electronics Circuit**  
3 Credits  
(vii) **Physical Electronics** 3 Credits
Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy hands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

(viii) **Measurements And Instrumentation** 3 Credits
General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal 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 analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(ix) **Control Theory** 3 Credits
Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

(x) **Communication principles** 3 Credits
Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, clipers and limiters. Amplitude modulated signal reception; discrimination, frequency tracking loop, phase locked loop and noise performance. Commercial radio systems. Transmission media; attenuation in open space, air, cable and fibre channels; construction of cables and fibres, sampling theorem, pulse amplitude modulation, pulse width modulation, multiplexing, quantization systems and pulse code modulation, delta modulation, courses and correction of errors in PCM and DM.

(xi) **Electric Power Principles** 3 Credits
Introduction to power systems and sources of electric energy, structure of electric system, load characteristics, electric energy transmission and distribution, line 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.

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

Practicals 9 Credits

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

Telecommunication Laboratory
A laboratory work on telecommunication designed to illustrate topics covered in Communication Principles as well as topics such as passive filters, tuned 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.

Engineering Mathematics 2 Credits

500 LEVEL

Reliability Engineering 2 Credits

Advanced Computer Programming And Statistics 3 Credits
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.

Control Engineering 3 Credits
State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realisation of systems having specified transfer function, applications to circuit synthesis and signal processing.
(iv) **Advanced Circuit Techniques** 3 Credits
Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops. Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate packages e.g. PSPICE, Electronic workbench, Visio technical etc should be encouraged.

(v) **Project** 6 Credits
This course lasts for one academic session. Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars.

(vi) **Electives** 16 Credits
These will be chosen by students with the Co-ordinators approval. The courses can be chosen from other programmes such as Mechanical Engineering, Physics and Mathematics/Computer Science. The courses chosen should provide some breadth to the students chosen area of specialisation.

**OPT 1 Electromechanical Devices Design** 2 Credits
Design of transformers, principles of AC and DC machine design, introduction to parks equations.

**OPT 2 Electrical Services Design** 2 Credits
Lighting installation, power installation, energy supply and distribution, choice of cables and conductors, wiring systems and accessories, outdoor low voltage lines and cables, protection of low voltage installation, and characteristics of low voltage equipment, Earthing and testing of electrical installation, illumination.

**OPT 3 Power Electronics And Devices** 3 Credits
Switching characteristics of diodes, transistors, thyristors etc. analysis of diode circuit with reactive loads, analysis of circuits using transistors as switches, power control circuits, ACDC converters, characteristics of switching transformers, power semiconductor device protection, examples of power electronic circuits, solar devices.

**OPT 4 Power Systems Engineering** 3 Credits
Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

**OPT 5 Power System Communication And Control** 2 Credits
Review of transmission line theory. High frequency communication on power lines carrier systems and power line carrier applications. Multiplexing, Telemetering, Signal processing and data transmission. Control of power generation, voltage control, system stability, automatic voltage regulators, regulating transformers.

**OPT 6 Switchgear And High Voltage Engineering** 2 Credits
Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightning protection, Electric cables and condensers.
OPT 7 Industrial Electronics Design 2 Credits
Characteristics and industrial applications of thyristors and other SCR devices. Transducers and their applications in sensing light, voltage pressure, motion, current temperature, etc. Mechanical relays, solid state relays and stepping motors. Real time control and remote control concepts in instrumentation. Micro-processor and micro-computer based systems.
Fire alarms, burglar alarms and general home and industrial instrumentation.

OPT 8 Micro-Computer Hardware And Software Techniques 3 Credits
Elements of digital computer design; control unit, micro-programming, bus organisation and addressing schemes. Micro-processors, system architecture, bus control, instruction execution and addressing modes. Machine codes, assembly language and high-level language programming, Micro-processors as state machines. Microprocessor interfacing: Input/output. Technique, interrupt systems and direct memory access; interfacing to analogue systems and applications to D/A and A/D converters. System development tools: simulators, EPROM programming, assemblers and loaders, overview of a available microprocessor application.

OPT 9 Communications Systems 3 Credits
Microwave frequencies and uses; microwave 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 operture antennae and the releated design parameters; introduction to antennae arrays. Radiowave propagation: propagation in the ionosphere, troposphere and in stratified media; principles of scatter propagation; applications in general broadcast, television and satellite communication systems. Radar systems nature of radar and radar equations; composition of a radar system; application of different types of radars.

OPT 10 Telecommunication Engineering 2 Credits
Cable telegraphy and telephony characteristics, cross talk, equation, Poleliness, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

OPT 11 Analogue And Digital Computer 2 Credits
Analogue computation, electrical analogue of mechanical, electromechanical systems and servomechanisms. Analogue computer elements: potentiometers, operational amplifiers, function generators, simulation of system transfer functions. Digital computer structure and elements, CPU, storage, peripherals Arithmetic processes, Hybrid computer systems.

OPT 12 Solid State Electronics 2 Credits
Physics and property of semi-conductors including high field effects, carrier injection and semi-conductor surface phenomena, devices technology, bulk and epitaxical material growth and impurity control, metal-semi-conductor interface properties, stability and methods of characterisation: controlled and surface-controlled devices.

OPT 13 Digital Signal Processing 2 Credits
Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and
software. Basic image processing concepts.

OPT 14  Digital Communications System 2 Credits

OPT 15  Special Topics 2 Credits
Topics in emerging technology in Electrical Energy – should be taught by one or more lecturers.

OPT 16  Telecommunication Services Design 2 Credits
B. ENG. INDUSTRIAL AND PRODUCTION ENGINEERING

(a) Course Summary

(i) Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science &amp; Eng. Of Materials and Metallurgy</td>
<td>10</td>
</tr>
<tr>
<td>Operations Research</td>
<td>5</td>
</tr>
<tr>
<td>Production Technology</td>
<td>6</td>
</tr>
<tr>
<td>Mechanics of Machines</td>
<td>8</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>5</td>
</tr>
<tr>
<td>Industrial Engineering Statistics</td>
<td>4</td>
</tr>
<tr>
<td>Thermodynamics</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Economics</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Drawing</td>
<td>6</td>
</tr>
<tr>
<td>Workshop Practice including:</td>
<td></td>
</tr>
<tr>
<td>Automobile workshop</td>
<td></td>
</tr>
<tr>
<td>Manufacturing Techniques/Workshop Practice</td>
<td>2</td>
</tr>
<tr>
<td>HFE and Factory Layout</td>
<td>5</td>
</tr>
<tr>
<td>Machine Tools</td>
<td>5</td>
</tr>
<tr>
<td>Project Planning and Control</td>
<td>6</td>
</tr>
<tr>
<td>Mechanical Engineering Design</td>
<td>4</td>
</tr>
<tr>
<td>Metrology</td>
<td>4</td>
</tr>
<tr>
<td>Control systems</td>
<td>3</td>
</tr>
<tr>
<td>Tool Design</td>
<td>3</td>
</tr>
<tr>
<td>Industrial Computers and Applications</td>
<td>2</td>
</tr>
<tr>
<td>Production Planning and Control</td>
<td>5</td>
</tr>
<tr>
<td>Engineering Materials, Selection and Economics</td>
<td></td>
</tr>
<tr>
<td>Engineer-in-Society</td>
<td>1</td>
</tr>
<tr>
<td>Technology Policy &amp; Development</td>
<td>2</td>
</tr>
<tr>
<td>Project</td>
<td>6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>104</strong></td>
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</table>

(ii) Other Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>Industrial Engineering</td>
<td>5</td>
</tr>
<tr>
<td>Electronic &amp; Electrical Engineering</td>
<td>10</td>
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<tr>
<td>Law and Management</td>
<td>4</td>
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<tr>
<td>Industrial Law</td>
<td>2</td>
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</tbody>
</table>

(iii) Basic Science Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematics</td>
<td>24</td>
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<tr>
<td>Physics</td>
<td>10</td>
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<tr>
<td>Chemistry</td>
<td>10</td>
</tr>
<tr>
<td>Computers &amp; Computing</td>
<td>3</td>
</tr>
</tbody>
</table>

(iv) Entrepreneurial Studies

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Entrepreneurial Studies</strong></td>
<td>4</td>
</tr>
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</table>

(v) Humanities

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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</thead>
<tbody>
<tr>
<td>General Studies</td>
<td>16</td>
</tr>
<tr>
<td>Electives</td>
<td>12</td>
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<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>100</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>204</strong></td>
</tr>
</tbody>
</table>
### Break-Down Of Courses Into Levels Of Study

#### 300 Level
- Engineering Mathematics: 3
- Computers & Computing: 2
- Theory of Machines: 2
- Operations Research: 2
- Manufacturing Technology: 2
- Thermodynamics: 2
- Fluid Mechanics: 2
- Industrial Engineering Statistics: 1
- Engineering Drawing: 4
- Workshop Practice: 4
- Metallurgy: 6
- HFE and Factory Layout: 2
- Electrical & Electronic Engineering: 43

#### 400 Level
- Operations Research: 2
- Engineering Economics: 2
- Project Planning and Control: 2
- Work Study and Systems Design: 2
- Industrial Process Design: 2
- Machine Tools: 2
- HFE and Factory Layout: 2
- Tool Design: 2
- Laboratory Practicals: 1
- Production Technology: 2
- Metrology: 2
- Introduction to Entrepreneurial Studies: 2
- Technical Communications: 2

**Total**: 25

#### 500 Level
- Industrial Computers and Applications: 5
- Engineering Metallurgy: 2
- Project Planning and Control: 2
- Mechanical Engineering Design: 4
- Works Study and Systems Design: 2
- Engineering Materials, Selection and Economics: 3
- Industrial Engineering Statistics: 2
- Machine Tools: 3
- Production and Inventory Design: 2
- Manufacturing Technology: 5
- Production Planning and Control: 2
- Project: 6
- Law and Management: 4
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electives</td>
<td>6</td>
</tr>
<tr>
<td>Laboratory Practicals</td>
<td>6</td>
</tr>
<tr>
<td>Technology Policy &amp; Entrepreneurship</td>
<td>2</td>
</tr>
<tr>
<td>Control Systems</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>59</strong></td>
</tr>
</tbody>
</table>
COURSE DESCRIPTIONS

(i) Machine Tools

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

(iii) Production Technology
Production process: Machining, Metal forming, Metal casting. Metal joining processes: welding, braising, soldering, mechanical joining, adhesive joining, heat treatment and surface finishing processes

(iv) Tool Designs

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

(vi) Engineering Economics
Economics of business settings: Costing of production systems; objectives of cost analysis and cost control.

(vii) Project Planning and Control
Production planning; production control; Corporate Strategy and long range planning; project cost analysis and control.

(viii) Work Study and Systems Design
Method study and work measurement; work Study; time study; System design and optimisation.

(ix) Industrial Process Design
Process capability; process reliability measurement; process selection and design.

(x) Human Factors Engineering and Factory Layout
Factory layout models; Labour and time analysis; job evaluation; Workforce management and control; Training and incentives.

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

Course Summary

(i) General Studies
- Sub-Total: 16 units

(ii) Basic Sciences
- Mathematics: 20 units
- Chemistry: 12 units
- Physics: 10 units
- Geology: 7 units
- Sub-Total: 49 units

(iii) Entrepreneurial Studies
- 4 units

(iv) Major Engineering Course
- (Petroleum Eng. Courses)
  - Introduction to Petroleum Eng.: 3 units
  - Drilling Courses: 12 units
  - Formation Evaluations: 12 units
  - Petroleum Production Engineering: 12 units
  - Reservoir Engineering: 12 units
  - Petroleum Economics: 3 units
  - Petroleum Eng. Laboratory: 6 units
  - Project: 4 units
  - Sub-Total: 64 units

(v) Other Engineering Courses
- Technical/Engineering Drawing: 2 units
- Workshop Practice: 2 units
- Strength of Materials: 4 units
- Fluid Mechanics: 6 units
- Thermodynamics: 3 units
- Applied Electricity: 4 units
- Computers & Computing: 2 units
- Other Engineering Electives: 5 units
- Specialisation: 12 units
- Total: 28 units

(vi) Components of Petroleum Engineering
- General Studies: 16 units
- Basic Sciences: 49 units
- Entrepreneurial Studies: 4 units
- Major Engineering Courses: 64 units
- Other Engineering Courses: 28 units
- Specialisation: 12 units
- Total: 173 units

Theory/Laboratory Ratio (Contact Hours) 62.5/37.5
### Break-Down Of Courses Into Levels of Study

#### 300 Level

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Studies</td>
<td>4</td>
</tr>
<tr>
<td>Engineering Economy</td>
<td>2</td>
</tr>
<tr>
<td>Engineering Analysis</td>
<td>5</td>
</tr>
<tr>
<td>Strength of Materials</td>
<td>3</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>3</td>
</tr>
<tr>
<td>Drilling Fluids Technology</td>
<td>4</td>
</tr>
<tr>
<td>Drilling Technology</td>
<td>3</td>
</tr>
<tr>
<td>Reservoir Engineering I</td>
<td>6</td>
</tr>
<tr>
<td>Petroleum Production Engineering I</td>
<td>3</td>
</tr>
<tr>
<td>Foundation Course in Entrepreneurial Studies</td>
<td>2</td>
</tr>
<tr>
<td>Petroleum Geology</td>
<td>3</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>38</strong></td>
</tr>
</tbody>
</table>

#### 400 Level (I Semester)

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industrial Studies</td>
<td>2</td>
</tr>
<tr>
<td>Applied Geophysics</td>
<td>2</td>
</tr>
<tr>
<td>Engineering Management and Law</td>
<td>2</td>
</tr>
<tr>
<td>Drilling Technology II</td>
<td>3</td>
</tr>
<tr>
<td>Reservoir Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>Petroleum Production Engineering II</td>
<td>3</td>
</tr>
<tr>
<td>Well Lodging</td>
<td>3</td>
</tr>
<tr>
<td>Introduction to Entrepreneurship Studies</td>
<td>2</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>20</strong></td>
</tr>
</tbody>
</table>

#### 500 Level

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drilling Technology III</td>
<td>3</td>
</tr>
<tr>
<td>Reservoir Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>Petroleum Refining Technology</td>
<td>3</td>
</tr>
<tr>
<td>Petroleum Production Engineering III</td>
<td>3</td>
</tr>
<tr>
<td>Reservoir Modeling and Simulation</td>
<td>3</td>
</tr>
<tr>
<td>Enhanced Oil Recovery</td>
<td>2</td>
</tr>
<tr>
<td>Project</td>
<td>4</td>
</tr>
<tr>
<td>Design</td>
<td>5</td>
</tr>
<tr>
<td>Petroleum Product Transport &amp; Storage</td>
<td>2</td>
</tr>
<tr>
<td>Process Technology</td>
<td>3</td>
</tr>
<tr>
<td>Offshore Operations</td>
<td>2</td>
</tr>
<tr>
<td>Natural Gas Processing</td>
<td>3</td>
</tr>
<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>36</strong></td>
</tr>
</tbody>
</table>
COURSE DESCRIPTIONS

300 Level

(i) Industrial Studies 2 Credits
Introduction to the organisational structure of manufacturing organisations. Evolution of an industrial, domestic and commercial product from society’s needs, or market survey; problem definition, design tools - simulation, graphs and layouts; feasibility studies. Team implementation/manufacture of selected simple engineering products for industrial, domestic and commercial purposes.

(ii) Industrial Studies II 2 Credits
Study of projects and contract documents for the various branches of Engineering; Drawing, Bill of Quantities, Identification of Materials, Material location, Quantity, Quality and handling requirements; Specification, Quality control and Measurements, Safety and Safety procedures.

(iii) Engineering Economy 2 Credits

(iv) Heat and Mass Transfer 4 Credits
Models of heat transfer, general heat conduction equation, steady state conduction, unsteady heat transfer by convection, natural and forced, laminar and turbulent. Heat transfer by radiation, fundamentals of black and gray bodies, combined models of heat transfer, radiation exchange between surfaces. Heat exchangers, conductors and dryers. Mass transfer fundamentals, diffusion and convection mass transfer.

(v) Strength of Materials I 3 Credits

(vi) Strength of Materials II 3 Credits

(vii) Engineering Analysis II 3 Credits
Statics of rigid bodies in three dimensions; Distributed Force-Centroids and Centres of Gravity; Analysis of Structures – Internal Forces, Newton’s Third Law, Trusses, Frames, and Machines; Forces – moment of inertia – areas and masses; Rotation of rigid body about a fixed axis, plan motion of rigid body; Relative motion; Applications. Principles of virtual work, Efficiency of simple machines. Review and engineering applications of Differential Equations; Partial Differential Equations; Laplace Transformation and other transform methods. Series solutions and special functions such as Bessel’s functions, Fourier series.
Engineering Analysis III 3 Credits
Numerical methods and digital computer methods applied to various engineering problems including matrix inversion, numerical approximation methods, optimisation methods and applications in engineering: Introduction to state space formulation, analysis and applications. Computer design of simple engineering components and systems.

Fluid Mechanics I 3 Credits

Fluid Mechanics II 3 Credits
Introduction to Hydrodynamics, stream function, flow fields, steam lined bodies, rotational and irrotational flows, velocity potential, conformal transformation. Jou Kowsky transformation. Thin aerofoil theory, characteristics of two dimensional aerofoil. Sections introduction to turbo – machines. Characteristics curves for pumps, axial flow machines, impulse and reaction turbines, fans, blowers and propellers. Introduction to gas dynamics. Introduction to boundary layer theory. Dimensional analysis and similarity laws

Drilling Fluids Technology 4 Credits
Functions and composition of drilling fluids. Mud properties; testing, classification and chemical analysis. Drilling mud calculations, control of mud properties. Well completion fluids. Drilling mud performance.

Drilling Technology I 3 Credits

Reservoir Engineering I 6 Credits
Fundamental properties of single and multiple fluid saturated rocks; porosity, permeability, relative permeability, fluid saturations, electrical resistivity capillary pressure. Surface forces, wettability, compressibility and correlations between rock properties.

Petroleum Production Engineering I 3 Credits
Properties of oil and Gas: Composition of oil and natural gas; classification of crude oil; natural gas. Well Completion: Tubing; types, tubing equipment, uses of tubing, calculations; use of wirelines, packers-types, uses; multiple zone completion; well heads – casing and tubing hangers; Christmas tree. Cruptive Production: Gas-oil ratio (GOR); productivity index; fluid flow and pressure losses; multiphase formation volume factor (Bt). Perforation: bullet perforation; jet perforation. Artificial Production: Gas lift; pumps.

Petroleum Geology 3 Credit
Petroleum prospecting, uses of geological data, reservoir rocks, reservoir fluids, traps, origin of oil and gas geology of the Niger Delta and Lake Chad Basin. Geophysics.
Petroleum Engineering Rock Mechanics  3 Credits

400 LEVEL

(i) Industrial Studies III  2 Credits
Group technology tasks: these may involve group design and manufacture of prepared drawings, specifications and planning schedules, a viable commodity which has a tested performance, and acceptable standard of finish and time and cost constraints, under a chosen leader; service and maintenance group tasks, etc. (Emphasis is for the students to appreciate the necessity to use people, materials and equipment to the best economic conditions and the need for personal relationship and the acceptance of responsibility when working as part of a team).

(ii) Technical Communications  2 Credits
Introduction to principles of effective communication with attention to the importance of emphasis, emotive content, and style; principles of technical writing, organisation and presentation of technical reports, feasibility studies, technical correspondence. Oral presentation of technical ideas; technical aids in presentation, organisation of practical applications.

(iii) Engineering Management and Law  2 Credits
Engineering profession: Professional ethics and conduct.
Law: Definition and specification; Applications of business law to engineering; Patents and inventions, trademarks and copyrights; Contracts and contract documents; Engineering business – types, the structure and functions of organisations: Professional problems – legal responsibilities, professional liability, role of engineer in law suits.
Management: Organisational structure and behaviour; engineer to engineer manager transition; Managerial functions, principles and techniques of planning, forecasting, organising technical activities; project selection and management; leadership, styles of leadership and management. Techniques in engineering management – motivated, appraisal, participative and control techniques.

(iv) Drilling Technology II  3 Credits
Pressure Control and Blowout Prevention: The need to control pressure; BOP valves; stack, choke line and choke manifold; choice of BOP system; control o kick; subsurface pressures and mud hydrostatic pressure; data for executing kick control; indications of kick; methods of circulating out a kick – Balanced Bottom Hole Pressure method (BBHP), driller’s method; kick when tripping, gas out mud. Cementing: Equipment; hole conditions; volume calculations and rate of circulation; squeeze cementing; cement plug.
Fishing: Fishing tolls; objects lost in the hole; fishing methods.
Casing Design: Mechanical properties – tension, collapse and burst; designing a casing string.

(v) Reservoir Engineering II  3 Credits
(vi) **Petroleum Production Engineering II** 3 Credits  
Surface completion: Gathering systems; service and cleaning systems; design and testing of flow lines. Emulsion problems; oil emulsions; emulsifying agents and deemulsifiers; choice and dosage of de-emulsifiers. Separation and separators; heat treatment. Dehydration: need for dehydration of gas; dew-point depression; absorption with glycol and absorption with solids.

(vii) **Well Logging** 3 Credits  

(viii) **Applied Geophysics and Petroleum Exploration** 2 Credits  
The scope of geophysics; solid earth geophysics; the shape of the earth; geomagnetism; marine geophysics; isostacy. Geophysical instruments, field data processing, electrical, seismic, radiometric, etc). Geophysical logging of borehole. Geophysical prospecting and exploration.

(ix) **Oil Pollution and Control** 3 Credits  

500 Level

(i) **Drilling Technology III** 3 Credits  

(ii) **Reservoir Engineering III** 3 Credits  
Water influx; steady-state; pseudo steady – state (Hurst); transient (Van Everdingen and Hurst). Well test: drill-stem tests (DST); Production tests; pressure tests; back-pressure tests on gas wells, productivity tests on oil wells, build-up and draw-down tests on oil wells, coning of water and gas; effects of partial penetration. Secondary recovery; water injection sweep efficiency stiles methods, Dykstra – Parsons method.

(iii) **Petroleum Refining Technology** 3 Credits  
Petroleum processing equipment; storage tanks; rectification columns; heat exchange apparatus; pipe fumances; pipelines and fittings; compressors and pumps. Preliminary processing. Thermal processes; thermal cracking; coking; pyrolysis. Catalytic processes; brief description; catalytic cracking; catalytic reforming; hydrogenation processes; hydrogen cracking.

(iv) **Petroleum Production Engineering III** 3 Credits  
Problem-well analysis: Work over techniques; well stimulation; fracturing and acidising. Sand control: gravel packing; sand consolidation. Pipelines and transportation: maximum pipeline capacity; other transportation systems. Metering of oil and gas; problems associated with flow measurement; flow measurement systems; liquid level controllers.
(v) **Reservoir Modeling and Simulation** 3 Credits

(vii) **Enhanced Oil Recovery** 3 Credits
Principles of displacement: rock properties; fluid properties in reservoir; phase behaviour; displacement efficiencies. Gas methods; miscible slug; enriched gas-high pressure lean gas; carbon dioxide; nitrogen and other inerts. Chemical methods; miscellar – polymers; polymer augmented waterflood; permeability alteration; caustic. Thermal methods; steam stimulation; steam drive; in-situ combustion.

(vii) **Petroleum Product Transport and Storage** 3 Credits
Transportation of crude oil: Pipelines; tankers – loading and unloading techniques, offshore loading systems, international regulations on tanker transportation. Custody transfer storage of crude oil tank farm operations – gauging, sampling, quality control, underground storage – caverns, porous rocks. Gas transportation: compressors, pipelines; liquefied natural gas transportation. Storage of natural gas; pressure tanks, re-injection in porous rocks, storage in caverns. Storage of LNG.

(viii) **Process Technology** 3 Credits

(ix) **Offshore Operation** 2 Credits
Offshore drilling: Offshore prospecting; offshore rigs; stationary and floating rigs; rig movement and stability; drilling from a floating vessel; subsea BOP stack; marine risers; subsea wellhead. Offshore production: subsea well completion methods; offshore processing equipment and design; loading systems and other transportation. Offshore operations: logistics, contingency planning; oilspill and oil removal.

(x) **Natural Gas Processing** 3 Credits
Gas laws; phase behaviour of natural gas system; gas from condenstate and oil fields; field separation processes; dehydration and sweetening of natural gas; scale problems; gas liquification.

(x) **Petroleum Economics** 2 Credits
The structure of the petroleum industry; economic geography - impact of oil resources on the economy of oil producing countries; linear programming; refinery economics; oil concessions in Nigeria; government participation; the Nigeria petroleum labour market; marketing and sales calculations; investment analysis; risk analysis and probability; financing energy crisis.

(xii) **Multiple Phase Flow in Pipes** 3 Credits
**B. ENG. METALLURGICAL AND MATERIALS ENGINEERING**

(a) **Course Summary**

(i) **Core Courses**
- Science and Engineering of Materials 5
- Fluid Mechanics 5
- Mechanics of Machines 5
- Engineering Drawing 6
- Workshop Practice (including Automobile Workshop) 2
- Thermodynamics 5
- Metallurgical Thermodynamics and Kinetics 2
- Manufacturing Technology 5
- Mechanical Processing of Materials 2
- Chemical Processing of Materials 2
- Mineral Processing and Technology 5
- Production Metallurgy 4
- Fuels, Refractories and Furnace Technology 2
- Extraction and refining of materials 4
- Metallurgical and Materials Process Design 9
- Non-Metals Technology 4
- Foundry Technology 6
- Heat and Mass Transfer 3
- Thermal Treatment Materials 3
- Corrosion Engineering 2
- Powder Technology 2
- Physical Metallurgy 2
- Engineer-in-Society 2
- Technology Policy and Development 2
- Project 6
- Engineering Materials Selections and Economics 3
- Other Materials & Metallurgy Laboratories 6

**Total** 104

(ii) **Other Courses**
- Electronic & Electrical Engineering Courses 10
- Basic Chemical Engineering 5
- Law and Management 4

(iii) **Basic Science Courses**
- Mathematics 24
- Physics 10
- Chemistry 10
- Computers & Computing 3

(iv) **Entrepreneurial Studies**
- 4

(v) **Humanities**
- General Studies 16
- Electives 8

**Total** 94

Grand Total 198
(b)  
**Break-Down Of Courses Into Levels Of Study**

### 300 Level

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Engineering Mathematics</td>
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<tr>
<td>Computers &amp; Computing</td>
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</tr>
<tr>
<td>Manufacturing Technology</td>
<td>2</td>
</tr>
<tr>
<td>Metallurgical Thermodynamics</td>
<td>2</td>
</tr>
<tr>
<td>Fluid Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Engineering Drawing &amp; Computer Aided Graphics</td>
<td>1</td>
</tr>
<tr>
<td>Workshop Practice</td>
<td>2</td>
</tr>
<tr>
<td>Engineer-in-Society</td>
<td>4</td>
</tr>
<tr>
<td>Foundry Technology</td>
<td>3</td>
</tr>
<tr>
<td>Materials Electives (Non-Metals)</td>
<td>2</td>
</tr>
<tr>
<td>Minerals Processing and Technology</td>
<td>3</td>
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<tr>
<td>Fuels, Refractories &amp; Furnace Technology</td>
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<tr>
<td>Electrical and Electronics Engineering Courses</td>
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<td>Basic Chemical Engineering Courses</td>
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<tr>
<td>Introduction to Deformation Processes</td>
<td>2</td>
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<td>Foundation Course in Entrepreneurial Studies</td>
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**Total 300 Level**

### 400 Level

<table>
<thead>
<tr>
<th>Course</th>
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<tr>
<td>Extraction and Refining of Materials</td>
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<tr>
<td>Mechanical Processing of Materials</td>
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<tr>
<td>Chemical Processing of Materials</td>
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<tr>
<td>Production Metallurgy I</td>
<td>2</td>
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<tr>
<td>Materials &amp; Metallurgical Laboratories</td>
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<tr>
<td>Metallurgical &amp; Materials Process Design</td>
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<tr>
<td>Foundry Technology</td>
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<tr>
<td>Corrosion Engineering</td>
<td>2</td>
</tr>
<tr>
<td>Technical Communications</td>
<td>2</td>
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<tr>
<td>Introduction to Entrepreneurship Studies</td>
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**Total 400 Level**

### 500 Level

<table>
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<tbody>
<tr>
<td>Mineral Processing and Technology</td>
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</tr>
<tr>
<td>Metallurgical Thermodynamics &amp; Kinetics</td>
<td>2</td>
</tr>
<tr>
<td>Powder Technology</td>
<td>2</td>
</tr>
<tr>
<td>Production Metallurgy II</td>
<td>2</td>
</tr>
<tr>
<td>Extraction and Refining of Materials</td>
<td>2</td>
</tr>
<tr>
<td>Metallurgical &amp; Materials Process Design</td>
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<tr>
<td>Heat and Mass Transfer</td>
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<tr>
<td>Thermal Treatment of Materials</td>
<td>3</td>
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<tr>
<td>Physical Metallurgy</td>
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<td>Project</td>
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<tr>
<td>Law</td>
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<td>Engineering Materials Selection &amp; Economics</td>
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<tr>
<td>Other Materials &amp; Metallurgical Laboratories</td>
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<td>Technology Policy and Development</td>
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<tr>
<td>Production &amp; Financial Management</td>
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<td>Materials Electives (Non Metals)</td>
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</table>

**Total 500 Level**

---

104
Electives

- Wood Product Engineering
- Polymer Science Technology
- Ceramics & Glass Technology
- Composite Materials
- Plastic Engineering
COURSE DESCRIPTIONS

(i) **Thermodynamics** 6 Credits
Dimensions and Units; Energy and energy conversions and surroundings; Temperature of scales; Zeroth Law; Heat and work; First Law of thermodynamics; Steady flow Energy equations; Second Law of Thermodynamics; Properties of pure substances; Perfect gases; Heat transfer, Gaseous mixtures; Engine Cycles; Heat pump and refrigeration cycles.

(ii) **Theory of Machines** 2 Credits
Simple mechanisms and their analysis; Vector diagrams; Simple harmonic motion; Newton’s Laws of motion; Force analysis of mechanism; friction effect; analysis and applications; Theory of Structures; Dynamics of linear systems; Balancing; Gear systems and Gear trains; Rigid body; Introduction to tribology.

(iii) **Fluid Mechanics** 6 Credits
Properties of fluids; Hydrostatics; fluid motion; momentum equation; Boundary Layer flow; Flow measurements; fluid operated machines; Rotodynamic machines; Fluid Power transmission; Pumps and pump design.

(iv) **Science and Engineering of Materials and Metallurgy** 3 Credits
Types of Engineering materials; physical properties of materials. Electrical properties of materials. Mechanical properties of materials; Thermal properties of materials; chemical properties of materials; Optical and magnetic properties of materials; Stability of materials in the service environment; Basic metallurgy; Non-metallic materials; Simple stress and strain; Bending and Torsion; Torsion; Deflection of beams; Complex stress and strain.

(v) **Engineering Drawing** 2 Credits
Use of drawing instruments; Lines, Lettering and dimensioning; paper sizes, scales and drawing layout; First and third angle projections; Auxiliary projections; Isometric projections; Freehand Sketching; Development; Machine drawing.

(vi) **Mechanical Engineering Design** 7 Credits
Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production matching; Optimisation in design.

(vii) **Manufacturing Technology** 2 Credits
Fabrication methods; Casting and pattern design; Forging and extrusion; Welding methods; Use of drilling, boring, grinding and other material processing machines; Foundry work.

(viii) **Workshop Practice** 2 Credits
Workshop setting; Types of workshop equipment, machines and materials; Use of instruments and tools, Machine operation practice; Safety procedures in workshops.

(ix) **Control Systems** 3 Credits
Control Engineering concepts; Transfer function; Differential Equation of control Systems; Transducers; Automatic control methods.

(x) **Engineering Statistics** 2 Credits
(xi) **Process Technology And Design 9 Credits (400 & 500 Levels)**
Mineral Processing and Technology, Extraction and Refining of materials; Non-metals; Foundry, Fuels, Refractions and Furnaces; Thermal Treatment of materials; Metallurgical and Materials process design.

(xii) **Heat And Mass Transfer 2 Credits (500 Level)**
Analogue between convective heat and mass transfer; Secondary surfaces; Heat transfer with phase change.

(xiii) **Corrosion Engineering 2 Credits (400 Level)**
Aqueous corrosion; Environmental aspects of corrosion; Oxidation and metals. Corrosion control.

(xiv) **Instrumentation 9 Credits**
Instrumentation methods of analysis; Dynamics of process and equipment; Controllers and their applications; Computer methods.
# B. Eng. Mining and Minerals Processing Engineering

## (a) Course Summary

### (i) Core Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Units</th>
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<tbody>
<tr>
<td>Mechanics of Machines</td>
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<tr>
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<td>Fluid Mechanics</td>
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<td>Engineering Drawing</td>
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<tr>
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<tr>
<td>Science and Engineering of Materials</td>
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<tr>
<td>And Metallurgy</td>
<td>5</td>
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<tr>
<td>Manufacturing Technology</td>
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</tr>
<tr>
<td>Geology</td>
<td>6</td>
</tr>
<tr>
<td>Mineral Processing and Technology</td>
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<tr>
<td>Mine Surveying</td>
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<tr>
<td>Mining Process Design</td>
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<tr>
<td>Mining Systems</td>
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<tr>
<td>Rock Mechanics</td>
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<tr>
<td>Explosive</td>
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<tr>
<td>Mine Ventilation</td>
<td>3</td>
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<td>Mine Health and Safety</td>
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<td>Plant Technology</td>
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<tr>
<td>Engineering Materials Selection</td>
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<tr>
<td>And Economics</td>
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<td>Project</td>
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<td>Technology Policy and Development</td>
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### (ii) Other Courses

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### (iii) Basic Science Courses

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<tbody>
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<td>Chemistry</td>
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<tr>
<td>Computers &amp; Computing</td>
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<tr>
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### (iv) Entrepreneurial Studies

- 4

### (v) Humanities

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<th>Course</th>
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</table>

**Grand Total**

- 188
(b) Break-Down Of Courses Into Levels Of Study

**300 Level**
- Engineering Mathematics: 6
- Computers & Computing: 3
- Thermodynamics: 2
- Fluid Mechanics: 2
- Engineering Metallurgy: 2
- Engineering Drawing: 2
- Workshop Practice: 2
- Engineer-in-Society: 1
- Manufacturing Technology: 2
- Electrical & Electronic Engineering: 3
- Civil Engineering Courses: 3
- Mine Surveying: 3
- Mining Systems: 3
- Laboratory Practicals: 3
- Foundation Course in Entrepreneurial Studies: 2

**Total** 38

**400 Level**
- Geology: 3
- Mining Systems: 3
- Mine Surveying: 3
- Drilling and Blasting: 3
- Mining Process Design: 2
- Plant Technology: 3
- Engineering Communications: 2
- Laboratory Practicals: 6

**Total** 25

**500 Level**
- Geology: 3
- Mining System: 3
- Petroleum Engineering: 3
- Mining Process Design: 2
- Mine Ventilation: 3
- Mine Health and Safety: 2
- Rock Mechanics: 3
- Engineering Metallurgy: 2
- Mineral Processing Technology: 3
- Engineering Materials, Selection and Economics: 3
- Project: 6
- Technology Policy & Development: 2
- Law and Management: 3
- Laboratory Practicals: 3

**Total** 41
COURSE DESCRIPTIONS

(i) See courses descriptions Common to all Levels

(ii) Geology 6 Credits
(400 & 500 Levels)
Elements of physical geology; Structural geology; Paleontology and Stratigraph; Mineralogy; Petrology; Geochemistry; Sedimentology; Geophysical prospecting methods, Photogeology; Hydro geology

(iii) Mineral Processing and Technology 3 Credits
(500 Level)

(iv) Mine Surveying 6 Credits
(300 & 400 Levels)
Basic land surveying theory and practice; Mine Surveying; Applications; Setting out and typical calculations.
(v) **Mining Systems** 9 Credits

*(300, 400 & 500 Levels)*

Surface mining operations; Design of surface mining systems; Surface excavation; Ore handling equipment; Case studies of typical surface mines; Underground mining operations; Tunnelling; Underground mining methods; Handling and haulage; Hydraulic transport and pipeline systems.

Analysis of elements of surface mine operation. Design of surface mining systems with emphasis on minimisation of adverse environmental impact and maximization of efficient use of mineral resources. Surface excavation. Ore estimates, grade control, short and long range planning, unit operations, equipment selection, cost estimation, slope stability and placer mining operation. Ore handling equipment. Case studies of typical surface mines: coal, metallic and non-metallic mines. One or more field trips to operating mines scheduled.

Selection, design and development of most suitable underground mining methods based on the physical and geological properties of mineral deposits. Unsupported and supported underground mining methods. Conservation and environmental systems and equipment, conveyors, cable rope-ways and rope haulage, trackless mining systems, hydraulic transport and pipeline systems. Calculations of ore reserve estimates, development planning and preparations for development and extraction, construction of development openings. Cases studies of typical underground mines: coal, metallic and non-metallic. Field trip(s) to operating mines scheduled.

(vi) **Rock mechanics** 3 Credits

*(500 Level)*

Mechanical properties of soils and rocks; Failure prediction methods; Mechanics of mine support and roof control.

Introduction to Rock Mechanics – Definition of terms and importance of rock mechanics; field applications in Mining, Civil and Petroleum Engineering. Classification and Index properties of rocks – Geological classification of rocks (crystalline rocks, organic rocks); Porosity Density; Permeability; Strength: Slaking and Durability: Sonic velocity as an index to degree of fissuring; Classification of rock masses for engineering purposes. Rock strength and Failure Criteria Modes of failure of rocks Common Laboratory strength tests (Uniaxial, Triaxial, Brazilian, Flexural tests); Stress-Strain behaviour in compression; Effect of confining pressure; The meaning of rock strength; Application of the complete Stress-Strain curve. The Mohr Coulomb failure criterion; The effect of water; The influence of the principal Stress ration on failure; Empirical criteria of failure; Coulom-Navier criterion of failure of rocks; Griffith brittle failure Criterion. Elastic properties. Applications of rock mechanics in engineering or underground openings. Rock slope stability. Support systems design and selection – caving and subsidence. Observation of mass deformations – extensometers and strain transducers. Case studies.

(vii) **Drilling & Blasting** 3 Credits

*(400 Level)*

Types and properties of explosives; Applications of explosives in rock drilling, boring; and mechanical breakage; Safety consideration in the use of explosives.


in surface and underground mines. Blasting patterns; special blasting techniques – smooth, pre-splitting, secondary blasting procedure. Disturbances created by blasting.

(viii) **Mining Process Design**  4 Credits  
**(400 & 500 Levels)**  
Sequence in mining systems; Design of mining process elements and layouts; Safety and control systems; Support system design.  
Design of the following mine structures such as access to mineral deposits. Mine layout, surface mine excavation methods. Underground mine excavation methods, drilling and blasting patterns. Underground roof supports, mine drainage system, mine ventilation network, mine transportation system and explosives magazines etc. This course basically involves drawing. Students are expected to provide necessary drawing tools such as drawing pens standard drawing papers, etc.

(ix) **Mine Ventilation**  3 Credits  
**(500 Level)**  
Effects and changes of poor mine ventilation;  
Air systems design; Mine ventilation design and control.  

(x) **Mine Health and Safety**  2 Credits  
**(500 Level)**  

(xi) **Plant Technology**  3 Credits  
**(400 Level)**  
Plant and process control; Mining machinery, operations; Plant maintenance.  
Essential features of a machine: gears, shaft bearings, couplings etc. Construction and application of wire rope used in mine machinery. Care of ropes. Lubricants for mine machinery.  
Transports: locomotives-battery, trolley wire and diesel conveyor belts haulage trucks, rope haulage-direct and endless rope. Hosting, Types of pumps and their application. Pumps characteristics compressors-reciprocating and rotary types, characteristic s and choice of compressors.
### B. ENG. MECHATRONICS ENGINEERING

**Course Summary**

1. **Humanities**
   - General Studies: 16

2. **Basic Sciences**
   - Mathematics: 12
   - Physics: 10
   - Chemistry: 8
   - **Sub-Total**: 36

3. **Entrepreneurial Studies**: 4

4. **Basic Engineering Courses**
   - Engineering Mathematics: 12
   - Computers & Computing: 3
   - Engineering Drawing: 4
   - Applied Mechanics: 4
   - Strength of Materials: 2
   - Material Science: 3
   - Thermodynamics: 2
   - Fluid Mechanics: 2
   - Basic Electrical Engineering: 6
   - Manufacturing Technology/Workshop Practice: 2
   - Engineer-in-Society: 1
   - **Sub-Total**: 41

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

6. **Options**
   - A choice of 20 Credits from any of the following courses: 2
     - Electromechanical Devices Design: 2
     - Electrical Services Design: 2
Power Electronics and Drives 3
Power Systems Engineering (Systems Analysis, Planning and Protection) 2
Power Systems Communication and Control 2
Switchgear and High Voltage Engineering 2
Industrial Electronics Design 2
Micro-Computer Hardware and Software Techniques 3
Communications Systems 2
Telecommunication Engineering 2
Analogue and Digital Computer 2
Solid State Electronics 2
Digital Signal Processing 2
Telecommunication Services Design 2
Digital communication systems 2
Special topics in Engineering Technology in Electrical Engineering
Total 174

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

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<thead>
<tr>
<th>Lecture/Lab. Units</th>
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<tbody>
<tr>
<td>Engineering Mathematics 6</td>
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<tr>
<td>Numerical Methods 4</td>
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<tr>
<td>Electromagnetic Fields and Waves 6</td>
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<tr>
<td>Circuit Theory 6</td>
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<tr>
<td>Electronic Circuit (Analogue &amp; Digital) 6</td>
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<tr>
<td>Physical Electronics 3</td>
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<tr>
<td>Measurements and Instrumentation 3</td>
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<tr>
<td>Control Theory 3</td>
</tr>
<tr>
<td>Communication Principles 3</td>
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<tr>
<td>Electric Power Principles 3</td>
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<tr>
<td>Electromechanical Devices and Machines 4</td>
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<td>Laboratory Practicals 9</td>
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<td>Foundation Course in Entrepreneurial Studies 2</td>
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<tr>
<td>Introduction to Entrepreneurship Studies 2</td>
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<td><strong>Sub-Total</strong> 60</td>
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500 Level
Reliability & Maintainability of Electrical & Electronic Components and Systems 2
Advanced Computer Programming and Statistics 3
Control Engineering 2
Advanced Circuit Techniques 4
Project 6
Electives 20
**Total** 20

Options
A choice of 16 Credits from any of the following courses 2
Electromechanical Devices Design 2
Electrical Services Design 3
<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
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<tbody>
<tr>
<td>Power Electronics and Drives</td>
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<tr>
<td>Power Systems Engineering (Systems Analysis,</td>
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<tr>
<td>Planning and Protection)</td>
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<tr>
<td>Power Systems Communication &amp; Control</td>
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<tr>
<td>Switchgear and High Voltage Engineering</td>
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<td>Industrial Electronic Design</td>
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<tr>
<td>Micro-Computer Hardware and Software Techniques</td>
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<td>Communications Systems</td>
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<td>Telecommunication Engineering</td>
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<tr>
<td>Analogue and Digital Computer</td>
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<td>Solid State Electronics</td>
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<td>Digital Signal Processing</td>
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<td>Digital communications system</td>
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<td>Special Topics</td>
<td></td>
</tr>
<tr>
<td>Telecommunication Services Design</td>
<td></td>
</tr>
</tbody>
</table>
Core Courses 300 Level (2 Semesters) And 400 Level (1 Semester): 3 Semesters

(vi) Engineering Mathematics 4 Credits

(vii) Numerical Methods 4 Credits
Polynomials and their zeros – methods of bisection, Newton, Bairstow, synthetic division and Lehmer; Direct methods for the solution of linear equations; Iterative process, its application to the solution of simultaneous linear equations; convergence; interpolation and differentiation method in Numerical integration – Newton Coates formulae and finite difference methods; The eigen system problem Solution of ordinary differential equations – methods of Taylor, Euler, Predictor – Corrector and Runge-Kutta. Use of appropriate soft ware packages (e.g mathlab) should be encouraged.

(viii) Electromagnetic Fields And Waves 6 Credits
Review of electromagnetic laws in integral form, Gauss’s Law, Ampere’s and Faraday’s Laws; Electrostatic fields due to distribution of charge, magnetic fields in and around current carrying conductors, time-varying magnetic and electric fields; conduction and displacement current; Maxwell’s equation (in rectangular co-ordinates and vector-calculus notation): Derivation of Maxwell’s equations; electromagnetic potential and waves; Poynting vector; Boundary conditions; wave propagation in good conductors, skin effect; plane waves in unbounded dielectric media, Fundamentals of transmission lines, wave-guides and antennae.

(ix) Circuit Theory 6 Credits
Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer’s methods of Synthesis, 2-port network synthesis, active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.

(x) Analogue Electronic Circuit 3 Credits

(vi) Digital Electronics Circuit 3 Credits
(vii) **Physical Electronics** 3 Credits
Free electron motion in static electric and magnetic fields, electronic structure of matter, conductivity in crystalline solids. Theory of energy bands in conductors, insulators and semi-conductors: electrons in metals and electron emissions; carriers and transport phenomena in semi-conductors, characteristics of some electron and resistors, diodes, transistors, photo cell and light emitting diode. Elementary discrete devices fabrication techniques and IC technology.

(viii) **Measurements And Instrumentation** 3 Credits
General Instrumentation, Basic Meter in DC measurement. Basic meter in AC measurements; rectifier voltmeter, electro-dynamometer and Wattmeter, instrument transformers; DC and AC bridges and their applications; general form of AC bridge universal impedance bridge; Electronic instruments for the measurement of voltage, current resistance and other circuit parameter, electronic voltmeters, AC voltmeters using rectifiers, electronic multimeter, digital voltmeter; oscilloscope: vertical deflection system, horizontal deflection system, probes, sampling CRO, Instruments for generating and analyzing waveforms; square-wave and pulse generator, signal generator, function generators, wave analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(ix) **Control Theory** 3 Credits
Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

(x) **Communication principles** 3 Credits
Amplitude modulation; double sideband, single sideband and vestigial sideband modulation schemes; simple modulators, power and bandwidth performance. Angle modulation; frequency modulation, phase modulation, band width requirements, 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.

(xi) **Electric Power Principles** 3 Credits
Introduction to power systems and sources of electric energy, structure of electric system, load characteristics, electric energy transmission and distribution, line 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.

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

Practicals 9 Credits

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

Telecommunication Laboratory
A laboratory work on telecommunication designed to illustrate topics covered in Communication Principles as well as topics such as passive filters, tuned 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.

Engineering Mathematics 2 Credits

500 LEVEL

Reliability Engineering 2 Credits

Advanced Computer Programming And Statistics 3 Credits
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.

Control Engineering 3 Credits
State space description of linear systems, concepts of controllability and observability; state feedback, modal control observers, realisation of systems having specified transfer function, applications to circuit synthesis and signal processing.
(x) **Advanced Circuit Techniques** 3 Credits
Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops. Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate packages e.g PSPICE, Electronic workbench, Visio technical etc should be encouraged.

(xi) **Project** 6 Credits
This course lasts for one academic session. Each student must undertake a project under the supervision of a lecturer, submit a comprehensive project report and present a seminar at the end of the year. A project status report is to be presented at the end of the first semester. Each student must attend Engineering Seminars.

(xii) **Electives** 16 Credits
These will be chosen by students with the Co-ordinators approval. The courses can be chosen from other programmes such as Mechanical Engineering, Physics and Mathematics/Computer Science. The courses chosen should provide some breadth to the students chosen area of specialisation.

**OPT 1 Electromechanical Devices Design** 2 Credits
Design of transformers, principles of AC and DC machine design, introduction to parks equations.

**OPT 2 Electrical Services Design** 2 Credits
Lighting installation, power installation, energy supply and distribution, choice of cables and conductors, wiring systems and accessories, outdoor low voltage lines and cables, protection of low voltage installation, and characteristics of low voltage equipment, Earthing and testing of electrical installation, illumination.

**OPT 3 Power Electronics And Devices** 3 Credits
Switching characteristics of diodes, transistors, thyristors etc. analysis of diode circuit with reactive loads, analysis of circuits using transistors as switches, power control circuits, ACDC converters, characteristics of switching transformers, power semiconductor device protection, examples of power electronic circuits, solar devices.

**OPT 4 Power Systems Engineering** 3 Credits
Representation of power systems, power system equation and Analysis, load flow studies, load forecasting, economic operation of power systems, symmetrical components, symmetrical and unsymmetrical faults, various types of relays used in power systems, protection systems of power transmission lines, principles of fault detection, discrimination and clearance, elements of power systems stability.

**OPT 5 Power System Communication And Control** 2 Credits
Review of transmission line theory. High frequency communication on power lines carrier systems and power line carrier applications. Multiplexing, Telementering, Signal processing and data transmission. Control of power generation, voltage control, system stability, automatic voltage regulators, regulating transformers.

**OPT 6 Switchgear And High Voltage Engineering** 2 Credits
Generation and measurement of high voltage and current; Breakdown theories for gaseous liquid and solid dielectrics, lightning phenomena, High Voltage equipment, insulation co-ordination, lightning protection, Electric cables and condensers.
OPT 7 Industrial Electronics Design 2 Credits
Characteristics and industrial applications of thyristors and other SCR devices. Transducers and their applications in sensing light, voltage pressure, motion, current temperature, etc. Mechanical relays, solid state relays and stepping motors. Real time control and remote control concepts in instrumentation. Micro-processor and micro-computer based systems.
Fire alarms, burglar alarms and general home and industrial instrumentation.

OPT 8 Micro-Computer Hardware And Software Techniques 3 Credits

OPT 9 Communications Systems 3 Credits
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 opentence antennae and the related design parameters; introduction to antennae arrays. Radiowave propagation: propagation in the ionosphere, troposphere and in stratified media; principles of scatter propagation; applications in general broadcast, television and satellite communication systems. Radar systems nature of radar and radar equations; composition of a radar system; application of different types of radars.

OPT 10 Telecommunication Engineering 2 Credits
Cable telegraphy and telephony characteristics, cross talk, equation, Poleiness, aerial and underground cables. Telegraph systems: codes, radio systems, terminal equipment (teleprinters, relays, switching systems, repeaters). Telephone receivers, switching (crossbar, electronic switches), PBX, PABX, Transmission standards, Telephone network structure.

OPT 11 Analogue And Digital Computer 2 Credits
Analogue computation, electrical analogue of mechanical, electromechanical systems and servomechanisms. Analogue computer elements: potentiometers, operational amplifiers, function generators, simulation of system transfer functions. Digital computer structure and elements, CPU, storage, peripherals Arithmetic processes, Hybrid computer systems.

OPT 12 Solid State Electronics 2 Credits
Physics and property of semi-conductors including high field effects, carrier injection and semi-conductor surface phenomena, devices technology, bulk and epitaxical material growth and impurity control, metal-semiconductor interface properties, stability and methods of characterisation: controlled and surface-controlled devices.

OPT 13 Digital Signal Processing 2 Credits
Discrete signals and Z-transform, digital Fourier Transform, Fast Fourier Transform. The approximation problem in network theory. Synthesis of low-pass filters. Spectral transforms and their application in synthesis of high-pass and band-pass filters. Digital filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and
software. Basic image processing concepts.

OPT 14  Digital Communications System 2 Credits

OPT 15  Special Topics 2 Credits
Topics in emerging technology in Electrical Energy – should be taught by one or more lecturers.

OPT 16  Telecommunication Services Design 2 Credits
Telephone installations, PABX installations choice of cables and accessories, computer networking: choice of cables, installations, accessories, optic fibre installations and accessories. Lighting protection techniques. Earthing techniques. Bill if Engineering material and Evaluation and billing of telecommunication installations
### B. ENG. AGRICULTURAL AND BIO-RESOURCES ENGINEERING

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Lecture/Lab. Units</th>
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<tbody>
<tr>
<td><strong>(i) General Studies</strong></td>
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<tr>
<td><strong>(ii) Basic Sciences</strong></td>
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<td>Mathematics</td>
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<td>Physics</td>
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<td>Chemistry</td>
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<td><strong>(iii) Entrepreneurial Studies</strong></td>
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<td><strong>(iv) Management and Humanities</strong></td>
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<tr>
<td>Economics</td>
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<td>Principles of Management</td>
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<td>Farm Management, Rural Sociology</td>
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<tr>
<td>and Agric. Extension</td>
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<td>Technical Communication</td>
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<td>Engineer-in-Society</td>
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<td><strong>(v) Basic Agriculture</strong></td>
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<td>Animal Production</td>
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<td>Crop Production</td>
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<tr>
<td>Soil Science</td>
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<td>Sub-Total</td>
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<tr>
<td>Engineering Mathematics &amp; Statistics</td>
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<td>Computers &amp; Computing</td>
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<td>Information Technology in Engineering</td>
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<td>Sub-Total</td>
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<tr>
<td><strong>(vii) Basic Engineering</strong></td>
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<tr>
<td>Basic Electrical Engineering</td>
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<td>Applied Mechanics</td>
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<td>Engineering Drawing</td>
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<tr>
<td>Machine Drawing and Design</td>
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<td>Fluid Mechanics</td>
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<tr>
<td>Hydraulics</td>
<td>2</td>
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<td>Hydrology</td>
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<td>Geology for Engineers</td>
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<td>Metallurgy</td>
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<td>Strength of Materials</td>
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<td>Materials Science</td>
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<tr>
<td>Manufacturing Tech/Workshop</td>
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<td>Practice</td>
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<td>Thermodynamics</td>
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<td>Laboratory Practicals</td>
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<td></td>
<td><strong>122</strong></td>
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</tbody>
</table>
Core Courses
(viii) Agricultural and Bio-Resources Engineering
- Basic Agric. & Bio-Res. Engineering 3
- Farm Power and Machinery 3
- Irrigation and Drainage 2
- Properties, Handling, Processing and Storage of Agricultural Materials 3
- Land Surveying 2
- Land Clearing and Development 3
- Soil and Water Conservation 3
- Farm Electrification 2
- Farm Structures and Environmental Control 3
- Agric. Mechanisation 2
- Workshop Practice 7
- Laboratory Practicals 6
- Final Year Project 41
Sub-Total 123

(ix) Specialisation and Electives
(Lecture/Lab. Units)
(Up to 20 Credits selected from any of the three options)

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

Farm Power and Machinery Option:
- Agric. Power 3
- Agric. Machinery 3
- Mechanics of Deformable Bodies 2
- Design of Agric. Machines 3
- Operations and Management of Farm Power and Machinery Systems 2
- Farm Transportation 2
- Engineering Properties and Handling of Agric. Materials 3
- Processing and Storage of Agric. Materials 3
- Food Engineering 2
- Automotive Service and Maintenance 2
- Industrial Studies 3
Sub - Total 28
Soil and Water Engineering Option:
- Irrigation 3
- Agricultural Land Drainage 2
- Advanced Hydraulics 3
- Rural Water Supply and Sanitation 2
- Design of Irrigation and Soil Conservation Structures 3
- Environmental Engineering 3
- Foundation Engineering 3
- Farm Transportation 2
- Automotive Service and Maintenance 2
- Industrial Studies 3
- Sub – Total 26

Grand Total 174 to 177

Break-down of Courses into Levels of Study:

### 300 Level

<table>
<thead>
<tr>
<th>Course Title</th>
<th>Lecture/Lab. Units</th>
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</thead>
<tbody>
<tr>
<td>Engineering Mathematics</td>
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<tr>
<td>Basic Agric. &amp; Bio-Res. Engineering</td>
<td>2</td>
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<tr>
<td>Land Surveying</td>
<td>3</td>
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<tr>
<td>Hydrology</td>
<td>3</td>
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<tr>
<td>Geology for Engineers</td>
<td>2</td>
</tr>
<tr>
<td>Machine Drawing and Design</td>
<td>2</td>
</tr>
<tr>
<td>Hydraulics</td>
<td>2</td>
</tr>
<tr>
<td>Metallurgy</td>
<td>2</td>
</tr>
<tr>
<td>Mechanics of Machines</td>
<td>2</td>
</tr>
<tr>
<td>Soil Mechanics</td>
<td>2</td>
</tr>
<tr>
<td>Soil Science</td>
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<td>Animal Production</td>
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<td>Crop Production</td>
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<tr>
<td>Technical Communication</td>
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<tr>
<td>Foundation Courses in Entrepreneurial Studies</td>
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<tr>
<td>Laboratory Practicals</td>
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<tr>
<td>Sub-Total</td>
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### 400 Level

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<th>Lecture/Lab. Units</th>
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<tr>
<td>Engineering Mathematics &amp; Statistics</td>
<td>3</td>
</tr>
<tr>
<td>Farm Power and Machinery</td>
<td>3</td>
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<tr>
<td>Irrigation and Drainage</td>
<td>3</td>
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<tr>
<td>Farm Structures and Environmental Control</td>
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<tr>
<td>Properties, Handling, Processing and Storage of Agric. Materials</td>
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</tr>
<tr>
<td>Farm Management, Rural Sociology and Agric. Extension</td>
<td>2</td>
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<tr>
<td>Economics</td>
<td>2</td>
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<tr>
<td>Introduction to Entrepreneurship Studies</td>
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### 500 Level

<table>
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<tbody>
<tr>
<td>Principles of Management</td>
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<tr>
<td>Farm Electrification</td>
<td>3</td>
</tr>
<tr>
<td>Soil and Water Conservation</td>
<td>3</td>
</tr>
<tr>
<td>Land Clearing and Development</td>
<td>2</td>
</tr>
<tr>
<td>Agric. Mechanisation</td>
<td>2</td>
</tr>
<tr>
<td>Final Year Project</td>
<td>6</td>
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<tr>
<td><strong>Sub-Total</strong></td>
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</tr>
<tr>
<td>Specialisation and Electives from any of the</td>
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</tr>
<tr>
<td>three options</td>
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<tr>
<td><strong>Sub-Total</strong></td>
<td><strong>36 to 39</strong></td>
</tr>
</tbody>
</table>

#### Engineering Mathematics Course Descriptions for Agricultural & Bio-Resources Engineering and Technology-Based Disciplines
COURSE DESCRIPTIONS

300 Level

Engineering Mathematics 6 Credits
2. Analytic geometry - Co-ordinate transformation - solid geometry, polar, cylindrical and spherical co-ordinates.
3. Elements of functions of several variables.
5. Fourier series - Euler coefficients, even and odd functions, sine and cosine functions, simple applications. Gama, Beta and probability functions.
6. Differential equation of second order - series solutions. Legendre and Bessel functions and their properties.

400 Level

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

Agricultural And Bio-Resources Engineering Course Descriptions

(i) Basic Agric. & Bio-Resources Engineering 2 Credits
Introduction to Agricultural & Bio-Resources engineering profession. Agricultural and Bio-Resources. Identification of various tractors. Identification of other farm power sources. Types of farm implements. Tractor driving and test. Use of tractor for various field operations.

(ii) Land Surveying 3 Credits

(iii) Hydrology 3 Credits

(iv) Geology for Engineers 2 Credits
(v) Machine Drawing and Design 2 Credits

(vi) Hydraulics 2 Credits

(vii) Metallurgy 2 Credits

(viii) Mechanics of Machines 2 Credits

(ix) Soil Science 2 Credits

(x) Soil Mechanics 2 Credits
Phase relationships, shear strength, consolidation, settlement, compaction. Machinery-soil-relationships, site investigations.

(xi) Animal Production 3 Credits

(xii) Crop Production 3 Credits

(xiii) Technical Communication 2 Credits

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

(xv) Irrigation and Drainage 3 Credits
drainage.

(xvi) **Farm Structures and Environmental Control** 3 Credits

(xvii) **Properties, Handling, Processing and Storage of Agric. Materials** 3 Credits

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

(xix) **Economics** 2 Credits

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

(xxi) **Farm Electrification** 3 Credits

(xxii) **Soil and Water Conservation** 3 Credits
Types of erosion, Soil erosion by water, Universal soil loss equation. Control of soil erosion by water. Wind erosion and its control, Desertification and control measures. Earth dams and farm ponds.

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

(xxiv) **Agricultural Mechanisation** 2 Credits
(xxv) **Final Year Project** 6 Credits
Individual student project to deepen knowledge, strengthen practical experience and encourage creativity and independent work. The project ends in a comprehensive written report.

(xxvi) **Agricultural Power** 3 Credits
Farm power sources. Farm tractor; selection, use, maintenance. Other power sources; selection, use, maintenance. Hitches and hitch systems, design considerations of single-axle, two-wheel drive, four-wheel drive and crawler tractors. Tractor mechanics. Power Measurement. Fluid controls. Ergonomics. Tractor testing and test codes.

(xxvii) **Agricultural Machinery** 3 Credits

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

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

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

(XXXI) **Irrigation** 3 Credits

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

(XXXIII) **Advanced Hydraulics** 3 Credits

(XXXIV) **Rural Water Supply and Sanitation** 2 Credits
Waste disposal in rural communities. Collection, conveyance, treatment and disposal of sewage from rural homes. Septic tanks, digestion ponds and family privies.

(35v) Design of Irrigation and Soil Conservation Structures 2 Credits

(36v) Environmental Engineering 3 Credits

(37v) Foundation Engineering 3 Credits

(38v) Advanced Thermodynamics 3 Credits

(39v) Engineering Properties and Handling of Agricultural Materials 3 Credits
Physical, mechanical, rheological and thermal properties of agricultural materials. Newtonian and Non-Newtonian fluids. Handling methods. Design and construction of appropriate material handling equipment for tropical products. Economics of material handling.

(40v) Processing and Storage of Agricultural Products 3 Credits

(41v) Solar Energy Applications to Processing and Storage 2 Credits

(42v) Food Engineering 2 Credits

(43v) Farm Transportation 2 Credits

(44v) Automotive Service and Maintenance 2 Credits
Service and maintenance of all the components of an automobile.

(45v) Industrial Studies 2 Credits
### B. ENG. TELECOMMUNICATIONS ENGINEERING

#### (a) Course Summary

**Humanities**
- General Studies: 16 Units

**Basic Sciences**
- Mathematics: 12 Units
- Physics: 10 Units
- Chemistry: 8 Units
- Total: 46 Units

**Entrepreneurial Studies**
- 4 Units

**Basic Engineering Courses**
- Engineering Mathematics: 6 Units
- Computers & Computing: 4 Units
- Engineering Drawing: 4 Units
- Applied Mechanics: 4 Units
- Strength of Materials: 2 Units
- Material Science: 3 Units
- Thermodynamics: 2 Units
- Fluid Mechanics: 2 Units
- Basic Electrical Engineering: 6 Units
- Manufacturing Technology/Workshop: 2 Units
- Engineer-in-Society: 1 Unit
- **Total**: 36 Units

**Core Courses**
- Engineering Mathematics: 12 Units
- Physical Electronics: 2 Units
- Analogue Electronic Circuits: 3 Units
- Digital Electronic Circuits: 3 Units
- Measurements and Instrumentation: 3 Units
- Circuit Theory: 6 Units
- Digital Devices and Logic Circuits: 3 Units
- Control Theory: 3 Units
- Communications Principles: 3 Units
- Electrical Machines: 2 Units
- Electrical Power Systems: 2 Units
- Computer Programming: 2 Units
- Assembly Language Programming: 2 Units
- Numerical Computer Technology: 3 Units
- Laboratory Practicals: 9 Units
- Advanced Circuit Design: 3 Units
- Solid State Electronics: 3 Units
- Communication Theory: 3 Units
- Telecommunications Engineering: 2 Units
- Digital Communication System: 3 Units
- Optical Communication System: 2 Units
- Image and Data Transmission System: 2 Units
- Industrial Electronics Design: 2 Units
- Digital Signal Processing: 2 Units
- Feedback and Control Systems: 2 Units
- Communication System Planning: 2 Units
- **Total**: 131 Units
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<tr>
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<td>Engineering Mathematics</td>
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<td>Physical Electronics</td>
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<td>Circuit Theory</td>
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<tr>
<td>Analogue Electronics Circuits</td>
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<tr>
<td>Digital Electronics Circuits</td>
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<tr>
<td>Measurements and Instrumentation</td>
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<td>3</td>
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<td>Electrical Machines</td>
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<td>Electric Power Systems</td>
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<td>Computers &amp; Computing</td>
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COURSE DESCRIPTIONS

Core Courses 300 Level, 400 Level And 500 Level

(i) Engineering Mathematics

(ii) Physical Electronics
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.

(iii) Analogue Electronics Circuits

(iv) Digital Electronics Circuits

(v) Measurements And Instrumentation
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 analysers, Electronic counters and their applications: time base circuitry, universal counter measurement modes; Analog and digital data acquisition systems: tape recorders, D/A and A/D conversions, sample and hold circuits.

(vi) Circuit Theory
Laplace and Fourier transforms, application of Laplace transformation to transient analysis of RLC circuits, transfer function concepts, reliability of transfer functions, Foster and Cauer's methods of Synthesis, 2-port network synthesis, active filters. Approximation to non-linear characteristic analysis and synthesis of non-linear resistive circuits, harmonic analysis of non-linear dynamic circuits, applications of computers in the analysis of linear and non-linear circuits.
(vii) **Digital Devices And Logic Circuits**

(viii) **Control Theory**
Basic concepts and examples of control systems; Feedback, Time response analysis, concept of stability, Routh-Hurwits criterion; Root-locus techniques, Frequency-response analysis, Polar and Bode plots, Nyquist stability criteria. Nicholas chart, compensation techniques chart, compensation techniques, introduction to non-linear systems.

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

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


(xi) **Electrical Power Systems**
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.

(xii) **Computer Programming**
Computer programming using structure BASIC such as QBASIC: symbols, keywords, identifiers, datatypes, operators, statements, flow of control, arrays, and functions. Extensive examples and exercises in solving engineering problems using QBASIC. Use of Visual programming such as Visual BASIC in solving engineering problems.

(xiii) **Assembly Language Programming**
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.

(xiv) Numerical Computer Technology

(xv) Practical
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, tuned 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.

Core Courses 500 Level: (2 Semesters)
(i) Advanced Circuit Design
Analysis and design of integrated operational amplifiers and advanced circuits such as wideband amplifiers, instrumentation amplifiers, multiplier circuits, voltage controlled oscillators, and phase locked loops. Design techniques for advanced analogue circuits containing transistors and operational amplifiers. Simulation of circuit using appropriate
packages e.g PSPICE, Electronic workbench, Visio technical etc should be encouraged.

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

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

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

(v) **Digital Communication System**

(vi) **Optical Communication System**
Optical transmitting devices, LEDs optical receivers, optical fibres/types, features, joining, couping/deep space communication system/capacity, reliability economy/application of PCM and A DPCM concepts.

(vii) **Image And Data Transmission System**
A/D and D/A transformation, coding, error detection and correction, Asynchronous and synchronous transmission, modern schemes, channel capacity, equalisation techniques, practical modern applications, simplified network configurations, data switching.

(viii) **Industrial Electronics Design**
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.

(ix) **Digital Signal Processing**
filtering, digital transfer function aliasing, one-dimensional recursive and non-recursive filters; Computer techniques in filter synthesis, Realisation of filters in hardware and software. Basic image processing concepts.

(x) **Feedback And Control Systems**
Failure analysis; Various types of joints, design of machine elements; system design, Design of gear systems; Material selection in design; Design; Design and production matching; Optimisation in design.

(xi) **Telecommunication Systems Planning**

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