MODEL CURRICULUM
FOR
UNDERGRADUATE PROGRAMME
B.E./Tech.
IN
ELECTRICAL ENGINEERING

ALL INDIA COUNCIL FOR TECHNICAL EDUCATION
(A statutory Body of Government of India)
I.G. Sports Complex, I.P. Estate
New Delhi-110 002
PERFACE

The need to ensure minimum acceptable standards and quality in curricula of Engineering Colleges spread across the country and recent technological advances have necessitated development of Model Curriculum for various disciplines of first degree course in Engineering by All India Council for Technical Education. The planning of engineering curricula is a complex exercise since it involves integration of not only the current educational needs of the profession but also the anticipated needs arising out of the fast changing national and international technological scene. To make the curricula both dynamic, to meet the evolving needs of the profession and flexible to adjust to unforeseen developments, the first step is to identify the core part of the curriculum which embodies scientific and engineering knowledge basic to the profession. To this core is added, in different proportions, the other ingredients of professional knowledge of both current and emerging technological processes and systems. With proper balancing of the core, specialized and elective subjects and suitable integration of meaningful practical and field exercises and challenging project activity, the curriculum can, not only provide the students with relevant professional knowledge, but also develop in them the capacity to tackle unknown engineering problems and help them acquire sound professional ethics and an awareness of their obligations to society.

In 1996 the AICTE initiated program to upgrade the syllabi for undergraduate education in technical institutions in India. An exercise to develop detailed curricula which will serve as a model for the institutions was taken up. The emergence, on the national scene, of several new engineering colleges added a sense of urgency to this effort. Since QIP Centres were already intimately involved with the curriculum development activities sponsored by AICTE, they were requested to undertake this important task.

I am glad that Model Curricula for various disciplines which are both dynamic and flexible and provide a proper balance in the teaching of basic sciences, social sciences and management, engineering sciences, technologies and their applications have been finalized. I am sure that this work will serve as a useful guide to the universities and institutions in framing their curricula.
I take this opportunity to express my deep appreciation for the valuable work done by the various members of the Expert Committees and the persons entrusted with the responsibility of coordinating the work in the respective disciplines.

April, 2000
New Delhi

Chairman
All India Council for Technical Education
INTRODUCTION

All India Council for Technical Education (AICTE) has been entrusted with the responsibility of coordinated development of technical education system through the country. Uniform growth of technical education requires continuous up-gradation of Curricula for courses at all levels in Technical Education. This need is further accentuated by the emergence of a large number of self-financing institutions in technical education where faculty does not have sufficient expertise. In pursuance of clause 10(1) of AICTE Act and with an objective of bringing about uniformity in the curriculum of Engineering, AICTE has initiated a programme to come up with the syllabi for undergraduate education in technical institutions.

The broad strategies for framing the curricula included the study and analysis of the existing curricula followed in various institutions with the country and also the feedback received in various work-shops involving faculty form different institutions. The draft Model Curriculum was discussed in a wide forum before coming up with the present version.

Based on the interaction and discussion with a number of experts the following recommendations were finalized.

- The duration of a degree level course should be limited to 4 years /8 semesters of about 90 working days each.

- A common first year syllabus with sufficient emphasis on Hum. & Science and Management subjects shall be adopted for all branches of engineering.

- The contact hours per week should normally be kept at about 30 hours.

- Weightage of 15-20% shall be given to non-professional (Basic Sciences and Humanities) subjects and about 10% to Management subjects.

- Normally the curriculum should include a Major Project of minimum 8 credits in Final Year (2 credits in 7th semester and 6 credits in 8th semester). Emphasis should be given to industry sponsored projects.
Wherever possible the students in 3rd & 4th year should be involved in group discussions on topics of current trends in Engineering & Technology. (No credit).

There should be continuous evaluation system. Various components of evaluation suggested are Teachers Assessment (TA), Class Tests (CT) also called minors in some of the institutions and End Semester Examination (ESE). To make the evaluation more objective, teachers assessment could be broken into various components like assignments, quizzes, attendance, group discussions, tutorials, etc. Similarly marks of Class Tests can be awarded by having at least two to three tests.

These two components i.e. TA & CT put together would form the sessional components. End Semester Examination will have to be conducted by the Institute through concerned affiliating University, as per its regulations.

On the basis of total marks (TA+CT+ESE) in each subject obtained, a letter grade should be awarded where A=10, B=8, C=6, D=4, F=0. Normally top 5 - 10% should be awarded ‘A’ Grade and last 5 – 10% ‘F’ Grade.

In order to evaluate grade point average for a semester the same could be done using the following illustration:

<table>
<thead>
<tr>
<th>Subjects</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>Credit = (L+(T=P)/2) Grade Awarded</th>
</tr>
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<tbody>
<tr>
<td>I</td>
<td>2</td>
<td>1</td>
<td>0</td>
<td>3 A</td>
</tr>
<tr>
<td>II</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>5 B</td>
</tr>
<tr>
<td>III</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4 A</td>
</tr>
<tr>
<td>IV</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4 B</td>
</tr>
<tr>
<td>V</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2 C</td>
</tr>
</tbody>
</table>

Semester Grade Point Average = \(\frac{3A + 5B + 4A + 4B + 2C}{3+5+4+4+2}\) = 8.55

L: Lecture
T: Tutorial
P: Practical
• In order to meet the demand of changing trends and emerging areas a student be given a choice to choose subjects offered as electives which consist of a professional elective (PE) of ‘12’ Credits and an open elective (non departmental elective) of ‘8’ Credits.

• Based on the recommendations a Model Curriculum has been framed. A model structure of the total courses to be undertaken by a student during his undergraduate programme in Electrical Engineering is shown in the subsequent tables. The institute may assign the course numbers depending upon the guidelines of the respective affiliating university.

This developmental exercise is underpinned by the philosophy that curriculum should transcend traditional instructional modes, embrace novel methods of teaching and enhance and embellish the learning process to produce quality engineers for the future. The success of the curriculum lies in its implementation. It is suggested that advantage be taken of modern technology by augmenting the role of a teacher with innovative audio-visual and digital teaching and learning aids. This curriculum is only a base line and institutions should aspire to develop over and above this. This development of this model curriculum has been possible only through the sustained and dedicated efforts of a large number of faculty members from various institutions. The AICTE expresses its gratitude to them for contributing their time and expertise in this important national task. Suggestions to improve the quality of contents of this curriculum will be highly appreciated.

April 2000
Member Secretary

(Prof. R.S. Nirjar)
All India Council for Technical Education
COURSE STRUCTURE
<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>SUBJECT</th>
<th>PERIODS</th>
<th>EVALUATION SCHEME</th>
<th>Credits</th>
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<td>L T P</td>
<td>SESSIONAL EXAM</td>
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<td>TA CT TOT</td>
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<td></td>
<td></td>
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<td>15 10 25 50 75 3</td>
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</tr>
<tr>
<td>2.</td>
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<tr>
<td>3.</td>
<td></td>
<td>Engineering Physics I</td>
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<td>30 20 50 100 150 4</td>
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</tr>
<tr>
<td>4.</td>
<td></td>
<td>Mathematic I</td>
<td>3 1 -</td>
<td>30 20 50 100 150 4</td>
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<tr>
<td>5.</td>
<td></td>
<td>Engineering Mechanics</td>
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<td>30 20 50 100 150 4</td>
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<tr>
<td>6.</td>
<td></td>
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<td>3 1 -</td>
<td>30 20 50 100 150 4</td>
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<td>7.</td>
<td></td>
<td>Chemistry/Physics Lab.</td>
<td>- - 3</td>
<td>25 - 25 25 50 2</td>
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<td>Electrical Laboratory</td>
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<td>10.</td>
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<td>Workshop Practice – I</td>
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<td>GP-I</td>
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<td>Total</td>
<td>16 6 12</td>
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TA - Teachers Assessment, CT - Class Test, ESE – End Semester Examination, Total Marks:

1000, Total Periods: 34, Total Credits: 32
<table>
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<th>Sl. No.</th>
<th>Course No.</th>
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<th>PERIODS</th>
<th>EVALUATION SCHEME</th>
<th>Credits</th>
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TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000, Total Periods: 34, Total Credits: 32
BRANCH: Electrical Engineering  
YEAR : II  
SEMESTER: III

<table>
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<th>Sl. No.</th>
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<tr>
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<td>Strength of Materials</td>
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<td>Fluid Mechanics &amp; Fluid Machinery</td>
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<td>Mathematics III</td>
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(PRACTICAL/DRAWING/DESIGN)

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<td>8</td>
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GP-III GENERAL PROFICIENCY | 50 | - | 50 | 2 |

Total | 16 | 6 | 12 | 1000 | 32 |

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000, Total Periods: 34, Total Credits: 32
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<th>PERIODS</th>
<th>EVALUATION SCHEME</th>
<th>Credits</th>
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<td></td>
<td>ESE</td>
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<td>2 1 -</td>
<td>15 10</td>
<td>25 50</td>
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<td>30 20</td>
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<td>30 20</td>
<td>50 100</td>
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<td>30 20</td>
<td>50 100</td>
<td>150</td>
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<td>Solid State Devices</td>
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<td>25 -</td>
<td>25 50</td>
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<td>8.</td>
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<td>25 -</td>
<td>25 50</td>
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<td>9.</td>
<td>Electrical Machines Lab-I</td>
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<td>10.</td>
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<td>16 6 12</td>
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TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000, Total Periods: 34, Total Credits: 32
### BRANCH: Electrical Engineering  
**YEAR : III**  
**SEMESTER: V**

<table>
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<td>Management Concepts and Techniques</td>
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<td>Power Systems-II</td>
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<tr>
<td>6</td>
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<td>Digital Electronics and Logic Design</td>
<td>3</td>
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|        |            | (PRACTICAL/DRAWING/DESIGN)                  |         |       |       |       |     |     |         |         |         |
|        |            |                                              |         |       |       |       |     |     |         |         |         |
| 7      |            | Analog Electronics                           | -       | -    | 3     | 25   | -  | 25  | 25     | 50     | 2       |
| 8      |            | Electrical Machines – II                     | -       | -    | 3     | 25   | -  | 25  | 25     | 50     | 2       |
| 9      |            | Power Systems                                | -       | -    | 3     | 25   | -  | 25  | 25     | 50     | 2       |
| 10     |            | Digital and Logic Design                     | -       | -    | 3     | 25   | -  | 25  | 25     | 50     | 2       |
|        |            | GENERAL PROFICIENCY                          |         |       |       |       |     |     |         |         |         |
|        | GP-V       |                                              |         |       |       |       |     |     | 50     | -      | 2       |
|        | Total      |                                              | 16      | 6    | 12    |       |     |     | 1000   |        | 32      |

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks:  
1000, Total Periods: 34, Total Credits: 32
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<td>Microprocessors &amp; Microcontrollers</td>
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TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000, Total Periods: 34, Total Credits: 32
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TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000, Total Periods: 31, Total Credits: 29
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(PRACTICAL/DRAWING/DESIGN)

| 6     |            | Project – II             | -      | -    | 12 | 100 | -   | 100 | 100 | 200    | 6       |
| GP-VIII | GENERAL PROFICIENCY |                          |         |      |    | 50  | -   | 50  |     |        | 2       |
| Total  |            |                          | 15     | 5    | 12 | 400 | 600 | 1000| 28  |        |         |

TA- Teachers Assessment, CT- Class Test, ESE – End Semester Examination, Total Marks: 1000, Total Periods: 32, Total Credits: 28

Total Credit of All the Four Year : 250
COURSE CONTENT
# MODEL CURRICULUM: ELECTRICAL ENGINEERING

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**OPEN ELECTIVES**

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<td>Science Technology &amp; Society</td>
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ENGLISH FOR PROFESSIONAL COMMUNICATION

Objective of the Course
To impart basic skills of communication in English through intensive practice to the first year UG students of engineering so as to enable them to function confidently and effectively in that language in the professional sphere of their life.

Desired Entry Behaviour
The student must have some basic command of English so that the student must be able to:

- Write reasonably and grammatically
- Understand (if not use) at least some 2500 general purpose words of English
- Use some 2000 (at least 1500) general purpose words of English to express himself in writing and 1500 such words to talk about day-to-day events and experiences of life.
- Understand slowly-delivered spoken material in Standard Indian English, and
- Speak reasonably clearly (if not fluently) on routine matters with his fellow students.

Teaching Method
- The topics must be covered essentially through plenty of examples. Lecture classes must be conducted as lecture-cum-tutorial classes.
- It is a course that aims to develop skills. It is, therefore, “practical” in orientation. Plenty of exercises of various kinds must be done by the students both inside and outside the classroom.
- The teacher must not depend on a single or a set of two or three text books. He must choose his materials from diverse sources.
- Keeping in view the requirements of his students, the teacher may have to prepare some teaching and exercise materials.
- For practice in listening, good tape recorders can be used if the more advanced facilities (for example, language laboratory) are not available. In fact they can be used very fruitfully.
- The teacher must be function as a creative monitor in the class-room.
- Minimum time should be spent in teaching phonetic symbols, stress, intonation etc. The aim should be to enable the student to find out for himself the correct pronunciation of a word from a learner’s dictionary. In teaching speaking, emphasis should be on clarity, intelligibility and reasonable fluency rather than on “correct” pronunciation of words. Classroom presentation and group discussion sessions should be used to teach speaking.
Some Key Concepts
Communication as sharing; context of communication: the speaker/writer and the listener/reader;
Model Curriculum/Electrical Engineering  1
Medium of communication; barriers to communication; accuracy, brevity, clarity and appropriateness in communication.

Writing
Selecting materials for expository, descriptive, and augmentative pieces; business letters; formal report, summarizing and abstracting; expressing ideas within a restricted word limit; paragraph division; the introduction and conclusion; listing reference material; use of charts; graphs and tables; punctuation and spelling; semantics of connectives, modifiers and modals; variety in sentences and paragraphs.

Reading Comprehension
Reading in various speeds (slow, fast, very fast); reading different kinds of texts for different purposes (for example, for relaxation, for information, for discussion at a later stage etc.); reading between the lines.

Speaking
Achieving desired clarity and fluency, manipulating paralinguistic features of speaking (voice quality, pitch, tone etc.); pausing for effectiveness while speaking; task-oriented, interpersonal, informal and semiformal speaking; making a short, classroom presentation.

Group Discussion
Use of persuasive strategies including some rhetorical devices (for emphasizing, for instance; being polite and firm; handling questions and taking in criticism of self; turn taking strategies and effective intervention; use of body language).
Telephonic Conversation

Listening Comprehension
Achieving ability to comprehend material delivered at relatively fast speed; comprehending spoken material in Standard Indian English, British English, and American English; intelligent listening in situations such as interview in which one is a candidate.

Suggested Text Books & References

ENGINEERING CHEMISTRY

Atoms and Molecules
Particle in a box illustrating energy quantization, angular momentum quantization, radial and angular part of H atom, wave functions/orbitals, probability and charge distribution. Many electron atoms. Homonuclear and heteronuclear diatomics, covalent bonds, ionic bonds and electro-negativity concepts, hybridization and shapes of molecules. Non-covalent interaction (Van Der Walls and hydrogen bonding).

Solid State
Idea of spatial periodicity of lattices; elements of bond theory. Conductors, semiconductors and insulators.
Experimental methods of structure determination using spectroscopic techniques such as IR, UV-Vis, NMR and Mass Spectrometry.
**Reaction Dynamics**
Rate laws, mechanisms and theories of reaction rates (collision and transition state theory). Lasers in Chemistry.

**Electrochemistry**
Application of electrode potentials to predict redox reactions in solution with special reference to Lattimer and Frost diagrams.

**Transition Metal Chemistry**
Structures of coordination compounds corresponding to coordination numbers up to 6. Types of ligands. Isomerism (geometrical, optical, ionization, linkage and coordination). Theories of bonding in coordination compounds, viz. crystal field theory, valence bond theory. Chelation. Brief application in organic synthesis and medicines etc.

**Organo Metallic Chemistry and Catalysis**
Structure and bonding in organo metallic complexes, the sixteen and eighteen electron rules. Homogeneous catalysis, the role of metals in catalytic cycles during some chemical reaction (e.g. hydroformylation, hydrogenation etc.). Role of metals in biology, oxygen carrier, electron transfer.

**Structure of Reactivity of Organic Molecules**
Inductive effect, resonance, hyper conjugation, electrometric effect. Carbonation, carbanion and free radicals. Brief study of some addition, elimination and substitution reactions. Conformation analysis (acyclic and cyclic molecules), geometrical and optical isomerism; E, Z and R, S nomenclature.

**Polymerization**
Basic concepts, classification and industrial application.

**Photochemistry**
Photo excitation of carbon substrates (Norrish type I and type II reactions), selected examples of the application of photolysis. Photosynthesis (Z-diagram). Chemistry of vision.

**List of Experiments**
• Acid-base titration (estimation of commercial caustic soda).
• Redox titration (estimation of iron using permanganometry).
• Complex metric titration (estimation of hardness of water using EDTA titration).
• Preparation and analysis of a metal complex (for example thiourea/copper sulfate or nickel chloride/ammonia complexes).
• Chemical kinetics (determination of relative rates of reaction of iodide with H2O2 at room temperature (clock reaction).
• Heterogeneous equilibrium (determination of partition coefficient of acetic acid between n-butanol and water).
• Photochemical oxidation – reduction (study of photochemical reduction of ferric salt).
• Viscosity of solutions (determination of percentage composition of sugar solution from viscosity).
• Viscosity of solutions (determination of percentage composition of sugar solution from viscosity).
• Synthesis of aspirin.
• Synthesis of p-nitro aniline from acetanilide.
• Detection of functional groups in organic compounds.
• Utilization of paper/thin layer/column chromatographic techniques in the separation of organic compounds.
• Radical polymerization of vinyl monomers such as styrene, acrylonitrile etc.
• Conductometric titration (determination of the strength of a given HCl solution by titration against a standard NaOH solution).

Suggested Text Books & References

• “Blocks 1-5 of Chemistry Course”, Indira Gandhi Open University, IGNOU, New Delhi, 1996.

ENGINEERING PHYSICS-I

Theory of Relativity
Inertial frame of reference, Noninertial frames and fictitious forces, Outline of relativity, Michelson-Morley experiment, Lorentz transformation of space and time, length contraction, variation of mass with velocity, equivalence of mass and energy.

Geometrical Optics
Combination of thin lenses, cardinal points of coaxial system of this lenses, thick lenses location and properties of cardinal points, graphical construction of images.

Physical Optics
Interference-analytical treatment of interference, intensity distribution of fringe system, coherence and non-coherent sources, fundamental conditions of interference, Fresnel’s biprism, displacement of fringes, wedge shaped films, Newton’s rings.  

Diffraction-single slit and double slit diffraction, diffraction grating, Limit of resolution, resolving power of grating and image forming systems.  

Polarization – Brewster’s Law, double refraction, geometry of calcite crystal, optic, axis, nicol prism, circularly and elliptically polarized light, retardation plates, production and analysis of planes, polarimeter.  

**Thermal Physics**  
Kinetic theory of gases, Maxwellian distribution, mean free path, transport phenomena in gases, Imperfect gases and Vander Waal’s equation of state.  

**Acoustics**  
Production and applications of Ultrasonic, Accoustics of buildings.  

**Dynamics of fluids**  
Continuity of fluids, Bernoulli’s theorem and its applications, Torcelli’s theorem, Viscosity flow of liquid through a capillary tube, capillaries in series and parallel, Stoke’s formula rotation viscometer  

**List of Experiments**  
- To determine the coefficient of viscosity of water by capillary flow.  
- To determine the thermal conductivity of a bad and good conductor by Lee’s method and Searl’s method respectively.  
- To determine the wave length of light by Newton’s ring method.  
- To determine the wave length of light by Fresnel’s biprism.  
- To determine the dispersive power of the given material of the prism.  
- To determine the focal length of combination of two thin lenses by nodal slide assembly and its verification.  
- Determination e/m by J.J. Thomson’s method.  
- Measurement of thermo emf between different types of thermocouples as a function of temperature difference between the junctions, measurement of an unknown temperature.  
- Use of Carry Foster Bridge.  
- Study of electromagnetic induction.
• Study of electromagnetic damping and determination of terminal velocity reached by a magnet falling in a metallic tube.
• Study of LCR circuits with AC current.
• Determination of Plank’s Constant using photocells.

Suggested Text Books & References
• Mathur, D.S., “Mechanics”.
• Saha and Srivastava “A Treatise on Heat”
• Singh, R.B. “Physics of Oscillations and Waves”
• Ghatak, A.K. “Optics”

MATHEMATICS – I

Calculus of Functions of One Variable
Successive differentiation, Liibnitz’s theorem (without proof). Rolle’s theorem, Mean value theorem and Taylor’s theorem. Fundamental theorems of integral calculus, elementary reduction formulae for integrals. Applications to length, area, volume, surface area of revolution, moments and centers of gravity.
Infinite Series : Convergence, divergence, comparison test, ratio test, Cauchy Leibnitz’s theorem, absolute and conditional convergence. Expansions of functions into Taylor and Maclaurin series.

Calculus of Functions of Several Variables

Vector Calculus.
Scalar and vector fields. Line and surface integrals. Gradient, divergence and curl. Line integrals independents of path. Green’s theorem, divergence theorem and Stoke’s theorem (without proofs) and their simple applications.
Suggested Text Books & References


ENGINEERING MECHANICS

Fundamentals of Mechanics – Basic concepts

Force Systems and Equilibrium
Force, Moment and couple, Principle of Transmissibility, Varignon’s theorem, Resultant of force systems-Concurrent and non-concurrent coplanar forces, Free body diagram, Equilibrium equation and their uses in solving elementary engineering problems.

Plane Trusses

Friction
Introduction laws of coulomb friction, simple contact friction problems, belt friction, the square screw thread, rolling resistance.

Properties of Surfaces
First moment of an area and centroid, second moment and product of area of a plane area, transfer theorems, relation between second moment and product of areas, polar moment of inertia, principle axes, mass moment of inertia.

Virtual Work
Work of a force, Principle of Virtual work and its application.

Kinematics of Rigid bodies
Plane motion, Absolute motion, Relative motion, Translating axes and rating axes.

Kinetics of Rigid bodies.
Plane motion, Work and energy, Impulse and momentum.

**List of Experiments**

- To determine the Newton’s second law of motion by Fletcher’s trolley apparatus.
- To determine the moment of inertia of a flywheel about its axis of rotation.
- To verify: (a) the conditions of equilibrium of forces by parallel force apparatus.
  
  (b) The principal of moments by crank lever.
- To find the compression in the rafters and tension in ties of simple roof truss models and to verify graphically.
- To determine the dry friction between inclined plane and slide boxes of different materials.
- To determine the coefficient of friction between the belt and rope and the fixed pulley.
- To determine the velocity ratio of a simple screw jack and to plot graph between (a) Effort-Load (b) Friction – Load. (c) Efficiency – Load.
- To measure the area of a figure with the help of a Polar Planimeter.

**Suggested Text Books & References**

- Shames, I.H., “Engineering Mechanics”, Prentice Hall of India

**BASIC ELECTRICAL ENGINEERING**

**DC Networks**

Kirchoff’s laws, node voltage and mesh current methods; Delta-star and star delta conversion; Classification of Network Elements, Superposition principle, Thevenin’s and Norton’s theorems.

**Single Phase AC Circuits**
Single phase EMF generation, average and effective values of sinusoids; Solution of R, L, C series circuits, the J operator, complex representation of impedances; Phasor diagram, power factor, power in complex notation; Solution of parallel and series-parallel circuits; Resonance.

Three Phase AC Circuits
Three phase EMF generation, delta and Y-connection, line and phase quantities; Solution of three phase circuits, balanced supply voltage and balanced load; Phasor diagram, measurement of power in three phase circuits; Three phase four wire circuit; Unbalanced circuits.

Magnetic Circuits
Ampere’s circuital law, B-H curve, solution of magnetic circuits; Hysteresis and eddy current loses; Relays, an application of magnetic force.

Transformers
Construction, EMF equation, ratings; Phasor diagram on no load and full load; Equivalent circuit, regulation and efficiently calculation; Open and short circuit test; Auto-transformers and three phase transformers.

Induction Motors
The revolving, magnetic field, principle of operation, ratings; Equivalent circuit; Torque – speed characteristics; Starters for squirrel cage and wound rotor type induction motors; Single Phase induction motors.

DC Machines
Construction, EMF and torque equation; Characteristics of DC generators and motors; Speed control of DC motors and DC motor starters; Armature reaction and commutation.

Electrical Measuring Instruments
DC PMMC instruments, shunts and multipliers, multi-meters; moving iron ammeters and voltimeters; Dynamometer wattmeter’s; AC watt-hour meters, Extension of instrument ranges.

Power Supply System
General structure of electrical power systems; Power transmission and distribution via overhead lines and underground cables, Steam, hydro, gas and nuclear power generation.

**List of Experiments**
- To measure the armature and field resistance of a DC machine.
- To calibrate a test (moving iron) ammeter and a (dynamometer) wattmeter with respect to standard (DC PMMC) ammeter and Voltmeters.
- Verification of circuit theorems, Thevenin’s and Superposition theorems (with DC sources only).
- Voltage-current characteristics of incandescent lamps and fusing time-current characteristics of fuse wire.
- Measurement of current, voltages and power in R-L-C series circuit excited by (single phase) AC supply.
- Open circuit and short circuit tests on a single-phase transformer.
- Connection and starting of a three-phase induction motor using direct on line (DOL), or star-delta starter.
- Connection and measurement of power consumption of a fluorescent lamp.
- Determination of open circuit characteristics (OCC) of a DC machine.
- Starting and speed control of a DC shunt motor.
- Connections and testing of a single-phase energy meter (unity power factor load only).
- Two –wattmeter method of measuring power in three –phase circuit (resistive load only).
- Measurement of thermo emf between different types of thermocouples as a function of temperature difference between the junction, measurement of an unknown temperature.
- Design and use of potentiometer.
- Study of LCR circuits with AC current.

**Suggested Text Books & References**
ENGINEERING GRAPHICS-I

General
Importance, Significance and scope of engineering drawing, Lettering, Dimensioning, Scales, Sense of proportioning, Different types of projections, Orthographic projection, B.I.S. Specifications.

Projections of Points and Lines
Introduction of planes of projection, Reference and auxiliary planes, projections of points and lines in different quadrants, traces, inclinations, and true lengths of the lines, projections on auxiliary planes, shortest distance, intersecting and non-intersecting lines.

Planes Other than the Reference Planes
Introduction of other planes (perpendicular and oblique), their traces, inclinations etc., projections of points and lines lying in the planes, conversion of oblique plane into auxiliary plane and solution of related problems.

Projections of Plane Figures
Different cases of plane figures (of different shapes) making different angles with one or both reference planes and lines lying in the plane figures making different given angels (with one or both reference planes). Obtaining true shape of the plane figure by projection.

Projection of Solids
Simple cases when solid is placed in different positions, Axis, faces and lines lying in the faces of the solid making given angels.

Development of Surface
Development of simple object with and without sectioning.
Isometric Projection

Nomography

Basic Concepts and Uses

Suggested Text Books & References


WORKSHOP PRACTICE I & II

Carpentry
Timber, definition, engineering applications, seasoning and preservation, plywood and plyboards.

Foundry
Moulding sands, constituents and characteristics. Pattern, definition, materials, types, core prints. Role of gate, runner, riser, core and chaplets. Causes and remedies of some common casting defects like blow holes, cavities, inclusions.

Metal Joining
Definitions of welding, brazing and soldering processes and their applications. Oxy-acetylene gas welding process, equipment and techniques, type of flames and their applications. Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrode coating. Welding positions. Type of weld joint. Common welding defects such as cracks, undercutting, slag inclusions, porosity.

Metal Cutting
Introduction to machining and common machining operations. Cutting tool materials. Definition of machine tools, specification and block diagram of lathe, shaper, drilling machine and grinder. Common lathe operations such as turning, parting chamfering and facing. Quick return mechanism of shaper. Difference between drilling and boring. Files-material and classification.

Forging
Forging principle, materials, operations like drawing, upsetting, bending and forge welding, use of forged parts.

List of Jobs to be made in the Workshop

Group A
1. T-Lap Joint and Bridle joint (Carpentry Shop) 4 hrs.
2. Mould of any pattern (Foundry Shop) 2 hrs.
3. Casting of any simple pattern (Foundry Shop) 2 hrs.

Group B
1. (a) Gas Welding practice by students
   on mild steel flat 2 hrs.
   (b) Lap joint by Gas welding
2. (a) MMA Welding practice by students 2 hrs.
   (b) Square butt joint by MMA Welding
3. (a) Lap joint by MMA Welding 1 hrs.
   (b) Demonstrations of brazing
4. Tin smithy for making mechanical joint and soldering of joints 2 hrs.

Group C
1. Job on lathe with one step tuning and chamfering operations 2 hrs.
2. Job on shaper for finishing two sides of a job 2 hrs.

3. (a) Drilling two holes of size 5 and 12 mm Diameter on job used/to be used for shaping
   (b) Grinding a corner of above job on bench grinder 2 hrs.

4. Finishing of two sides of a square piece by filing 2 hrs.

Suggested Text Books & References


INTRODUCTION OF COMPUTING

Introduction
Introduction to the computer devices such as keyboard, mouse, printers, disk, files, floppies, etc.
Concept of computing, contemporary OSs such as DOS, Windows 95, MAC-OS, UNIX, etc. (Only brief user level description)
Introduction to the e-mail, ftp, rlogin and other network services, worlds wide web.
Introduction to the typesetting software such as Microsoft office.

Introduction to programming
Concept of algorithms. Example of Algorithms such as how to add ten numbers, roots of a quadratic equation. Concept of sequentially following up the steps of the algorithm.
Notion of program, programmability and programming languages. Structure of programs, object codes, compliers.
Introduction to the Editing tools such as vi or MS-VC editors.
Concepts of the finite storage, bits bytes kilo, mega and gigabytes. Concepts of character representation.

Languages for system programming; study of Basic, Fortran, Pascal, Cobol, etc.
COMPUTER PROGRAMMING LAB

Concepts of flow charts and decision tables, Examples and practice problems.
Introduction to Digital computers and its components, Introduction to DOS and UNIX operating systems.

Development of computer programs for example
- Roots of quadratic and Cubic equations
- Summation of N natural numbers
- Arranging numbers in ascending and descending orders.
- Separation of odd and even numbers, etc.

Suggested Text Books & References

ENVIRONMENT AND ECOLOGY

General
Introduction, components of the environment, environmental degradation.

Ecology
Air Pollution and Control
Atmospheric composition, energy balance, climate, weather, dispersion, sources and effects of pollutants primary and secondary pollutants, green house effect, depletion of ozone layer, standards of control measures.

Water Pollution and Control
Hydrosphere, natural water, pollutants their origin and effects, river/lake/ground water pollution, standards and control.

Land Pollution
Lithosphere, Pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes); their origin and effects, collection and disposal of solid waste, recovery and conversion methods.

Noise Pollution
Sources, effects, standards and control.

Suggested Text Books & References
**ENGINEERING PHYSICS-II**

**Vector analysis**
Scalar and vector fields, gradient of a scalar field, Divergence and curl of a vector fields, Line integral of a vector field, Gauss-divergence theorem, Stoke’s theorem.

**Electromagnetism**
Quantization & conservation of charges, Coulomb’s law (vectorial form) and superposition principle, Concept of electric field lines, flux of E-field, Gauss’ law, Electric Potential Energy and Potential, Conductors, capacitors and dielectric materials, Magnetic field, Force on a moving charge in a magnetic field, Force on current element, Torque on current loop, Biot-Savart law, Ampere’s law, Electromagnetic induction and Faraday’s law, magnetism in materials, Maxwell’s equations, Electromagnetic Waves.

**Thermoelectricity**
Seebeck effect, law of successive temperatures, law of intermediate metals, peltier effect, Thomson effect, Thermoelectric power, application of thermodynamics on thermocouple.

**Modern Physics**
Elements of wave properties of particles and particle properties of waves, Nuclear Energy, Lasers- spontaneous and stimulated emission of radiation, Einstein coefficient, Parts of laser, types of lasers and their application.

**Solid State Devices**
Energy band diagram; covalent bonds; bound and free electrons, holes; electron and hole mobilities; intrinsic and extrinsic semiconductors; Fermi and impurity levels; impurity compensation, charge neutrality equation and semiconductor conductivity; Einstein relation; drift and diffusion current; photo conductivity and Hall effect.

**Suggested Text Books & References**
**MATHEMATICS – II**

**Linear Algebra**

**Ordinary Differential Equations**
Formation of ODE’s, definition of order, degree and solutions. ODE’s of first order: separable variables, homogenous and nonhomogenous equations, exactness and integrating factors, linear equations and Bernoulli equations. General linear ODE’s of nth order:; solutions of homogenous and nonhomogenous equations, operator method, methods of undetermined coefficients and of variation of parameters. Solutions of simple simultaneous ODE’s

**Laplace Transforms**
Transforms of elementary functions, transforms of derivatives and derivatives of transforms, inverse transforms, transforms of periodic functions, unit step function, shifting theorems, solutions of ODE’s using Laplace transforms.

**Numerical Methods**
Difference operators – forward, backward, central, shift and average operators and relations between them. Newton’s forward and backward interpolation. Lagrange interpolation and the error formula for interpolation. Numerical differentiation and integration. – Trapezoial rule and Simpson’s one-third rule including error formulas.

**Suggested Text Books & References**
ENGINEERING THERMODYNAMICS

Fundamentals and Definitions
System, Control Volume, properties, state, state change, and diagram, Dimensions and units.

Work
Mechanics and Thermodynamics definitions, Displacement work at part of a system boundary, Engine Indicator, Displacement work in various quasi-static processes, shaft work, electrical work.

Heat
Temperature, thermal equilibrium, Zeroth law of thermodynamics, sign convention for heat transfer.

First Law of Thermodynamics
Statement, Application to non-cyclic process, Energy, modes of energy, Pure substance, Specific heats, First Law for Control Volumes.

Second Law of Thermodynamics
Direct and reversed heat engines, Kelvin-Planck and Clausius Statements and their equality, reversible and irreversible processes, Carnot cycle, Thermodynamic departure scale.

Entropy
Definition, calculation through Tds relations, T-s diagrams, entropy as a measure of irreversibility
Properties of pure substances – Use of steam Tables and Mollier Diagram.

Ideal gas
Properties of ideal gas and ideal gas mixtures with and without a condensible vapour-psychrometry.

Real gas
Equations of state, generalized charts for compressibility, enthalpy changes and fugacity.

Second Law: Analysis of Engineering Processes
Availability and irreversibility and their application in Thermal Engineering.


**BASIC ELECTRONICS**

**Semiconductor Diodes**
Introduction, Ideal diode, PN semiconductor diode, Diode equivalent circuits, Zener diode, Light diodes.

**Bipolar Junction Transistor**
Introduction, Transistor construction, Transistor operation, Common-base configuration, common emitter and common collector configuration.

**Field Effect Transistor**
Introduction, Construction and characteristics of JFETs, Transfer characteristics, Depletion type MOSFET, Enhancement type MOSFET.

**Operational Amplifier**
Introduction, Differential and common mode operation, Constant gain multiplier, voltage summing, voltage buffer.

**Semiconductor Devices**
Introduction of silicon controlled rectifier, GRO, TRIAC, DIAC, injunction transistors, IGBT.

**Cathode Ray Oscilloscope**
Introduction, Cathode ray tube-theory & construction.

**Electronic Instruments**
Transducers
Introduction, classification and types of electrical transducers.

Display Devices and Recorders
Introduction, Digital instruments, Digital Vs Analog instruments, Recorders-Analog recorders, graphic recorders, strip-chart recorders.

Data Acquisition Systems
Introduction, Components and uses.

BASIC ELECTRONICS LAB.
- Characteristics Curve for common base emitter and common collector transducers.
- Characteristics of field effect transistors.
- Verification of properties of operational amplifiers.
- Study of CRO
- Study of working of data acquisition system.

Suggested Text Books & References
- Milliman & Halkias, “Basic Electronics Principle”

ENGINEERING GRAPHICS – II

Basic Concepts
I.S. drawing conventions line symbols, kinds of line, drawing sheet lay-out rules of printing, preferred scales.

Projections
Perspective, orthographic, isometric and oblique projections, isometric scale, isometric drawing. Technical sketching.
Shape Description (External)
Multiplanar representation in first and third angle systems of projections, glass-box concept, sketching of orthographic view from pictorial views, precedence of lines. Sketching of pictorial (isometric and oblique) views from Multiplanar orthographic views. Reading exercise. Missing line and missing view exercises.

Shape Description (Internal)
Importance of sectioning, principles of sectioning, types of sections, cutting plane representation, section lines, conventional practices.

Size Description

Computer Aided Drafting
Basic concepts and used.

Suggested Text Books & References.

NUMERICAL ANALYSIS AND COMPUTER PROGRAMMING, C, C++

Numerical Analysis
Approximations and round of errors, Truncation errors and Taylor Series. Determination of roots of polynomials and transcendental equations by Newton-Raphson, Secant and Bairstow’s method.
Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss-Siedal iteration methods.

Curve fitting – linear and nonlinear regression analysis.

Backward, Forward and Central difference relations and their uses in Numerical differentiation and integration, Applications of difference relations in the solution of partial differential equations.

Numerical solution of ordinary differential equations by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.

**Computer Programming**

Introduction to computer programming in C and C++ languages. Arithmetic expressions, Simple programmes. The emphasis should be more on programming techniques rather than the language itself. The C programming language is being chosen mainly because of the availability of the compilers, books and other reference materials.

Example of some simple C program. Dissection of the program line by line. Concepts of variables, program statements and function calls from the library (print for example).

C data types, print, char, float, etc.

C expressions, arithmetic operations, relational and logic operations.

C assignment statements, extension of assignment to the operations. C primitive input output using getchar and putchar, exposure to the scan and print function.

C statements, conditional execution using if, else. Optionally switch and break statements may be mentioned.

Concepts of loops, example of loops in C using for, while and do-while. Optionally continue may be mentioned.

One dimensional arrays and example of iterative programs using arrays, 2–d arrays. Use in matrix computations.

Concepts of Sub-programming, functions. Example of functions. Argument passing mainly for the simple variables.

Pointers, relationship between arrays and pointers. Arguments passing using pointers.

Array of pointers, Passing arrays as arguments.

Strings and C string Library.

Structure and unions Defining C structures, passing structures as arguments. Program examples.

File I/O. Use of open, scan and print routines.
Lab

Development of computer program for:
Numerical integration by Trapezoidal and Simpson’s rule.
Gauss-Siedel iteration method
Various matrix operation and their use as sub-routines.
Uses of pointers, data structure, loops, arrays.

Suggested Text Books & References


MATERIAL SCIENCE

Crystal Structures
Space lattice and crystal structures, Determination of Crystal structure by X-ray technique, Imperfections in crystals like point, line and planar defects. Influence of imperfections on properties of materials. Dislocation multiplication. Diffusion, Mechanisms, Laws and applications.

Behaviour of Materials
Elastic, inelastic and viscoelastic behaviour of materials, plastic deformation, strain hardening. Yield point phenomena, Ductile and brittle fracture.
Mechanical Properties of Materials.
Tensile and compression test, shear test, fatigue test, hardness test, impact test, Creep strength of materials.

Dielectric Materials
Principles, temperature and frequency effects, ferroelectric materials.

Polymers
Types, properties, additives, application.

Material Science Lab
To study the lattice structure of various type of unit Cells. Observe the Miller Indices for various Planes and directions in a unit Cell.
To study the micro-structure of Cast Iron, Mild Steel, Brass Solder under, Annealed, Cold Worked, forged/rolled conditions.
To verify the Hall effect.
To determine the fracture characteristics of ductile and brittle materials.
To determine the chemical composition of a few common alloys.
To determine %age of C and S content in an alloy with Fe as main constituent.

Suggested Text Books & References
- Vlack, Van. “Material Science for Engineers”.

STRENGTH OF MATERIALS

Introduction

Simple Stresses and Strains
Normal and shearing stresses in axially loaded members; Concept of factors of safety; Normal and shearing strains; Stress strain relationship; Hook’s law; Modulus of rigidity; Complementary shear stress; Poisson’s ratio; Bulk modulus; relation between various elastic constants; Volumetric strain.

**Mechanical Properties of Materials.**
Definition of elastic materials; Plastic materials; Ductile materials; Brittle materials; Permanent set; Elastic limit, Fatigue limit; Ultimate strength; Modulus of resilience; Modulus of toughness; Modulus of rupture; Proof stress; Malleability; Toughness hardness and their measurement.

**Mechanics of Rigid Bodies**
Types of forces; Types of supports; Resultant and equilibrium of forces; Free body diagram; Resolution and composition of forces.

**Centroid and Moments of Inertia**
Centroid and centre of gravity; Second moment of inertia; Polar moment of inertia; Radius of gyration.

**Bending Moment and Shear Force**
Definitions and concept; SFD and BMD for cantilever; Simply supported and over hanging beams subjected to various combination of ladings; Point of inflection; Elastic curves; Relation between the load S.F. and B.M.

**Simple Theory of Bending**
Flexure formula; Stress variation and different types of beam sections; Beams of uniform strength; Composite beams.

**Combined Stresses**
Combined bending and axial stresses; Eccentricity about one axes and about both axes ; Conditions for no tension in the section; Application to dam section and wind resisting sections.

**Torsion of Shafts**
Torsion’s formula; Maximum torque transmitted by a solid and hollow circular shaft; Shear stress; power transmitted by a shaft; Circular shaft under combined bending and torsion.
Shear Stress for Beams
Expression for shear stress; shear stress variation in different types of beam sections.

Complex Stresses
Principal stresses and strains; shear stress; Mohr’s circle method; theory of elastic failures.

Slope and Deflection
Statically determinate beams using Macaulay’s method; Area moment method and conjugate beam method.

Thin Pressure Vessels
Circumferential and longitudinal stresses in cylindrical shell; Spherical shell under internal pressure.

List of Experiments
- Introduction of testing equipments
- Uniaxial tension test (Mild steel, Timber)
- Uniaxial compression test (Timber-along and across, concrete, bricks, etc.)
- Torsion test (Mild steel/aluminium).
- Bending stress distribution in beams using demec gauges and extensometer.
- Analysis of truss model with spring members
- Compression test on brick masonry specimen
- Hardness Test
- Creep Test
- Impact Test
- Strength of Etched and Un-etched glass
- Spring Test
- To study the microstructure of various metals

Suggested Text Books and References
FLUID MECHANICS AND FLUID MACHINERY

Introduction
Definition and fluid properties, Units and Dimensions, Classification of fluids, Normal and Shear stresses in fluids.

Statics of Fluids
Types of forces on fluid system, Mechanics of fluids at rest and in rigid body translation, Manometry, Forces on fully and partially submerged bodies.

Kinematics of Fluid Motion
Types of motion, Streamlines, Pathlines and Streaklines, Velocity and rotation, Stream function, Acceleration of a fluid particle, voracity and Circulation, Irrational flow, Potential function, Differential equation of conversation of mass.

Dynamics of Ideal Fluid Flow.
Euler’s equations of motion, Bernoulli’s equation and applications to flow measurement, pumping, fluid machines.

Integral Analysis of Flow
System and control volume approaches, The transport theorem, Conservation of mass, linear momentum equation, energy equation, Application to rotodynamic machines.

Mechanics of Viscous Flow
Navier-Stokes equations, Exact solutions, Flow between parallel plates, Laminar Flow through a circular pipe. Transition from laminar to turbulent flows, Turbulent flow in a circular pipe, Concept of the Boundary Layer and drag on the bodies, Phenomenon of separation.

Dimensional Analysis and Similarity in Motion
Bukingham’s P-theorem, Geometric, kinematics and dynamic similarity, Applications.
**Fluid Energy Conservation Systems**


**Suggested Text Books & References**


**MATHEMATICS –III**

**Introduction to Partial Differential Equations**

Classification of second order linear partial differential equations, solution by separation of variables of heat conduction and wave equations, Laplace equations.

**Numerical Methods**

Errors in computation. Nonlinear equation \( f(x) = 0 \) in one variable: Regula-falsi; secant and Newton-Raphson methods, convergence of these methods. Linear algebraic system of equations; Gauss elimination method, decomposition method; Jacobi and Gauss-Seidal iterative methods, rate of convergence of these methods, ill conditioned systems.

**Interpolation**

Lagrange, divided difference, equispaced Newton forward and backward difference formulas.

**Approximation**

Least Squares, differentiation using interpolation formulas.

**Integration**

Trapezoidal and Simpson rules, Gauss Quadrature rules.
Ordinary differential equations
Taylor, Euler and Runge-Kutta second order and classical fourth order formulas.

Partial differential equations
Finite difference schemes for one-dimensional heat and wave equations and Laplace equation.

Suggested Text Books & References

ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Electrical Measurements

Measurement of Resistance, Inductance and Capacitance
Measurement of low, medium and high resistances, insulation resistance measurements, AC bridges for inductance and capacitance measurement.

Instrument Transformers
Current and Potential transfers, ratio and phase angle errors, design consideration and testing.

Electronic Measurements
Electronic Voltmeter, multimeter, wattmeter & energy meter. Time, frequency and phase angle measurements using CRO; Spectrum & wave analyzer. Digital counter, frequency meter, voltmeter, multimeter and storage oscilloscope.
Instrumentation
Transducers, classification & selection of transducers, strain gauges, inductive & capacitive transducers, piezoelectric and Hall-effect transducers, thermisters, thermocouples, photo-diodes & photo-transistors encoder type digital transducers, signal conditioning and telemetry, basic concepts of smart sensors and application. Data Acquisition Systems.

List of Experiments

- Study of Kelvin’s Bridge and its application for measurement of low resistance.
- Price Guard-wire method for measurement of high resistance.
- Loss of charge method for measurement of insulation resistance.
- Schering Bridge for measurement of capacitance and loss angle.
- Measurement of inductance and Q-factor using AC bridges.
- Measurement of ratio and phase angle errors of instrument transformers using (a) comparison method (b) absolute method.
- Study and use of (a) integrating type (b) dual-slope type electronic voltmeters.
- Spectrum analyzer and its use for analyzing frequency spectra of periodic and non periodic signals.
- Study and use of LVDT or displacement transducers.
- Resistance strain gauges using unbalance bridge circuits.
- Study and use of grey-coded disk or digital transducer.
- Study and use of time-division and frequency-division multiplexing.
- Phase locked loops and applications for phase measurements.

Suggested Text Books & References

SOLID STATE DEVICES

Properties of Insulators in static and alternating fields
Electronic, ionic and orientation polarization; internal field and static dielectric constant of solids; Ferro-electric and Piezoelectric materials; Effects of alternating fields on electronic and ionic polarization; complex dielectric constant of solids, dielectric losses.

Magnetic materials
Origin of magnetic dipoles in solids; permanent magnetic dipoles; diamagnetic, paramagnetic, Ferromagnetic, Anti-Ferromagnetic and Ferromagnetic materials.

Conductors
Concepts of relaxation time, collision time and mean free path; electron scattering, average drift velocity and conductivity; Joule heating, thermal conductivity and super conductors.

Semiconductors
Energy band diagram; covalent bonds; bound and free electrons, holes; electron and hole mobilities; intrinsic and extrinsic semiconductors; Fermi and impurity levels; impurity compensation, charge neutrality equation and semiconductor conductivity; Einstein relation; drift and diffusion currents; photo conductivity and Hall effect.

Semiconductor diode
Theory and band diagram of pn-junction; pn-junction as a diode; current components and I-V characteristics of pn-diode; effect of temperature on diode current; breakdown mechanisms avalanche and Zener diodes; LED.

Transistors
Basic structure and principle of operation of BJT; current components and amplifying properties of BJT; Common base (CB) configuration and its input and output characteristics; current gain and active, saturation and cut-off regions of output characteristics of CB-configuration. Common emitter(CE) configuration and its input and output characteristics; active, saturation and cut-off regions of CE-output characteristics; Leakage currents; large signal current gain; dc current gain small –signal current gain of CE-configuration.
Common collector configuration; comparison of the properties of the three configurations; thermal runway.

Basic structure and characteristics of JFET, drain conductance and transconductance of JFET, important properties of JFET.

**List of Experiments**
- Rectifying and breakdown characteristics of pn-junction and point contact diodes.
- Input and output characteristics of bipolar junction transistor in (a) common base and (b) common emitter configurations.
- ID-VD characteristics of junction field effect transistor.
- SCR characteristic.
- Measurement of h-parameters of bipolar junction transistor
- Study of basic properties of operational amplifier.
- Measurement of energy band gap and resistivity of semiconductor sample.
- Measurement of carrier concentration in a semiconductor by Hall measurements.
- Measurement of junction capacitance and ideality factor of semiconductor diode.
- Effect of temperature of leakage current and breakdown voltage of pn-junction
- UJT and relaxation oscillator
- Frequency response of RC-coupled amplifier.

**Suggested Text Books & References**

**CIRCUIT THEORY**

**Review of circuit concepts**
L,C, mutual inductance, Controlled sources, Transformers, dot convention for coupled circuits, Nodal & loop analysis, relation between field & circuit parameters.
Network Theorems (with proof)
Thevenin’s, Norton’s, Tellegen’s, Reciprocity theorem, Maximum power transfer theorem, Compensation theorem, Reciprocity theorem.

Time and Frequency domain analysis of circuits for step, ramp, exponential and damped exponential inputs; Wave form synthesis, Laplace transform method and complex frequency approach.

Network functions
Driving point and Transfer function, Calculations of network function Poles and Zeros and their significance, concept of stability of active networks, Frequency response (frequency & phase plots)

Coupled circuits and Two-Port Networks
Analysis of mutually coupled circuits; two port parameters, relations among different parameters, scattering parameters.

Elements of Filter Design
Low-Pass, high pass and band-pass filters; Butter worth and Chebyshev approximations; Design of 1st order and 2nd order low-pass filters; Elementary synthesis techniques.

Suggested Text Books & References
- Valkenburg, Van “Network Analysis”, PHI

ELECTROMAGNETIC THEORY

General Principles
The field concept. Source of Electromagnetic field – Classification, Potential, boundary conditions.

Boundary value problems in Electrostatics
Laplace and Poisson’s equations. Product solution method of solving Laplace’s equation. Rectangular, Spherical and Cylindrical coordinates; Method of Images; Field plotting methods.
Conformal transformation technique
Complex transformations involving circular and elliptical boundaries, Bilinear and Schwartz-Christoffel transformations.

Numerical methods
Finite difference equivalent of Laplace’s equation. Iteration and relaxation methods.

Magnetostatic fields
Laws of magnetostatics: Vector potential; Boundary value problems in Magnetostatics; Current sheet and flux sheet.

Electromagnetic fields
Maxwell’s equations in point & integral forms, Relation between field theory and circuit theory.

Electromagnetic wave equation
Propagation of Electromagnetic waves in dielectrics and conductors, space sheet, transmission lines.

Radiation and Antenna
Retarded potential, Hertzian dipole, Antenna pattern, directivity and gain Application of field theory to electrical devices.

List of Experiments
- Field plotting of electromagnetic systems on a PC using standard softwares. Application for low and high frequency devices. (Suggested software’s: GEMINI (Infolytica), ANSYS, ANSOFT, NISA).

Suggested Text Books & References
ELECTRICAL MACHINES-I

Electromagnetic and transformers
Review of laws of Electromagnetic and Electromechanics, Maxwell’s equations. Three-Phase transformers, special constructional features – cruciform mitering, alternative winding arrangements, cooling methodology, conservators, breathers, Buchholz relay, alternative phase connections, vector phase groups. Phase conversions-3 to 1, 3 to 2, 3 to 6 and 3 to 12. Parallel operation and load sharing. Special Purpose Transformers: Pulse, isolation, welding, rectifier, high frequency.

DC Machines

Polyphase Synchronous Machines

Analysis under sudden short circuit. Transient parameters.
Motoring mode, Transition from motoring to generating mode, Phasor diagram, steady state operating characteristic, V-curves, starting, synchronous condenser, hunting –damper winding effects, speed control including solid state control.


**Suggested Text Books & References**


**Electrical Machine Lab.I**

Characteristics of DC machines – motors and generators with different excitation. Hopkinson’s test and Fields test – loss calculations and prediction of performance characteristics. Speed control of dc motors – conventional and electronics.

Alternative three phase connection modes of two winding phenomenon, power rating in each case. Transformer Vector phase group studies. Experimental determination of permissible and non-permissible connection combination for paralleling.

Phase conversion using Scott connection and perform load test.

Phase conversion using three single centre tapped transformers or multiwinding single phase transformers.

No load short-circuit and ZPF tests on a synchronous machine. Determination of voltage regulation at specified load by i) EMF ii) MMF iii) Potier’s method iv) ASA methods and comparison of results.

Load angle characteristic and comparison with theoretically predicted results.

V-curves and inverted V-curves of synchronous machines. Comparison with predicted characteristics.

Synchronization of three phase alternator with infinite bus bar. Study of variation of excitation and mechanical power input on performance.

Slip-test, short circuit and lagging current tests on a salient pole machine and determination of armature parameters. Estimation of voltage regulation at specified loads using Blondel’s method. Comparison with results from load test.

Sudden short circuit test and determination of Xd, Xd’, Xd” and machine time constants.

Determination of XI, X2, X0 by fault simulation methods.

Study of Automatic Voltage Regulators (AVR) and switch over from grid to stand alone mode.

**Suggested Text Books & References.**

DIGITAL ELECTRONICS

Review of Karnaugh maps, minimal realization of combinational circuits.
Half adder, comparator, multiplexer.
Transistor (BJT & MOS) as switching element.
Logic gates: TTL, ECL and CMOS gates.
State transition diagram, asynchronous and synchronous design, counters, registers.
Schmidt triggers, A/D and D/A converters.

List of Experiments

- To study the switching characteristics of a diode.
- To study the switching characteristics of a bipolar junction transistor (BJT).
- Implementation of logic functions using gates, multiplexers and demultiplexers.
- To set up an RS, a clocked RS, JK, Edge triggered JK, Master Slave KJ flip flops using NAND Gates.
- Design & Implementation of sequential memory using shift register to design and test counters and sequence detectors using J-K flip flops.

Suggested Text Books & References


POWER SYSTEM-I

Generation of Electric Power
Brief description of Thermal, hydro nuclear and gas power plants & other non-conventional power plants.

Transmission and Distribution Systems
DC 2 –wire and 3 –wire systems, AC single phase, three phase and 4-wire systems, comparison of copper efficiency.
Distribution Systems: primary and secondary distribution systems, concentrated & uniformly distributed loads on distributors fed at one and both ends, ring distribution, sub mains and tapered mains, voltage drop and power loss calculations, voltage regulators.

**Overhead Transmission Lines**
Types of Conductors, Line parameters; calculation of inductance and capacitance of single and double circuit transmission lines, three phase lines with stranded and bundle conductors, Generalized ABCD constants and equivalent circuits of short, medium & long lines. Line Performance: regulation and efficiency of short, medium and long lines, Series and shunt compensation, Introduction to FACTS.

**Overhead Line Insulators**
Type, string efficiency, voltage distribution in string of suspended insulators, grading ring, preventive maintenance.

**Mechanical Design of Transmission Lines.**
Different types of tower, sag-tension calculations, sag-template, string charts, vibrations & damaging Corona-corona losses, radio & audio noise, transmission line – communication line interference.

**Cables**
Calculations of capacity of cables, charging current, stress, grading, heating of cables, Construction and characteristics of HV & EHV cable.

**Tariffs & Load Curves**
Definition & different tariffs for domestic, commercial, industrial application, Different Load and Load duration curves. Curves their significance.

**Introduction to EHV/HVDC transmission**
Brief description of both the systems with working & constructional details.

**Suggested Text Books & References**
• Burke James, J., “Power Distribution Engineering; Fundamentals and Applications” Marcel Dekker Inc., 1996.
• “Electric Transmission and Distribution Reference Book”, Westinghouse Electric Corporation:

MANAGEMENT CONCEPTS AND TECHNIQUES

Basic Concepts and Functions of Management
Planning: Nature Purpose and Objectives of Planning; Organizing; Nature and Purpose of Organizing; Authority and Responsibility; Staffing, Supply of Human Resources; Performance Appraisal; Controlling; System and Process of Controlling; Control Techniques.

Human Resource Management
Nature and Scope of Human Resource Planning; Training and Development : Recruitment and Selection; Career Growth; Absenteeism: Grievances; Motivation and its Types; Need for Motivation: Reward and Punishment; Models of Motivation; Leaders; Kinds of Leaders, Leadership Styles, roles and Functions of Leaders; Conflict Management; Kinds and ; Causes of Conflict; Settlement of Conflicts. Group and Team Working, organizational Design and Development.

Marketing Management
Marketing Environment : Consumer Markets and Buyer Behaviour; Marketing Mix, Advertising and Sales Promotions; Channels of Distribution.

Financial Management and Accounting Concepts
Production/Operations Management
Planning and Design of Production and Operations Systems; Facilities Planning Location, Layout and Movement of materials; Materials Management and Inventory Control; Maintenance Management PERT & CPM.

Management Information System
Role of Information in decision making; Information System Planning, Design and Implementation Evaluation and Effectiveness of the Information System.

Statistical Quality Control, Total Quality Management and ISO Certification.

Social and Ethical Issues in Management
Ethics in Management, Social Factors; Unfair and Restrictive Trade Practices.

Strategic and Technology Management

Suggested Text Books & References.
**ANALOG ELECTRONICS**

**Diodes & BJT’s**
Diode junction characteristics, breakdown, photodiode, LED, wave shaping by diodes, Basic construction, operation and characteristics; regions of operation; biasing, bias stability; current mirror biasing, Transistor as an amplifier; various configurations viz. CE, CB and CC; load line analysis; design for maximum symmetrical swing, thermal stabilization.

**FET**
JFET and MOSFET devices; device structure, characteristics and equations; FET as amplifier; CS, CD and CG configurations.

**Small Signal Analysis**
Mid-frequency response of BJT and FET circuits; hybrid parameter models and analysis; low frequency response including the effects of emitter bypass and coupling capacitors; high frequency response.

**Multistage Transistor Circuits**
Difference amplifier, cascade amplifier; internal details of op amps. Some linear and non-linear applications of op-amps; Schmidt trigger using op-amps.

**Power Amplifiers**

**Feedback in Amplifiers.**
Different types of feedback; stability and oscillation; Wien Bridge, Phase Shift, Colpitts and Hartley Oscillators.

**Operational amplifiers**
Introduction to and use of Circuit Simulation Software (SPICE)
List of Experiments

- Design and test a multistage RC-coupled amplifier with given specifications.
- Design and test a current mirror using BJT
  (a) Set up an RC oscillator using a BJT to give sinusoidal output at 2kHz.
  (b) Set up a Wien Bridge oscillator using a BJT to give sinusoidal output at 2kHz.
- Design and test a series voltage regulator with short circuit protection.
- To design and test a complementary symmetry power amplifier and observe the performance
- Implement a summer and integrator by using op-amps.

Suggested Text Books & References


CONTROL ENGINEERING

Introduction to control problem
Industrial Control examples; Transfer function models of mechanical, electrical, thermal, and hydraulic systems. Systems with dead-time. System response. Control hardware and their models; potentiometers, synchros, LVDDT, dc and ac servomotors, tachogenerators electro-hydraulic valves, hydraulic servomotors, electro-pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis, transfer function.

Basic characteristics of feedback control systems

**Frequency-response analysis**
Relationship between time & frequency response, Polar plots, Bode’s plot, stability in frequency domain, Nyquist plots, Nyquist stability criterion. Performance specifications in frequency-domain. Frequency-domain methods of design, Compensation & their realization time & frequency domain
Lead and Lag compensation.

Op-amp based, and digital implementation of compensators. Tuning of process controller. State variable formulation and solution.

**State variable Analysis**
Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability.

**Introduction to Optimal control & Nonlinear control.**
Optimal Control problem, Regulator problem, Output regulator, trekking problem
Nonlinear system – Basic concept & analysis.

**List of Experiments**
- Identification of Transfer Function of a system using Bode plots from experimentally obtained frequency response.
- Experimental study of characteristics of Synchro Device, AC & DC Servo motors.
- Study of D.C. Servo System for position control and speed control.
- Position control of DC Servo System with Lead/Lag Compensator in the loop.
- Experimental study of a Hydraulic servomechanism.
- Experimental study of a Pneumatic System.
- PID tuning on process Control Simulator.
- Stepper Motor Control using 8-bit Microprocessor.
- PID Control of a Thermal and / or Liquid Level System.
- Digital Feedback Control of a plant using PC in the feedback loop.
Suggested Text Books & References

- Nagrath & Gopal, “Modern Control Engineering”, New Ages International

ELECTRICAL MACHINES – II

Three phase Induction motor
Review or constructional details. Review of Polyphase Distributed AC Windings. Production of EMF, Coupled circuit equations, steady state analysis –equivalent circuit, Phasor diagram, power flow diagram and torque-slip characteristics.
Starting and speed control Effect of rotor resistance starting, double squirrel cage rotor. Speed control schemes including solid state and vector control. Braking.
Effect of space/time harmonics and analysis.
Testing Losses and Efficiency.
Induction generators – Grid connected and Self excited mode – Applications.

Single Phase Motors
Induction Types Doubles revolving field theory, equivalent circuit, characteristics, starting of single phase motor, shaded pole machines.
Synchronous types Hystereris motor, reluctance motor, stepper motors – variable reluctance and permanent magnet type. PM Synchronous motor – brushless motor.

Special Electric Motors
Switched reluctance motor, linear machines – power energy and levitation types, PM brushless dc motors.

Machines for control Systems
Disc motors, printed Circuit motors. Servo motors-a.ca nd d.c, tachogenerators, Synchros, Disk machines.
List of Experiments

- Determination of complete torque speed characteristics of three phase induction machine in braking, motoring and generation regions and its calibration.
- Study of effect of rotor resistance on the load characteristics of a wound – rotor induction motor.
- Determination of equivalent circuit parameters, prediction of performance. Verification from actual load test. (b) Separation of losses of Induction motors and estimation of efficiency.
- Determination of torque step rate characteristic of a stepper motor. Determination of operating range.
- Load characteristic of universal motor, operating on dc and ac supply Comparison of performance.
- Experimental determination of performance characteristics of two phase servo motor.
- Load characteristic of hysteresis motor and shaded pole motor.
- Characteristic of permanent magnet motor.
- Characteristic of switched reluctance motor.

Suggested Test Books & References


**POWER SYSTEM –II**

**System Representation.**
Single line representation., Per Unit systems, modeling of transformer, load, synchronous machine.

**Formation of Network Matrices.**
Bus admittance and impedance matrices, algorithms for formation of Z-Bus and Y-Bus matrices, modification of bus impedance matrix, Sparsity oriented inversions for Y Bus.
Short Circuit Studies

Load Flow Studies
Power system equations, solution techniques, Gauss-Seidel iterative method, Newton-Raphson method, Fast-decoupled method, Comparison of methods, acceleration of convergence, voltage controlled busses, digital computer studies of load flow, information from load flow.

Stability Studies
Stability problem, Swing equation, power angle equation, Equal area criterion of stability, Elements of steady state and dynamic stability studies, Methods of simulation for transient stability, Representation of network, load and generators, System security concepts.

Power System Monitoring and Control
Economic operation & load dispatch, elementary ideas of voltage-VAR and load-frequency controls, Load-frequency control elements, Voltage control elements, Block diagram representation of hydro and steam turbine governors, Tie-line bias control.

Suggested Text Books & References

DIGITAL ELECTRONICS AND LOGIC DESIGN

Number Systems and Codes
Decimal Odometer, Binary Odometer, Number Codes, Why Binary numbers are used, Binary-to-Decimal Conversion, Decimal-to-Binary Conversion, Hexadecimal Numbers, Hexadecimal-Binary
Conversion, Hexadecimal-to-Decimal Conversion, Decimal-to Hexadecimal Conversion, BCD Numbers, The ASCII Code.

Gates
Inverter, or gates, and gates, Boolean algebra
Nor Gates, De Morgan’s First Theorem, Nand Gates, De Morgan’s Second Theorem Exclusive – Nor Gates, The Controlled Inverter, Exclusive-Nor gates.

TTI Circuits

Boolean Algebra and Karnaugh Maps
Boolean Relations, Sum-of-Products method, Algebraic Simplification, Karnaugh maps, Pairs, Quads, and Octets, Karnaugh Simplifications, Don’t – Care Conditions.

Arithmetic – Logic Units.
Binary Addition, Binary Subtraction, Half Adders, Binary Adders, signed Binary Numbers, 2’s Complement, 2’s-Complement Adder-Subtractor.

Flip Flops
RS Latches, Level Clocking, D Latches, Edge-Triggered D Flip-Flops, Edge-Triggered. 7K Master-slave Flip-Flop.

Registers and Counters
Buffer Registers, Shift Registers, Controlled Shilt Registers, Ripple Counters, Synchronous Counters Ring counters, Other counters, Three-State Register, Bus-Organize computers.

Memories
ROMs PROMs and EPROMs, RAMs. A small TTL Memory, Hexadecimal Addresses.

Operational amplifier (741) and its application.
Suggested Text Books and References.

- Malvino, A.P., “Digital Computer Electronics”

**SIGNALS & SYSTEMS**

**Dynamic Representation of Systems**

**Fourier Analysis of Continuous Time Signals and Systems.**
Fourier Series, Fourier Transform and properties, Parseval’s theorem, Frequency response of LTI systems. Sampling Theorem.

**Fourier Analysis of Discrete Time Signals & Systems**
Discrete-Time Fourier series, Discrete-Time Fourier Transform (including DFT) and properties Frequency response of discrete time LTI systems.

**Laplace Transform**
Laplace Transform and its inverse: Definition, existence conditions, Region of Convergence and properties, Application of Laplace transform for the analysis of continuous time LTI system (stability etc.) Significance of poles & zeros.

**Z-Transform**
Random Signals

Suggested Text Books & References

MICROPROCESSORS AND MICROCONTROLLERS

Architecture of 8085 Microprocessor

Programming of 8085
Instruction formats, Addressing modes, Instruction set, Need for Assembly language – Development of Assembly language programmes.

Memory Interfacing
Interface requirements - Address space partitioning – Buffering of Buses – timing constraints – Memory control signals – Read and write cycles – interfacing SRAM, EPROM and DRAM sections.

I/O Interfacing
Interrupts and DMA

Applications

Intel 8051 Microcontroller

8051 Peripheral Functions

Suggested Text Books and References
COMMUNICATION ENGINEERING

Review
Review of Frequency Bands Fourier Transform and Fourier series.

Amplitude Modulation Systems
Need for modulation, normal AM, generation and demodulation (envelope & synchronous detection), modulation index, DSBSC: generation and demodulation, Effect of phase and frequency offset on demodulation, SSB: Generation using filter and phasing method, detection. Frequency division multiplexed systems using SSB.

Angle Modulation Systems
Concept of frequency and phase modulation, frequency deviation and modulation index, FM spectra, Carson’s rule, narrowband FM, generation of Wideband FM Armstrong method, direct FM generation. Demodulation of FM-discriminatory, PLL

Sampling and Discrete time Modulations
Sampling Theorem – low pass and band pass, Pulse Amplitude Modulation (PAM), Pulse Width Modulation (PWM), Pulse Position Modulation (PPM) their generation and detection-phase time division multiplying.

Review of random signals and noise, signal to noise ratio in amplitude and angle modulated systems. Thermal and shot noise.

Digital Communication
PCM, quantization noise, bandwidth, advantages over analog communication, PCM system, Differential PCM, Delta Modulation, Digital Modulation – ASK, FSK, PSK, DPSK, Digital Multiplexing.

Power Line Carrier
Interfacing with powerline, description of a typical system.
Microwave Communication
Transmit and Receive Antennas, Link Budget, Line of Sight Systems, Satellite Link-GT ratio of earth station, VSATS and GPSS, FDMA, TDMA, CDMA.

Optical Communication Systems.

Mobile Communication.

Suggested Text Books & References

POWER ELECTRONICS

Power Semiconductor Devices
History of development of Power Electronic devices, Constructional features, Characteristics, rating and specification, gate/base drive circuits, protection including cooling and application consideration of diodes, SCRS, GTO, BJTS, MCT, MOSFET and IGBT. Electromagnetic interference.

AC to DC Converters
Operation and analysis of Single phase and multi-phase uncontrolled and controlled rectifiers with R, RL and back EMF load, effect of source inductance, free wheeling effect, power factor improvement methods for phase controlled rectifiers, filters.

AC to AC Voltage Converter
Operation and analysis of single phase integral cycle and phase controlled converters, Configuration of three phase controllers.
**DC to DC Converters**

Single phase and three phase bridge inverters, VSI and CSI, voltage control – PWM & Square wave operation, Harmonics and their reduction techniques.

**Cycloconverters**

Single phase and three phase-configurations and operating Principle.

**List of Experiments**

- Study of V.I. characteristic of SCRS triac & diac.
- Study of BJT, IGBT, GTO & MOSFET
- To Study a UJT firing circuit for the control of SCRS.
- To generate and study the PWM control signal for Single Phase dc to ac inverter.
- To Study and use of the single phase half controlled & fully controlled AC to DC Converter and effect of firing angle control on load voltage & wave Forms.
- To study and use of back to back connected SCR/triac Controlled AC Voltage controller and its wave forms with Variation of firing angle.
- To study & use chopper circuit for the control of DC Voltage using (1) Pulse width control (2) Frequency Control & (3) Current limit Control.
- Study of Single Phase inverter and its wave form.
- Study of Three phase firing circuit with synchronization, and testing with three phase AC to DC bridge converter.
- Testing of wave forms of digital firing modules.
- Study and Testing of a Three Phase bridge inverter with different types of loads.
- To Study the harmonics & reactive power measurement in AC mains with rectifier and AC Voltage Controller loads.

**Suggested Text Books & References**

POWER SYSTEM STABILITY

Introduction
System Modeling and Dynamics of Synchronous Generator

Small Signal Stability analysis (Low Frequency Oscillations)
- Application of P.S. Stabilizers
- Analysis of Multi-machine System.

Small Signal Stability Analysis (Subsynchronous Frequency Oscillations).
- Transient Stability Analysis
- Dynamic Stability Analysis
- Dynamic Equivalencing
- Voltage Stability Analysis
- Static Var Control and Loads
- Direct Stability evaluation – Lypnor and Popor’s criteria

Suggested Text Books and References

DESIGN OF CONTROL SYSTEMS

Review of frequency response – Frequency domain specifications – Design of controllers for single loop systems in the frequency domain: Lag, lead, lag-lead networks as compensators – Design of P, PDT, I, PI and PID controllers for first, second and third order systems – Control loop with auxiliary feedback – Feedforward control – Multivariable control.
Ziegler and Nichol’s methods – Oppelt’s method – State variable representation of control systems – Design using state variable feedback.

A.C. Carrier control systems.

**Modern Control Theory**


Pole placement – Quadratic performance Index – Linear regulator problem.

**Suggested Text Books and References**

**COMPUTER AIDED POWER SYSTEM**

**Representation of Power System Components**
- Modelling, Ybus formulation
- GS, NR, FDLF methods

**Optimal power system operation**
- Unit commitment
- Reliability
- Economic Dispatch
- Emission Dispatch
- Optimal Load flow
- Optimal Hydro-thermal scheduling
Power System Security
State estimation
Load forecasting
Fault analysis-balanced and unbalanced
Automatic generation control
Power system stability
Power system transients
Computer aided Power System protection

Suggested Text Books and References


NETWORK SYNTHESIS

Introduction of synthesis problem
Formulation of state synthesis problems
Basic Impedance Synthesis Problem, LC and RC impedances
Reciprocal and Synthesis
Transfer functions of ladder networks
Properties of second–order systems
Second-order Low – Pass Networks
Second-order Band – Pass Networks
Second-order High – Pass Networks
Approximations, LP, HP, B.Pass.
Band-stop functions and realizations
Reciprocal transfer functions synthesis
Non reciprocal transfer functions synthesis
T.F. Synthesis with prescribed loading.
Scattering matrix synthesis.

Suggested Test Books and References


POWER SYSTEM PROTECTION AND SWITCHGEAR

Protection
Importance of protective relaying power systems – fundamental requirements of a good protection scheme – Primary and Back-up Relaying.

Classification of Relays
Constructional (Viz., elector mechanical and Static Relays) and Functional viz. Overcurrent, Directional, Differential, Distance Relays etc. their principles and applications.

Current Trends in Protective Relaying
Microporcessor and PC based Relaying.

Switchgear
Classification of Switchgear, Fault Analysis, Symmetrical Faults on a synchronous machine, Fault clearing process, Arcing Phenomena and principles of arc interruption, AC and DC circuit breakers, Different types of circuit breakers and their constructional features, Testing and Selection of circuit breakers.

Suggested Text Books and References

- The Elementary Council, “Power System Protection”, Vol. 1,2, & 3, Peter Peregrinus Ltd., 1990
HIGH VOLTAGE ENGINEERING

Breakdown in Gases

Breakdown in Liquid and Solids
Mechanisms of breakdown in liquids, suspended particle, suspended water, cavitations and bubble and electronic breakdown theories. Mechanisms of breakdown in solids; intrinsic electro-mechanical, erosion, surface, thermal and streamer, Relation between electric strength of solids and time, intrinsic breakdown strength.

Impulse Generator
Specifications of an impulse voltage Wave, standard impulse, reasons for adopting the particular shape, Analysis and control of simple circuit of impulse generator. Multistage impulse generator (Marks circuit) circuit-working, earthing and tripling. Techniques to observer wave front on C.R.O.

Generation of High Voltage
Methods of generation of power frequency high voltage cascade transformers and resonance methods, Generation of high voltage D.C., voltage stabilization. Tesla coil.

Measurement of High Voltage
Potential dividers-resistive, capacitive and mixed dividers for high voltage. Sphere gap; construction, mounting, effect of nearby earthed objects, humidity and atmospheric conditions, effect of irradiation and polarity, Electrostatic voltmeter; principle and classification, constructional details of
an absolute electrostatic voltmeter. Oscilloscopes and their applications in high voltage measurement.

**High Voltage Testing**

**Over Voltage and Insulation Coordination**
Lighting, Switching and temporary over voltages, BIL, SIL, methods of insulation coordination.

**Suggested Text Books & References.**

**DIGITAL SIGNAL PROCESSING**

Sampling and data reconstruction process. Z transforms.
Discrete linear systems. Frequency domain design of digital filters.
Quantization effects in digital filters.
Discrete Fourier transform and FFT algorithms.
High Speed convolution and its applications to digital filtering. Multi-rate filtering.
Suggested Text Books & References


## LIST OF SUGGESTED OPEN ELECTIVES

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## PROFESSIONAL ELECTIVES

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<td>3. Technology Management</td>
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<td>4. Decision Support and Executive Information</td>
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<td><em>System</em></td>
<td>5. Microprocessor Based System Design</td>
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<td>6. Knowledge Management</td>
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<td>7. IT in Marketing Management</td>
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<td>8. IT in HR Management</td>
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<td>9. IT in Finance Management</td>
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<td>11. Advanced Control Systems</td>
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<td>12. Modeling and Simulation</td>
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<td>13. Robotics and Automation</td>
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<td>14. Neural Networks and Fuzzy systems</td>
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<td>19. Digital Signal Processing</td>
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**Note:** The Institutions can frame Syllabi of Professional Electives and Open electives to be offered by them in the particular area.
HUMAN VALUES

The objectives of the course is an exploration of human values which go into making a ‘good’ human being, a ‘good’ human society and a ‘good’ life. The context is the work life and the personal life of modern Indian professionals. The course has been taught for two years as an elective course to B.Tech part-III students of IT- BHU.

1. The value-crisis in the contemporary Indian Society.
2. The nature of values; the value spectrum for a ‘good’ life.
3. The Indian system of values.
5. Psychological values: integrated personality; mental health.
6. Societal values: the modern search for a ‘good society; justice, democracy rule of law; values in the Indian constitution.
7. Aesthetic values: perception and enjoyment of beauty.
8. Moral and ethical values: nature of moral judgments; canons of ethics; ethics of virtue; ethics of duty; ethics or responsibility.
9. work ethics; professional ethics.
10. Spiritual values; different concepts; secular spirituality.
11. Relative and absolute values.
12. Human values: humanism and human values; human rights; human values as freedom, creativity, love and wisdom.
13. Management by values: professional excellence; inter-personal relationships at work place; leadership and team building; conflict resolution and stress management; management of power.
**SCIENCE, TECHNOLOGY AND SOCIETY**

It will be innovative course dealing with social, human and ethical implications of engineering and technology, with special reference to the Indian situation. Its three main components are:

(i) Social and Cultural history of technology.
(ii) Social and Human critiques of technology.
(iii) Engineering Ethics and Professional Ethics.

The proposed course structure is as follow:

1. Science, Technology and Engineering, as knowledge and as social and professional activities.
2. Inter-relationship of technology growth and social, economic and cultural growth; historical perspective.
5. Rapid technological growth and depletion of resources. Reports of the club of Rome. Limits to growth; sustainable development.
8. Technology and the arms race. The nuclear threat.
9. Appropriate technology movement Schumacher; later developments.