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

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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.

In1996 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 co-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 7^{th} semester and 6 credits in 8^{th} 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+EST) 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:

Subjects	L	T	P	Credit =(L+(T=P)/2)	Grade Awarded
I	2	1	0	3	A
II	3	1	2	5	B
III	3	1	0	4	A
IV	3	1	0	4	B
V	0	0	3	2	C

Semester Grade Point Average = $\dfrac{3A + 5B + 4A + 4B + 2C}{3+5+4+4+2}$

$=(30+40+40+32+12)/18 = 8.55$

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

BRANCH: Electrical Engineering YEAR : I

SEMESTER: I (Common to all branches)

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
(THEORY)			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
1		Language (professional Comm. in English	2	1	-	15	10	25	50	75	3
2.		Engineering Chemistry	2	1	-	15	10	25	50	75	3
3.		Engineering Physics I	3	1	-	30	20	50	100	150	4
4.		Mathematic I	3	1	-	30	20	50	100	150	4
5		Engineering Mechanics	3	1	-	30	20	50	100	150	4
6.		Basic Electrical Engineering	3	1	-	30	20	50	100	150	4
(**PRACTICAL/DRAWING/DESIGN)**											
7.		Chemistry/Physics Lab. (To be taken in alternate weeks)	-	-	3	25	-	25	25	50	2
8.		Engineering Mechanics/ Electrical Laboratory	-	-	3	25	-	25	25	50	2
9.		Engineering Graphic I	-	-	3	25	-	25	25	50	2
10.		Workshop Practice – I	-	-	3	25	-	25	25	50	2
	GP-I	**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

BRANCH: Electrical Engineering YEAR : I SEMESTER: II (Common to all branches)

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
(THEORY)			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
1		Introduction to Computing	2	1	-	15	10	25	50	75	3
2.		Environment & Ecology	2	1	-	15	10	25	50	75	3
3.		Engineering Physics II	3	1	-	30	20	50	100	150	4
4.		Mathematics II	3	1	-	30	20	50	100	150	4
5		Engineering Thermodynamics	3	1	-	30	20	50	100	150	4
6.		Basic Electronics	3	1	-	30	20	50	100	150	4
(**PRACTICAL/DRAWING/DESIGN)**											
7.		Basic Electronics Lab.	-	-	3	25	-	25	25	50	2
8.		Computer Programming Lab.	-	-	3	25	-	25	25	50	2
9.		Enginering Graphics II (M/C Drawing)	-	-	3	25	-	25	25	50	2
10.		Workshop Practice II	-	-	3	25	-	25	25	50	2
	GP-II	**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

BRANCH: Electrical Engineering YEAR : II

SEMESTER: III

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Numerical Analysis & Computer Programming (C, C++)	2	1	-	15	10	25	50	75	3
2.		Material Science	2	1	-	15	10	25	50	75	3
3.		Strength of Materials	3	1	-	30	20	50	100	150	4
4.		Fluid Mechanics & Fluid Machinery	3	1	-	30	20	50	100	150	4
5		Mathematics III	3	1	-	30	20	50	100	150	4
6.		Electrical Measurements and instrumentation	3	1	-	30	20	50	100	150	4
(**PRACTICAL/DRAWING/DESIGN)**											
7.		Numerical Analysis & Computer Programming (C, C++)	-	-	3	25	-	25	25	50	2
8.		Material Science /Strength of Materials	-	-	3	25	-	25	25	50	2
9.		Fluid Mechanics & Fluid Machinery	-	-	3	25	-	25	25	50	2
10.		Electrical Measurements and Instrumentation	-	-	3	25	-	25	25	50	2
	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

BRANCH: Electrical Engineering YEAR : II

SEMESTER: IV

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Solid State Devices	2	1	-	15	10	25	50	75	3
2.		Circuit Theory	2	1	-	15	10	25	50	75	3
3.		Electromagnetic Theory	3	1	-	30	20	50	100	150	4
4.		Electrical Machines – I	3	1	-	30	20	50	100	150	4
5		Digital Electronics	3	1	-	30	20	50	100	150	4
6.		Power System - I	3	1	-	30	20	50	100	150	4
(**PRACTICAL/DRAWING/DESIGN)**											
7.		Solid State Devices	-	-	3	25	-	25	25	50	2
8.		Circuit Theory	-	-	3	25	-	25	25	50	2
9.		Electrical Machines Lab-I	-	-	3	25	-	25	25	50	2
10.		Digital Electronics Lab	-	-	3	25	-	25	25	50	2
	GP-IV	**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

BRANCH: Electrical Engineering YEAR : III

SEMESTER: V

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Management Concepts and Techniques	2	1	-	15	10	25	50	75	3
2.		Analog Electronics	2	1	-	15	10	25	50	75	3
3.		Control Engineering	3	1	-	30	20	50	100	150	4
4.		Electrical Machines – II	3	1	-	30	20	50	100	150	4
5		Power Systems-II	3	1	-	30	20	50	100	150	4
6.		Digital Electronics and Logic Design	3	1	-	30	20	50	100	150	4
(**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
	GP-V	**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

BRANCH: Electrical Engineering YEAR : III

SEMESTER: VI

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Signals & Systems	2	1	-	15	10	25	50	75	3
2.		Microprocessors & Microcontrollers	2	1	-	15	10	25	50	75	3
3.		Communication Engineering	3	1	-	30	20	50	100	150	4
4.		Power Electronics	3	1	-	30	20	50	100	150	4
5		Power System Stability	3	1	-	30	20	50	100	150	4
6.		Design of Control System	3	1	-	30	20	50	100	150	4
(**PRACTICAL/DRAWING/DESIGN)**											
7.		Power Electronics	-	-	3	25	-	25	25	50	2
8.		Microprocessors & Microcontrollers	-	-	3	25	-	25	25	50	2
9.		Power System Stability	-	-	3	25	-	25	25	50	2
10.		Control System	-	-	3	25	-	25	25	50	2
	GP-VI	**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

BRANCH: Electrical Engineering YEAR : IV

SEMESTER: VII

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
(THEORY)											
1		Computer Aided Power System	2	1	-	15	10	25	50	75	3
2.		Network Synthesis	3	1	-	30	20	50	100	150	4
3.		Power System Protection & Switchgear	3	1	-	30	20	50	100	150	4
4.		Open Elective – I	3	1	-	30	20	50	100	150	4
5		Professional Elective - I	3	1	-	30	20	50	100	150	4
(PRACTICAL/DRAWING/DESIGN)											
7.		Colloquium	-	-	3	25	-	-	25	50	2
8.		Computer Aided Power System	-	-	3	25	-	-	25	50	2
9.		Switch Gear & Protection	-	-	3	25	-	-	25	50	2
10.		Project - I	-	-	3	25	-	-	25	50	2
	GP-VII	**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: 31, Total Credits: 29

BRANCH: Electrical Engineering YEAR : IV

SEMESTER: VIII

Sl. No.	Course No.	SUBJECT	PERIODS			EVALUATION SCHEME					Credits
(THEORY)			L	T	P	SESSIONAL EXAM			ESE	SUB TOTAL	
						TA	CT	TOT			
1		Open Elective –II	3	1	-	30	20	50	100	150	4
2.		Professional Elective – II	3	1	-	30	20	50	100	150	4
3.		Professional Elective –III	3	1	-	30	20	50	100	150	4
4.		High Voltage Engineering	3	1	-	30	20	50	100	150	4
5		Digital Signal Processing	3	1	-	30	20	50	100	150	4
(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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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 class-room.
- 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;

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

- Bhaskar. W. W. S. and Prabhu, N.S. "English Through Reading", Vol.-I & II, MacMillan, 1978. D'Souza Eunice and Shahani, G. "Communication Skills in English", Noble Publishing House, 1977.
- Sharma R.C. and Mohan, K., "Business Correspondence and Report Writing," Tata Mcgraw Hill, New Delhi, 1994.
- Fiske, John "Introduction to Communication Studies", Rotledge, London, 1990.
- Gartside, L. "Model Business Letters", Pitman, London, 1992.
- Longman, "Longman Dictionary of Contemporary English", (or 'Oxford Advanced Learner's Dictionary of Current English', OUP), 1998.
- Nurnberg, Maxwell and Morris, Rosenblum "All About Words", General Book Depot, New Delhi, 1995.

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. hydroformyalation, 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 **H2 O2** 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 HCI 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.
- Alberty, R.A. and Silbey, R.J. "Physical Chemistry", John Wiley & Sons, Inc., Singapore, 1996.
- Cotton, F.A, Wilkinson, G. and Gaus, P.L. "Basic Inorganic Chemistry", John Wiley & Sons, Inc., Singapore, 3rd Ed., 1996.
- Graham-Solomon, T.W. "Fundamentals of Organic Chemistry", John Wiley & Sons, Inc., Singapore, 1997.
- Odian, G.G. "Principles of Polymerization" , John Wiley & Sons, Inc., New York, 1981.

- Sykes, P. "A Guidebook to Mechanism of Organic Chemistry", Longman Inc., New York, 1981
- Dyer, J.R. "Application of absorption Spectroscopy of Organic Compounds", Prentice Hall of India, 1965.
- Williams, D.H. and Fleming, I., "Spectroscopic Methods in Organic Chemistry", Tata McGraw Hill edition, New Delhi, 4th Ed., 1988.
- Atkins, P.W. "Physical Chemistry", Oxford Univ. Press, 4th Ed., 1990.
- Pine, S.H., "Organic Chemistry", McGraw Hill Book Co., New Delhi, 5th Ed., 1987.
- Sharma, B.K., "Engineering Chemistry", Krishna Prakashan Media (P) Ltd., Meerut, 1996.
- Conn, E.E. and Stumpf, P.K. "Outlines of Biochemistry", Wiley Eastern Ltd., New Delhi, 4th Ed., 1985.
- Morrison, R.T. and Boyd, R.N. "Organic Chemistry", Prentice Hall of India, 6th Ed., 1992.
- Rao, C.N.R. and Agarwala, U.C. "Experiments in General Chemistry", East-West Press, New Delhi, 1969.
- Furnis, B.S., Hannaford, A.J., Smith, P.W.G. and Tatchell, A.R., Vogel's "Textbook of Practical Organic Chemistry", ELBS, 5th Ed., 1989.
- Vogel's "Textbook of Quantitative Analysis", Longman, New York, 4th Ed., 1978.
- Elias, A.J.Sundar Manoharan S. and Raj, H. "Laboratory Experiments for General Chemistry", I.I.T. Kanpur, 1997.

ENGINEERING PHYSICS-I

Theory of Relativity

Inertial frame of reference, Noninetrial frames and fictious 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.

Accoustics

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

- Jenkins and White, "Optics", McGraw-Hill Book Company.
- 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, Libnitz'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

Partial derivatives, chain rule, gradient and directional derivative. Differentiation of implicit functions, exact differentials. Tangent planes and normals. Maxima, minima and saddle points. Simple problems in extrema of functions with constraints – method of Lagrange multipliers. Multiple integrals – double and triple integrals. Jacobeans and transformations of coordinates. Applications of areas, volumes etc.

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

- Thomas, G.B. and Finney, R.L. "Calculus and Analytic Geometry", 6th Edition, Addison-Wesley/Narosa, 1985
- Piskunov, "Differential and Integral Calculus", Vol-I & II, Mir Publishers, Moscow, 1979.

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

The Structural model, simple trusses, analysis of simple trusses: method joints, method of sections graphical method.

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

- Beer, F.P. and Johnston, F.R., "Mechanics for Engineers", McGraw Hill,.
- Shames, I.H., "Engineering Mechanics", Prentice Hall of India
- Meriam, J.L., "Statics", John Wiley.
- Meriam, J.L., "Dynamics", John Wiley.

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 cure, solution of magnetic circuits; Hysteresis and eddy current loses; Relays, an application of magnetic force.

Transformers

Construction, EMF equation, ratings; Phasor diagram on no lad 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 voltmeters; 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

- Hughes Edward (revised by Ian McKenzie Smith), "Electrical Technology", Seventh Edition, English Language Book Society Publication with Longman, 1995.
- Del Torro, Vincent "Electrical Engineering Fundamentals" Second Edition, Prentic Hall of India Pvt. Ltd. 1994.
- Cotton H. "Advanced Electrical Technology", Issac Pitman, London, 1967.

- Wildi, Theodore "Electrical Machines, Drives and Power Systems', Second Edition, Prentice Hall, 1991.
- Cogdell, J.R. "Foundations of Electrical Engineering", Second Edition, Prentice Hall, 1996.
- Parke Smith S. (Ed. Parker Smith N N), "Problems in Electrical Engineering", Tenth Edition, Asia Publications, 1995.

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

- Narayana, K.L. and Kannaiah, P., "Engineering Graphics", Tata McGraw Hill, New Delhi, 1988.
- Bhatt, N.D., "Elementary Engineering drawing", Charotar Book Stall, Anand, 1988.
- Lakshminarayanan, V. and Vaish Wanar, R.S., "Engineering Graphics", Jain Brothers, New Delhi, 1998.
- Chandra, A.M. and Chandra Satish, "Engineering Graphics", Narosa, 1998.

WORKSHOP PRACTICE I & II

Carpentry

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

Foundry

Moulding sands, constitutents 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, constitutents 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

- Begeman, M.L. and Amstead, B.H., "Manufacturing Process", John Wiley , 1968.
- Chapman, W.A.J. and Arnold, E., "Workshop Technology", Vol. I & III, Viva Low Priced. Student Edition, 1998.
- Raghuwanshi, B.S. "Workshop Technology", Vol.I & II, Dhanpat Rai and Sons, 1998.
- Chaudhary, Hajra, "Elements of Workshop Technology", Media Promotors & Publishers, 1997.
- Crawford, S. "Basic Engineering Processes", Hodder & Stoughton, 1985.

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

- Kernighan, B.W., "The Elements of Programming Style", McGraw –Hill.
- Yourdon, E., "Techniques of Program Structures and Design", Prentice-Hall.
- Press, W.H., Teukolsky, S.A., Vetterling, W.T. & Flannery, B.P., "Numerical Recipes in Fortran", Cambridge University Press.
- Gotterfied, B.S. "Schaum's Outline of Theory & Programming with Basic", McGraw Hill, New Delhi.
- Schied, F.S., "Theory and Problems of Computers & Programming', McGraw Hill, New Delhi.

ENVIRONMNET AND ECOLOGY

General

Introduction, components of the environment, environmental degradation.

Ecology

Elements of Ecology: Ecological balance and consequences of change, principles of environment impact assessment.

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

- Masters, G.M., "Introduction to Environmental Engineering and Science", Prentice-Hall of India Pvt. Ltd., 1991.
- Nebel, B.J. "Environmental Science", Prentice-Hall Inc., 1987.
- Odum E.P., "Ecology: The Link Between the Natural and Social Sciences", IBH Publishing Com. Delhi.

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

- Rangwala and Mahajan, "Electricity and Magnetism", Tata McGraw Hill, 1998.
- Verma, H.C., "Concepts of Physics, Part-2", Bharati Bhawan (P&D), 1998.
- Beiswer, "Modern Physics", McGraw-Hill Inc., New York, 1995.
- Mani and Mehta, G.K. "Modern Physics", Affiliated East –West Press Pvt. Ltd. 1998

MATHEMATICS – II

Linear Algebra

Vector spaces – linear independence and dependence of vectors, inner products, linear transformation , Matrices and determinants. System of linear equations –consistency and inconsistency. Gauss elimination, rank of a matrix, inverse of a matrix. Eigenvalues and eigenvectors of a matrix, diagonalization of a matrix.

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

- Kreyszig, E. "Advanced Engineering Mathematics", 5th Ed., Wiley Eastern, 1985.
- Krishnamurthy, V., Mainra, V.P. and Arora, J.L. "An Introduction to Linear Algebra", Affiliated East-West, 1976.
- Boyce and Diprima, R.C. "Elementary Differential Equations and Boundary Value Problems", 3rd Ed., Wiley, 1977.

ENGINEERING THEROMODYNAMICS

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 hear transfer.

First Law of Thermodynamics

Statement, Application to non-cyclic process, Energy, modes of energy, Pure substance, Specific hears, 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 condensable 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.

Suggested Text Books & References "Engineering Thermodynamics", John Wiley and Sons, 1955.

- Van Wylen, G.J., and Sonntag, R.E., "Fundamentals of Classical thermodynamics", John Wiley and Sons, 4th edition, 1997.
- Nag, P.K., "Engineering Thermodynamics", Tata McGraw Hill, 2nd Edition, 1998.

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

Introduction, Electronic Voltmeters, Vacuum type voltmeters, Differential amplifiers, D.C. Voltmeter with direct coupled amplifier, Electronic multimeter.

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

- Robert Boylesta & Louis Nashelsky, "Electronics Devices & Circuit Theory", Prentice Hall of India.
- Milliman & Halkias, "Basic Electronics Principle"
- Sawhney, A.K., "Electrical & Electronics Measurement and Instrumentation", Dhanpat Rai & Sons.

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

Dimensioning, tools of dimensioning. Size and location dimensions. Principles and conventions of dimensioning. Dimensioning exercise.

Computer Aided Drafting

Basic concepts and used.

Suggested Text Books & References.

- French and Vireck, "The fundamental of Engineering Drawing and Graphic Technology". McGraw Hill, 4th Ed., 1978.
- "IS : 696(1972) Code of Practice for General Engineering Drawing", ISI New Delhi.
- P.S. Gill, "A Text Book of Machine Drawing", Katson Publishing House, Ludhiana, 1980.
- Giesecke, Mitchell, Spener, Hill and Dygon, "Technical Drawing ", McMillian & Co., 7th Ed., 1980.
- George Omura, "Mastering AUTOCAD", B.P.B. Publication, New Delhi.

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

- Shastry, S.S., "Numerical Methods", Prentice Hall Inc., India, 1998
- Noble Ben, "Numerical methods", New York International Publications, New York, 1964.
- Stanton Ralph G., "Numerical Methods for Engineering", Englewood Cliffs, N.J. Prentice Hall Inc., 1961.
- Buckingham, R.A., "Numerical Methods", Sir Isaac Pitman Sons. Ltd., London, 1957.
- Bakhvalov, N.S., Numerical Methods", Mir Pub., Moscow, 1977.
- Grewal, B.S., "Numerical Methods", Khanna Pub., New Delhi, 1998.
- Kaicher, Sudhit. "The complete ANSI C", BPB Publications, New Delhi, 1996.
- Kernighan, B.W., and Ritchie, D.M., "The C Programming Language", Prentice Hall of India 1998.
- Gottfreid Byron S., "Programming with C', Tata McGraw Hill, 2nd edition 1998.

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".
- Raghavan,, V "Material Science and Engineering", Prentice Hall.
- Callister, "Material Science and Engineering", Astern Wiley.

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; Reltion between the load S.F. and B.M.

Simple Theory of Bending

Flexture 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

- Singh, Surendra, "Strength of Materials", Vikas Publishing House Pvt. Ltd. New Delhi.
- Jain, O.P. and Jain, B.K., "Theory and Analysis of Structures". Vol. I. Nemchand and Bros. Roorkee.
- Popov, E.P., "Mechanics of Materials". Prentice Hall of India, 1993.

- Beer and Johnston, “Mechanics of Materials”. McGraw Hill Book Company, 1987
- Timoshenko and Young, “Strength of Materials”. Van Nostrand and Company, 1993.

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

Mechanisms, Types of Pumps and hydro-turbines, Classification, Working principle, Characteristics and Applications, Wind energy and wind turbines.

Suggested Text Books & References

- Fox, R.W. and Mc Donald, A.T., "Introduction to Fluid Mechanics", 4th edition, John Wiley and Sons Ins., 1995.
- Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publishing House (P) Ltd., 1976.
- Gupta, Vijay and Gupta, S.K., "Fluid Mechanics and Applications", Tata McGraw Hill Co., 1985.
- Modi, P.N. and Seth, S.M., "Hydraulic and Fluid Mechanics", Standard Book House, 1968.

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

- Jain, M.K. Kyengar, S.R.K. and Jain, R.K., "Numerical Methods for Scientific and Engineering Computation", 3rd Edition, New Age International, 1998.
- Froberg, C.E., "Introduction to Numerical Analysis", Addison – Wesley, 1995.
- Conte, S.D., and Boor, S.D., "Elementary Numerical Analysis: An algorithmic Approach", 3rd Edition, McGraw Hill, 1984.
- Jain, M.K. Iyengar, S.R.K. and Jain, S.R.K. "Computational Methods for Partial Differential Equations", New Age International, 1998.

ELECTRICAL MEASUREMENTS & INSTRUMENTATION

Electrical Measurements

Standards of Measurement & Errors, Review of indicating and integrating instruments: Voltmeter, Ammeter, Wattmeter, Multimeter and Energy meter.

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

- Helfrick and Cooper, "Modern Electronic Instrumentation and Measurement Techniques", Prentice-Hall of India, Reprint 1988.
- Jones, B.E., "Instrumentation Measurement and Feedback", Tata McGraw-Hill, 1986.
- Golding, E.W., "Electrical Measurement and Measuring Instruments", 3rd Edition, Sir Issac Pitman and Sons, 1960.
- Buckingham, H. and Price, E.N., "Principles of Electrical Measurements", 1961.

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-paramaters 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 facto 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

- Dekker, A.J., "Electrical Engineering Materials', PHI, New Delhi, 1998
- Allison, J., "Electrical Engineering Materials And Devices", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1998.
- Millman, J. and Halkias, C.C., "Electronic Devices and Circuits", Tata McGraw Hill, 1998.

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 1^{st} order and 2^{nd} order low-pass filters; Elementary synthesis techniques.

Suggested Text Books & References

- Kuo, F.F., "Network Analysis", John Wiley and Sons Inc., 1966.
- 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 Sehwartz-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 wavers 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, ANSOF, NISA).

Suggested Text Books & References

- Rao, N.N., "Elements of Engineering Electromagnetic", Third Edition, Prentice Hall, India, 1992.
- Mathew, N., Sadiku, O., "Elements of Electromagnetic", Second Edition, Saunders College publishing, 1994.
- Ramo, S., Whinnery, S. and Van Duzer, T., "Fields and Waves in Communication Electronics", 3rd Edition, John Wiley and Sons, 1994.
- Kraus, J.D., "Electromagnetic", 3rd Edition, McGraw Hill, 1989.

- Jordan, E.C., and Balmain, K.G., "Electromagnetic Waves and Radiating Systems", Second Edition, Prentice Hall, India, 1995.
- Hayat William H., "Engineering Electromagnetic", McGraw Hill

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

Review of constructional features. Methods of excitation, Armature windings, Power balance, Voltage and torque equations. Operation as generator – Self excitation principles. Characteristics, Armature reaction, Commutation. Operation as a Motor – Characteristics and their control. Starting, speed control including solid state controllers. Braking. Losses, Efficiency. Testing and applications of dc motors. Amplidyne & Metadyne.

Polyphase Synchronous Machines

Constructional features. Polyphase Distributed AC Windings: Types, Distribution, coil span and winding factors. Excitation systems, emf equation and harmonic elimination. Generator Mode: Interaction between excitation flux and armature mmf, equivalent circuit model and phasor diagram for cylindrical rotor machine. Salient pole machines: two reaction theory, equivalent circuit model and phasor diagram. Power angle equations and characteristics. Voltage regulation and affect of AVR. Synchronizing methods, Parallel operation and load sharing, active and reactive power control, operation on infinite busbar.

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.

Testing of synchronous Machines – Stability considerations. Brushless generators, Single Phase generators.

Suggested Text Books & References

- Mcpherson, George, "Introduction to Electric Machines and Transformers", John Wiley and Sons, 1980.
- Nasser Syed, A., "Electric Machine and Transformer:, New York, Macmillan, 1984.
- Sen, P.C., "Thyristor DC Drives", Newyork, Wiley, 1991.
- Sen, P.C., "Principal of Electric Machines and Power Electronics", (Second Ed.), John Wiley & Sons 1997.
- Say, M.G., "Alternating Current Machines", (5th Ed.)ELBS, 1986
- Fitzgerald, Kingsley C. and Umans, S.D., "Electric Machinery", (5ty Ed.,), McGraw-Hill Book Co., 1992.
- McPherson, G. and Laramore R.D., "An Introduction to Electrical Machines and Transformers", (2nd Ed), John Wiley & Sons, 1990.
- Clayton, A.E., "Performance and Design of Direct Current Machines", 3rd Ed. Pitman 1961.
- Say, M.G. and Taylor, E.O., "Direct Current Machines" Second Ed., ELBS, 1985.
- Del Toro, V., "Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., Englewood Cliffs., 1985.
- Del Toro, V, "Electromechanical Devises for Energy Conversion & Control Systems', PHI Pvt. Ltd., 1975.
- Garik, M.L. & Weil, R.T., "DC Y & AC Machines", Affiliated East-West Pvt. Ltd., East-West student Edition, 1968.
- Kosow, I.L., "Electric Machinery & Transformers', PHI, 2nd Ed. 1992
- Griffiths, D.J., "Introduction to Electrodynamics", PHI, 1981.
- Nasar Syed, A., "Electric Machines & Power Systems, Volume-I", McGraw-Hill, Inc. U.S.A., 1995
- Nasar Syed, A & Unnewehr, L.E., "Electromechanics & Electric Machines, Volume-II", John Wiley & Sons, Canada, 1979.

- Openshaw Taylor, E., "The Performance & deign of A.C. Commutator Motors", A.H. Wheeler & Co., (P) Ltd. Allahabad 1971.
- Ivanov-Smotensky, A., "Electrical Machines Vol.-3", Mir Publishers Moscow, 1982.
- Ivanov-Smolonsky, A., "Electrical Machines Vol.-2", Mir Publishers Moscow, 1982.
- Fitzgerald, A.E. & Kingsley Charles, Jr., "Electrical Machinery (2nd Ed.)", Mc.Graw-Hill & Kogakusha Company Ltd. Japan, 1961.

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.

Murthy, S.S. et al, "Electromechanics Laboratory Manual", Wiley Eastern, 1982.

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.

Memories : RAM, ROM, EPROM, EEPROM, RS, JK, T & D flip-flops.

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

- Taub and Schilling, “Digital Integrated Electronics”, McGraw-Hill, 1976.

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, submains 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

- Grainger John, J. and Stevenson, Jr. W.D., "Power System Analysis", McGraw Hill, 1994.
- Harder Edwin, I., "Fundamentals of Energy Production", John Wiley and Sons, 1982.

- Deshpande, M.V., "Elements of Electric Power Station Design", A.H. Wheeler and Company, Allahabad, 1979.
- "Modern Power System Practice", Volume 1 to 8, Central Electricity Generating Board, Pergamon Press, Oxford, 1994.
- Burke James, J., "Power Distribution Engineering; Fundamentals and Applications" Marcel Dekker Inc., 1996.
- "Electric Transmission and Distribution Reference Book", Westinghouse Electric Corporation:
- East Pittsburg, Pa, 1964.
- Wadhwa, C.L., "Electric Power Systems", Second Edition, Wiley Eastern Limited, 1985.
- Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, 1995.

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

Book Keeping; Financial Statements Analysis: Financial Ratios: Capital Budgeting: break-even Analysis.

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

Need, Nature, Scope and Strategy SWOT analysis, value chain concept.

Suggested Text Books & References.

- Kotler Philip, "Marketing Management", Prentice Hall of India 1997.
- Luthans Fred, "Human Resource Management", McGraw-Hill, Inc. 1997
- Robbins Stephen, P., "Organizational Behaviours Concepts, Controversies and Application", Prentice Hall, Englewood, Cliffs, New Jersey, 1989.
- Khan, M.Y. & Jain, P.K., "Financial Management", Tata McGraw-Hill, 1997.
- Porter Michael, "Competitive Advantage", The Free Press, 1985.
- Porter Micheal, "Competitive Strategy", The Free Press, 1980.
- Bhushan, Y.K., "Fundamentals of Business Organization and Management", Sultan Chand and Sons, 1998.
- Ahuja, K.K., "Industrial Management", Khanna Publishers, 1998.

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 abalysis; low frequency response including the effects of emitter bypass and coupling capacitors; high frequncey 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

Class A, Class B and Class C operation. Push pull amplifier. Complementary symmetry configuration.

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 BJTs
  (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

- Sedra Adel, S. and Smith Kenneth C., "Microelectronic Circuits (Oxford Series in Electrical Engineering", June 1997.
- Sedra, K.C., "1995 Problems Supplement to Microelectronic Circuits", Oxford University Press, 1995.
- Reberts, G.W and Sedra, A.S., "SPICE (The Oxford Series in Electrical and Computer Engineering)", second edition, 1996.
- Millman & taub, "Pluse Digital Switching Waveforms", McGraw Hills.

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

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity, and robustness. Basic modes of feedback control; proportional, integral and derivative. Feed-forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Time response of second-order systems, steady-state errors, and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation.

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 o 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

- Gopal, M., "Control System: Principles and Design", Tata McGraw-Hill, 1997.
- Kuo, B.C., "Automatic Control System", Prentice Hall, Sixth edition, 1993.
- Ogata, K., "Modern Control Engineering" , Prentice Hall, second edition, 1991.
- 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 it's 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.
- Speed control of Induction motor – Conventional, electronic. Solid state speed control using (i) V constant, (ii) V/f constant, (iii) slip – energy injection.
- Load characteristic of Induction generator working in (i) Grid connected mode (ii) Self Determination of equivalent circuit parameters of a single phase Induction motor. Prediction of torque – speed characteristic. Verification from load test.
- 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 hysterisis motor and shaded pole motor.
- Characteristic of permanent magnet motor.
- Characteristic of switched reluctance motor.

Suggested Test Books & References

- Mcpherson George, "Introduction to Electric Machines and transformers", John Wiley and Sons, 1980.
- Nasser Syed, A., "Electric Machine and Transformer", New York, Macmillan, 1984.
- Sen, P.C., "Thyristor DC Drives", New York Wiley, 1991.
- Sen, P.C., "Principal of Electric Machines and Power Electronics", (Second Ed.), John Wiley & Sons 1997.
- Say, M.G., "Alternating Current Machines", (5^{th} Ed.) ELBS, 1986.
- Fitzgerald, Kingsley C., Umans, S.D., "Electric Machinery" (5^{th} Ed.), Mc.Graw-Hill Book Co., 1992.
- McPherson, G. and Laramore, R.D. "An Introduction to Electrical Machines and Transformer", (2^{nd} Ed.), John Wiley & Sons, 1990.

- Clayton, A.E., "Performance and Design of Direct Current Machines', 3rd Ed.Pitman 1961.
- Say, M.G., and Taylor, E.O., "Director Current Machines" Second Ed., ELBS, 1985.
- Del Toro, V., Electrical Machines & Power Systems", 1985, Prentice-Hall, Inc., Englewood Cliffs.
- Del Toro, V., Electromechanical Devices for Energy Conversion & Control Systems", PHI Pvt. Ltd.., 1975.
- Garik, M.L., & Weil, R.T., "DC & AC Machines", Affiliated East-West Pvt. Ltd., East-West student Edition, 1968.
- Kosow, I.L., "Electric Machinery & Transformers", PHI, 2nd Ed. 1992.
- Griffiths, D.J., "Introduction to Electrodynamics", PHI, 1981.
- Nasar, Syed A., "Electric Machines & Power Systems, Volume-I", McGraw-Hill, Inc. U.S.A., 1995.
- Nasar, Syed A., & Unnewehr, L.E., "Electromechanics & Electric Machines, Volume-II:, John Wiley & Sons, Canada, 1979.
- Openshaw Taylor, E., "The Performance & Design of A.C. Commutator Motors". A.H. Wheeler & Co.(P). Ltd., Allahabad 1971.
- Ivanov –Smotensky, A., "Electrical Machines Vol-3", Mir Publishers Moscow, 1982.
- Invanov-Smolonsky, A., "Electrical Machines Vol-2", Mir Publishers Moscow-1982.
- Fitzgerald, A.E. & Kingsley, Jr. Charles, "Electrical Machinery (2nd Ed.,)", McGraw-Hill & Kogakusha Company Ltd. Japan, 1961.
- Murthy et al S., "Electro-mechanics Laboratory Manual", Wiley Eastern, 1982.

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

Short circuit studies for balanced three phase networks for various types of shunt faults using sequence networks. Short circuit studies using Z-Bus matrix.

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

- Elgerd ,O.I., "Electric Energy Systems Theory : An Introduction", Tata McGraw Hill, Second edition, 1982.
- Gainger John, J. and Steveson, W.D., Jr., "Power System Analysis", McGraw Hill, 1994.
- Kundur, P., "Power System Stability and Control", Mc. Graw Hill inc. 1994.
- Kimbark, E.W., "Power System Stability, Vol. I : Elements of Stability Calculations", Johns Wiley & Sons, 1948.

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 Centrolled Inverter, Exclusive-Nor gates.

TTI Circuits

Digital Integrated Circuits, 7400 Devices, TTL Characteristics, TTL Overview, and or –Invert Gates, Open-Collector Gates, Multiplexers.

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-Substractor.

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"
- Tabu and Shilling, "Digital Integrated Electronics", McGraw Hill, 1976.

SIGNALS & SYSTEMS

Dynamic Representation of Systems

Systems Attributes, Causality linearity, Stability, time-invariance. Special Signals, Complex exponentials, Singularity functions (impulse and step functions)., Linear Time-Invariant Systems: Differential equation representation convolution Integral. Discrete form of special functions. Discrete convolution and its properties. Realization of LTI system (differential and difference equations).

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

Z-Transform and its inverse: Definition, Existence Region of convergence and properties. Application of Z-Transform for the analysis of Discrete time LTI systems, Significance of poles and zeros.

Random Signals

Introduction to probability. Bayes Theorem, concept of random variable, probability density and distribution functions, function of a random variable. Moments, Independence of a random variable. Introduction to random process. Auto and cross correlation. Wide-sense stationarity, power spectral density White noise, Random Processes through LTI systems.

Suggested Text Books & References

- Oppenheim Alan, V., Willsky Alan. S., and Nawab, H., "Signals and Systems', Prentice Hall, 1997.
- Haykin Simon, "Communication Systems", 3rd Edition, John Wiley, 1995.

MICROPROCESSORS AND MICROCONTROLLERS

Architecture of 8085 Microprocessor

Functional Block Diagram – Registers, ALU, Bus systems, Timing and control signals, Machine cycles and timing diagrams.

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

Memory mapped I/O Scheme – I/O mapped I/O scheme – Input and Output cycles – Simple I/O ports – Programmable peripheral interface (8255). Data transfer schemes : Programmable data transfer, DMA data transfer – Synchronous, Asynchronous and interrupt driven data transfer schemes – Interfacing – Simple keyboards and LED displays.

Interrupts and DMA

Interrupt feature – Need for interrupts – Characteristics of Interrupts – Types of Interrupts – Interrupt structure – Methods of servicing interrupts – Development of Interrupt service subroutines – Multiple interrupt request and their handling – need for direct memory access – Devices for Handling DMA – Programmable DMA controller 8237.

Applications

Interfacing of A/D converters (ADC 0800/ADC 0808/ADC 0809) – Interfacing of D/A converters (DAC 0800) – Waveform generators – Multiplexed seven segment LED display systems – Measurement of frequency, phase angle and power factor-Traffic light controller – Stepper motor Control.

Intel 8051 Microcontroller

Architecture of 8051 – Memory Organization – Addressing modes – Instruction set – Boolean processing – Simple programmes.

8051 Peripheral Functions

8051 interrupt structures – Timer and serial functions – parallel port features : Modes of operation – Power control, features – Interfacing of 8051 – Typical applications – MCS 51 family features 8031/8051/8751.

Suggested Text Books and References

- Goankar, R.S., "Microprocessor Architecture Programming and Applications with the 8085/8080A', 3rd Edition, Penram International Publishing House, 1997.
- Singh. I.P., "Microprocessor Systems", Module 9 : Microcontrollers and their Applications", IMPACT Learning Material Series IIT, New Delhi, 1997.
- Douglas, V.Hall., "Microprocessor and Interfacing Programming and Hardware", 2nd Edition, McGraw Hill Inc., 1992.
- Kenneth, L.Short., "Microprocessors and Programmed Logic", Prentice Hall of India, 2nd Edition, 1987.
- Microcontroller Hand Book, INTEL, 1984.

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.

Types of optical fibers – step index & graded index, multimode and single mode. Attenuation and dispersion in fibers. Optical transmitters LEDS and Laser Diode. Optical Receivers – PIN and APDs, Fiber optic links.

Mobile Communication.

Suggested Text Books & References

- Haykins Simon, "Communication Systems", 3rd Edition, John Wiley, Singapore, 1984.
- Couch Leon, W., "Modern Communication Systems", Prentice Hall, India 1998.
- Keiser Gerd, "Optical Fiber Communications", 2nd Edition, McGraw Hill (International Student Edition), 1991.
- Lathi, "Modern Digital & Analog Communication System", Oxford University Press.

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

- Rashid Muhammad, H., "Power Electronics: Circuits, Devices and Applications", 2nd Ed. Prentice-Hall, 1998.
- Mohan Ned, Undeland Tore, M. and Robbins William, P., "Power Electronics: Converter, Applications and Design", John Wiley & Sons, 1994.
- Landev Cyrill, W., "Power Electronics", McGraw Hills, London, 1981.
- Dewan, S.B. and Satrughan A., "Power Semiconductor Circuits", John Wiley & Sons, 1975.

- Dubey, G.K., Doradlla, S.R., “Thyristerised Power Controllers”, Wiley Eastern, 1987.

POWER SYSTEM STABILITY

Introduction

System Modeling and Dynamics of Synchronous Generator

Small Signal Stability analysis (Low Frequency Oscillations)

- Analysis of Single Machine System.
- 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

- Nagrath, I.J. and Kothari, D.P., “Power System Engineering”, Tata McGraw Hill, New Delhi, 1994.
- Podiyar, K.R., “Power System Dynamics : Stability and Control”, Interline, 1996.

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

Formulation of equations of a system – Linearization – Input – Output relations – State space methods – State transition Matrix – Stability – Controllability, observability and transfer function.

Lyapunov's direct method – Sensitivity – Optimal control formulation – Calculus of variations – Performance indices – Pontryagin's maximum principle – Time optimal control – principle of optimally – dynamic programming.

Pole placement – Quadratic performance Index – Linear regulator problem.

Suggested Text Books and References

- Gopal, M., "Control Systems : Principles and Design", Tata McGraw Hill, 1997.
- Kuo, B.C., "Digital Control Systems", second edition, Saunders College Publishing, 1992.
- Ogata, K., "Discrete Time Control System", Prentice Hall, 1987.

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

- Nagrath, I.J. and Kothari, D.P., "Power System Engineering", Tata McGraw Hill, New Delhi 1994.
- Mahalanabis, A.K., Kothari, D.P. and Ahson, S.I., "Computer Aided Power System analysis and Control", TMH, New Delhi, 1988.
- Chakrabarti, A., Kothari, D.P. and Mukhopadhyay, A.K., "Performance, Operation and Control of EHV Transmission System", Wheeler Publication, New Delhi, 1995.
- Indulkar, C.S. and Kothari D.P., "Power System Transients: A Statistical Approach", Prentice Hall of India, New Delhi, 1996.

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

- Anderson et al, B.D.O., "Network Analysis and Synthesis A modern Systems Theory Approach", Prentice – Hall, INC, Englewod Cliffs, New Jersey, 1973.
- Budak Aram, "Passive and Active Network Analysis and Synthesis", Houghtnn Miffin Co., Boston, 1974.

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

- Van, A.R., & Warrington, C., "Protective Relays : Their Theory and Practice", Vol. 1 & 2, Chapman and Hall, 1969.
- Paithankar, Y.G., "Transmission Network Protection : Theory and Practice", Marcel Dekker, Inc., 1998.
- GEC Measurements, "Protective Relays : Application Guide", GEC Measurements, 1987.

HIGH VOLTAGE ENGINEERING

Breakdown in Gases

Mechanisms of breakdown in gases, various related ionization processes. Townsends and Streamer theories. Paschen's law, Breakdown in Non-uniform fields. Effect of wave shape of impressed voltage on the breakdown strength. Breakdown of sphere gap and rod gap.

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

Measurement of insulation resistance of cables. Wet and dry flashover test of insulators. Testing of insulators in simulated polluted conditions. Testing off transformers and rotating machines. Measurement of break-down strength of oil. Basic techniques of non-destructive testing of insulators; measurement of loss angle, High Voltage Schering bridge, and partial discharge measurement techniques.

Over Voltage and Insulation Coordination

Lighting, Switching and temporary over voltages, BIL, SIL, methods of insulation coordination.

Suggested Text Books & References.

- Bewley, :.V., "Traveling Waves on Transmission Systems", Wiley New York, 2nd Edition, 1963.
- Naidu, M.S. and Kamaraju, V., "High Voltage Engineering", Tata McGraw Hill, 1982.
- Wadhwa, C.L., "High Voltage Engineering", Wiley Eastern, 1994.
- Radzevig, D.K., "High Voltage Engineering", Khanna Publisher (translated by M. Chaurasia), 1992.
- Westinghouse Transmission and Distribution Reference Book", IBH-Oxford, 1964.

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

- Rabiner, L.R. & Gold, B., "Theory and Application of Digital signal Processing", Prentice Hall, 1989.
- Oppenheim & Schafer, "Digital Signal Processing", Prentice Hall, 1995.

LIST OF SUGGESTED OPEN ELECTIVES

&

PROFESSIONAL ELECTIVES

Open Elective

1. Enterprise Resource Management
2. E-Commerce, Strategic IT
3. Technology Management
4. Decision Support and Executive Information System
5. Software Technology
6. Knowledge Management
7. IT in Marketing Management
8. IT in HR Management
9. IT in Finance Management
10. Project Management and Software Tools
11. Human Values
12. Science Technology and Society

Professional Electives

1.Non Conventional Energy Sources
2. High Voltage Engineering
3. Special Electrical Machines
4. HDVC Transmission
5. Microprocessor Based System Design.
6. Advanced Topics in Microprocessors and Microcontrollers
7. Computer Aided Designs of Electrical Machines
8. VLSI Design
9. Biomedical Instrumentation
10. Electronic Product Design
11. Advanced Control Systems
12. Modeling and Simulation
13. Robotics and Automation
14. Neural Networks and Fuzzy systems
15. Computer Networks
16. Computer Graphics
17. System Software
18. Digital System Design
19. Digital Signal Processing
20. Digital Image Processing
21.Economic Analysis.

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.
4. Material development and its values : the challenge of science and technology.
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.
3. Ancient, medieval and modern technology/industrial revolution and its impact. The Indian Science and Technology.
4. Social and human critiques of Technology : Mumford and Ellul.
5. Rapid technological growth and depletion of resources. Reports of the club of Rome. Limits to growth; sustainable development.
6. Energy crisis, renewable energy resources.
7. Environmental degradation and pollution. Eco-friendly technologies, Environmental regulations. Environmental ethics.
8. Technology and the arms race. The nuclear threat.
9. Appropriate technology movement Schumacher; later developments.
10. Technology and the developing nations. Problems of technology transfer. Technology assessment /impact analysis.
11. Human operator in the engineering projects and industries. Problems of man machine interaction. Impact of assembly line and automation. Human centered technology.
12. Industrial hazards and safety. Safety regulations. Safety engineering.
13. Politics and technology. Authoritarian versus democratic control of technology. Social and ethical audit of industrial organizations.
14. Engineering profession. Ethical issues in engineering practice. Conflicts between business demands and professional ideals. Social and Ethical responsibilities of the Engineer. Codes of professional ethics. Whistle blowing and beyond. Case studies.