UNIVERSITY OF CALCUTTA

Faculty of Engineering and Technology
4 year B.Tech. Course

(Department: Radio Physics and Electronics)

Electronics and Communication Engineering

Course Structure

1st SEMESTER (*common to all streams*)

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	English	HU101	03	2	1	0	03
2	Physics-I	PH102	03	2	1	0	03
3	Chemistry-I	CH103	03	2	1	0	03
4	Engineering Mathematics-I	MA104	03	2	1	0	03
5	Basic Electrical Engineering	EE105	03	2	1	0	03
6	Language Lab	HU106	1.5	0	0	3	03
7	Physics Lab-I	PH107	1.5	0	0	3	03
8	Chemistry Lab-I	CH108	1.5	0	0	3	03
9	Basic Electrical Engineering Lab	EE109	1.5	0	0	3	03
	TOTAL		21	10	5	11	27

2nd SEMESTER (*common to all streams*)

Serial No.	Name	Code	Credit	Weekly Load			Total Load
				L	T	P	
1	Physics-II/ Chemistry-II#	PH201/CH201	03	2	1	0	03
2	Engineering Mathematics-II	MA202	03	2	1	0	03
3	Engineering Mechanics	ME203	03	2	1	0	03
4	Basic computer Science and Engineering	CS 204	03	2	1	0	03
5	Basic Electronics	BE205	03	2	1	0	03
6	Physics Lab –II/ Chemistry Lab–II#	PH206/CH206	01	0	0	2	02
7	Workshop Practice	ME 207	1.5	0	0	3	03
8	Engineering Drawing	ME 208	1.5	0	0	3	03
9	Computer Programming Lab	CS 209	1.5	0	0	3	03
10	Basic Electronics Lab	BE210	1.5	0	0	3	03
	TOTAL		**22**	10	5	14	29

Total credit in 1st Year considering both, 1st and 2nd semester is 21+22=43

Electronics and Communication Engineering (ECE)

(3rd SEMESTER – 8th SEMESTER)

Sl. No.	**Semester – III**	L	T	P	Credit
1.	EC2.1.1 – Electromagnetic Fields and Waves	3	0	0	3(Th)
2.	EC2.1.2 – Circuit and Network Theory	3	1	0	4(Th)
3.	EC2.1.3– Signals and Systems	3	0	0	3(Th)
4.	*ECOE2.1.4.1– Numerical Analysis	3	1	0	4 (Th)
	(Select an appropriate open elective course and code from TABLE-4)				
5.	**ECHN2.1.5– Materials and Physical Electronics**	3	0	0	3(Th)
6.	EC2.1.6 – Circuit and Network Laboratory	0	0	3	1.5 (P)
7.	*ECOE2.1.7.1- Algorithms and Advanced Data Structures Laboratory	0	1	3	2.5(P)
	(Select an appropriate open elective course and code from TABLE-4)				
8.	EC2.1.8 – Electronics Workshop	0	0	3	1.5 (P)
9.	ECHS2.1.9 – Human Values and Professional Ethics	3	0	0	3 (Th)

Sl. No.	**Semester – IV**	L	T	P	Credit
1.	EC2.2.1 - Analog Circuits	3	1	0	4 (Th)
2.	EC2.2.2 – Electronic Devices	3	1	0	4 (Th)
3.	EC 2.2.3 - Control Theory and Systems	3	0	0	3 (Th)
4.	*ECEL2.2.4.1 – Communication Principles & Techniques	3	0	0	3 (Th)
	(Select an appropriate program elective course and code from TABLE-3)				
5.	**ECHN2.2.5 –Antennas and Radio Wave Propagation**	3	0	0	3 (Th)
6.	EC2.2.6 – Analog Circuits Laboratory	0	0	3	1.5 (P)
7.	*ECEL2.2.7.1 – Analog Communication Laboratory	0	0	3	1.5 (P)
	(Select an appropriate program elective course and code from TABLE-3)				
8.	**ECHN2.2.8 Antenna Laboratory**	0	0	3	1.5 (P)
9.	ECMC2.2.9- Environmental Science	2	0	0	0 (Th)

Sl. No.	**Semester – V**	L	T	P	Credit
1.	EC3.1.1 – Digital System Design	3	1	0	4(Th)
2.	EC3.1.2 – Computer Architecture & Organization	3	0	0	3 (Th)
3.	EC3.1.3 - Digital Communication	3	0	0	3(Th)
4.	*ECEL3.1.4.1 - Satellite Communications	3	0	0	3(Th)
	(Select an appropriate program elective course and code from TABLE-3)				
5.	**ECHN3.1.5 – Probability Theory and Stochastic Process**	2	0	0	2(Th)
6.	EC3.1.6 – Digital System Design Laboratory	0	0	3	1.5(P)
7.	EC3.1.7 – Digital Communication Laboratory	0	0	3	1.5(P)
8.	EC3.1.8 – Electronic Devices Laboratory	0	1	3	2.5(P)
9.	*ECOE3.1.9.1- Advanced Programming Language Laboratory	0	1	4	3(P)
	(Select an appropriate open elective course and code from TABLE-4)				

Sl.No.	**Semester – VI**	L	T	P	Credit
1.	EC3.2.1 – Computer Networking	3	1	0	4(Th)
2.	EC3.2.2 – Microprocessor and Microcontroller	3	0	0	3(Th)
3.	EC3.2.3 – Digital Signal Processing	3	0	0	3(Th)
4.	*ECEL3.2.4.1 – Microwave and Navigational Electronics	3	0	0	3(Th)
	(Select an appropriate program elective course and code from TABLE-3)				
5.	**ECHN3.2.5 - High Speed Electronics**	3	0	0	3(Th)
6.	EC3.2.6 – Microprocessor and Microcontroller Laboratory	0	0	3	1.5(P)
7.	EC3.2.7 – Digital Signal Processing Laboratory	0	0	3	1.5(P)
8.	*ECEL3.2.8.1 – Microwave Laboratory	0	0	4	2 (P)
	(Select an appropriate program elective course and code from TABLE-3)				
9.	ECMC3.2.9-Constitution of India and Civil Society	2	0	0	0 (Th)
10.	EC3.2.10 - Mini-Project on Electronic Design	0	0	4	2 (P)
11.	ECP3.2.11 - Industrial Training/Internship (Summer/June)	0	0	0	3

Sl. No. **Semester – VII**		L	T	P	Credit
1.	*ECEL4 1.1.1 –Instrumentation and Power Electronics *(Select an appropriate program elective course and code from TABLE-3)*	3	0	0	3 (Th)
2.	*ECEL4.1.2.1–Optoelectronic Devices and Fiber Optics *(Select an appropriate program elective course and code from TABLE-3)*	3	0	0	3 (Th)
3.	**ECHN4.1.3 –Microelectronics and VLSI**	3	0	0	3(Th)
4.	**ECHN4.1.4 - Mobile Communication and Networks**	3	0	0	3(Th)
5.	* ECEL4.1.5.1– Instrumentation and Power Electronics Laboratory *(Select an appropriate program elective course and code from TABLE-3)*	0	0	3	1.5(P)
6.	*ECEL4.1.6.1– Optoelectronic Devices and Fiber Optics Laboratory *(Select an appropriate program elective course and code from TABLE-3)*	0	0	3	1.5(P)
7.	**ECHN4.1.7 - Microelectronics and VLSI Laboratory**	0	0	3	1.5(P)
8.	ECHS4.1.8 – Engineering Economics and Industrial Management	3	0	0	3 (Th)
9.	ECP4.1.9 – Project Work (Foundation)	0	0	8	4(P)

Sl. No. **Semester – VIII**		L	T	P	Credit
1.	ECP4.2.1 – General viva-voce	0	0	0	5
2.	ECP4.2.2 – Project work & Dissertation	0	0	20	10

***** Recommended Elective Courses. Detailed options can be obtained from TABLE-3 and TABLE-4

Total Credit for B.Tech in Electronics and Communications Engineering: 158

Total Credit for B.Tech. (Honours) in Electronics and Communications Engineering: 178

ABBREVIATIONS:

EC	:	Core Courses
ECEL	:	Program Elective Courses
ECOE	:	Open Elective Courses
ECHN	:	Honours Courses
ECHS	:	Humanities and Social Sciences, including Management Courses
ECMC	:	Mandatory Courses
ECP	:	Project Work /Dissertation/VivaVoce

TABLE-1: LIST OF CORE COURSES

COURSE CODE	COURSE TITLE
EC2.1.1	Electromagnetic Fields and Waves
EC2.1.2	Circuit and Network Theory
EC2.1.3	Signals and Systems
EC2.1.6	Circuit and Network Laboratory
EC2.1.8	Electronics Workshop
EC2.2.1	Analog Circuits
EC2.2.2	Electronic Devices
EC 2.2.3	Control Theory and Systems
EC2.2.6	Analog Circuits Laboratory
EC3.1.1	Digital System Design
EC3.1.2	Computer Architecture & Organization
EC3.1.3	Digital Communication
EC3.1.6	Digital System Design Laboratory
EC3.1.7	Digital Communication Laboratory
EC3.1.8	Electronic Devices Laboratory
EC3.2.1	Computer Networking
EC3.2.2	Microprocessor and Microcontroller
EC3.2.3	Digital Signal Processing
EC3.2.6	Microprocessor and Microcontroller Laboratory
EC3.2.7	Digital Signal Processing Laboratory
EC3.2.10	Mini-Project on Electronic Design

TABLE-2: LIST OF HONOURS COURSES

COURSE CODE	COURSE TITLE
ECHN2.1.5	Materials And Physical Electronics
ECHN2.2.5	Antennas And Radio Wave Propagation
ECHN2.2.8	Antenna Laboratory
ECHN3.1.5	Probability Theory And Stochastic Process
ECHN3.2.5	High Speed Electronics
ECHN4.1.3	Microelectronics And VLSI
ECHN4.1.4	Mobile Communication And Networks
ECHN4.1.7	Microelectronics And VLSI Laboratory

TABLE-3: LIST OF PROGRAM ELECTIVE COURSES

COURSE CODE	COURSE TITLE
ECEL2.2.4.1 ECEL2.2.7.1 ECEL2.2.1.2 ECEL2.2.7.2 ECEL2.2.1.3 ECEL2.2.7.3	Communication Principles & Techniques Analog Communication Laboratory Scientific Computing Scientific Computing Laboratory Bio Medical Electronics Bio Medical Electronics Laboratory
ECEL.3.1.4.1 ECEL3.1.4.2 ECEL3.1.4.3	Satellite Communications Information Theory & Coding Error Correcting Codes
ECEL3.2.4.1 ECEL3.2.8.1 ECEL3.2.4.2 ECEL3.2.8.2 ECEL3.2.4.3 ECEL3.2.8.3 ECEL3.2.4.4 ECEL3.2.8.4	Microwave and Navigational Engineering Microwave Laboratory Digital Image and Video Processing Digital Image and Video Processing Laboratory Nanolelectronics Nanoelectronics Laboratory Embedded Systems Embedded Systems Laboratory

ECEL4.1.1.1 ECEL4.1.5.1 ECEL4.1.1.2 ECEL4.1.5.2 ECEL4.1.1.3 ECEL4.1.5.3	Instrumentation and Power Electronics Instrumentation and Power Electronics Laboratory Introduction to MEMS Introduction to MEMS Laboratory Speech & Bio-medical Signal Processing Speech & Bio-medical Signal Processing Laboratory
ECEL4.1.2.1 ECEL4.6.1.1 ECEL4.1.2.2 ECEL4.1.6.2 ECEL4.1.2.3 ECEL4.1.6.3	Optoelectronic Devices and Fiber Optics Optoelectronic Devices and Fiber Optics Laboratory Adaptive Signal Processing Adaptive Signal Processing Laboratory Mixed Signal Design Mixed Signal Design Laboratory

TABLE-4: LIST OF OPEN ELECTIVE COURSES

COURSE CODE	COURSE TITLE
ECOE2.1.4.1 ECOE2.1.4.2 ECOE2.1.4.3	Numerical Analysis Engineering Statistics & Optimizations Artificial Intelligence & Machine Learning
ECOE2.1.7.1 ECOE2.1.7.2 ECOE2.1.7.3	Algorithms and Advanced Data Structures Laboratory Sensor and IoT Laboratory Decision Analysis & Game Theory
ECOE3.1.9.1 ECOE3.1.9.2 ECOE3.1.9.3	Advanced Programming Language Laboratory Robotics and Mechatronics Laboratory Data Analytics Laboratory

TABLE-5: PROJECT WORK, DISSERTATION AND GENERAL VIVA-VOCE

COURSE CODE	COURSE TITLE
ECP3.2.11	Industrial Training/Internship (Summer/June)
ECP4.1.9	Project Work (Foundation)
ECP4.2.2	Project Work & Dissertation
ECP4.2.1	General Viva-Voce

TABLE-6: LIST OF HUMANITIES & SOCIAL SCIENCES INCLUDING MANAGEMENT, AND MANDATORY COURSES

COURSE CODE	COURSE TITLE
ECHS 2.1.9	Human Values and Professional Ethics
ECHS 4.1.8	Engineering Economics and Industrial Management
ECMC 2.2.9	Environmental Science
ECMC 3.2.9	Constitution of India and Civil Society

Note: A student will be eligible to get undergraduate degree with Honours or additional minor engineering if he/she completes an additional 20 credits, recommended as Honours Subjects. If any recommended Honours and Open Electives courses are not offered that course or its equivalent can be obtained through MOOCs. Any student completing any course through MOOC will have to submit an appropriate certificate to earn corresponding credit.

UNIVERSITY OF CALCUTTA

Faculty of Engineering and Technology
4 year B.Tech. Course

(Department: Radio Physics and Electronics)

Electronics and Communication Engineering

Detailed Syllabus: 1st Semester (common to all streams)

THEORETICAL PAPERS

COMMUNICATION ENGLISH, MANAGEMENT AND SOCIAL SCIENCES

Sub Code: HU101 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

1.1. COMMUNICATIVE ENGLISH (GRAMMAR): [18L]

Course Objective: The objective of the course is to enhance the understanding of the students on the principles, techniques and application of grammar and to acquire appropriate proficiency and skills in reading, writing, speaking and comprehension.

Module 1: [3L]

Sentences: Clauses, Phrases, Types of Sentences, Sentence Structures and Transformation, Correction of Errors in Sentences.

Module 2: [1L]

Misplaced Modifiers and Modals.

Module 3: [4L]

Vocabulary Building and Usage: Word Formations (by adding suffixes and prefixes),Root words from foreign languages and their use in English; Synonyms; Antonyms; One Word Substitution/Single

Word for a group of Words, Standard abbreviations; Redundant Words/ Redundancies/Redundantism; Clichés.

Module 4: [3L]

Remedial Grammar: Noun Pronoun Agreement, Articles, Prepositions, Agreement of Subject and Verb; Fill in the blanks using correct Words.

Module 5: [1L]

Précis Writing.

Module 6: [1L]

Essay, Paragraph Writing.

Module7: [1L]

Comprehension Passage.

Module 8: [3L]

Rapid reading- 'Bill Moss, Tentmaker' by Robert Gannon.

Module 9: [1L]

Taking notes: Dictation.

1.2 .COMMUNICATIVE ENGLISH (TECHNICAL COMMUNICATION) [6L]

Course Objective: The objective of the course is to enhance the understanding of the students on the principles of effective technical communication and their application in official or professional communication.

Module 1: [2L]

The Theory of Communication –Definition & Scope; Barriers of Communication; Effective Communication (Verbal / Nonverbal).

Module 2: [1L]

Job Application Letter; C.V./Bio-data/Resume.

Module 3: [3L]

Organizational Communication: Memorandum; Notice; Official Notes; Minutes; Report (Technical Report): Progress Report, Event Report; Project Proposal; Brochures; Newsletters; Technical Articles; Manuals; Business Letter Circular, Agenda, Invitation, Seminars, Press Release, Newspaper Insertion.

1.3. MANAGEMENT AND SOCIAL SCIENCES [16L]

Course Objective: To understand the principles of management and their application to the functioning of an organization.

Module 1: [2L]

The Development of Management: Scientific Management - Organic Organization,

Networked organization, Postmodern Organization, Debureaucratization, Transformation of Management.

Module 2: [1L]

Labour Management: Fordism, Post-Fordism and the Flexible Firm.

Module 3: [1L]

Principles of management and their application to the functioning of an organization Contents:

Definition of management, science or art.

Module 4: [1L]

Manager vs entrepreneur; Types of managers- managerial roles and skills.

Module 5: [1L]

Evolution of management- scientific, human relations, system and contingency approaches.

Module 6: [1L]

Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises.

Module 7: [1L]

Organization culture and environment.

Module 8: [1L]

Current trends and issues in management.

Module 9: [1L]

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies.

Module 10: [1L]

Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

Module 11: [1L]

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning.

Module 12: [1L]

Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Module 13: [1L]

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment.

Module 14: [1L]

Leadership, types & theories of leadership, effective communication.

Module15: [1L]

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Course Outcomes:

1. The students will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.
2. The students will acquire proficiency in formal official communication skills.
3. Upon completion of this course, the students will get a clear understanding of management functions in an organization.

Reference Books:

1. Effective English Communication, by V. Syamala.
2. Best Science Writing: Reading and Insights edited by Robert Gannon prescribed text

   (Hyderabad: University Press (India) Limited, 1991).
3. Effective Technical Communication, M. Ashraf Rizvi, Tata Mc Graw-Hill.2005
4. Pronunciation Practice Activities – Martin Hewings – Cambridge University Press
5. A Textbook of English Phonetics for Indian Students – T. Balasubhramanian-Macmillan Publications

1. Concise Oxford Dictionary
2. Practical English Usage. Michael Swan. OUP. 1995.
3. Remedial English Grammar. F.T. Wood. Macmillan.2007
4. English For All edited by Nilanjana Gupta
5. Communication Skills. Sanjay Kumar and Pushp Lata. Oxford University Press. 2011.
6. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press
7. . David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004
8. Raman Sharma, Technical Communications, Oxford Publication, London, 2004.
9. Dale Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004. (ISBN: 07828357-4)
10. Sharma, R. and Mohan, K. Business Correspondence and Report Writing, TMH New Delhi 2002.
11. Robins S.P. and Coulter M., Management, Prentice Hall India, 10th ed., 2009.
12. Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.
13. P.C. Tripathy & P.N. Reddy, Principles of Management, Tata McGraw Hill, 1999.

PHYSICS - I

Sub Code: PH-102 **L-T-P: 3-0-0**
Total Lectures 40 hours + Contact Hours **Credit: 3**

Course objectives:

The objective of the course is to enhance the understanding of the Students' on some basic philosophies and corresponding application based reasoning of Physics. To help the students in acquiring the necessary skills to solve the application based problems useful for almost all branches of physics and engineering, on the basic of theoretical understanding.

1.1. Optics: [14L]

Module 1: [2L]

Introduction to interference and examples -Young's double slit experiment, Newton's rings (qualitative).

Module 2: [4L]

Diffraction: Introduction to diffraction, Fraunhofer and Fresnel diffraction, Fraunhoffer diffraction due to single slit and plane diffraction grating, characteristics of diffraction grating and its applications. The Rayleigh criterion for limit of resolution and resolving power of Diffraction gratings.

Module 3: [3L]

Polarization – Polarisation by reflection, Brewster's law, polarisation by double refraction, polaroids, Malus Law, linearly, circularly and elliptically polarized light (qualitative), half wave and quarter wave plates, Optical activity

Module 4: [2L]

Fibre Optics: Introduction, total internal reflection, numerical aperture and various fibre parameters, step and graded index fibres, application of optical fibres.

Module 5: [3L]

Lasers: Principles and working of Laser: population inversion, pumping, various modes, types of Laser (qualitative), application of Laser

1.2. Thermodynamics: [6L]

Module 1: [2L]

Degrees of freedom and Equipartition of energy, Energy and Work, First Law of Thermodynamics.

Module 2: [4L]

Second Law of Thermodynamics, Heat engines, Carnot's theorem, Entropy and equilibrium, Change in Entropy, Enthalpy, Free Energy, Chemical Potential, Gibb's function, Maxwell's relations(qualitative).

1.3. Quantum Mechanics- I: [12L]

Module 1: [5L]

Black body radiation, Planck's radiation law and its uniqueness, Compton Effect and its significance-wavelength shift and recoil of electron

Module 2: [4L]

Wave nature of Particles, De-Broglie hypothesis, Matter wave, Born interpretation of wave function, Uncertainty principle, Operators- Eigen value and Eigen function, operators and expectation values of some dynamical variables like momentum, total energy, angular momentum etc.

Module 3: [3L]

Schrödinger wave equation in three dimension and one dimension and its' significance, Time-dependent and time independent form, Application of Schrodinger wave equation in case of particle in one dimensional box (qualitative).

1.4. Dielectric and Magnetic Properties of Materials: [8L]

Module 1: [2L]

Divergence and Curl of electrostatic field, Gauss's law and its application, Laplace's and Poisson's equations for electrostatic potential

Module 2: [3L]

Dipole moments, electric field and potential due to dipole, Bound charges and Dielectric polarization, polar and non-polar dielectrics, Electric displacement vector, dielectric susceptibility, permittivity and dielectric constant, Boundary conditions, simple electrostatics problems in presence of dielectrics

Module 3: [3L]

Magnetisation, magnetic field $\boldsymbol{B}$ and $\boldsymbol{H}$, permeability and susceptibility, classification of magnetic materials, discussion of magnetic field in presence of magnetic materials(qualitative).,

Course Outcomes:

I. Students will be enriched with some basic thoughts of Physics needed for advancement in

II. Development of the idea about the basic concepts of mechanics required for all branches of

the engineering.

III. Students will be familiar with the idea about the most important physical phenomena

corresponds to different wings of Physics and also will be knowledgeable about the logic behind those phenomena.

IV. Students will be able to utilize the concept which they gather in solving the problem having technological aspects.

Reference books:

1. Introduction to Optics by Hecht E. Addison-Wesley
2. OPTICS by Ajoy Ghatak, 2nd edition,Tata McGraw Hill
3. Fundamentals of Optics by F. A. Jenkins and H.E. White, McGraw-Hill
4. Geometrical and Physical Optics by B K. Mathur
5. Principles of Optics by M. Born and E. Wolf, Cambridge University Press
6. Introduction to Electrodynamics by David Griffiths, Prentice Hall
7. Principles of Physics by David Halliday, Robert Resnick Jearl Walker , 10ed,Wiley.
8. Electricity, Magnetism, and Light by Wayne M. Saslow, Academic Press.
9. Electromagnetism by Grant and Phillips, John Wiley.
10. Thermodynamics in Materials Science by Robert DeHoff, CRC Press.
11. A treatise on Heat By M. N. Saha and B. N. Srivastava. The Indian Press.
12. Heat and Thermodynamics by Zemansky and Dittman, McGraw-Hill.

13. Fundamentals of Statistical and Thermal Physic by Reif, Sarat Book Distributors.

14. Introduction to Quantum Mechanics by David J. Griffiths, Prentice Hall .

15. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles by Eisberg & Resnick, Wiley.

16. Introduction to Electrodynamics by David Griffiths, Prentice Hall.

17. Electricity, Magnetism, and Light by Wayne M. Saslow, Academic Press.

18. Electromagnetism by Grant and Phillips, John Wiley.

19. Web Platform: NPTEL, SWAYAM, Archive.org etc

CHEMISTRY –I

Sub Code: CH-103 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective: The objective is to Impart in depth understanding of fundamental concepts in chemistry that have been introduced at the 10+2 levels in school and to develop analytical skill among students necessary to design and solve the new problems. The course will familiarize

students with different analytical techniques used in present day chemistry and explore the relevance in engineering applications.

Module 1: Atomic and molecular structure [12L]

Introduction to quantum theory: Schrodinger equation. Origin of quantization. Particle in a box and its applications with respect to conjugated molecules and nanoparticles. Forms of the hydrogen atom wave functions and the plots of these functions to explore their spatial variations.

Bonding in molecules: Valence bond theory, Molecular orbital theory. Bonding and plots of molecular orbitals for diatomic and polyatomic molecules. Pi-molecular orbitals of butadiene and benzene and aromaticity.

Crystal field theory: Bonding in octahedral complexes, tetrahedral, tetragonally distorted octahedral and square planar complexes. Magnetic properties of all types of complexes. Color of complexes. Band structure of solids and the role of doping on band structures.

Module 2: Intermolecular forces and real gases [4L]

Ionic, dipolar and van der Waals interactions. Deviation of real gas from ideal behavior. Equations of state of real gases and critical phenomena.

Module 3: Spectroscopic techniques and applications [6L]

Principles of spectroscopy and selection rules. Electronic spectroscopy. Vibrational spectroscopy.

Nuclear magnetic resonance spectroscopy. Applications.

Module 4: Electrochemistry [8L]

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies. Free energy and emf. Electrochemical series and its application. Nernst equation and applications of emf measurements. Potentiometric titrations: Acid base, oxidation reduction, precipitation titrations. Corrosion.

Module 5: Stereochemistry [4L]

Representations of three dimensional structures. Structural isomers and stereoisomers. Symmetry. Chirality and optical activity. Enantiomers, diastereomers, racemates. Configuration. Geometrical and conformational isomerism. Conformations of cyclic and acyclic systems.

Module 6: Organic reactions [6L]

Electronic influencing effects, Reactive intermediates. Aromaticity. Introduction to reactions involving rearrangement, substitution, addition, elimination, oxidation-reduction, cyclization and ring opening. Synthesis of a commonly used drug molecule.

Course Outcome:

The students will be able to

1. Understand and apply the concepts of basic quantum chemistry and chemical bonding to explain the molecular structure and physical/electronic properties of molecules.
2. Apply fundamental principles of electronic, vibrational, rotational and nuclear magnetic resonance spectroscopy towards identifying the structure of organic molecule.
3. Understand and apply fundamental concepts of electrochemistry.
4. Apply basic principles of organic chemistry for analyzing reaction mechanism and to develop methodology for synthesis.

Reference Books:

1. Chemistry: Principles and Applications by M. J. Sienko and R. A. Plane
2. Concise Inorganic Chemistry by J.D. Lee
3. General & Inorganic Chemistry, Vol I and Vol II by R.P. Sarkar
4. Physical Chemistry by P. W. Atkins and J. de Paula
5. Fundamentals of Molecular Spectroscopy by C. N. Banwell
6. Organic Spectroscopy by W. Kemp.
7. Organic Chemistry by I. L. Finar
8. Organic Chemistry by J. Clayden and N. Greeves
9. Organic Chemistry by R. T. Morrison and R. N. Boyd
10. Organic Chemistry by T. W. G. Solomons and C. B. Fryhle
11. A Guidebook to Mechanism in Organic Chemistry by P. Sykes
12. Engineering Chemistry (NPTEL Web book) by B. L. Tembe, Kamaluddin and M. S. Krishnan
13. Engineering Chemistry by Prasanth Rath

ENGINEERING MATHEMATICS-I

Sub Code: MA-104 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and vector algebra. At the end of this course students will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines.

Module 1: Differential Calculus: [11 L]

Differential Calculus: Successive differentiation, Leibnitz Rule. Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule; Maxima and minima.

Multivariable Calculus: Limit, continuity and partial derivatives, directional derivatives, total derivative; Tangent plane and normal line; Maxima, minima and saddle points; Method of Lagrange multipliers.

Module 2: Sequences and series: [12 L]

Convergence of sequence and series, tests for convergence; Power series, Taylor's series, series for exponential, trigonometric and logarithm functions; Fourier series: Half range sine and cosine series, Parseval'stheorem.

Module 3: Vector Algebra: [7L]

Vector calculus: Brief review of vector algebra, scalar and vector triple products, Directional derivatives, gradient, divergence, curl, vector integration, statements and applications of Gauss's theorem, Green's theorem, Stokes' theorem, examples

Module 4: Integral Calculus (Integration): [10L]

Int. Calculus: Properties of definite integrals, Quadrature, Rectification, Double integral, Triple integrals,change of order of integration, change of variables, determination of length, area, volume.Applications of definite integrals to evaluate surface areas and volumes of revolutions

Course Outcome:

The students will learn:

- To Use Leibnitz Theorem to determine the nth derivative of product of functions. They will develop series expansion by Taylor's and Maclaurin's series. They will be examine the function for maxima and minima and discover its extreme value.
- To use the tool of power series and Fourier series for learning advanced Engineering Mathematics.
- To deal with functions of several variables that are essential in most branches of engineering.
- To recognize scalar and vector functions. They will evaluate Gradient, Divergence and Curl of a point function depending upon its nature.
- To apply the integral formulae to estimate length, surface area and volume of revolution of a curve.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43nd Edition, 2015.
2. P.N. Wartikar & J.N .Wartikar, AppliedMathematics (Volume I and II) Pune Vidyarthi Griha Prakashan, 7th Edition 1994.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons Inc., 10th Edition, 2011
4. Peter V. O' Neil, Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th Edition, 2011.
5. Glyn James, Advanced Modern Engineering Mathematics, Pearson Education, 4th Edition, 2010.
6. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2008.
7. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
8. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984.

BASIC ELECTRICAL ENGINEERING

Sub Code: EE-105 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective: The objective of the course is to enhance the understanding of the Students' on

the basics of AC & DC circuits along with basics of three phase circuits and to help the students to understand the basics of basic electrical machines, also helps the students understand the necessity of power system components.

Module -1 [L-3]

D.C. Circuits: Network theorems – Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum power transfer theorem. Star-Delta & Delta-Star transformation.

Module -2 [L 3]

Magnetic Circuit: MMF, Flux ,Reluctance. B-H Loop. Hysteresis and Eddy current loss. Magnetic circuit analysis with air gap.

Module -3 [L3]

A.C. Fundamentals : Sinusoidal quantities, phase & phase difference, average & RMS values, form factor & peak factor, concept of Sinusoids, impedance & admittance, power & power factor,

Module -4 [L 3]

A.C. Circuits: Series and parallel R-L-C Circuits, Form Factor, Peak. Factor. Phasor concept of Sinusoids. Impedance and Admittance. Power, Power Factor, V A, V AR.

Module -5 [L 3]

Balanced 3-phase: 3-phase AC balanced circuits. Phase-sequence, Star and Delta connections. Connection of wattmeter in 1-ph circuit for power measurement & Connection of two wattmeters in 3-ph circuit for power measurement.

Module -6 [L 2]

Power Factor Improvement: Causes & effect of low power factor, advantages of power factor improvement, methods of power factor improvement.

Module -7 [L 7]

DC Machines: Construction, working, different types, EMF equation, characteristic (Generator & Motor), starting and speed control.

Module -8 [L 7]

1-PhaseTransformer: Construction. EMF equation. Phasor diagram. Equivalent circuits.. Open circuit and Short circuit test. Losses and Efficiency

Module -9 [L 7]

3-Phase Induction Machine: Types of induction machines. Rotating magnetic field, slip, torque equation, torque speed curve .DOL starting and reduced voltage starting.

Module -10 [L 1]

Power System Structure: Single line diagram of a power system structure.

Course Outcome:

1) The students will be able to understand the basic laws of electrical engineering & its application
2) Students knowledge will be enhanced about the basics of AC & DC circuits
3) Students will get an idea about the three phase system
4) Students will be able to analyses the basic electrical machines with the help of basic concepts of electrical engineering gathered.
5) Get an idea about the components of power system.

Reference Books:

1. Basic Electrical Engineering By I.J.Nagrath ,Tata McGraw-Hill Publishing Co. Ltd
2. Basic Electrical Engineering By T.K. Nagsarkar& M.S. Sukhija, Oxford University Press
3. Electrical & Electronics Technology By Hughes, Dorling Kindersley India, New Delhi
4. Electrical Technology By H. Cotton, CBS Publisher, New Delhi
5. A course in Electrical Engineering Vol-I & II By C.L.Dawes Publisher: McGraw-Hill Book Co. Inc

PRACTICAL PAPERS:

LANGUAGE LAB

Sub Code: HU-106 **L-T-P: 0-0-3**

Total : 36 hours **Credit: 1.5**

Course Objective:

The objective of the practical classes is to make the students familiar with the applied aspects of the English language, pronunciation, behavioural strategies and realistic dimensions of interpersonal interaction in the context of organizational communication. The practical exercises include the following topics:

Exercises:

- Group Discussion –Principle & Practice [Courtesy- Teaching Cohesion and Coherence strategies for handling criticism and adverse remarks. Teaching strategies of Turn-taking, timing, effective and creative intervention, formal and informal language, kinesics (use of body language), politeness and courtesies and all components of soft skills].
- Mock /Job Interview.
- Role Play/Conversation.
- Formal Presentation [power point presentation/extempore/ public speaking skills, Elementary Phonetics (theory): Pronunciation/ Stress/Intonation/ Rhythm/ Voice modulation/ Pitch and Accent of connected speech].
- Listening Comprehension: Audio File Analysis/Video File Analysis.

Course Outcomes:

1. The students will acquire skills on conflict management, presentation, decorum, grooming, courtesy, appropriate pronunciation.
2. The students will also acquire better verbal ability in Spoken English.

Reference:

The manual required for all the exercises will be given to the students.

PHYSICS LAB – I

Sub Code: PH-107 **L-T-P: 0-0-3**

Total : 36 hours **Credit: 1.5**

Course objectives:

The objective of the practical classes is to make the students familiar with the technological features of theory as well as to provide hand-on experience of corroboration between model theory and it's practical aspect.

Experiments:

Experiments are based on modern optics-Lasers, general properties of matter, mechanics with advanced measurement techniques and Virtual lab

Reference:

The manual corresponds to all experiments will be provided to the students.

CHEMISTRY LAB – I

Sub Code: CH-108 **L-T-P: 0-0-3**

Total :36 hours **Credit: 1.5**

Choice of 8 − 10 experiments from the following:

1. Titrations: Acid –base, conductometric, pH-metric, complexometric titrations.
2. Estimation of hardness of water.
3. Determination of chloride content of water.
4. Colligative properties using freezing point depression.
5. Determination of the rate constant of a reaction.
6. Determination of cell constant and conductance of solutions.
7. Potentiometry-determination of redox potentials and emfs.
8. Determination of the partition coefficient of a substance between two immiscible liquids.

9. Determination of surface tension and viscosity.
10. Thin layer chromatography.
11. Saponification/acid value of an oil.
12. Synthesis of drug molecule/polymer.
13. Lattice structures and packing of spheres.
14. Models of potential energy surfaces.
15. Chemical oscillations-Iodine clock reaction.
16. Adsorption of acetic acid by charcoal.

Course Outcome:

The students will be able to

1. Apply the basic principles of chemistry to measure molecular/system properties such as surface tension, viscosity, pH, conductance of solutions, redox potentials, chloride content of water, etc.
2. Able to analyze the significant parameters of water related to industrial applications.
3. Synthesize simple molecules.
4. To design new experiments applying the fundamentals of chemistry.

ELECTRICAL ENGINEERING LAB – I

Sub Code: EE-109 **L-T-P: 0-0-3**

Total : 36 hours **Credit: 1.5**

Course Objective:

The objective of this practical course is to familiarize the students to the various instruments & devices & its hand on use, to run the rotating electrical machines & to familiarize with the construction & use of single phase transformer.

Experiments on the following topic:

- Familiarization experiments (Variac, Potential divider, MCV.MIV,MCA,MIA &Wattmeter)

- Characteristics of Tungsten and Carbon filament lamps
- Experiments on DC circuits and DC machines
- Study of AC series R-L-C series circuit
- Experiments on Single phase Transformer
- Calibration of voltmeter, ammeter and energy meter
- Experiments on magnetic circuit principles

Course Outcome:

The students will be able to learn-

1) The use of different instruments & devices in a circuits
2) How to make an electrical circuit & the safety measures.
3) The practical application of basics of electrical engineering like AC/DC circuits.
4) The practical use of rotating & static electrical machines.

SEMESTER-II

THEORETICAL PAPERS

PHYSICS - II

Sub Code: PH-201 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course objectives:

The objective of the course is to enhance the understanding of the Students' on some basic philosophies and corresponding application based reasoning of Physics. To help the students in acquiring the necessary skills to solve the application based problems useful for almost all branches of physics and engineering, on the basic of theoretical understanding.

1.1. Electromagnetic Theory: [6L]

Module 1: [3L]

Biot-Savart law, The divergence and Curl of $\boldsymbol{B}$, Ampere's law, Inductance- self and mutual, magnetic vector potential, Faraday's law of electromagnetic induction, Differential form of Faraday's law and its' consequence.

Module 2: [3L]

Maxwell's equations, Maxwell's equation in vacuum and in matter, energy in an electromagnetic field, Poynting's theorem (qualitative), Electromagnetic wave equation in Vacuum and in matter (brief).

1.2. Introduction to Statistical Mechanics: [3L]

Statistical approach to system of particles, Phase space, Macrostate, Microstate, Density of states, Brief discussion on Maxwell Boltzmann, Fermi-Dirac and Bose-Einstein statistics and their differences.

1.3. Quantum Mechanics - II: [12L]

Module 1: [5L]

Application of Schrödinger equation in – (i) Barrier potential with qualitative discussion on examples like tunneling, alpha decay etc, (ii) The square well potential, (iii) Infinite square well potential and (iv) Simple Harmonic oscillator ,

Module 2: [4L]

Application of Schrödinger equation in three dimension- (i) Particle in three dimensional box and concept of degeneracy, (ii) One-electron Atom problem – Equations, Solutions, Eigenvalues, Quantum number and Eigen functions.

Module 3: [3L]

Application of quantum mechanics to solid - Free electron Theory of metals, Fermi Level, Density of states, qualitative discussion on Bloch's Theorem, Kronig- Penny model and origin of band gaps.

1.4. Mechanics: [10L]

Module 1: [2L]

Meaning of gradient-Potential energy function, equipotential surfaces, Conservative vector fields - gravitational and electrostatic examples.

Module 2: [2L]

Central forces; Conservation of Angular Momentum; Features of central force motion. Energy equation and energy diagrams (qualitative);

Module 3: [2L]

Non-inertial frames of reference; Rotating coordinate system, Velocity and Acceleration in a Rotating Coordinate System

Module 4: [2L]

Angular momentum of a system of particles, Torque, Moment of inertia , Parallel and Perpendicular axes theorem and consequences

Module 5: [2L]

Motion of a rigid body in a plane, Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, rigid body motion in three-dimension (brief)

1.5. Waves & Oscillation: [9L]

Module 1: [2L]

Simple harmonic motion, Composition of simple harmonic motion, Mechanical and electrical simple harmonic oscillators, complex number notation and phasor representation of simple harmonic motion.

Module 2: [2L]

Damped harmonic oscillator – heavy, critical and light damping, energy decay in a damped harmonic oscillator (brief).

Module 3: [2L]

Forced vibration and resonance, steady state motion of forced damped harmonic oscillator, power absorbed by oscillator, steady state, application in mechanical and electrical oscillation (brief), ,

Module 4: [3L]

Wave equation in one dimension and travelling wave solution, Standing waves, Wave velocity and group velocity, Acoustics wave and velocity of sound, ultrasonic(qualitative)

Course Outcomes:

V. Students will be knowable with some basic facts of Physics needed for advancement in Technology.

VI. Students will achieve quantitative knowledge about higher level ideas of Physics such as advance quantum mechanics, statistical mechanics etc.

VII. Students will be able to identify the characteristics differences between Macro and micro world appearing from their dimensional uniqueness.

VIII. Students will be efficient to apply the fundamental concepts of modern Physics in their future prospect as well as in the advancement of technology for mankind.

Reference books:

1. Introduction to Electrodynamics by David Griffiths, Prentice Hall
2. Principles of Physics, 10^{th} ed, David Halliday, Robert Resnick Jearl Walker , Wiley
3. Electricity, Magnetism, and Light by Wayne M. Saslow, Academic Press.
4. Electromagnetism by Grant and Phillips, John Wiley.
5. Thermodynamics in Materials Science by Robert DeHoff, CRC Press
7. Fundamentals of Statistical and Thermal Physics, Reif, Sarat Book Distributors
8. Introduction to Quantum Mechanics by David J. Griffiths.(Prentice Hall)
9. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles by Eisberg & Resnick, Wiley
10. Classical Mechanics by Goldstein, Poole and Safko Pearson Education.
11. Concepts of Modern Physics, Arthur Beiser, Sixth Edition, McGraw-Hill.
12. An Introduction to Mechanics by Klepner and Kolenkow, McGraw Hill.
13. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
14. Theory of Vibrations with Applications — WT Thomson
15. The Physics of Waves and Oscillations by N.K. Bajaj,Tata McGraw-Hill.
16. Oscillations and waves in physics by Ian G. Main.
17. Web Platform: NPTEL, SWAYAM, Archive.org etc

CHEMISTRY - II

Sub Code: CH-201 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course objective:

The objective is to develop understanding of the concepts and applications of chemical kinetics and different analytical techniques. Course will impart knowledge of physical/chemical behavior and applications of various engineering materials and explore water chemistry, green chemistry and non-conventional energy sources.

Module 1: Analytical techniques [8L]

Applications of spectroscopic techniques. Surface characterization techniques. Diffraction and scattering. Chromatographic methods of separation and analysis. Mass spectrometry. Thermal analysis.

Module 2: Kinetics of Chemical Reactions [10L]

Reversible, consecutive and parallel reactions. Steady state approximation. Chain and oscillatory reactions. Kinetics of photochemical & photophysical processes. Catalysis.

Module 3: Metals and Alloys: [3L]

Phase rule and applications to one, two and multi-component systems. Iron-carbon phase diagram.

Types of alloys, carbon steel, alloy steel, alloys of Cu, Al, Pb.

Module 4: Polymers [3L]

Mechanism of polymerization and synthesis of polymers. Molecular weight, shape and conformation of polymers. Crystallinity, melting point and glass transition. Copolymerization. Viscoelasticity. Elastomers-structure, applications and curing. Conducting polymers and applications.

Module 5: Surfactants and lubricants [3L]

Critical micelle concentration and its determination. Hydrophobic and hydrophilic interactions. Micelles and reverse micelles. Detergents. Fricohesity of lubricants and chemical properties, types and mechanism of lubrication. Additives of lubricants and freezing points of lubricants.

Module 6: Nanomaterials [3L]

Properties of nanomaterials, size dependent properties, general methods of synthesis, bottom-up and top-down approach, characterization of nanomaterials, electron microscopy, self-assembly, nanoscale materials, Applications of nanomaterials.

Module 7: Environmental and green chemistry [6L]

Water chemistry: Sources of water. Hardness of water and softening methods. Alkalinity of water.
Boiler feed water. Treatment of water for domestic and industrial use.

Air, water and noise pollution. Optimum level of pollution. Significance and determination of COD and BOD. Solid waste treatment of collection of NKP. Greenhouse effect and global warming. e-Waste. Radioactive pollution. Applications of green chemistry and green technology. Concept ofatomic and molecular economy and its use in green chemistry.

Module 8: Energy science [4L]

Analysis of coal. Petroleum refining, liquid fuels, anti-knock agents. Cracking of oils. Limitations of fossil fuels. Alternative and non-conventional sources of energy - solar, wind, geo, hydro-power and biomass. Advantages and disadvantages. Nuclear energy, reactors and nuclear waste disposal. Safety measures for nuclear reactors. Battery technology. Rechargeable batteries. Fuel cells. Photovoltaics.

Course Outcome:

The students will be able to

1. Appreciate the usefulness of new analytical techniques for elucidating the structure of chemical systems.
2. Apply the basic principle of chemical kinetics in order to analyze and develop chemical reactors and reaction systems.

3. Use the knowledge on compounds of interest like polymers, surfactants, nanomaterials and appreciate their engineering applications.
4. Able to apply the principles of green chemistry in designing alternative reaction methodologies to minimize hazards and environmental degradation.

Reference Books

1. Fundamentals of Analytical Chemistry by S. Crouch, D. West, F. Holler, D. A. Skoog
2. Organic Spectroscopy by W. Kemp.
3. Physical Chemistry by P. W. Atkins and J. de Paula
4. Chemical Kinetics, by K. Laidler
5. Introduction to Nanoscience by S. M. Lindsay
6. Nanoscience and Nanotechnology: Fundamentals to Frontiers by M. S. R. Rao, S. Singh
7. A Textbook of Engineering Chemistry by Shashi Chawla
8. Engineering Chemistry by S. S. Dara
9. Engineering Chemistry by P. C Jain and M. Jain
10. A Textbook of Environmental Chemistry by O. D. Tyagi and M. Mehra
11. Engineering Chemistry (WIND) by Wiley editorial

ENGINEERING MATHEMATICS-II

Sub Code: MA-202 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours **Credit: 3**

Course Objective:

The objective of this course is to know the use of mathematical techniques in Linear algebra that are needed by engineers for practical applications, familiarize with differential equation with its application in Laplace transform, introduction to the concepts of improper integrals, Gamma, Beta function which are needed in engineering applications, and finally to acquaint

with numerical methods in evaluating polynomial equations, differential equation and integration.

Module 1: Linear Algebra: Matrices, Vectors, Determinants, Linear Systems: [12 L]

Inverse and rank of a matrix, Determinants, Cramer's Rule, Solutions of Linear Systems: Existence, Uniqueness , rank-nullity theorem, Symmetric, skew symmetric, and orthogonal matrices, Vector Space, Linear dependence of vectors, basis, Eigenvalues and eigen vectors , Cayley-Hamilton Theorem and Orthogonal transformation.

Module 2: Convergence of improper integrals: [3 L]

Convergence of improper integrals, tests of convergence, Beta and Gamma functions elementary properties.

Module 3: Differential Equation: [10 L]

First order equations, Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations, solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Second order linear differential equations with variable coefficients; Method of variation of parameters; Wronskian

Module 4: Integral transform: [7 L]

Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions, inverse Laplace transform, convolution theorem, Evaluation of integrals by Laplace transform, solving ODEs by Laplace Transform method, Fourier transforms.

Module 5: Numerical Methods: [8 L]

Finite differences, Newton's forward and backward interpolation formulae, Trapezoidal rule and Simpson's 1/3rd rule of integration, Solution of polynomial and transcendental equations, Bisection method, Newton Raphson method and Regular Falsi method, Numerical solutions of first order differential equations by Euler's method and 4th order Runge- Kutta method.

Course Outcomes

The students will learn:

- to solve mathematical tools for the solutions of differential equations that model physical processes.

- the essential tools of matrices and linear algebra including linear transformations, eigenvalues, diagonalization and orthogonalization.
- to familiarize with techniques in improper integrals . They will have a basic understanding of Beta and Gamma functions.
- the different tools of Laplace and Fourier transform for learning advanced Engineering Mathematics.
- To deal with techniques in Numerical Analysis that are essential in most branches of engineering.

Text / Reference Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
2. D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
3. Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2008.
4. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications,Reprint, 2010.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
7. V. Krishnamurthy, V.P. Mainra and J.L. Arora, An introduction to Linear Algebra, Affiliated East–West press, Reprint 2005.
8. S.S. Sastry, Introductory methods of numerical analysis, PHI, 4th Edition, 2005.
9. S. L. Ross, Differential Equations, 3rd Ed., Wiley India, 1984
10. E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

ENGINEERING MECHANICS

Sub Code: ME-203 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours
Credit: 3

Course Objectives

The main objective of a course Mechanics should be build a strong foundation, to acquaint the students with as many general methods of attack as possible , and to illustrate the application of these methods to practical engineering into consideration. The basic essence of this subject resolves around the concept of statics as well as dynamic equilibrium.

Modern day engineering mechanics idealizes the practical problems. Engineering Mechanics deals with the Mechanics of rigid bodies. -Statics and Dynamics- without taking the effect of their deformation structures separately. Therefore to meet the present -day needs, the focus of teaching engineering mechanics turned to the knowledge of proper conceptualization and modeling, assuming that rest of the things will be carried out using standard techniques.

Module 1: [2L]

Statics: Basic concepts, Scalars and vectors, parallelogram law, Lami's theorem,

Module 2: [2L]

Application of Vectors in Mechanics, Force Systems in two Dimensions;

Module 3: [4L]
Moments and Couples; Resultants and Components in concurrent coplanar, forces, parallel forces in a plane, Free Body Diagram Concept

Module 4: [4L]

Fundamentals of Friction, Limiting angle of Friction, Applications to wedges.

Module 5:[6L]

Centroid, Moment of Inertia.
Module 6:[5L]

Plane Trusses; Frames and Machines.

Module 7:[2L]

Dynamics: Introduction to vector calculus, Definition of vectors in Dynamics.

Module 8:[5L]

Two dimensional Kinematics in Rectangular Co-ordinates, Rectilinear Motion, Curvilinear motion of particle and description of different coordinate systems, Kinetics.

Module 9:[4L]

Newton's Law and D' Alembert's principle, and application to rectilinear and curvilinear motion, constrained motion,

Module 10:[4L]

Energy and Momentum methods. Linear Impulse; Angular Impulse and Momentum – Central Force Motion.

Module 11:[2L]

Concept of Stress and Strain , Stress-Strain Diagram of Ductile and Brittle Material ,Normal stress , shear stress etc., Relevant numerical.

Course Outcomes:

On successful compulsion at the End of Course, students will able to understand and capable of answering in the following areas.

1. Drawing Free Body diagrams and determination of Resultant of forces and/or Moments.
2. Determination of the centroid and Second Moment of areas of different sections.
3. Analysis of Statically Determinate plane frame.
4. Application of Law of Mechanics to determine the efficiency of simple machines with consideration.
5. Application of Newton’s Laws of motion of the moving bodies.
6. Application of D-Alembert’s principle and related numerical.
7. Analysis of Plane Curvilinear motion.
8. Basic concept of Strength of materials, Understanding of Stress- Strain Diagram and related numerical.

Reference Books :

1. Engineering Mechanics by S Timoshenko , D H Young and J V Rao , Tata McGraw Hill
2. Engineering Mechanics (Statics & Dynamics, VolumeI&II) by J.L. Meriam and L.G. Kraige, Wiley India pvt Limited.
3. A Text book of Engineering Mechanics by A. R. Basu ,DhanpatRai& Co.
4. Engineering Mechanics by Basudeb Bhattacharyya, Oxford University Press.
5. Engineering Mechanics by S S Bhavikatti, New Age International (P) Limited.
6. Engineering Mechanics by A. K. Tayal , Umesh Publications.
7. Engineering Mechanics by K L Kumar, Tata McGraw Hill
8. Engineering Mechanics by P.K Nag , SukumarPati & T.K. Jana , McGraw Hill Education (India) Private Limited.
9. Engineering Mechanics by B B Ghosh, S Chakrabarti& S Ghosh, Vikas Publishing House pvt Ltd.
10. Strength of Material by S S. Ratan, McGraw Hill Education (India) Private Limited.
11. NPTEL on line courses relevant to your topic ;Source: onlinecourses.nptel.ac.in

BASIC COMPUTER SCIENCE AND ENGINEERING

Sub Code: CS-204 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours
Credit: 3

Course objectives:

The objective of this course is to give the introduction of computing systems to the students. The students will also learn the basics of programming languages. In order to solve good programming problems data structure is also taught.

Module- 1. Introduction to Computer: [8 L]

Basic Building blocks, Algorithms, Flowcharts, Pseudo codes, System and Application Software-concepts & terminologies, Concepts of Machine Language, Assembly Language and High level languages, Fundamentals of World Wide Web and Internet

Module- 2. Introduction to Programming: **[14 L]**

Variables, Assignments; Expressions; Input/Output; Conditionals and Branching; Iteration; Functions; Recursion; Arrays; Pointers; Structures;

Module- 3. Introduction to Data Structure: (18 L)

Array, Stack, Queue, Linked List Searching: Linear Search, Binary Search, Sorting: Bubble, Insertion, Selection

Course Outcome:

1. The students will have the fundamental knowledge about the computing system.
2. Students will learn different type of data structures, their basic operations and applications.
3. Students will come to know about the basic features of programming language.
4. They will learn to write basic to advanced program.

Reference Books:

1. Computer Fundamentals by P.K.Sinha
2. Data Structures by Seymour Lipschutz
3. Fundamentals of Data Structures in C by E.Horowitz, Sartaj Sahni
4. Data Structures Using C by Reema Thareja
5. The C programming Language by Brian W. Kernighan and Dennis M. Ritchie
6. Programming with C by Byron Gottfried
7. Programming in ANSI C by E. Balagurusamy
8. Understanding Pointers in C by Kanetkar Yashavant P.

BASIC ELECTRONICS

Sub Code: BE-205 **L-T-P: 3-0-0**

Total Lectures 40 hours + Contact Hours
Credit: 3

Course Objective:

The objective of this course is to acquaint to the students initially the basic concepts of semiconductors and semiconductor devices which are widely used in electronics engineering. Further the electronic circuits used in electronics engineering, comprising of analog electronic and digital electronic circuits will also be introduced in this course. Lastly, the important application areas of electronics engineering, namely communication engineering and sensor and actuators will also be introduced.

Module 1: Concepts of Semiconductors [6L]

Basic ideas of electronics, charged particles, review of atomic energy levels, elementary concepts of

energy bands in crystals, conduction band and valence band, distinction between metal, semiconductor and insulator, Fermi-Dirac Distribution and definition of Fermi level, intrinsic and

extrinsic semiconductors, concepts of majority and minority carries in semiconductors, current flow in semiconductors.

Module 2: Semiconductor Devices [12L]

P-N Junction and Diode, Concept of space charge, effects of forward and reverse bias, current-voltage characteristics of P-N junction diode, concept of breakdown, Zener diode principle and applications, equivalent circuit of diodes, concepts of rectifiers, principle of LED. Bipolar junction transistor, mechanism of transistor action, current components in a bipolar transistor, modes of transistor operation, I-V characteristics of a bipolar transistor, transistor biasing, introduction to field effect transistor, principle of junction field effect transistor, concept of metal semiconductor field effect transistor, p-channel and n-channel, current flow in field effect transistors and I-V characteristic curves.

Module 3: Analog Electronics using Operational Amplifier [7L]

Concept of Analog Signaland Analog Electronics, Basic concept of positive and negative feedback, Basic information of operational amplifier, ideal characteristics, 741- OPAMP, Basic OPAMP applications using ideal model:inverting amplifier, non-inverting amplifier, summing amplifier, difference amplifier, differentiation and integration using operational amplifier, comparator circuit using operational amplifier

Module 4: Digital Electronics using Gates [13L]

Concept of Digital Signal, Binary Numbers, Signed-binary numbers, Decimal-to-Binary & Binary-to Decimal Conversion, Binary Addition, Subtraction, Multiplication and Division, Hexadecimal Number Systems, Logic Gates like OR, AND, NAND, NOR and NOT, Boolean Algebra, De Morgan's Theorems, Laws of Boolean Algebra, Logic Circuit Implementation of Boolean Expressions, Arithmetic circuits, Combinational circuits: Multiplexers, De-Multiplexers, Encoders Decoder, Comparator, Sequential circuits: counters, registers, ADC and DAC, Basic ideas of flip flops.

Module 5: Electronics Applications [2L]

Introduction to communication systems. Principle of modulation including amplitude and frequency modulation. Transmitter and receiver system.

Course Outcome:

As outcome of this course, the students will be trained with the fundamentals of semiconductor devices and circuits and important application areas of electronics engineering.

Reference Books:

1. Electronics: Fundamentals and Applications, D.Chattopadhyay and P.C. Rakshit
2. Electronic Devices and Circuits, J.Millman and C.C. Halkias.
3. Linear Integrated Circuits, D.Roychoudhury and S.Jain

PRACTICAL PAPERS

SUB: PHYSICS LAB-II

Sub Code: PH-206 **L-T-P: 0-0-2**

Total : 24 hours + Help Room
Credit: 1

Course objectives:

The objective of the practical classes is to make the students familiar with the technological features of theory as well as to provide hand-on experience of corroboration between model theory and it's practical aspect.

Experiments are based on electricity and magnetism, optics and quantum mechanics with advanced measurement techniques.

Course Outcome:

In practical classes the students will get hand-on experience about the commissioning of the theory to the application domain. They also find out the real time difficulties and their solutions by optimizing the constraints and precision measurements.

Reference:

The laboratory manual corresponds to all experiments will be provided to the students.

CHEMISTRY LAB - II

Sub Code: CH – 206 **L-T-P: 0-0-2**

Total : 24 hours + Help Room
Credit: 1

Experiments:

1. Study of kinetics of chemical reactions.
2. Redox titrations: Dichromatometry, Permanganometry, Iodometry and Iodimetry.

3. Experiments based on Chromatography (paper, thin layer, column chromatography)
4. Detection of different functional groups in known and unknown organic samples.

Course Outcome:

The students will be able to

1. Understand the principles of chemical kinetics through experimentation.

2. Understand the fundamental principle of different analytical methods and instruments.

3. Systematically identify organic functional groups.

WORKSHOP PRACTICE

Sub Code: ME – 207
L-T-P: 0-0-3

Total : 36 hours + Help Room
Credit: 1.5

Course Objectives:

Designed for the core course on Workshop Practice offered to all first-year degree level students of engineering, Work shop Practice presents clear and concise explanation of the basic principles of manufacturing processes and equips students with overall knowledge of engineering materials, tools and equipment commonly used in the engineering field. The curriculum describes the general principles of different workshop processes such as primary and secondary shaping processes, metal joining methods. The workshop processes covered also include the hand-working processes such as bench work, fitting, welding, sheet metal work, and carpentry. It also explains the importance of safety measures to be followed in workshop processes and details the procedure of writing the records of the practices. The tools and equipment used in each hand-working process are enumerated before elaborating the process.

Fitting Shop:

Introduction to different hand tools, equipment and measuring devices, sawing, filing & drilling process. Practice Jobs on Mild Steel Plate, Production of nuts and bolts.

Carpentry Shop:

Specification of wood and wood products, Introduction to Tools and equipment, different wood joints. Practice jobs on Dove Tail Notch or Dovetail Bridle Joint or Cross Joint

Forging Shop:

Demonstration of forging a Octagonal Chisel.

Welding Shop

Metal joining process, Arc welding practice.

Sheet metal work

Sheet metal work through, production of funnel.

Course Outcomes:

At the End of Course, students will able to understand as well as familiar with carpentry, fitting, forging, welding and sheet metal work through the following areas.

1. Nomenclature, application use of different hand tools.
2. To get familiarized with the properties of different engineering materials- metals & alloys and non metals.
3. To learn about the various measuring devices and to know about the importance of sequential plans of action in manufacturing through practice in various sections.
4. Acquire knowledge about, different measuring instruments their working principle, application areas and able to handle the same.
5. Hands on practice of simple job related to Fitting shop
6. Hands on practice of simple joint related to Carpentry shop.
7. Overview of Forging Shop.
8. Sheet metal working, through Construction of Funnel.
9. Introduction to welding Process-through practice job using MMAW .

Reference Books:

1. Work shop Technology (Volume- I and Volume-II , By Hazra ,Choudhary),Media Promoters & Publishers Pvt Ltd.
2. Mechanical Workshop Practice, PHI Learning Pvt. Ltd.
3. Work shop Manual / P.Kannaiah / K. L. Narayana / Scitech Publishers.

ENGINEERING DRAWING

Sub Code: ME – 208 **L-T-P: 0-0-3**

Total : 36 hours + Help Room **Credit: 1.5**

Course Objectives

Primary objective of the course of Engineering Drawing is to understand the language of engineers which is very much essential for engineering career. Students of all engineering disciplines to develop a spatial bent of mind to observe, visualize and understand the structure of objects from different perspectives.

Module:1

Engineering Lettering, Numbering

Module:2

Types of Lines and Dimensioning methods.

Module:3

Construction of Plane Scales, Diagonal Scales & Venier Scales.

Module:4

Engineering Curves – Parabola, Ellipse, Involutes

Module:5

Orthographic Projection of Points, Lines, Surfaces, Solids and Section of solids.

Module:6

Introduction of Isometric projection.

Module:7

Introduction to CAD tools – basics; Introduction of Development and Intersection of surfaces.

Course Outcomes:

Course Outcomes at the End of Course, students will able to solve the problems in the following areas.

1. Construction and Interpretation of drawing scales as per the situation.
2. Generation of simple Curves like ellipse, cycloid and Involutes of circle, square.
3. Visualization and generation of Orthographic projections of points, lines and planes.
4. Visualization and generation of Orthographic projections of solids like cylinders, cones, prisms and pyramids.
5. Layout development of solids for practical situations.
6. Development of isometric projections of simple objects.

Reference Books

1. Engineering Drawing By N.D. Bhatt Pvt. Ltd.,
2. Engineering Drawing By N S Parthasarathy and Vela Murali, Oxford University press
3. A Text Book of Engineering Drawing - by R.K.Dhawan.

COMPUTER PROGRAMMING LAB

Sub Code: CS - 209 **L-T-P: 0-0-3**

Total : 36 hours + Help Room
Credit: 1.5

Course Objective:

The objective of this practical course is to conceptualize the basic features of programming language. The students will learn how to write the different programs for simple to advanced problems using C language.

Experiments on the following topic:

The assignments will be given based on the topics covered in Module-II and Module-III of CS 204.

They will write the programs using C.

Course Outcome:

1. The students will learn how to analyze a given problem.
2. They can identify what types of the variables, data structure are required to solve a problem.
3. Students can write program for a given problem.
4. They will understand how to prepare test set for a given problem.

Reference Books:

1. The C programming Language by Brian W. Kernighan and Dennis M. Ritchie
2. Programming with C by Byron Gottfried
3. Programming in ANSI C by E. Balagurusamy
4. Understanding Pointers in C by Kanetkar Yashavant P.

BASIC ELECTRONICS LAB

Sub Code: BE – 210 **L-T-P: 0-0-3**

Total : 36 hours + Help Room **Credit: 1.5**

Course Objective:

The objective of this course is to train the students on the working of semiconductor diodes and transistor circuits, analog electronic circuits using operational amplifiers, digital logic circuits using Gates through hands-on-experiments.

Each experiment should be carried over bread boards and/or kits. Experimental observations should be properly tabulated and/or represented graphically. The derived results from experimental data should be compared with theoretical models and errors should be properly reported. Conclusion should be scientifically drawn. Each experiment should be preceded with a theoretical discussion of the concerned topic and identification of the associated circuit components and/or measuring instruments.

Experiment 1: Identification of Circuit Components

Study of resistors, capacitors and inductors. Determination of values and comparison of the same with measurement by multi meters/ LCR meters.

Experiment 2: Semiconductor Diodes

2(a): Identification of Ordinary P-N diode and Zener Diode.

2(b): Study the Forward Bias V-I Characteristics of P-N Junction Diode and determination of impedance.

2(c): Forward and Reverse Characteristics of Zener Diode, Load Voltage and Line Voltage Regulation.

Experiment 3: Bipolar Transistors

3(a): Identification of NPN and PNP Bipolar Transistors.

3(b): Study input & output characteristics of transistor in CE & CB modes and determination of hybrid parameters.

Experiment 4: MOSFET

4(a): Identification of MOSFET

4(b): Study V (DS) vs. I (D) characteristics and Study V (GS) vs. I (D) characteristics and hence to calculate the MOFET parameters.

Experiment 5: Analog Electronics using Operational Amplifiers

5(a): Identification of 741C OPAMP, pin diagram and power supply requirements. Concept of positive and negative supply.

5(b): Study of inverting and non-inverting amplifier configurations.

5(c): To use integrating and differentiating circuits with 741C OPAMP and study with C.R.O.

Measurement of phase and frequency with C.R.O.

Experiment 6: Digital Electronics using Logic Gates

6(a): Identification of various digital logic gates.

6(b): Study of NOT, OR, AND, NAND, NOR & XOR gates and verification of truth tables.

Course Outcome:

As outcome of this course, the students will develop a mindset to verify the principles of electronics using practical devices and components. The practical utilities and performance of basic electronic devices and circuits will thus be clearly demonstrated.

Detailed Syllabus: Semester-III

EC2.1.1 – ELECTROMAGNETIC FIELDS AND WAVES [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Transmission Lines- Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss- less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

Maxwell's Equations- Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

Uniform Plane Wave and Media Interface- Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

Wave propagation in waveguides- Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide.

Radiation- Solution for potential function, Radiation from the Hertzian dipole, Power radiated by hertzian dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antennas

Text/Reference Books:

1. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
2. M. N. O. Sadiku, Elements of electromagnetics, Oxford University Press
3. J. R. Reitz, F. J. Milford, R. W. Christy, Foundations of Electromagnetic Theory, Addison-Wesley /Indian edition
4. D. M. Pozar, Microwave Engineering, Wiley-India

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carry out impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form
7. Understand principle of radiation and radiation characteristics of an antenna

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EC2.1.2 – CIRCUIT AND NETWORK THEORY [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Circuit Analysis:

Circuit elements: Types of circuit elements, independent voltage and current sources, controlled sources, coupled circuits and their controlled source representations. [2]

Methods of Analysis: Topological description of network; Network variables; Source transformation technique; Mesh and Node analyses; Dual and Inverse networks. [5]

Graph Theory: Graph of network; Incidence matrix; Cut-set and Tie-set matrices. [3]

Network Transformations & Theorems: Network configurations; Transformation to Equivalent T and PI networks; T – PI transformation; Theorems – Superposition, Reciprocity, Thevenin's, Norton's, Maximum power transfer; Inductive Coupling - Identification of relative polarities, Linear transformer; tuned transformers. [7]

Transient & Steady-State Analysis: Laplace transformation and Properties; Transient response in RL, RC and RLC circuits; Fourier analysis for periodic signals; Fourier transform, Steady-state response - Amplitude and Phase spectra. [5]

Circuit Synthesis:

Positive Real function: Definition; Properties; Testing of positive Real and Application to Driving-point Impedance/admittance function. [2]

Synthesis of Two-Terminal Reactive Networks: Poles and zeros; Foster's reactance theorem; Synthesis of LC networks in Foster and Cauer Canonic forms. [4]

Synthesis of Two-Terminal RL, RC networks: Poles and Zeros of RL and RC driving point impedance functions; Synthesis of RL, RC networks in Foster's and Cauer canonic forms; Synthesis of RLC networks. [6]

Two-Port Networks: Impedance, admittance, transmission and hybrid parameters; Matrix forms of input-output relations; Cascade, parallel and series connection of two ports; Characteristic impedance and propagation function; Balanced and unbalanced networks; Bartlett's bisection theorem and its applications; Special Networks-Gyrator, Negative Impedance Converter. [7]

Suggested Books:

1. Fundamentals of Electric Circuit Theory, D. Chattopadhyay and P. C. Rakshit, S. Chand, 9th Edition (Revised), New Delhi, 2011.
2. Network Analysis and Synthesis, F. F. Kuo, Wiley-India, Second Edition, New Delhi, 2009 (reprint).
3. Circuit Theory Fundamentals and Applications, A. Budak, Prentice Hall Inc, NJ, second Edition, 1987.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand basics electrical circuits with nodal and mesh analysis.
2. Appreciate electrical network theorems.
3. Apply Laplace Transform for steady state and transient analysis.
4. Determine different network functions.
5. Appreciate the frequency domain techniques.

EC2.1.3 – SIGNALS AND SYSTEMS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Signals and systems as seen in everydaylife, and in various branches of engineering and science.

Energy and power signals, continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, reliability.

Linear shift-invariant (LSI) systems, impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs. Characterization of causality and stability of linear shift-invariant systems. System representation through differential equations and difference equations.

Periodic and semi-periodic inputs to an LSI system, the notion of a frequencyresponse and its relation to the impulse response, Fourier series representation, the Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality. The Discrete-Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem.The idea of signal space and orthogonal bases,

The Laplace Transform, notion ofeigen functions of LSI systems, a basis of eigen functions, region of convergence, poles and zeros of system, Laplace domain analysis, solution to differential equations and system behavior.

The z-Transform for discrete time signals and systems- eigen functions, region of convergence, z-domain analysis.

State-space analysis and multi- input, multi-output representation. The state-transition matrix and its role. The Sampling Theorem and its implications- Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold, and so on. Aliasing and its effects. Relation between continuous and discrete time systems.

Text/Reference books:

1. A.V. Oppenheim, A.S. Willsky and I.T. Young, "Signals and Systems", Prentice Hall, 1983.
2. R.F. Ziemer, W.H. Tranter and D.R. Fannin, "Signals and Systems - Continuous and Discrete", 4th edition, Prentice Hall, 1998.
3. Papoulis, "Circuits and Systems: A Modern Approach", HRW, 1980.
4. B.P. Lathi, "Signal Processing and Linear Systems", Oxford University Press, c1998.
5. Douglas K. Lindner, "Introduction to Signals and Systems", McGraw Hill International Edition: c1999.
6. Simon Haykin, Barry van Veen, "Signals and Systems", John Wiley and Sons (Asia) Private Limited, c1998.
7. Robert A. Gabel, Richard A. Roberts, "Signals and Linear Systems", John Wiley and Sons, 1995.
8. M. J. Roberts, "Signals and Systems - Analysis using Transform methods and MATLAB", TMH, 2003.
9. J. Nagrath, S. N. Sharan, R. Ranjan, S. Kumar, "Signals and Systems", TMH New Delhi, 2001.
10. Ashok Ambardar,"Analog and Digital Signal Processing", 2nd Edition, Brooks/ Cole Publishing Company (An international Thomson Publishing Company), 1999.
11.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze different types of signals
2. Represent continuous and discrete systems in time and frequency domain using different transforms
3. Investigate whether the system is stable
4. Sampling and reconstruction of a signal

ECOE2.1.4.1 – NUMERICAL ANALYSIS [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Mathematical Preliminaries: Continuity of a Function and Intermediate Value Theorem; Mean Value Theorem for Differentiation and Integration; Taylor's Theorem (1 and 2 dimensions).

Error Analysis: Floating-Point Approximation of a Number; Loss of Significance and Error Propagation; Stability in Numerical Computation.

Linear Systems: Gaussian Elimination; Pivoting Strategy; LU factorization; Residual Corrector Method; Solution by Iteration; Conjugate Gradient Method; Ill-Conditioned Matrices, Matrix Norms; Eigenvalue problem - Power Method; Gershgorin's Theorem.

Nonlinear Equations: Bisection Method; Fixed-Point Iteration Method; Secant Method; Newton Method; Rate of Convergences; Solution of a System of Nonlinear Equations; Unconstrained Optimization.

Interpolation by Polynomials: Lagrange Interpolation; Newton Interpolation and Divided Differences; Hermite Interpolation; Error of the Interpolating Polynomials; Piecewise Linear and Cubic Spline Interpolation; Trigonometric Interpolation; Data Fitting and Least-Squares Approximation Problem.

Differentiation and Integration: Difference formulae; Some Basic Rules of Integration; Adaptive Quadratures; Gaussian Rules; Composite Rules; Error Formulae.

Differential Equations: Euler Method; Runge-Kutta Methods; Multi-Step Formulae; Predictor-Corrector Methods; Stability and Convergence; Two Point Boundary Value Problems.

References

1. K. E. Atkinson, An Introduction to Numerical Analysis (2nd edition), Wiley-India, 1989.

2. S. D. Conte and Carl de Boor, Elementary Numerical Analysis - An Algorithmic Approach (3rd edition),McGraw-Hill, 1981.

Course Outcomes:

At the end of this course students will be able to solve engineering problems involving

1. Error Analysis using Numerical Techniques

2. Functions and Continuity Testing
3. Linear and non-linear equations
4. Interpolation and Extrapolation of Series using various Numerical Techniques
5. Differential equations using MATLAB or C

ECOE2.1.4.3 – ARTIFICIAL INTELLIGENCE & MACHINE LEARNING [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Course Objective: The objective is to develop understanding of the fundamental concepts of Artificial Intelligence and Machine Learning. This course will provide a strong foundation of different newly invented techniques in Artificial Intelligence. Thus the Students will be capable to apply these techniques in applications which involve perception, reasoning and learning.

Introduction to artificial intelligence, History of AI, AI applications, What is machine learning? Machine learning applications.

Search and Planning- Problem spaces and search, Heuristic search strategies.

Knowledge Representation and Reasoning- Knowledge and rationality, Logic and inference, Representing knowledge using rules, Bayesian reasoning.

Introduction to Bayesian learning theory, Decision tree learning algorithm.

Neural Network basics - Perceptron and MLP, FFN, Backpropagation.

Supervised methods: Nearest Neighbor, Naive Bayes, Decision Trees, Linear Regression, Support Vector Machines (SVM).

Unsupervised Methods: Clustering – k-means, hierarchical clustering.

Semi-supervised methods; Reinforcement learning.

Concept of Fuzzy logic: Dimensionality reduction: PCA, ICA;

Concept of Deep Learning- Convolutional neural networks; Recurrent neural networks and LSTMs.

References

1. Stewart Russell and Peter Norvig. "Artificial Intelligence-A Modern Approach ", 2nd Edition, Pearson Education/ Prentice Hall of India, 2004.

2. Elaine Rich and Kevin Knight, “Artificial Intelligence”, 2nd Edition, Tata McGraw-Hill, 2003.

3. Amit Konar. "Artificial Intelligence and Soft Computing - Behavioral and Cognitive Modeling of the Human Brain", CRC Press.

Course Outcomes:
At the end of this course students will be able to

1. Understand the various searching techniques and apply these techniques in various applications which involve perception, reasoning and learning.

2. Analyze different reasoning and learning methods and develop new mathematical problems based on these methods.

3. Understand the dynamic behavior of a system and design real world problems for implementation.

4. Employ various machine learning techniques to design new AI machine for real world problems.

ECHN2.1.5 – MATERIALS AND PHYSICAL ELECTRONICS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Structures of Solids: Atoms and their binding, Bonds, Crystal Structures, Unit Cells, Lattice directions and planes (Miller Indices), Materials: Crystalline, Polycrystalline and Amorphous Materials. [4]

Crystalline Solids and Defects: Metals, Semiconductors and Insulators, Defects in crystals: point defect, Line defect, Planar defect. [4]

Magnetic Materials : magnetization, microscopic theory, dipole moment, atomic magnetic moment, permeabilty and magnetic susceptibility; Classification: dia, para, ferro, antiferro, frrimagnetic materials; Ferromagnetism : origin, hysteresis, saturation magnetization, coercivity, curie temperature, domain; Soft and Hard Materials; Magnetic Resonance; Applications: motors, sensors, medical, giant magnetoresistance, spintronics. [4]

Concepts of Growth Techniques: Principles of Czochralski method, Zone melting, CVD, LPE, VPE, MBE, MOCVD. [6]

Phonons: Vibration of Crystalline solids with monoatomic basis, Two atoms per primitive basis, Acoustic and Optical phonons [2]

Semiconductor Characterization: Measurement of crystal structure by XRD, determination of energy band gaps, carrier concentration and mobility, surface morphology. [4]

Review of Quantum Mechanics: Wave-particle duality, Schrödinger equation, Meaning of wave function; Simple applications: potential well, potential barrier, tunneling. [2]

Basic Semiconductor Physics: Band structures, Electrons and Holes, E-k relations, Effective mass, Density-of-states function, Classifications – Elemental, Compound and Alloy semiconductors, Intrinsic and extrinsic, Direct and indirect gap, Heavily doped and amorphous semiconductors. [7]

Semiconductor Statistics : Classical and Fermi-Dirac Statistics, Carrier concentrations under equilibrium, heavily doped semiconductors. [2]

Transport Phenomena: Relaxation time, Scattering mechanisms, Mobility, Diffusion, Einstein relation, Hall effect and Hall mobility. [5]

Excess Carriers : Method of generation, recombination, lifetime in direct and indirect gap semiconductors, degenerate and non-degenerate semiconductors, Quasi-Fermi level, Continuity equation. [3]

Optical Properties: Optical absorption, Luminescence, Photoluminescence and Electroluminescence. [2]

Suggested Books:

1. B. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices," Sixth Edition, Prentice Hall, 2009.
2. D. K. Schroder, Semiconductor Material and Device Characterization, 3rd Ed., Wiley Interscience, 2006.
3. D. A. Neamen and D. Biswas, "Semiconductor Physics and Devices," 4th Ed, Tata McGraw Hill, 2012.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. draw the crystalline structure of various kinds of semiconductors
2. apply interesting properties of many magnetic materials in electronic applications
3. process various semiconductors
4. characterize different types of semiconductors
5. calculate energy eigen values and eigen functions in a quantum-mechanical system
6. compute equilibrium carrier concentrations, and band diagram of semiconductors

7. calculate mobility of carriers, and current densities
8. apply semiconductor equations and statics to compute excess carrier concentration, generation and recombination rates, and quasi-Fermi levels
9. determine absorption of light in a semiconductor

EC2.1.6 – CIRCUIT AND NETWORK LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Hands-on experiments related to the course contents of **EC2.1.2**.

Resistor: Measurement of input resistance of a voltmeter, single stage and cascaded attenuator design and measurements

Capacitors: Measurements of audio frequency response of RC circuits with electronic voltmeter, study of pulse response of RC circuits with CRO, integration and differentiation.

Inductors: Experiments on audio frequency and pulse response of RL circuits.

RLC circuits: Audio frequency and pulse response

ECOE2.1.7.1 – ALGORITHMS AND ADVANCED DATA STRUCTURES LABORATORY [0 1 3]

CREDIT: 2.5 **Contact: 4 hours per week; Total 48 Hours**

The objective of the course is to familiarize students with basic data structures and their use in fundamental algorithms.

Introduction to data structure and algorithms. Stacks, queues, and linked lists.

Dictionaries: skip-lists, hashing, analysis of collision resolution techniques.

Trees, traversals, binary search trees, optimal and average BST's. 2-4 trees and red-black trees.

Tries and pattern matching. Priority queues and binary heaps.

Sorting: merge, quick, radix, selection, heap.

Graphs, Breadth first search and connected components.

Depth first search in directed and undirected graphs and strongly connected components.

Spanning trees: Prim's and Kruskal's algorithm, union-find data structure.

Dijkstra's algorithm for shortest paths, shortest path tree. Directed acyclic graphs: topological sort and longest path.

EXPERIMENTS

1. Design and implementation of an N-element stack along with PUSH, POP operation.
2. Design and Implementation of stack to perform infix to postfix conversion and to evaluate the postfix expression.
3. Design and Implementation of an N-element queue having properties like-
   a) Insertion, b) retrieval, c) throwing status message like queue FULL and queue EMPTY etc.
4. a) Implementation of singly connected linked list, b) its traversal, c) insertion of node at the beginning/ middle/end of the linked list, d) deletion of node from the beginning/ middle/end of the linked list e) reversal of the linked list, f) splitting of the linked list etc.
5. Design and implementation of circular linked list, concatenation of two circular linked lists etc.
6. Implementation of sorting methods like- a) Quick Sort, b) Merge Sort, c) Selection Sort etc.
7. a) Implementation of Binary search tree, b)Data insertion, c) Data deletion, d) Pre-order, post-order and in-order traversal of tree.
8. Implementation to perform following operation in graph-
   a) DFS traversal
   b) BFS traversal

Suggested Books

1. Data Structures", Seymour Lipschutz: The McGraw-Hill.
1. Introduction to Algorithms, Cormen, Leiserson, Rivest and Stein: Prentice Hall of India.
2. Data Structures and Algorithms: Aho, Hopcroft and Ullmann: Addison Wesley.

EC 2.1.8- ELECTRONICS WORKSHOP [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Design and construction of small power transformer.

To construct two mutually coupled RF coils and measure their inductances,

self-capacitances, mutual inductance and self-coefficient of coupling and also study the variation of Q of one of the coils with frequency.

Fabrication of Printed Circuit Board

Determination of carrier concentration and mobility of a semiconductor using Hall Effect measurements

Determination of the band-gap of a semiconductor

Fabrication and characterization of a Schottky diode

ECHS2.1.9 – HUMAN VALUES AND PROFESSIONAL ETHICS [3 0 0]

CREDIT: 3 **Contact Hours: 36L**

The values of liberal society. The nature and characteristics of professions. Obligations and professional services. Obligation to clients, professions and third parties.

The foundations and norms of professional ethics. The need for separate code of conduct for professionals. The relation between professional and general ethics. Moral conflict and the issue of autonomy of professional ethics.

Certain specific issues pertaining to medical ethics, legal ethics, environmental ethics, computer ethics and business ethics would be discussed.

Texts/References:

Camenisch, P.F.: Grounding Professional Ethics in a Pluralistic Society, N.Y.: Haven Publications, 1983.

Bayles, M.D.: Professional Ethics, California: Wardsworth Publishing Company, 1981.

Koehn, D. : The Ground of Professional Ethics, Routledge, 1995.

Wuest, D.E. : Professional Ethics and Social Responsibility, Rowman & Littlefield, 1994.

SEMESTER-IV

EC2.2.1 – ANALOG CIRCUITS [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Diode Circuits, Amplifier models: Voltage amplifier, current amplifier, trans- conductance amplifier and trans-resistance amplifier. Biasing schemes for BJT and FET amplifiers, bias stability, various configurations (such as CE/CS, CB/CG, CC/CD) and their features, small signal analysis, low frequency transistor models, estimation of voltage gain, input resistance, output resistance etc., design procedure for particular specifications, low frequency analysis of multistage amplifiers.

High frequency transistor models, frequency response of single stage andmultistage amplifiers, cascode amplifier. Various classes of operation (Class A, B, AB, C etc.), their power efficiency and linearity issues. Feedback topologies: Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth etc., calculation with practical circuits, concept of stability, gain margin and phase margin.

Oscillators: Review of the basic concept, Barkhausen criterion, RC oscillators(phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), non-sinusoidal oscillators. Current mirror: Basic topology and its variants, V-I characteristics, outputresistance and minimum sustainable voltage (VON), maximum usable load. Differential amplifier: Basic structure and principle of operation, calculation of differential gain, common mode gain, CMRR and ICMR. OP-AMP design: design of differential amplifier for a given specification, design of gain stages and output stages, compensation.

OP-AMP applications: review of inverting and non-inverting amplifiers, integratorand differentiator, summing amplifier, precision rectifier, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop, design guidelines.

Text/Reference Books:

1. J.V. Wait, L.P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, McGraw Hill, 1992.
2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill, 1988.
3. P. Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press, 1989.
4. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College11
5. Publishing, Edition IV
6. Paul R. Gray and Robert G.Meyer, Analysis and Design of Analog Integrated Circuits, John Wiley, 3rd Edition

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the characteristics of diodes and transistors
2. Design and analyze various rectifier and amplifier circuits
3. Design sinusoidal and non-sinusoidal oscillators
4. Understand the functioning of OP-AMP and design OP-AMP based circuits

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EC2.2.2 – ELECTRONIC DEVICES [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Introduction to Semiconductor Physics: Review of Quantum Mechanics, Electrons in periodic Lattices, E-k diagrams. Energy bands in intrinsic and extrinsic silicon; Carrier transport: diffusion current, drift current, mobility and resistivity; sheet resistance, design of resistors

Generation and recombination of carriers; Poisson and continuity equation P-N junction characteristics, I-Vcharacteristics, and small signal switching models; Avalanche breakdown, Zener diode, Schottky diode

Bipolar Junction Transistor, I-V characteristics, Ebers-Moll Model,MOS capacitor, C-V characteristics, MOSFET, I-V characteristics, and small signal models of MOS transistor, LED, photodiode and solar cell;

Integrated circuit fabrication process: oxidation, diffusion, ion implantation, photolithography, etching, chemical vapor deposition, sputtering, twin-tub CMOS process.

p-n-p-n Switching Device: p-n-p-n diode, basic structure, The two terminal analogy, forward blocking state, conduction state, triggering mechanisms, reverse blocking and breakdown, operation of SCR: Gate Control, turning off the SCR, concept of bilateral device and its application: UJT, DIAC, TRIAC.

Text /Reference Books:

1. G. Streetman, and S. K. Banerjee, “Solid State Electronic Devices,” 7th edition, Pearson,2014.
2. D. A. Neamen and D. Biswas, “Semiconductor Physics and Devices,” 4th Ed, Tata McGraw Hill, 2012.
3. S. M. Sze and K. N. Kwok, “Physics of Semiconductor Devices,” 3rd edition, John Wiley &Sons, 2006.
4. C.T. Sah, “Fundamentals of solid state electronics,” World Scientific Publishing Co. Inc, 1991.

5. Y. Tsividis and M. Colin, "Operation and Modeling of the MOS Transistor," Oxford Univ.Press, 2011.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand the principles of semiconductor Physics

Understand and utilize the mathematical models of semiconductor junctions and MOS transistors for circuits and systems

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EC2.2.3 – CONTROL THEORY AND SYSTEMS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Introduction: Notion of feedback; open and closed loop systems; various types of control system with examples

Mathematical Modeling and representations: Basic control system components; Electrical analogy of spring-mass-dashpot system; DC generator and servomotor; Block diagram algebra; Reduction of a block diagram to canonical form; signal flow graph and its construction; Mason's gain formula; Different feedback characteristics of control system

Transfer function: Linear Time Invariant (LTI) systems; concept and definition of transfer function; poles and zeroes of a transfer function zero state and zero input response; free and forced responses, performance indices

Time domain analysis: Standard Test signals; time domain transient and steady state analysis and response: first order system; second order systems; performance criteria; steady state error; Concept of system types, error constants and error series; Effects of poles and zeroes on transient response

Stability: Absolute and relative stability; Routh- Hurwitz criterion; Nyquist stability criteria; Nyquist Plot; interpretation of Nyquist Plot; gain margin and phase margin; System with transportation lag

Frequency response analysis: Frequency responses; Bode diagrams; Relative stability and Bode diagram; All pass and Minimum phase system; Constant-M and Constant-N Nichol's Chart; Approximation of transient response from Constant-N Nichol's Chart;

Root-locus analysis and design: Root-locus principles; rules for root-locus construction; construction techniques of root-locus; properties of root-locus and root-locus design

Control system design: Gain compensation; pole-zero compensation; lead, lag and lag-lead compensation, elements of PD, PI and PID controller, industrial controller

Modern control systems: Analytical tools; conventional control versus modern control; state variable approach; concept of state models; state equations; output equations; Diagonalization; eigen values and eigen vectors; solution of state equation; state transition matrix; state diagram; relation between transfer function and differential equation; characteristics equation; Controllability and Observability

Books:

1. K. Ogata, "Modern Control Engineering", 4e, Pearson Education.
2. I.J. Nagrath & M. Gopal, "Control Systems Engineering", New Age International publication.
3. D. Roy Choudhury, "Control system Engineering", PHI
4. B.C. Kuo, "Automatic Control System", PHI

Reference Books:

1. B.S. Manke, "Linear Control Systems," Hanna Publications, Delhi
2. Bandyopadhyaya, "Control Engineering Theory and Practice", PHI
3. Norman S, Nise, "Control System Engineering", 3rdEdition, John Wiley & Sons.
4. R.C. Dorf & R.H. Bishop, "Modern Control System", 11e : Pearson Education
5. Graham C Goodwin, Stefan F. Graebe, Mario E. Salgado, Control System Design, PHI
6. Macia & Thaler, Modeling & Control of dynamic system. Thompson.

Course Outcomes:

Students successfully completing the course will be able to-

1. understand the fundamental aspects of feedback based control system
2. understand the concept of mathematical modeling of different physical system which are suitable for analysis and design of control system
3. perform time response and frequency response based stability as well as performance analysis of the control system
4. apply the fundamental knowledge of time response and frequency response analysis for the designing of controller

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ECEL2.2.4.1 – COMMUNICATION PRINCIPLES & TECHNIQUES [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Introduction: Basic elements of communication systems. Signal-to-noise ratio, channel bandwidth, information rate. Fundamental constraints.

Communication Signals and Spectra: Time and Frequency domain representation of communication signals. Line spectra , average power, aperiodic signals, continuous spectra, Fourier transformation, properties of the unit impulse, step and signum functions, convolution

and multiplication, time and frequency convolution, properties of Fourier transformation, time delay and scale change, frequency translation and modulation, differentiation and integration, phasors.

Signal Transmission and Filtering: Linear time-invariant system. Impulse response, superposition integral, transfer function and frequency response, signal distortion in transmission.Distortionless transmission, linear distortion , equalization. Nonlinear distortion and companding. Filters and filtering, ideal filters, pulse response and rise time, quadrature filters and Hilbert transforms. Correlation and spectral density. Correlation of power signals, correlation of energy signals, input-output correlations. Parseval's power theorem, spectral density functions, Wiener-Khinchin theorem.

Amplitude Modulation : Modulation principles. Bandpass signals , AM modulation, DSB-SC modulation, SSB and VSB modulation. Different types of modulator circuits. Square law modulator, balanced modulator, ring modulator for AM generation. Phase-shift methods, successive filtering technique for SSB generation. Vestigial filter for VSB-SC signal. Different types of demodulator circuits. Envelope detector, synchronous detector.

Angle Modulation: Phase and frequency modulation. Single tone and multi-tone frequency modulation. Narrowband and wideband FM. Transmission bandwidth of FM signal. Generation of Narrowband and Wideband FM. Different types of FM modulators. Armstrong method of FM generation. Varactor diode modulator, reactance modulator. Demodulation of FM/PM signals. Principle of FM demodulation. Use of PLL for FM detection. Different types of FM demodulators, discriminators.

Radio Receivers: TRF receiver. Principle of superheterodyne receiver.AM broadcast receivers.RF amplifier, mixer, IF amplifier, detector, AGC and tone control. Selectivity, sensitivity of the receiver.FM receivers. Noise limiter, squelch, AFC, tuning indicator, volume expander. SSB receivers, measurement of receiver performance.

Noise: Classification and origin of noise. Thermal noise. Noise power spectral density and available noise power.White noise, coloured noise. Equivalent temperature, noise figure, noise bandwidth. Signal transmission in the presence of noise. Signal-to-noise ratio in SSB, DSB, AM systems for synchronous, envelope and square-law detection. Threshold effect. Signal-to-noise ratio in FM system. Pre-emphasis and de-emphasis.

Suggested Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, Zhi Ding, The Oxford Series in Electrical and Computer Engineering

2. An Introduction to Analog and Digital Communications, Simon S. Haykin, Michael Mohen, Wiley
3. Principles of Communication systems, Herbert Taub, Donald Schilling, GoutamSaha, Tata McGraw-Hill
4. Communication System: An Introduction to Signal and Noise in Electrical Communication, A Bruce Carlson, Paul B. Crilly and Janet Rutledge, McGraw Hill Publishers
5. Analog and Digital Communication Systems, Martin S. Roden, Prentice Hall India Learning.
6. Electronic Communications: Modulation and Transmission, Robert J. Schoenbeck, Prentice Hall India Learning
7. Modern Communication Systems, Principles and Applications, Leon W. Couch, Prentice Hall India Learning
8. Advanced Electronic Communications Systems, Wayne Tomasi, Prentice Hall India Learning.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise

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ECHN2.2.5 – ANTENNAS AND RADIO WAVE PROPAGATION [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Fundamental Concepts- Physical concept of radiation, Radiation pattern, near-and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency.

Wire Antennas- Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Aperture and Reflector Antennas-Huygens' principle, radiation from rectangular and circular apertures, design considerations, Radiation from sectorial and pyramidal horns, design concepts, prime-focus parabolic reflector and Cassegrain antennas.

Broadband Antennas- Log-periodic and Yagi-Uda antennas, frequency independent antennas, broadcast antennas.

Microstrip Antennas- Basic characteristics of micro strip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Dielectric Resonator Antennas- Basic Principle, Resonant mode in rectangular and cylindrical structures, design Aspects.

Array Antennas-Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays, and synthesis of antenna arrays.

Smart Antennas-Basic concept, benefits of smart antennas, fixed weight beam forming basics, Adaptive beam forming.

Different modes of Radio Wave propagation used in current practice:

Sky wave propagation: Structure of the ionosphere. Application of ionized layers as reflector of radio signals. Mechanism of refraction. Skip distance. Effect of Earth's magnetic field. Energy loss in the ionosphere due to collisions. Maximum Usable Frequency. Fading and diversity mechanisms.

Space wave propagation: Reflection from ground for vertically and horizontally polarized waves. Reflection characteristics of Earth. Resultant of direct and reflected ray at the receiver. Duct propagation.

Ground wave propagation: Attenuation characteristics for ground wave propagation, Calculation of field strength at a distance.

Text/Reference Books:

1. J.D. Kraus, Antennas, McGraw Hill, 1988.
2. C.A. Balanis, Antenna Theory - Analysis and Design, John Wiley, 1982.
3. R.E. Collin, Antennas and Radio Wave Propagation, McGraw Hill, 1985.
4. J. Volakis, Antenna Engineering Handbook, McGraw Hill, 2018.
5. Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon, Microstrip Antenna Design Handbook, Artech House, 2001.
6. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill, 2005
7. R.E. Crompton, Adaptive Antennas, John Wiley
8. S. K Mitra, The Upper Atmosphere, Asiatic Society Monograph Series, 5.
9. K.G. Budden -Radio waves in the ionosphere, Cambridge University Press
10. J. Griffiths Radio Wave Propagation and Antennas: An Introduction, Prentice Hall

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the design specifications and characteristics of various types of antennas.

2. Understand the Radio Wave Propagation characteristics of various Atmospheric Layers.

EC2.2.6 – ANALOG CIRCUITS LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

1. Simulation and measurement of current-voltage characteristics of Bipolar Junction Transistors (BJTs) and current-voltage characteristics of MOSFET and determination of various parameters.

2. Design of a two-stage R-C coupled amplifier using BJTs, and simulation and measurement of its gain and bandwidth. Multi stage BJT-based Amplifier.

3. Differential Amplifier. (Study of Differential Gain, Common Mode Gain, and CMRR etc). **OPAMP circuits:** Comparators, Schmitt Trigger, audio oscillators and Butterworth active filters – design and measurements.
4. Design, simulation and measurement of gain and other parameters for Instrumentation Amplifier Circuit
5. Design of an active low pass filter (LPF) using OPAMP, and its simulation and measurement to obtain output response, pass band gain and cut-off frequency.
6. Design of an active high pass filter (HPF) using OPAMP, and its simulation and measurement to obtain output response, pass band gain and cut-off frequency.
7. Design of an active band pass filter (BPF) using OPAMP and its simulation and measurement to obtain output response, quality factor, bandwidth, and low and high cut-off frequencies.
8. Design, simulation and measurement of the characteristics for Precision Rectifier Circuit.
9. Design, simulation and measurement of the characteristics for RC Oscillator Circuit.
10. Design, simulation and measurement of the characteristics for Multivibrator Circuits using IC 555 timer.
11. Simulation and measurement of current-voltage characteristics of MOSFET and determination of various parameters.

ECEL2.2.7.1 – ANALOG COMMUNICATIONS LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Hands-on experiments related to the course contents ECEL2.2.4.1

Study of Amplitude Modulation and Demodulation.
Study of Frequency Modulation and Demodulation.
Study of Phase Modulation and Demodulation.
Study of effects of noise on signals.

ECHN2.2.8 – ANTENNA LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

1. Radiation Pattern of dipole antenna.
2. Radiation Pattern of a folded-dipole antenna.
3. Radiation pattern of a 3-element Yagi-Uda Antenna.
4. Beam width, gain and radiation pattern of a 3-element, 5-element and 7- element, Yagi-Uda antenna - Comparative study.
5. Radiation pattern, Gain, Directivity of a Pyramidal Horn Antenna.
6. Measure far field radiation patterns of the following printed antennas:
    a. Circular micro-strip patch antenna
    b. Cavity enclosed micro-strip patch antenna
    c. Printed dipole antenna
7. Calculate the half power beam width in the E-plane and H-plane of the antennas and compute their directivity.
8. Measure the gain of the antennas using gain transfer method

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ECHN2.2.9 – ENVIRONMENTAL SCIENCE [2 0 0]

CREDIT: 0 **Contact Hours: Total 24L**

Introduction: Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission and effluents.

Pollution Prevention: Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.

Air Pollution Control: Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers.

Water Pollution Control: Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation.

Biological Treatment: Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying.

Solids Disposal: Solids waste disposal - composting, landfill, briquetting / gasification and incineration.

Reference:

https://nptel.ac.in/downloads/103107084/

SEMESTER-V

EC3.1.1 – DIGITAL SYSTEM DESIGN [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Logic Simplification and Combinational Logic Design: Review of Boolean Algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

MSI devices like Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

Sequential Logic Design: Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo-Random Binary Sequence generator, Clock generation.

D/A and A/D Converters : Weighted resistor and R-2R ladder type D/A converter; Parallel-comparator type; Successive approximation type; Dual Slope; Counting A/D converters.

Logic Families and Semiconductor Memories: TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing, Memory elements, Concept of Programmable logic devices like FPGA. Logic implementation using Programmable Devices.

VLSI Design flow: Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data typesand objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation

VHDL constructs and codes for combinational and sequential circuits.

Text/Reference Books:

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. Douglas Perry, "VHDL", Tata McGraw Hill, 4th edition, 2002.
3. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition ,2006.
4. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits
2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation

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EC3.1.2 – COMPUTER ARCHITECTURE AND ORGANIZATION [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Basic Structure of Computers, Functional units, software, and performance issues software, machine instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly language, Stacks, Queue, Subroutines.

Processor organization, Information representation, number formats.

Multiplication & division, ALU design, Floating Point arithmetic, IEEE-754 floating point formats. Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit. Microprogrammed Control - Basic concepts, minimizing microinstruction size, multiplier control unit. Microprogrammed computers - CPU control unit

Memory organization, device characteristics, RAM, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces
Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network

Text/Reference Books:

1. M.M.Mano, “Computer System Architecture”, Edition
2. C.W.Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
3. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition
4. V.Carl Hammacher, “Computer Organisation”, Fifth Edition.
5. A.S.Tanenbum, “Structured Computer Organisation”, PHI, Third edition
6. Y.Chu, "Computer Organization and Microprogramming”, II, Englewood Chiffs, N.J., Prentice Hall Edition

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand basic principles of computer’s working
2. Understand how computers are designed and built

3. Analyze the performance of computers
4. Understand issues affecting modern processors (caches, pipelines etc.).

EC3.1.3 – DIGITAL COMMUNICATION [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Introduction: A historical perspective in the development of digital communication. Elements of a communication system. Advantages and shortcomings of a digital link.

Information System and Channel Capacity: Measure of information, information content of a message. Entropy, information rate, source encoding. Error free communication in noisy channels. Channel capacity. Shannon-Hartley theorem, bandwidth S/N trade-off. Ideal communication systems.

Baseband Formatting Techniques: Sampling , Quadrature sampling, Quantization, Companding, PCM, DPCM, ADPCM, Delta Modulation, ADM, Delta Sigma modulation, Linear predictive coders, vocoder, Digital Multiplexers, T1 system.

Line coding: Line codes, desirable features, Line codes in use, UPNRZ, UPRZ, PNRZ, PRZ, AMI, Manchester, HDB3**,** Duo-binary, Differential encoding and spectral characteristics

Baseband Reception Techniques: Noise in Communication Systems; Receiving Filter – Correlator type, Matched Filter type, Equalizing Filter - Signal and system design for ISI elimination, Implementation, Raised Cosine Filter, Eye Pattern analysis; Bit Synchronisation, Frame Synchronisation, Scrambler.

Bandpass Signal Transmission and Reception: Memory less modulation methods - Representation and Spectral characteristics, ASK, PSK, QAM, QPSK, FSK; Bandpass receiving filter, Error performance – Coherent and Non-coherent detection systems.

SPREAD Spectrum Modulation: PN sequence, Direct Sequence Spread Spectrum(DSSS), Frequency Hopping Spread Spectrum(FHSS), Code Division Multiple Access of DSSS, Applications.

Error Control Coding: Basic Concept, FEC, ARQ, Hybrid ARQ, Factor Describing FEC code, Parity Check and Detection, Block Code, BCH codes, Cyclic Codes, Convolution Codes.

Suggested Books:

1. S. Haykin, “Communication System", John Wiley & Sons.
2. B.P.Lathi and Zhi Ding, " Modern Digital and Analog Communication Systems", Oxford University Press.
3. H. Taub and D. L. Schilling, "Principle of Communication System", Tata Mc Graw Hill.
4. W. Tomasi, " Electronic Communication System", Pearson Education.
5. A. Bhattacharya, " Digital Communication", Tata Mc. Graw Hill.
6. J.G. Proakis, “Fundamentals of Communication Systems”, Pearson Education.
7. B. Sklar, Digital Communication, Pearson Education.
8. L. W. Couch, "Digital and Analog Communication Systems", Pearson Education.

Course Outcomes:

At the end of this course students will demonstrate the ability to

3. Analyze and compare different digital modulation schemes for their efficiency and bandwidth
4. Analyze the behavior of a communication system in presence of noise
5. Investigate pulsed modulation system and analyze their system performance

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ECEL3.1.4.1 – SATELLITE COMMUNICATIONS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Introduction to Satellite Communication: Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication.

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity etc. of a satellite, concepts of Solar day and Sidereal day.

Satellite sub-systems: Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems etc.

Typical Phenomena in Satellite Communication: Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.
Satellite link budget

Flux density and received signal power equations, Calculation of System noise temperature for satellite receiver, noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

Text /Reference Books:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill,2009

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

ECHN3.1.5 – PROBABILITY THEORY AND STOCASTIC PROCESS [2 0 0]

CREDIT: 2 **Contact Hours: 24 L**

Sets and set operations; Probability space; Conditional probability and Bayes theorem; Combinatorial probability and sampling models.

Discrete random variables, probability mass function, probability distribution function, example random variables and distributions; Continuous random variables, probability density function, probability distribution function, example distributions; Joint distributions, functions of one and two random variables, moments of random variables;

Conditional distribution, densities and moments; Characteristic functions of a random variable;

Random sequences and modes of convergence (everywhere, almost everywhere, probability, distribution and mean square); Limit theorems; Strong and weak laws of large numbers, central limit theorem.

Random process. Stationary processes. Mean and covariance functions. Ergodicity. Transmission of random process through LTI. Power spectral density.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

EC3.1.6 – DIGITAL SYSTEM DESIGN LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Hands-on experiments related to the course contents EC3.1.1

1. Experiments on TTL NAND and NOR gates as universal logic module.
2. Design and testing of a) Half adder/subtractor circuits b) Full adder/subtractor circuits c) 9's/10's complement generator d) Parity checker/generator e) Comparator circuit using basic NAND/NOR or 4 bit adder (7483) chip and 7485.
3. Experiments on Multiplexers using 74153.
4. Experiments on Demultiplexers using 74155.
5. Experiments on Encoding/Decoding logic using 74138 and basic gates.
6. Experiments on a) Latches/flip-flops by NAND/NOR logic b) Seven Segment displays both CA/CC type.
7. Experiments on Asynchronous and Synchronous counters. Design of Hybrid Counters.
8. Experiments on shift registers using 7474 and NAND gates.
9. Experiments on semiconductor memories using 7489.

EC3.1.7 – DIGITAL COMMUNICATION LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Hands-on experiments related to the course contents EC3.1.3

i. Experiments on Amplitude Shift Keying Modulation and Demodulation.
ii. Experiments on Phase Shift Keying Modulation and Demodulation.
iii. Experiments on Frequency Shift Keying Modulation and Demodulation .
iii. Study and spectral analysis of various Line Codes.
iv. Study of Time Division Multiplexing and De multiplexing.
v. Study of Pulse Amplitude Modulation at Natural Sampling.
vi. Study of Pulse Amplitude Modulation at Flat Top Sampling.
vii. Study of Pulse Width Modulation.
Viii. Study of Pulse Position Modulation.
ix. Experiment on Pulse Code Modulation Technique.
x. Experiment on Delta, Adaptive Delta Modulation and Demodulation.

EC3.1.8 – ELECTRONIC DEVICE LABORATORY [0 1 3]

CREDIT: 2.5 **Contact: 3 hours per week; Total 48 Hours**

Hands-on experiments related to the course contents EC2.2.2

Experiment on JFET: I-V characteristics, design of common source amplifier and frequency response characteristics, JFET as voltage variable resistor (VVR).

Experiment on Solar cell and LDR: Solar Cell - Photodiode characteristics, solar cell I-V characteristics, maximum power versus illumination, series resistance of solar cell, Fill-factor, Light Dependent Resistor (LDR) - I-V characteristics, resistance versus illumination.

Experiment on SCR: Critical gate-current characteristics, amplitude control circuit to trigger the SCR.

Experiment on UJT: I-V characteristics, Estimation of UJT parameter, Circuit for saw-tooth wave generation, Triggering of SCR using UJT.

Experiment on DIAC/TRIAC: Design of a phase-control circuit using RC-circuit, determination of phase angle and control voltage, range of power control, output power versus conduction angle.

ECOE3.1.9.1 – ADVANCED PROGRAMMING LANGUAGE LABORATORY [0 1 4]

CREDIT: 3 **Contact: 3 hours per week; Total 60 Hours**

Python Programming Language:

SEMESTER-VI

EC3.2.1 – COMPUTER NETWORKING [3 1 0]

CREDIT: 4 **Contact Hours: 48 L**

Introduction to computer networks and the Internet: Application layer: Principles of network applications, The Web and Hyper Text Transfer Protocol, File transfer, Electronic ail, Domain name system, Peer-to-Peer file sharing, Socket programming, Layering concepts.

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing. Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Transport layer: Connectionless transport - User Datagram Protocol, Connection-oriented transport – Transmission Control Protocol, Remote Procedure Call.

Congestion Control and Resource Allocation: Issues in Resource Allocation, Queuing Disciplines, TCP congestion Control, Congestion Avoidance Mechanisms and Quality of Service.

Network layer: Virtual circuit and Datagram networks, Router, Internet Protocol, Routing algorithms, Broadcast and Multicast routing

Link layer: ALOHA, Multiple access protocols, IEEE 802 standards, Local Area Networks, addressing, Ethernet, Hubs, and Switches.

Text Reference books:

1. J.F. Kurose and K. W. Ross, “Computer Networking – A top down approach featuring the Internet”, Pearson Education, 5th Edition
2. L. Peterson and B. Davie, “Computer Networks – A Systems Approach” Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, “Telecommunication Switching System and Networks”, Prentice Hall
4. S. Keshav, “An Engineering Approach to Computer Networking” , Pearson Education
5. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition
6. Andrew Tanenbaum, “Computer networks”, Prentice Hall
7. D. Comer, “Computer Networks and Internet/TCP-IP”, Prentice Hall
8. William Stallings, “Data and computer communications”, Prentice Hall

Course Outcomes:
At the end of this course students will demonstrate the ability to:

1. Understand the concepts of networking thoroughly.
2. Design a network for a particular application.
3. Analyze the performance of the network.

EC3.2.2 – MICROPROCESSOR AND MICROCONTROLLER [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Introduction to Microprocessors: Evolution, features and applications.

Microprocessor Architecture : Register section, Arithmetic and Logic Unit, Interface, Timing and Control Section

Organization of the Intel 8085: MPU Block diagram, Pin description, Generating Control signals, Demultiplexing Address/Data bus, Bus buffering, 8085 Instruction and Timing processes.

Instruction Set and Programming of the 8085: Data transfer, Arithmetic and Logic operation, Branching, Stack and Subroutines, Input and Output. Assembly Language Programming using the Instruction Set.

Interfacing Memory and I/O Devices : The Address map, Address decoding techniques, Memory Interfacing, Design of I/O Ports using MSI and PPI, Keyboard and Display interfacing, DAC and ADC interfacing techniques. Timer, Serial & Parallel IO.

Data Transfer Schemes : Synchronous, asynchronous and interrupt driven mode of data transfer, DMA transfer.

The 8085 Interrupt systems : Multiple interrupts, Masking and non-masking interrupts, Enabling and disabling interrupts, Device polling.

Organization of Intel 8086 : MPU Block diagram, Functions of Execution Unit(EU) and Bus Interface Unit(BIU) , Concept of instruction pipelining, Functions of different types of registers, Pin description, Difference between 8086 and 8088, Even and Odd byte and word access from memory. Arithmetic Coprocessors; System level interfacing design;

Addressing modes, Instruction Set and Assembly Language Programming of the 8086.

Interrupt in 8086.

Microcontroller: Main features of Intel 8051, Functional block, Programme and data memory structure.

Concepts of virtual memory, Cache memory, Advanced Microprocessor Architectures- Intel 286, 486, Pentium.
Introduction to RISC processors; ARM microcontrollers interface designs.

Text/Reference Books:

1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996
2. D A Patterson and J H Hennessy, "Computer Organization and Design The hardware and software interface. Morgan Kaufman Publishers.
3. Douglas Hall, Microprocessors Interfacing, Tata McGraw Hill, 1991.
4. Kenneth J. Ayala, The 8051 Microcontroller, Penram International Publishing, 1996.

Course Outcomes:
Students successfully completing the course will be able to -

1. Understand the microprocessor's and microcontroller's internal architecture and its operation within the area of application
2. Develop the requisite programming skill and apply them in different application development with the help of the instruction set for target microprocessor and microcontroller
3. Interface design of peripherals like, I/O, A/D, D/A, timer etc.
4. Develop systems using different microprocessors and microcontrollers

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EC3.2.3 – DIGITAL SIGNAL PROCESSING [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Sampling and reconstruction of signals: Sampling of analog signals, Sampling theorem, Aliasing, Reconstruction formula, Sampling of bandpass filter.

Discrete time systems: Attributes, Analysis of LTI systems, Inverse Systems, Frequency analysis, Discrete Fourier Transform (DFT), Circular convolution, DFT based implementation of linear convolution, Filtering of long data sequence, Z-Transform, Poles and Zeros, Fast Fourier Transform algorithm. Computational complexity of FFT.

Digital filter structures, Cascade and parallel structures, Propagation of input quantization noise to digital filter output.

Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations, Lowpass, Bandpass, Bandstop and High pass filters. Effect of finite register length in FIR filter design.

Design of FIR Digital filters: Window method, Park-McClellan's method.

Introduction to multi-rate signal processing: Decimation, Interpolation, Identity, Polyphase representation, Digital filter banks, Half band filters.

Application of DSP.Parametric and non-parametric spectral estimation.

Text/Reference Books:

1. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall, 1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms And Applications, Prentice Hall, 1997.
4. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
5. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
6. D.J.DeFatta, J. G. Lucas andW.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Represent signals mathematically in continuous and discrete time and frequency domain
2. Get the response of an LSI system to different signals
3. Design of different types of digital filters for various applications

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ECEL3.2.4.1 – MICROWAVE AND NAVIGATIONAL ELECTRONICS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

A. Microwave Engineering

Introduction: Microwave engineering – Areas of applications

Analysis of Microwave Transmission lines. Coaxial, Rectangular, Circular waveguide, Strip line, Microstrip line.

Microwave circuit analysis: Scattering parameter representation of microwave circuits: properties of S-parameters, signal flow graph and decomposition rules, applications to microwave junction characterization.

Passive circuit components: Application and design aspects of both waveguide and planer circuit based components like terminations, tuners, hybrids, couplers, attenuator, phase shifter, circulator, isolator, frequency meter, flanges, connectors and adapters. Lumped circuit elements at microwave frequency.

Active Sources: Tubes – Klystron, Traveling Wave Tube and Magnetron—only principle of operation and application view points, principle of dielectric heating and microwave oven. Solid state devices – Schottky diode, Varactor diode and PIN diode– features and fields of application, Gunn and IMPATT as oscillators and amplifiers.

Microwave Measurement Techniques: Impedance measurement - V.S.W.R method; Reflectometer method; use of Smith chart; Bridge method. Detection and measurement of power - Diode detector; Bolometer; thermocouple and calorimeter as microwave power sensors; balanced and self-balancing bridges. Q-measurement - Transmission method; V.S.W.R method; Transient decay or decrement method; Dynamic methods. Frequency and Noise figure measurement.

Fundamentals of EMI/EMC: Introduction, RF/microwave shielding for EMI/EMC, human exposure limit to RF/microwave radiation.

B. Navigational Engineering:

Introduction: Radar fundamentals, derivation of range equation, factors influencing the range performance, radar cross-section of targets and radar clutter.

Pulse and CW radar: Block diagram of pulsed radar, Doppler Effect in radar and FM-CW radar.

Pulse Doppler and MTI radar: MTI radar principle and system block diagram (POS and MOPA systems), blind speed and multiple staggered PRF to mitigate the effect of blind speed, digital MTI and blind phase.

Surveillance and Tracking radar: Effect of scanning on range performance, tracking radar principles and techniques (lobe switching, conical scan and monopulse technique).

Special radar techniques: Synthetic aperture radar, pulse compression radar.

Navigation: Early satellite-based navigation systems, Basic principle of operation of GPS, Indian Regional Navigation Satellite System (IRNSS)

Text Books:

1. Pozar, D. M., "Microwave Engineering", 4th Ed, John Wiley and Sons, New York, 2012.
2. Kar, Subal, "Microwave Engineering—Fundamentals, Design and Applications", Universities Press (India) Privet Lmited, 2016.
3. Liao, S. Y., "Microwave Devices and Circuits", 3RD Ed., Pearson Education Inc, India, 2003.
4. Skolnik, M. I., "Introduction to Radar Systems", 3rd Ed., Mc Graw-Hill Book Company, New York, 2001.

Reference Books:

1. Das, A., and Das, S. K., "Microwave Engineering", 2nd Ed., Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2009.
2. Gupta, K. C., "Microwaves", Wiley Eastern Limited, 1979.
3. Collin, R. E., "Foundations for Microwave Engineering", 2nd Ed., Wiley-IEEE Press, 2001.
4. Rizzi, P. A., "Microwave Engineering Passive Circuits", Prentice- Hall of India Pvt. Ltd., New Delhi, 1999.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various microwave system components their properties.
2. Appreciate that during analysis/ synthesis of microwave systems, the different mathematical treatment is required compared to general circuit analysis.
3. Design microwave systems for different practical application.
4. Understand the various principles of Navigational Electronics

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ECEL 3.2.4.2 - DIGITAL IMAGE AND VIDEO PROCESSING [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighborhood, adjacency, connectivity, distance measures.

Image Enhancements and Filtering-Gray level transformations, histogram equalization and

specifications, pixel-domain smoothing filters – linear and order-statistics, pixel-domain sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters –low-pass and high-pass, band-pass, notch filters.

Color Image Processing-Color models–RGB, YUV, HSI; Color transformations– formulation, color complements, color slicing, tone and color corrections; Color image smoothing and sharpening; Color Segmentation.

Image Segmentation- Detection of discontinuities, edge linking and boundarydetection, thresholding – global and adaptive, region-based segmentation.

Wavelets and Multi-resolution Image processing- Time, frequency analysis, continuous wavelet transforms, wavelet bases and multi-resolution analysis, wavelets and Subband filter banks, wavelet packets.

Image Representation - How to represent an image, significant features-invariant properties, shape descriptors, regional features, texture content, texture complexity

Fundamentals of Video Coding-Inter-frame redundancy, motion estimation techniques – full-search, fast search strategies, forward and backward motion prediction, frame classification, Video sequence hierarchy–Group of pictures, frames, slices, macro-blocks, Elements of a video encoder and decoder.

Text/Reference Books

1. R.C. Gonzalez and R.E. Woods, Digital Image Processing, Pearson Education, 3rd edition 2008

2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India, 2nd edition 2004

3. Murat Tekalp, Digital Video Processing, Prentice Hall, 2nd edition 2015

Course Outcomes

The students will learn:

1. Mathematical representation of various types of images and their analysis.

2. Enhancement of certain properties of images and Segmentation methods

3. Different algorithms for image feature extraction and pattern recognition

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ECHN3.2.5 – HIGH SPEED ELECTRONICS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Transmission line theory (basics), crosstalk and nonideal effects; signal integrity: impact of packages, vias, traces, connectors; non-ideal return current paths, high frequency power delivery, methodologies for design of high speed buses; radiated emissions and minimizing system noise;

Noise Analysis: Sources, Noise Figure, Gain compression, Harmonic distortion, Intermodulation, Cross-modulation, Dynamic range

Devices: Passive and active, Lumped passive devices (models), Active models (low vs high frequency)

RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers (and Distributed) Power Amplifiers, Class A, B, AB and C, D E Integrated circuit realizations, Cross-over distortion Efficiency RF power output stages

Mixers – Upconversion, Downconversion, Conversion gain and spurious response. Oscillators Principles. PLL. Transceiver architectures.

Printed Circuit Board Anatomy, CAD tools for PCB design, Standard fabrication, Micro-via Boards. Board Assembly: Surface Mount Technology, Through Hole Technology, Process Control and Design challenges.

Text/Reference Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall "High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices", August 2000, Wiley-IEEE Press
2. Thomas H. Lee, "The Design of CMOS Radio-Frequency Integrated Circuits", Cambridge University Press, 2004, ISBN 0521835399.
3. Behzad Razavi, "RF Microelectronics", Prentice-Hall 1998, ISBN 0-13-887571-5.
4. Guillermo Gonzalez, "Microwave Transistor Amplifiers", 2nd Edition, Prentice Hall.
5. Kai Chang, "RF and Microwave Wireless systems", Wiley.
6. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand significance and the areas of application of high-speed electronics circuits.
2. Understand the properties of various components used in high speed electronics
3. Design High-speed electronic system using appropriate components.

EC3.2.6 – MICROPROCESSOR AND MICROCONTROLLER LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Hands-on experiments related to the course contents EC3.2.2

1. Experiments on Assembly language Programming using Microprocessor kit.
2. Interfacing Experiments: Keyboard, Display, Wave shaping, etc.

EC3.2.8.2 – DIGITAL SIGNAL PROCESSING LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Hands-on experiments related to the course contents EC3.2.4.2

ECEL3.2.8.1 – MICROWAVE LABORATORY [0 0 4]

CREDIT: 2 **Contact: 4 hours per week; Total 48 Hours**

1. To study the characteristics of Reflex Klystron tube.
2. To measure the normalized unknown load impedance.
3. To measure the loaded Q- factor of a cavity resonator.
4. To measure attenuation of a transmission line and its impedance.
5. To measure the different parameters of a directional coupler.
6. To study the E- plane radiation pattern of a pyramidal horn antenna
7. To measure the principal radiation patterns of a microstrip patch antenna
8. To measure the principal radiation patterns of a printed dipole antenna
9. To measure the gain of an antenna

ECEL 3.2.8.2- DIGITAL IMAGE AND VIDEO PROCESSING LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Experiments related to the course contents ECEL 3.2.4.2

ECMC3.2.9 – CONSTITUTION OF INDIA AND CIVIL SOCIETY [2 0 0]

CREDIT: 0 **Contact Hours: 24L**

ECOE3.2.10 – MINI-PROJECT/ELECTRONIC DESIGN WORKSHOP [0 0 4]

CREDIT: 2 **Contact: 4 hours per week; Total 48 Hours**

Hands on hardware projects

ECP3.2.11 – INDUSTRIAL TRANING / INTERNSHIP (SUMMER/JUNE) [0 0 0]

CREDIT: 3 **Contact: 36 Hours**

SEMESTER-VII

ECEL4.1.1.1 – INSTRUMENTATION AND POWER ELECTRONICS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Qualities of Measurements: Static and Dynamic Characteristics, Zero order instruments, First and second order instruments and their responses (to Step input, Ramp input & Sinusoidal input), Error in Measurement, Types of Static Error, Sources of Error, Statistical Analysis, Introduction to Reliability

Bridges: Whetstone's Bridge, Kelvin's Bridge, AC Bridges, Maxwell's Bridge, Hay's Bridge, Schering's Bridge, Wien's Bridge, Anderson Bridge, De Sauty Bridge,

Function generator and Oscilloscope: Use of non-linear transconductance to obtain an inverse function, linearization of transducer using function generator. Construction and principle of operation, Dual Trace Oscilloscope, (VHF) Sampling Oscilloscope, Storage Oscilloscope (for VLF Signal)

Microcomputer based instrumentation: Advantage of using the microprocessor in instruments, measurement of frequency, phase difference, time period, pulse width, power factor using microprocessor.

Data communication for Instrumentation: IEEE 488, RS232, USART, MODEM, Introduction to long distance data communication.

Power Semiconductor devices and their characteristics, Types of power electronic circuits, characteristics of switches, Thyristor operation, two transistor model, operation of SCR, DIAC, TRIAC, operation of MOSFET and IGBT.

Three phase rectifier, controlled rectifier, DC-DC converter, switch-mode DC-AC inverter, switching power supplies, speed control of DC motor.

Measurements on Semiconductors: Hot Point Probe, Measurement of Sheet Resistance, Measurement of Contact Resistance from TLM method, Hall Effect Measurement, The method of Haynes-Schokley to measure carrier mobility and diffusion coefficient, FTIR method, Split C-V Measurement, Zerbst technique to measure carrier lifetimes from MOS C-T data, Basic idea of SEM and TEM, Concept of Dynamic Light Scattering (DLS) technique for reliable measurement of size of nanoparticles, Measurement of photoluminescence.

Transducer: Capacitive and Piezoelectric Transducers, LVDT, Measurement of Temp and flow, RF Power measurement

References:

1. Electrical and Electronic Measurements and Instrumentation, by A K.Sawhney
2. Modern electronic instrumentation and measurement techniques, by Helfrick and Cooper
3. Operational Amplifiers: Design and Applications, by Gene E. Tobey
4. Microcomputer Theory and Applications with the Intel SDK-85, by Mohamed Rafiquzzaman
5. M.H. Rashid, "Power Electronics: Circuits, Devices and Applications", Prentice Hall of India Ltd.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.
5. Understand the various Electronics based measurement techniques.

ECEL 4.1.1.3 - SPEECH AND BIOMEDICAL SIGNAL PROCESSING [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Introduction to Speech production and modeling - Human Auditory System; General structure of speech coders; Classification of speech coding techniques; Requirements of speech coding –quality, coding delays, robustness.

Linear Prediction of Speech- Basic concepts of linear prediction; Linear Prediction Analysis of nonstationary signals, Long term and short-term linear prediction models; Moving average prediction.

Introduction to ECG signals and its nature, pre-processing of ECG signals, noise removal - baseline wondering, power line interference, RR signal construction by measuring the time interval of successive R peaks, Detection of QRS complex, Temporal and morphological features of RR signal, Decomposition of RR signal in wavelet domain, non linear models of feature, Detection of various heart diseases.

Text/Reference Books

1. Quatieri, T. F. (2002). Discrete-Time Speech Signal Processing, Prentice-Hall, New Jersey.

2. Rabiner, L. R., and Juang, B.-H. (1993). Fundamentals of Speech Recognition, Prentice-Hall, New Jersey.

3. U. R. Acharya, J. S. Suri, J. A. E. Spaan, S. M. Krisnan, Advances in Cardiac Signal Processing, Springer; 2007 edition.

Course Outcomes

At the end of the course, the students will learn:

1. Mathematical model of speech signal

2. Analysis procedure of speech signal.

3. ECG signal processing

4. ECG signal detection techniques

ECEL4.1.2.1 – OPTOELECTRONIC DEVICES AND FIBER OPTICS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Basic Optical Processes in Semiconductors: Equilibrium and Non-equilibrium conditions, Excess Carriers, Ambipolar transport, Direct and indirect band-gap semiconductors- Absorption and Recombination; Radiative and Non-radiative recombinations.

Optical Emitters: LED- principle, structure, materials, performance characteristics (L-I curve, efficiency, modulation, etc.); Semiconductor Laser-Principle, Structure, Performance characteristics (Threshold current, Power Output, Bandwidth, modes)

Optical Fiber: Structure, Light guiding mechanism, Numerical Aperture, Attenuation characteristics, Single mode and multimode fibers.

Optical Receivers: Front-end photo receivers, Photo detectors- types, structures, principles, performance characteristics- Quantum efficiency/Responsively, bandwidth, gain; preamplifiers-biasing, performance; Noise.

Optical Amplifiers: Stimulated Emission, Spontaneous Emission, Semiconductor Optical Amplifier, Erbium Doped Fiber Amplifier --principles, structures and performance characteristics.

Point-to-point Link: Building blocks; Intensity Modulation/Direct Detection system; Direct and External Modulation. Wavelength Division Multiplexing; Dispersion Compensation and Management.
Optical Networks: FDDI, SDH/SONET, Cable TV, WDM-Access Networks, FTTC, FTTH.

Suggested Books:

Semiconductor optoelectronic Devices, P. Bhattacharya, 6th Edition, PHI, New Delhi, 2002.

1. Fiber-optic Communication, G. Keiser, Tata McGraw Hill Publishing Company Limited, 4th Reprint, New Delhi, 2008.
2. Optoelectronics and Photonics: Principles and Practices, S. O. Kasap; Pearson (EEE), New Delhi, 2009.
3. Optical Networks, Ramaswami, Sivarajan, and Sasaki, Elsevier, Morgan Kaufmann, Third Edition, 2010

Course Outcomes:
At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors
4. Analyze system performance of optical communication systems
5. Design optical networks and understand non-linear effects in optical fibers

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ECHN4.1.3 – MICROELECTRONICS AND VLSI [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Manufacturing process: steps for MOS and Bipolar technology: Lithography, Doping, Oxidation, CVD/PVD, Etching, Process integration.

Design process: Issues in IC Design – size and compatibility, full custom, semi custom / ASIC: quality matrix – cost, robustness, performance, power consumption. Layout techniques schematic, stick diagram, physical design; scaling, design rules and DRC.

Design of digital circuits: Review of CMOS design techniques, CMOS inverter and basic gates, comparison with other logic families, static vs dynamic logic, delay calculation, logical effort, driving large capacitive loads.

The Wiring Network: Elmore delay calculation, lumped and distributed RC lines; delay in long lines-buffers and buffer placement.

Design Automation: Custom vs semi-custom circuit partitioning, placement and routing/ floorplanning; algorithms for physical design.

The MOS Device: Small Signal and Large Signal equivalent circuit; MOS device modeling; MOS SPICE models; SPICE simulation of MOS circuits.

MOS Components and Sub-circuits: MOS Switch; MOS Diode/Active resistors; MOS Capacitors; Switched Capacitor Resistor; Current Sinks and Sources; Current Mirrors; Current and Voltage reference; Bandgap reference; SPICE Simulation examples.

CMOS Amplifiers: Inverters - Characteristics and properties as amplifiers; Differential amplifiers; Cascade Amplifiers; Output Amplifiers; Gilbert cell; Frequency response characteristics; SPICE simulation examples.

Switched capacitors circuit: General considerations; Switched capacitor integrators; first and second order switched capacitor filter circuits.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Use tools for VLSI IC design.
3. To understand the fabrication process of CMOS technology

ECHN4.1.4 – MOBILE COMMUNICATION AND NETWORKS [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Cellular concepts-Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Signal propagation-Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate.

Capacity of flat and frequency selective channels. Antennas-Antennas for mobile terminal-monopole antennas, PIFA, base station antennas and arrays.

Multiple access schemes- FDMA, TDMA, CDMA and SDMA. Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM.

Receiver structure- Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff. Performance measures- Outage, average snr, average symbol/bit error rate. System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

Text/Reference Books:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill, 1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall, 1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York, 1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the working principles of the mobile communication systems.
2. Analyze mobile communication systems for improved performance

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ECEL4.1.5.1 – INSTRUMENTATION AND POWER ELECTRONICS LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

i. Load Measurement using Strain Gauged Load Cell at tensile and compressed mode.
ii. Measurement of small displacement using LVDT .
iii. Measurement of Pressure using LVDT.
iv. Design of a PID Controller to control the temperature of an oven sensed by a thermocouple.
v. Measurement of angular speed sensed by a proximity sensor.
vi. To study the characteristics of a thermocouple.
vii. Automated measurement of LVDT characteristics.
viii. Automated measurement of Photo diode characteristics.
ix. Chopper control circuit using Thyristor.
x. Study Bridge rectifier circuit by controlling phase of SCR

xi. Study of characteristics of IGBT.
xii. DC motor speed control using SCR

ECEL4.1.5.3 SPEECH AND BIOMEDICAL SIGNAL PROCESSING LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Simulation of speech processing techniques -Time-frequency analysis using MATLAB, Spectral analysis, Simulation of Speech Enhancement and Speech recognition procedures

Simulation model of ECG signal analysis, noise removal, Segmentation of ECG signals into frame, computation of non linear features, wavelet domain feature analysis, Identification of arrhythmia patterns

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ECEL4.1.6.1 – OPTOELECTRONIC DEVICES AND FIBER OPTICS LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Experiments on LED, Laser: LI characteristics.
Optical Fiber: Numerical aperture, attenuation measurements
Photodetector: V-I characteristics under different biasing, Current-power characteristics, saturation, Eye-diagram
Experiments with optical voice link module.

ECHN4.1.7 – MICROELECTRONICS AND VLSI LABORATORY [0 0 3]

CREDIT: 1.5 **Contact: 3 hours per week; Total 36 Hours**

Semiconductor processing: Wet and dry oxidation of Silicon, Dopant incorporation in Silicon, Photolithography, Etching, Physical Vapor Deposition

Study on the basics of Hardware Description Language and different modeling style. Application of the modeling styles for the following experiments using the hardware description language.

Experiments on the design and FPGA based implementation of basic logic gates, Boolean functions and their verifications

Experiments on the design and FPGA based implementation of Combinational Logic Circuits- MUX, DEMUX, Decoder, Adder etc. and verifications.

Experiments on the design and FPGA based implementation of Sequential Logic Circuits and Systems- Basic Flipflops, Ripple Up-Down Counter, Decade Counter etc. and their verification.

ECHS4.1.7 – ENGINEERING ECONOMICS AND INDUSTRIAL MANAGEMENT [3 0 0]

CREDIT: 3 **Contact Hours: 36 L**

Nature and Functions of the Economic System: Basic questions of Economics - The Economic System-Unit of Economic Analysis- How the economic system works - Possible alternatives of the organizational forms.

Market Morphology: Different market forms and their mechanism.

Demand Analysis: Demand theory-Methods of forecasting demand-Price relations-Income relations-Multiple relations.

Cost Analysis: Concepts of cost under different purposes-cost and rate of output-cost and size of the plant-cost and profit forecasting-short run and long run production function-firm's optimal decision relating to input combinations-expansion path of a firm- return to scale-short run and long run cost of production-average and marginal cost-supply curve for the firm and the industry.

Pricing: Price determination under different types of market-Cost plus pricing-cyclical pricing and other pricing mechanism including price differentials.

Capital Budgeting: Demand for capital-supply of capital-capital rationing-classification of capital expenditure-capital budgeting. The Circular Flow of Income: The model of circular flow of income-equilibrium in the circular flow income-household consumption-investment and saving-fluctuations in the levels of economic activity-theory of employment.

Money, Banking and the Price Level: The concept of money-functions of money-system of issue of paper money-role and functions of commercial and central banks-Credit money-demand for money- institutions of money market-determination of price level-value of money-inflation, deflation and stagflation.

National Income and National Product: Concept of national income and national product-measurement of national income difficulties and limitations-index number.

Government and Economic System: Role of Government-sources of Government revenue-deficit financing and its effects-Government regulation and business concentration-multinational firm and its regulations.

INDUSTRIAL MANAGEMENT: Introduction to Business Management and Industrial Organization: Concept, characteristics and classification of business activities. Types of business organizations: Features. Basic management and entrepreneurial decisions and considerations in establishing Business Enterprises. Plant Location: Plant layout, factory buildings.

Administrative Management: Concept, functions of management.

Materials Management: Industrial purchasing, storekeeping, materials handling, inventory management and control Production Planning and Production Control.

Scientific Management: Elements, contemporary thoughts in management.

Financial Management: Capital and capitalization, estimation of total capital requirement of a business – sources of finance,

Personnel Management: Wages, incentives, industrial discipline. Role of Computers in Management: Computers and management functions, computer based financial system, inventory system, computer in human resources management.

ECP4.1.9 – PROJECT WORK (FOUNDATION) [0 0 8]

CREDIT: 4 **Contact Hours: 48**

SEMESTER-VIII

ECP4.2.1 – GENERAL VIVA-VOCE [0 0 0]

CREDIT: 5

ECP4.2.2 – PROJECT WORK AND DISSERTATION [0 0 20]

CREDIT: 10
