



**Department of Electronics and Communication Engineering  
AU College of Engineering (Autonomous)**

**Scheme of Instruction, Examination and Syllabus  
(Grading System)**

**B.E. (Electronics and Communication Engineering) – 4 Year degree Course  
(With effect from 2006 - 2007 admitted batch onwards)**

**Department of Electronics and Communication Engineering  
AU College of Engineering (Autonomous)**

**Scheme of Instruction, Examination and Syllabus**

**B.E. (Electronics and Communication) – 4 Year Degree Course**

**Common Scheme of Instruction & Examination  
I/IV B.E./B.Tech (Four Year Course) – Semester System  
(with effect from 2006 – 2007 admitted batch onwards)**

**First Year**

**I & II Semesters**

Code No.	Subject	Credits	Periods		Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
			Theory	Tutorial / Lab				
ENG 1001	English – I	2	2	1	3	30	70	100
ENG 1002	Mathematics – I	4	3	-	3	30	70	100
ENG 1003	Mathematics – II	4	3	-	3	30	70	100
ENG 1004	Physics Theory	4	3	-	3	30	70	100
ENG 1005	Chemistry Theory	4	3	-	3	30	70	100
ENG 1006	History of Science and Technology	4	3	-	3	30	70	100
ENG 1007	Computer Programming and Numerical Methods	4	3	-	3	30	70	100
ENG 1008	Engineering Graphics	5	2	4	3	30	70	100
ENG 1009	Physics Laboratory	2	-	3	3	50	50	100
ENG 1010	Chemistry Laboratory	2		3	3	50	50	100
ENG 1011	Workshop	2		3	3	50	50	100
ENG 1012	Programming Laboratory	2		3	3	50	50	100
	Total	39	22	17		440	760	1200

**B.E. 3<sup>rd</sup> Semester****B.E. 2<sup>nd</sup> Year 1<sup>st</sup> Semester**

<i>Code No.</i>	<i>Subject</i>	<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
			<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
EEM 211	Mathematics-III	4	3	1	-	3	30	70	100
EME 212	Engineering Mechanics and Strength of Materials	4	3	1	-	3	30	70	100
EEE 213	Network Theory	4	3	1	-	3	30	70	100
ECE 214	Electrical Machines	4	3	1	-	3	30	70	100
ECE 215	Electronic Devices and Circuits	4	3	1	-	3	30	70	100
EEP 216	Material Science	4	3	1	-	3	30	70	100
ECE 217	Network Laboratory	2	-	-	3	3	50	50	100
ECE 218	Electronic Devices and Circuits Laboratory	2	-	-	3	3	50	50	100
	Total	28	18	6	6	-	280	520	800

**B.E. 4<sup>th</sup> Semester****B.E. 2<sup>nd</sup> Year 2<sup>nd</sup> Semester**

<i>Code No.</i>	<i>Subject</i>	<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
			<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
EEM 221	Mathematics – IV	4	3	1	-	3	30	70	100
ECE 222	Electromagnetic Field Theory & Transmission Lines	4	3	1	-	3	30	70	100
ECE 223	Analog Electronic Circuits	4	3	1	-	3	30	70	100
ECE 224	Probability Theory & Random Process	4	3	1	-	3	30	70	100
ECE 225	Signals and Systems	4	3	1	-	3	30	70	100
ECE 226	Advanced Network Theory	4	3	1	-	3	30	70	100
ECE 227	Environmental Studies	3	3	-	-	3	30	70	100
ECE 228	Electrical Machines Laboratory	2	-	-	3	3	50	50	100
ECE 229	Analog Electronic Circuits Laboratory	2	-	-	3	3	50	50	100
	Total	31	21	6	6	-	310	590	900

**B.E. 5<sup>th</sup> Semester**  
**B.E. 3<sup>rd</sup> Year 1<sup>st</sup> Semester**

Code No.	Subject	Credits	Periods			Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
			Theory	Tutorial	Lab				
ECE 311	Pulse and Digital Circuits	4	3	1	-	3	30	70	100
ECE 312	Linear ICs and Applications	4	3	1	-	3	30	70	100
ECE 313	Analog Communications	4	3	1	-	3	30	70	100
ECE 314	Core Elective - I	4	3	1	-	3	30	70	100
ECE 315	Switching Theory and Logic Circuits	4	3	1	-	3	30	70	100
ECE 316	Antennas and Wave Propagation	4	3	1	-	3	30	70	100
ECE 317	Free Elective - I	4	3	1	-	3	30	70	100
ECE 318	Linear ICs and Pulse Circuit Laboratory	2	-	-	3	3	50	50	100
ECE 319	Digital ICs Laboratory	2	-	-	3	3	50	50	100
ECE 320	Soft Skills	1	-	-	3	-	100	-	100
	Total	33	21	7	9	27	410	590	1000

**Core Elective - I**

1. Computer Architecture and Organization
2. Image Processing and Pattern Recognition
3. Information Networks

**Free Elective - I**

1. Civil : Traffic Engineering and Management
2. Mechanical : Statistical Quality Control
3. ECE : Basic electronic Devices & Applications
4. EEE : Non-conventional Energy Sources
5. Metallurgy : Engineering Materials
6. CSSE : Data Structures
7. Chemical : Corrosion Engineering
8. Marine : Power Plant Engineering
9. Instrument Tech : Electronic Instrumentation
10. Geo-Engg : Spatial Information Technology
11. Architecture : Interior Design

## B.E. 6<sup>th</sup> Semester

### B.E. 3<sup>rd</sup> Year 2<sup>nd</sup> Semester

Code No.	Subject	Credits	Periods			Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
			Theory	Tutorial	Lab				
EEE 321	Control Systems	4	3	1	-	3	30	70	100
ECE 322	Microprocessors and Applications	4	3	1	-	3	30	70	100
ECE 323	Data Structures (Common with Metallurgy)	4	3	1	-	3	30	70	100
ECE 324	Computer Network Engineering	4	3	1	-	3	30	70	100
ECE 325	Digital Communication	4	3	1	-	3	30	70	100
ECE 326	Core Elective - II	4	3	1	-	3	30	70	100
ECE 327	Analog communication Laboratory	2	-	-	3	3	50	50	100
ECE 328	Microprocessors & Applications Laboratory	2	-	-	3	3	50	50	100
	Total	28	18	6	6	-	280	520	800

#### Core Elective - II

1. EMI / EMC
2. Micro Electronics
3. Electronic Measurements and Instrumentation
4. Software Engineering

**B.E. 7<sup>th</sup> Semester**  
**B.E. 4<sup>th</sup> Year 1<sup>st</sup> Semester**

<i>Code No.</i>	<i>Subject</i>	<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
			<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
ECE 411	Digital Signal Processing	4	3	1	-	3	30	70	100
ECE 412	Information Theory and Coding	4	3	1	-	3	30	70	100
ECE 413	TV and Satellite Communication	4	3	1	-	3	30	70	100
ECE 414	Microwave Engineering	4	3	1	-	3	30	70	100
ECE 415	Core Elective - III	4	3	1	-	3	30	70	100
ECE 416	Digital Communication Laboratory	2	-	-	3	3	50	50	100
ECE 417	Digital Signal Processing Laboratory	2	-	-	3	3	50	50	100
ECE 418	Industrial Training and Seminar	2	-	-	-	-	100	-	100
ECE 427	Project	-	-	-	4	-	-	-	-
	Total	26	15	5	10	-	350	450	800

**Core Elective - III**

1. Cellular and Mobile Communications
2. VLSI Design and Embedded Systems
3. Advanced Microprocessors

**B.E. 8<sup>th</sup> Semester**  
**B.E. 4<sup>th</sup> Year 2<sup>nd</sup> Semester**

Code No.	Subject	Credits	Periods			Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
			Theory	Tutorial	Lab				
EHM 421	Engineering Economics and Management	4	3	1	-	3	30	70	100
ECE 422	Radar Engineering and Navigational Aids	4	3	1	-	3	30	70	100
ECE 423	Core Elective - IV	4	3	1	-	3	30	70	100
ECE 424	Fiber - Optic Communications	4	3	1	-	3	30	70	100
ECE 425	Free Elective - II	4	3	1	-	3	30	70	100
ECE 426	Microwave Engg. & Antenna Laboratory	2	-	-	3	-	50	50	100
ECE 427	Project	8	-	-	12	-	50	50	100
	Total	30	15	5	15	-	250	450	700

**Core Elective - IV**

1. Data Communications
2. Bio-Medical Signal Processing
3. Microwave Networks

**Free Elective - II**

1. Fundamentals of Mobile Communications
2. Basics of GPS

**NOTE:**

EHM indicates that the course is drafted by the Department of Humanities.  
 EME indicates that the course is drafted by the Department of Mechanical Engineering.  
 ECE indicates that the course is drafted by the Department of Electronics and Communication Engineering.  
 EEE indicates that the courses is drafted by Department of Electrical Engineering.  
 EEM indicates that the courses is drafted by Engineering Mathematics Department.  
 EEP indicates that the course is drafted by Engineering Physics Department

ECE 320 Soft Skills is common for all Branches

## ENG 1001 ENGLISH - I

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
2	2	1	3	30	70	100

The emphasis on English Language is enormously increasing as an effective medium of communication in all sectors the World over. As a consequence of this, the acquisition of effective communication skills in English has become most important to the students to flourish in their careers. In this connection there is a need to train the students to equip themselves with the necessary skills required for effective communication in English thereby enabling them to get a good placement immediately after the completion of their under-graduate courses. To meet the objectives of developing proficiency in English communication the following curriculum is designed for favorable consideration.

### **CURRICULUM: THEORY AND PRACTICE (LANGUAGE LAB)**

1. A textbook with focus on skills approach.

- Intended to develop the language skills of Listening, Speaking, Reading & Writing.

#### **2. Vocabulary**

- a) One - Word Substitution
- b) Words often Confused - Pairs of Words
- c) Synonyms and Antonyms
- d) Foreign Phrases
- e) Phrasal verbs derived from the following dynamic verbs

- Go, Get, Run, Take, Look, Hold, Put, Stand, Etc.

f) Idioms and Phrases

#### **3. Grammar**

- a) Error Analysis
- b) Tense
- c) Voice
- d) Concord
- e) Articles and Prepositions

#### **4. Writing Skills**

a) Précis Writing

b) Note Making

c) Letter Writing - (Letters of Enquiry, Invitation, Regret, Congratulations, Condolences, Complaint, Breaking the ice.)

d) Reading Comprehension

e) Content Writing : Paragraph Writing and Essay Writing

**Practice (Language Lab)**

1. Spoken English : Varieties
2. Speech Mechanism
3. The consonant and vowel sounds of English
4. Word Accent
5. Accent in Connected Speech
6. Rhythm and Intonation
7. conversation

**Textbook Prescribed:**

Select essays and short stories from Srivastava, B., and Mahesari, V.K. (Ed.) Modes of English Prose (An Anthology of prose selections).

**Reference Books:**

1. Sharma, G.V.L.N., English for Engineering Students.
2. Margaret M Maison, Examine your English, Macmillan
3. Krishnaswami, N. and Sriram, T., Current English for Colleges, Macmillan
4. Krishnaswami, N. and Sriram T., Creative English for Communication, Macmillan.

## ENG 1002 MATHEMATICS - I

Credits	Periods		Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
	Theory	Tutorial / Lab				
4	3	-	3	30	70	100

### **Partial Differentiation and its Applications**

Functions of two or more variables, partial derivatives, homogenous functions - Euler's Theorem, Total Derivative, Differentiation of implicit functions, Geometrical interpretation - Tangent plane and normal to a surface. Change of variables, Jacobians, Taylor's theorem for functions of two variables, Jacobians, Taylor's theorem for functions of two variables, Errors and approximations, Total differential, Maxima and minima of functions two variables, Lagrange's method of undetermined multiples, Differentiation under the integral sign - Leibnitz Rule, Involutes and evolutes.

### **Multiple Integrals and their Applications**

Double integrals, Change of order of integration, Double integrals in polar coordinates, Areas enclosed by plane curves, Triple integrals, Volume of solids, Change of variables, Area of a curve of a curved surface, Calculation of mass, center of gravity, center pressure, Moment of inertia, Product of inertia, Principle axes, Beta function, Gamma function, Relation between Beta and Gamma functions, Error function or probability integral.

### **Solid Geometry (Vector Treatment)**

Equation of a plane, Equation of straight line, Condition for a line to lie in a plane, Coplanar lines, Shortest distance between two lines, Intersection of three planes, Equation of sphere, Tangent plane to a sphere, Cone, Cylinder, Quadric surfaces.

### **Infinite Series**

Definitions, Convergence, Divergence and oscillation of a series, General properties, Series of positive terms, comparison tests, Integral test, D'Alembert's ratio test, Raabe's test, Logarithmic test, Cauchy's root test, Alternating series - Leibnitz's rule, Series of positive or negative terms, Power series, Convergence of exponential, Logarithmic and binomial series, Uniform convergence, Weirstrass M-test, Properties of uniformly convergent series.

### **Fourier Series**

Euler's formulae, Conditions for a Fourier expansion, Functions having point of discontinuity, Change of interval, Odd and even functions - Expansions of odd or even periodic function, Half range series, Parseval formula, Practical harmonic analysis.

### **Textbooks:**

Higher Engineering mathematics by B.S. Grewal  
Mathematics for Engineering by Chandrica Prasad

### **Reference Books:**

Higher Engineering Mathematics by M.K. Venkatraman  
Advanced Engineering Mathematics by Erwin Kreyzig

## ENG 1003 MATHEMATICS – II

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	-	3	30	70	100

### **Linear Algebra**

Rank of a matrix, Eigen values, Eigen vectors of a Matrix, Cayley Hamilton theorem, Consistency of equations, Matrix inversion, Gaussian elimination scheme, Cholesky factorization, Jacobi and Gauss-Seidal iterative methods for solving simultaneous equations, Eigen value solution using forward iteration, Inverse iteration, Hermitian and skew Hermitian forms, Unitary Matrix, Functions of a Matrix, Quadratic forms and conical forms.

### **Differential Equations of First Order and its Applications**

Formation of differential equation, Solution of a differential equation, Geometrical meaning, Equations of the first order and first degree, Variables separable, Homogeneous equations, Linear equations, Bernoulli's equation, Exact equations, Equation reducible to exact equations, Equations of the first order and higher degree, Clairaut's equation, Geometric applications, Orthogonal trajectories, Physical applications, Simple electric circuits, Heat flow, Chemical applications, Newton's law of cooling.

### **Linear Differential Equations**

Higher order linear differential equations with constant coefficients, Deflection of beams, Simple harmonic motion, Oscillatory electric circuits.

### **Series Solution of Differential Equations**

Frobenius method, Special function as solution from series, Bessel equation, Bessel functions of first and second kind, Equation reducible to Bessel's equations, Legendre's equations, Legendre polynomial, Rodrigues formula, Generating functions, Recurrence relation, Orthogonality relation for Bessel functions and Legendre polynomial.

### **Laplace Transforms**

Transforms of elementary functions, Properties of Laplace transforms, Existence conditions, Inverse transforms, Transform of derivatives, Transform of Integrals, Multiplication's by 't' - division by 't', Convolution theorem, Application to ordinary differential equations and simultaneous linear equations with constant coefficients, Unit step function, Impulse functions and periodic functions.

**Textbooks:**

Theory of Matrices by Shantinayanan

Higher Engineering Mathematics by B.S. Grewal

Advanced Mathematics for Engineering Students, Vol. 2 by Narayana, Manieavachgon Pillay,  
Ramanaiah

**Reference Books:**

Higher Engineering Mathematics by M.K. Venkataraman

Advanced Engineering Mathematics by Erwin Kreyozig

Engineering Mathematics by P.P. Gupta

A textbook on Engineering Mathematics by N.P. Bali

## ENG 1004 PHYSICS THEORY

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	-	3	30	70	100

### **Thermodynamics**

Heat and work, First law of thermodynamics and applications, Reversible and irreversible process, Carnot cycle and efficiency, Entropy, Second law of thermodynamics, Entropy and disorder, Entropy and Probability, Third law of thermodynamics, Thermography and its applications.

### **Electromagnetism**

Concept of electric field - Point charge in electric field, Dipole in an electric field, Gauss law, Some applications, Electric potential and field strength, Potential due to a point charge and dipole.

Magnetic field - Magnetic force on current, Torque on current loop, Hall effect, Ampere's law, B near a long wire, B for a solenoid and toroid, The Biot-Savart's law, B for a circular current loop.

Faraday's law of induction, Lenz's law, Calculation of inductance, L-R circuit, Energy stored in magnetic field, Induced magnetic fields, Displacement current, Energy density in electric and magnetic fields, Poynting vector S.

Maxwell's equations and electromagnetic waves (both differential and integral forms), Magnetic properties of materials, Paramagnetism, Diamagnetism, Ferromagnetism, Ferrite and its applications.

### **Optics**

Interference - Principles and superposition - Young's experiment - Coherence - Interference of thin films, Wedge shaped film, Newton's rings, Michelson interferometer and its applications.

Diffraction - Single slit (Qualitative and quantitative treatment).

Polarisation - Polarisation by reflection, Refraction and double refraction in uniaxial crystals, Nicol prism, Quarter and half wave plate, circular and elliptical polarization and detection.

### **Lasers and Fibre Optics**

Spontaneous and stimulated emissions, population inversions, Ruby laser, Gas laser, Semiconductor laser, Applications of lasers.

Fibre optics, Optical fibre and total internal reflection, Acceptance angle and cone of a fibre, Fibre optics in communications, Optical parts in fibre, Fibre optic sensors.

### **Ultrasonics**

Production of ultrasonics by magnetostriction and piezoelectric effects – Ultrasonics and diffraction pattern, Applications of Ultrasonics.

### **Modern Physics**

The quantization of energy, Photoelectric effect, De Broglie concept of matter waves, uncertainty principle, Schrodinger wave equation, application to a particle in a box.

Elementary concepts of Maxwell-Boltzmann, Bose-Einstein's and Fermi Dirac statistics, Fermi Dirac distribution function (no derivations), Free electron theory of metals, Band theory of solids, Kronig-Penny model, Metals, Insulators and Semiconductors, Ferroelectrics and their applications.

Superconductivity, Meissner effect, Types of superconductors and applications of superconductors.

Nanophase materials – Synthesis, Characterization of nanostructured materials, properties and applications.

Renewable Energies – Solar, Wind and tidal – Applications.

### **Books Recommended:**

1. Engineering Physics by R.K. Gaur and S.D. Gupta
2. Physics by David Halliday and Robert Resnick – Part I and Part II
3. Modern Engineering Physics by A.S. Vadudeva
4. University Physics by Young and Freedman
5. Materials Science by V. Rajendra and A. Marikani
6. Nonconventional Energy by Ashoke V. Desai

## ENG 1005 CHEMISTRY THEORY

Credits	Periods		Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
	Theory	Tutorial / Lab				
4	3	-	3	30	70	100

### 1. Water Chemistry and Pollution

**Water Chemistry :** Sources of water – impurities – Hardness and its determination – W.H.O. limits . Boiler troubles and their removal. Water softening methods – Lime soda, Zeolite and Ion exchange. Municipal water treatment – Break point chlorination. Desalination of sea water – Electrodialysis and Reverse osmosis methods.

**Water Pollution :** Source – BOD-COD-Sewage treatment – preliminary, primary, secondary and tertiary.

**Air Pollution :** Source – Air pollutants – CO, Sox, NOx, Hydrocarbons and particulates, Acid rain – Green house effect – Control of air pollution (General)

### 2. Solid state Chemistry:

Classification of solids – types of crystals – properties – imperfections in crystals, Band theory of solids, Chemistry of semiconductors – Intrinsic, Extrinsic, Compound and defect, Organic semiconductors and superconductivity, Purification of solids by zone refining – Single crystal growth – Epitaxial growth, Elementary ideas on liquid crystals.

### 3. Energy Sources

**Thermal Energy :** Coal – Ranking of coal – analysis (proximate and ultimate) Calorific value and determination (Bomb calorimeter method) – COKE- Manufacture- Otto Hoffmann's process – Applications

**Chemical Energy :** Electrode potential – Calomel electrode – Galvanic cells – Primary secondary – Acid and alkaline cells – Fuel cells.

**Nuclear Energy :** Fission and fusion – Power reactors – Atomic pile applications.

**Solar Energy :** Methods of utilization – Thermal conversion – Liquid Flat – Plate collector – Photovoltaic conversion – Solar Cell – Applications.

### 4. Corrosion Chemistry

Origin and theories of corrosion – Types of corrosion – Factors affecting corrosion – Corrosion control methods, Protective coatings – Metallic coatings – Chemical conversion coatings – Phosphate, Chromate, Anodized, Organic coating – Paints – Special paints – Varnishes and lacquers.

## 5. Fuels and Lubricants

Petroleum – Refining – Motor fuels – Petrol and Diesel Oil – Knocking – Octane number – Cetane number, Synthetic petrol – Fisher – Tropsch and bergius methods, LPG and CNG – Applications, Rocket fuels – Propellants – Classification.

**Lubricants** : Classification – Mechanism – Properties of lubricating oils – Selection of lubricants for Engineering applications.

## 6. Polymers and Plastics

Definition – Types of polymerization – Mechanism of addition polymerization, Effect of polymer structure on properties, Plastics – Thermoplastic resins and thermosetting resins – Compounding of plastics – Fabrication of plastics, Preparation and properties of cellulose derivatives – Vinyl resins – Nylon (6, 6) – Backelites – Polycarbonates – Epoxy resins, Reinforced plastics, Conducting polymers, Engineering applications of polymers.

## 7. Building Materials

**Portland Cement** : Manufacture – Dry and wet process, Setting and hardening of cement – Cement concrete – RCC – Decay of concrete – Special cements.

**Refractories** : Classifications – Properties – Engineering applications

**Ceramics** : Classification – Properties – Uses

### Prescribed Textbooks:

1. Engineering Chemistry, P.C. Jain and M. Jain – Dhanapathi Rai & Sons, Delhi.
2. A textbook of Engineering Chemistry, S.S. Dara – S. Chand & Co., New Delhi
3. Engineering Chemistry, B.K. Sharma – Krishna Prakashan, Meerut
4. A textbook of Engineering Chemistry, Balasubramanian et al. – Allied Publishers
5. Material Science and Engineering V. Raghavan – Prentice-Hall India Ltd.

## ENG 1006 HISTORY OF SCIENCE AND TECHNOLOGY

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	-	3	30	70	100

### 1. Historical Perspective

The nature of science and technology, Roots of science and technology in India, Science and society, Scientists and society, Science and Faith and the rise of applied sciences.

### 2. Policies and Plans after Independence

Nehru's vision of science for independent India, Science and technology developments in the new era science and technology developments during the Five Year Plan Periods and science and technology policy resolutions.

### 3. Research and Development (R&D) in India

Expenditure in R&D, Science and Technology Education, Research activities and promotion of technology development, Technology mission, Programs aimed at technological self reliance, activities of council of scientific and industrial research (CSIR).

### 4. Science and Technological Developments in Major Areas

Space - Objectives of space programs, Geostationary Satellite Services - INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology

Ocean Development - Objectives of ocean development, Biological and mineral resources, Marine research and capacity building

Defence Research - Spin-off technologies for civilian use,

Biotechnology - Applications of biotechnology in medicine, Biocatalysts, Agriculture, Food, Fuel and Fodder, Development of biosensors and animal husbandry

Energy - Research and development in conservation of energy, India's nuclear energy program, technology spin-offs.

## **5. Nexus between Technology Transfer and Development**

Transfer of Technology - Types, Methods, Mechanisms, Process, Channels and Techniques, Appropriate technology, Technology assessment, Technological forecasting, Technological innovations and barriers of technological change.

### **Textbooks:**

1. Kalpana Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi - 58.
2. Srinivasan, M., Management of Science and Technology (Problems & Prospects), East-West Press (P) Ltd., New Delhi.

### **Reference Books:**

1. Ramasamy, K.A., and Seshagiri Rao, K., (Eds), Science, Technology and education for Development, K., Nayudamma Memorial Science Foundation, Chennai - 8.
2. Kohili, G.R., The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.
3. Government of India, Five Year Plans, Planning Commission, New Delhi.
4. Sharma K.D., and Quresh M.A., Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

## ENG 1007 COMPUTER PROGRAMMING AND NUMERICAL METHODS

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	-	3	30	70	100

### Objectives

To make the student familiar with programming in C and enable the student to implement the numerical methods described in this course using C as programming language.

### Section A

#### Computer programming in C

##### Basics

Variables - Constants - Expressions - Operators and their precedence and associativity.

Basic input and output statements, Control structures, Simple programs in C using all the operators and control structure.

##### Functions

Concept of a function - Parameters and how they are passed - Automatic Variables - Recursion - Scope and extent of variables, Writing programs using recursive and non-recursive functions.

##### Arrays and Strings

Single and multidimensional arrays - Character array as a string - Functions on strings, Writing C programs using arrays and for string manipulation.

##### Structures

Declaring and using structures - Operations on structures - Arrays of structures - User defined data types - Pointers to using files.

##### Files

Introduction - File structure - File handling functions - File types - File error handling - C Programming examples for using files.

## Section B

### Computer oriented numerical methods

#### 1. Basic Concepts

Preliminary concepts of algorithms - Flow charts and their execution traces - A simplified model of a computer.

#### 2. Representation for Characters and Numbers

Representation for integer and real numbers, Effect of finite representation on arithmetic operations for example overflow, underflow, associativity and normalization, Some elementary methods for overcoming these limitations.

#### 3. Numerical Methods

Notation of round-off and truncation errors, numerical methods of finding roots of an algebraic equation of one variable, Successive bisection method, False position method, Newton Raphson method and secant method.

#### 4. Solutions of Simultaneous Algebraic Equations

Gauss elimination method and Gauss Seidal methods.

#### 5. Interpolation

Lagrange's Interpolation and difference table methods.

#### 6. Numerical Integration

Simpson's Rule, Gaussian quadrature for formula.

#### 7. Numerical Solution of Differential Equation

Eular's method, Taylor's series method and runge-Kutta method.

#### Books

Section A : Programming with C by K.R. Venugopal & Sudeep R Prasad

Section B : Introduction to Numerical Methods by S.S. Sastry

Elementary Numerical Methods by S.D. Conte

#### Rerencence

C Programming Language by Kerningham & Ritchie

## ENG 1008 ENGINEERING GRAPHICS

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
5	2	4	3	30	70	100

### **Introduction**

Drawing instruments and uses, Lettering scales in common use.

### **Curves**

Curves used in Engineering Practice, Conic sections, Construction of conics by different methods, Rectangular-hyperbola, Cycloidal curves, Trochoids, Eip and hypo-cycloids, Involute and Archimedean spiral.

### **Orthographic Projections**

Projection of points, Projection of straight lines, Traces of a line, Projection of planes and projection on auxiliary planes.

### **Solids and Developments**

Projection of solids in simple positions, Projection of solids with axis inclined to one of the reference planes and parallel to the other, projection of solids with axis inclined to both the reference planes, Projection of spheres, Development of surfaces of solids, Development of transition piece connecting a square and circular pipe Helices and screw threads.

### **Sections and Intersections**

Sections of different solids and true shape of sections, Intersection of surfaces-simple problems with cylinders, Prisms and cones.

### **Isometric and Perspective Projections**

Isometric projection and conversion of orthographic projection into isometric projection, Perspective projection, Theory of visual ray method and vanishing point method, Simple problems involving regular geometrical solids.

### **Textbook**

Elements of Engineering Drawing by N.D. Bhatt

### **Reference**

Engineering Graphics by K.L. Narayana and P. Kanniah

## ENG 1009 PHYSICS LABORATORY

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
2	-	3	3	50	50	100

### 12 of the following experiments must be completed

1. Lee's Method - Determination of coefficient of thermal conductivity of a bad conductor.
2. Melde's Experiment - Determination of the frequency of an electrically maintained tuning fork.
3. Newton's Rings - Determination of radius of curvature of a convex lens.
4. Diffraction Grating - Determination of wavelengths in mercury line spectrum using spectrometer.
5. Determination of Cauchy's constants using Spectrometer and mercury light.
6. Wedge Method - Determination of thickness of a paper by forming parallel interference fringes.
7. Michelson's Interferometer - a) Determination of wavelength of light                      b) Resolution of spectral lines.
8. Determination of  $\mu$  using calcite crystal.
9. Optical Bench - a) Young's double slit b) Lloyd's mirror c) Biprism                      d) Diffraction at an edge e) Thickness of wire
10. Ultrasonic Diffraction - Velocity of ultrasonic waves in liquids.
11. Variation of magnetic field along the axis of current carrying circular coil - Stewart and Gee's apparatus
12. Calibration of voltmeter using potentiometer.
13. Carey Foster's bridge a) laws of resistance b) temperature coefficient of resistance.
14. B-H curves - determination of hysteresis loss
15. Calendar and Barnes method - Determination of specific heat of water.
16. Hall Effect - a) Determination of hall coefficient b) Determination of charge density
17. Photoelectric Effect - a) Characteristics of photoelectric cell                      b) Determination of Planck's constant.
18. Determination of Rydberg constant using hydrogen discharge tube.
19. Determination of  $e/m$  of an electron - Thomson's method.
20. Determination of band gap of semiconductor.

## ENG 1010 CHEMISTRY LABORATORY

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
2	-	3	3	50	50	100

### List of Experiments

1. Determination of sodium carbonate.
2. Determination of sulfuric acid using a strong base.
3. Estimation of iron (II) using potassium permanganate.
4. Estimation of Oxalic acid using potassium permanganate.
5. Determination of volume strength of hydrogen peroxide.
6. Estimation of calcium in a sample of Portland cement.
7. Estimation of chromium (VI) using Ferrous Ammonium Sulphate.
8. Estimation of copper (II) using sodium thiosulphate.
9. Analysis of Bleaching power for chlorine content.
10. Estimation of Zinc by EDTA method.
11. Determination of hardness of a water sample (EDTA method).
12. Determination of alkalinity of a water sample.

### Demonstration Experiments

13. Determination of viscosity of lubricating oil.
14. Preparation of copper pigment.
15. Preparation of Phenol-Formaldehyde resin.
16. Digital pH meter.
17. digital potentiometer
18. D.O. analyzer

## ENG 1011 WORKSHOP

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
2		3	3	50	50	100

### **1. Carpentry**

Bench work, tools used in carpentry, jobs for class work – half lap joint mortise and tenon joint, half-lap dovetail joint, corner dovetail joint, bridle joint.

### **2. Sheet Metal**

Tools used in sheet metal work, Laying developments of sheet metal jobs, soldering, Jobs for class work – square tray, taper side tray, funnel, elbow pipe.

### **3. Fitting**

Tools used in fitting work, Different files, Chisels, Hammers and bench vice, Jobs for class work – Hexagon, Rectangular, Circular, and triangular fits, External and internal threads with dies and taps.

### **Reference**

Elements of workshop technology, vol. 1 by S.K. and H.K. Hajra Choudary

## ENG 1012 PROGRAMMING LABORATORY

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
2	-	3	3	50	50	100

1. Write a program to read  $x$ ,  $y$  coordinates for 3 points and then calculate the area of a triangle formed by them and print the coordinates of the three points and the area of the triangle. What will be the output from your program if the three given points are in a straight line?
2. Write a program, which generates 100 random integers in the range of 1 to 100. Store them in an array and then print the arrays. Write 3 versions of the program using different loop constructs. (eg. For, while, and do write).
3. Write a set of string manipulation functions e.g. for getting a sub-string from a given position. Copying one string to another, reversing a string, adding one string to another.
4. Write a program which determines the largest and the smallest number that can be stored in different data types of like short, int., long, float and double. What happens when you add 1 to the largest possible integer number that can be stored.
5. Write a program, which generates 100 random real numbers in the range of 10.0 to 20.0, and sort them in descending order.
6. Write a function for transposing a square matrix in place (in place means that you are not allowed to have full temporary matrix).
7. First use an editor to create a file with some integer numbers. Now write a program, which reads these numbers and determines their means and standard deviation.
8. Given two points on the surface of the sphere, write a program to determine the smallest arc length between them.
9. Implement bisection method to find the square root of a given number to a given accuracy.
10. Implement Newton Raphson method to determine a root of polynomial equation.
11. given a table of  $x$  and corresponding  $f(x)$  values, write a program which will determine  $f(x)$  value at an intermediate  $x$  value using Lagrange's interpolation.

## B.E. 2<sup>nd</sup> Year 1<sup>st</sup> Semester

### EEM 211 MATHEMATICS-III

Credits	Periods			Exam Hrs.	Sessional Marks	Exam Marks	Total Marks
	Theory	Tutorial	Lab				
4	3	1	-	3	30	70	100

#### 1. Vector Calculus

Differentiation of vectors, curves in space, Velocity and acceleration, Relative velocity and acceleration, Scalar and Vector point functions, Vector operator  $\nabla$ ,  $\nabla$  applied to scalar point functions, Gradient,  $\nabla$  applied to vector point functions, Divergence and curl, Physical interpretations of  $\nabla$ ,  $F$  and  $\nabla \times F$ ,  $\nabla$  applied twice to point functions,  $\nabla$  applied to products of point functions, integration of vectors, Line integral, Circulation, Work, Surface integral-flux, Green's theorem in the plane, Stoke's theorem, Volume integral, Divergence theorem, Irrotational and solenoidal fields, Green's theorem, Introduction of orthogonal curvilinear coordinates : Cylindrical, Spherical and polar coordinates.

#### 2. Introduction of Partial Differential Equations

Formation of partial differential equations, Solutions of PDEs, Equations solvable by direct integration, Linear equations of first order, Homogeneous linear equations with constant coefficients, Rules for finding the complimentary function, Rules of finding the particular integral, Working procedure to solve homogeneous linear equations of any order, Non-homogeneous linear equations.

#### 3. Applications of Partial Differential Equations

Method of separation of variables, Vibrations of a stretched string-wave equations, One-dimensional and two-dimensional heat flow equations, Solution of Laplace's equation, Laplace's equation in polar coordinates.

#### 4. Integral Transforms

Introduction, Definition, Fourier Integral, Sine and Cosine Integrals, Complex Forms of Fourier Integral, Fourier Transform, Fourier and Cosine Transforms, Finite Fourier Sine and Cosine Transforms. Properties of F - Transforms, Convolution Theorem for F - Transforms, Parseval's Identity for Fourier Transforms, Fourier Transforms of the Derivatives of a Function, Applications to Boundary Value Problems, Using Inverse Fourier Transforms only.

#### Text Book :

Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Pub. New Delhi, 34<sup>th</sup> Edition, 1998.

#### Reference Books :

1. A Text Book on Engineering Mathematics, N. P. Bali Etal, Laxmi Pub. Pvt. Ltd. - New Delhi.
2. Higher Engineering Mathematics, Dr. M. K. Venkataraman, National Pub. and Co. - Madras.
3. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Eastern Pvt. - N. Delhi.

## EME 212 ENGINEERING MECHANICS AND STRENGTH OF MATERIALS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### **Engineering Mechanics**

Concurrent Forces in a Plane and its Equilibrium, Centroids of Composite Plane Figures, General Case of Forces in a Plane.

Moment of Inertia of Plane Figures, Parallel Axis Theorem, Polar M.I., Concept of Mass M.I., Rectilinear Translation, Kinematics, Principle of Dynamics, Motion of a Particle Under Constant Force, Force Proportional to Displacement and Free Vibrations (SHM), D' Alembert's Principle, Momentum, Impulse - Work and Energy.

Rotation of a Rigid Body about a Fixed Axis Kinematics, Equation of Motion of a Rigid Body about a Fixed axis, Rotation and Constant Moment, Torsional Vibration.

### **Strength of Materials:**

Simple Stress and Strain, Stresses on Inclined Plane, Two-dimensional Stress Systems, Principal Stress and Principal Planes, Mohr's Circle.

Shearing Force and Bending Moment, Types of Loads, Types of Supports, S.F. and D.M. Diagrams for Cantilever and Simply Supported Beams under Concentrated Loads and under U.D.L.

Flexure formula, Bending Stresses on the above types of Beams with Rectangular and Circular Sections.

Torsion of Circular Shafts, Determination of Shear Stress.

### **Text Books**

1. Engineering Mechanics, S. Timoshenko (Relevant sections only).
2. Elements of Strength of Materials, S. Timoshenko (Relevant sections only).

## EEE 213 NETWORK THEORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### 1. Analysis of DC Circuits:

Active Elements, passive Element, Reference Directions for current and voltage, Kirchoffs Laws, Voltage and Current Division Nodal Analysis, MESH Analysis, Linearity and superposition, Thevenin's and Norton's Theorem, Source Transformation.

### 2. DC Transients:

Inductor, Capacitor, Source free RL, RC and RLC Response, Evaluation of Initial conditions, application of Unit-step Function to RL, RC and RLC Circuits, Concepts of Natural, Forced and Complete Response.

### 3. Sinusoidal Steady State Analysis:

The Sinusoidal Forcing Function, Phasor Concept, Average and Effective values of Voltage and Current, Instantaneous and Average Power, Complex Power, Steady State Analysis Using Mesh and Nodal Analysis, Application of Network Theorems to AC Circuits, Balanced 3-phase circuits, Resonance, Concept of Duality.

### 4. Coupled Circuits:

Magnetically Coupled Circuits, Dot Convention, Y, Z, H, T - Parameters of Two - Port Networks, Reciprocity Theorem.

### 5. Laplace Transform Techniques:

Transforms of Typical Signals, Response of Simple Circuits to Unit - Step, Ramp and Impulse Functions, Initial and Final Value Theorem, Convolution Integral, Time Shift and Periodic Functions, Transfer Function.

### Text Books

1. Engineering Circuit Analysis, Willam H. Hayt Jr., and Jack E. Kemmerly, 5<sup>th</sup> Edition, McGraw Hill.
2. Network Analysis, M. E. Vanvalkenburg, 3<sup>rd</sup> Edition, PHI.

## ECE 214 ELECTRICAL MACHINES

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### 1. Electric Energy System

Basic Structure, Generation, Transmission, Distribution and Utilization of Electric Power, Non - Conventional Energy Sources (Elementary treatment only).

### 2. DC Machines

Constructional Features, Function of Commutator, Induced EMF and Torque Expressions, Relationship Between Terminal Voltage and Induced EMF for Generator and Motoring Action, Different Types of Excitation and Performance Characteristics of Different Types of DC Machines, Starting and Speed Control of DC Motors, Losses and Efficiency, Efficiency by Direct Loading, Swinburne's Test and Hopkin's Test, Applications of DC Machines.

### 3. Transformers

Constructional Details, EMF Equation, Equivalent Circuit, Voltage Regulation, Losses and Efficiency, Auto - Transformers, Instrument Transformers, Open/Short - Circuit Tests and Determination of Efficiency and Regulation.

### 4. Three - Phase Induction Machines

Construction, Rotating Magnetic Field and 3ph Induction Motor, Power Flow Diagram, Torque and Torque-slip Characteristics, Condition for Max. Torque and its Value, Starting and Speed Control, Losses and Efficiency, Equivalent Circuit and Circle Diagram of Induction Motor, No - Load and Rotor - Blocked Tests and Efficiency and Torque - Speed Characteristics.

### 5. Three - Phase Synchronous Machines

Generation of EMF, Constructional Details, Induced EMF, Synchronous Generator on No - Load and Load, Synchronous Impedance and Voltage Regulation.

6. V - Curves and Inverted V - Curves, Synchronous Condenser, Starting of Synchronous Motors, Applications of Synchronous Machines.

### 7. Single - Phase Motors

Double Revolving Field Theory, Methods of Starting Single Phase Induction Motors, Universal Motor, Stepper Motor.

#### Text Books :

1. Electrical Machines, S. K. Bhattacharya, TMH Publications N. Delhi.
2. A First Course In Electrical Engineering, S. M. Tiwari, A. S. Binsaroor, Wheeler Publications.

## ECE 215 ELECTRONIC DEVICES AND CIRCUITS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### 1. Energy Band Theory of Solids

Intrinsic and Extrinsic Semiconductors Doping, Doping Materials, Carrier Mobility, Conductivity, Diffusion and continuity equation, Hall - Effect and its Application.

### 2. Semiconductor Diodes

Band structure of PN Junction, Quantitative Theory of PN Diode, Volt - Amp. Characteristics, Temperature Dependence, Transition and Diffusion Capacitance of PN Junction, Zener and Avalanche Breakdowns, Tunnel Diode, LED, Schottky Barrier Diode, Varactor Diode, Photo Diode, PIN Diode, Point Contact Diode.

### 3. Diode Rectifiers

Half-wave, Full-wave and Bridge Rectifiers with and without Filters, Ripple Factor and Regulation Characteristics.

### 4. Bipolar Junction Transister

NPN and PNP junction Transistor, Characteristics of Current Flow across the Base Regions, Minority and Majority Carrier Profiles, CB, CE and CC Configurations and their Input and Output Characteristics. Comparison of CE, CB and CC Configurations. Junction Biasing for Saturation, Cutoff and Active Region,  $\alpha$  and  $\beta$  Parameters and the relation between them.

### 5. JFET

JFET and its characteristics, Pinch off Voltage, Drain Saturation Current, MOSFET - Enhancement and Depletion Modes, Small signal models of FET.

### 6. Transistor Biasing Circuits

Various Biasing Circuits and Stabilization, Thermal Runaway, Thermal Stability, Biasing of FETs.

### 7. Small Signal - Low Frequency Transistor Biasing Circuits

Transistor as an Amplifier, h - parameter model, Analysis of Transistor Amplifier Circuits using h - parameters. CB, CE and CC Amplifier configurations and performance factors. Analysis of Single Stage Amplifier, RC Coupled Amplifiers. Effects of Bypass and Coupling Capacitors. Frequency Response of CE Amplifier, Emitter - Follower, Cascaded Amplifier, High Frequency model of Transistor.

### Text Books :

1. Electronic Devices and Circuits, G.S.N. Raju, I.K. International Publications, New Delhi, 2006.
2. Electronic Devices and Circuits 2<sup>nd</sup> Edition, B. V. Rao and K. Raja Rajeswari, Pearson Education
3. Integrated Electronics Analog Digital Circuits, Jacob Millman and D. Halkias, McGraw Hill.
4. Electronic Devices and Circuits Theory, Boylsted, Prentice Hall Publications.

## EEP 216 MATERIAL SCIENCE

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### 1. Conducting Materials

Relaxation Time and Electrical Conductivity. Sources of Resistivity of Metals and Alloys, Electrical Conductivity at High Frequencies. Geometrical and Magnetic Field Effects on Electrical Conductivity. Types of Conducting Materials.

### 2. Dielectric Materials

Types of Electric Polarization, Frequency and Temperature Effects on Polarization, Dielectric Loss, Dielectric Breakdown, Insulating Materials, Ferro-electric Materials, Electrets.

### 3. Magnetic Materials

Types of Magnetic materials, Ferro and Ferri magnetism, Hard and Soft Magnetic materials, Ferrites - Microwave applications, Magnetic bubbles.

### 4. Super Conducting Materials

Types of Super Conductors, High Tc Super Conductors and High Frequency Applications.

### 5. Integrated Circuits - Fabrication

Crystal Growth, Epitaxial Process, Masked Diffusion, Fabrication of Thin Films, Principles of IC Packaging.

#### Text Books :

1. Material Science, M. Arumugam, Anuradha Agencies Publishers.
2. Science of Engineering Materials, C. M. Srivastava and C. Srinivasan, Wiley Eastern Ltd.
3. Integrated Circuits, R. M. Warner Jr., McGraw Hill.

## ECE 217 NETWORK LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

Ten Experiments based on Networks Theory.

## ECE 218 ELECTRONIC DEVICES AND CIRCUITS LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

1. Study of CRO and Applications
2. V-I Characteristics of PN Junction Diode
3. V-I Characteristics of Zener Diode and Zener regulator characteristics.
4. V-I Characteristics of LED
5. V-I characteristics of Photo diode
6. Half-wave and full-wave rectifiers
7. Half-wave and full-wave rectifiers with capacitor filter
8. CE characteristics of BJT, h-parameters
9. CB characteristics of BJT, h-parameters
10. Voltage gain, input impedance and output impedance of emitter follower
11. Drain and transfer characteristics of JFET
12. Frequency response of CE amplifier

### **Textbook**

Electronic devices and circuits (Chapter 14), G.S.N. Raju, IK International Publishers, New Delhi, 2006.

## B.E. 2<sup>nd</sup> Year 2<sup>nd</sup> Semester

### EEM 221 MATHEMATICS - IV

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

#### 1. Functions of a Complex Variables

Continuity concept of  $f(z)$ , Derivative of  $f(z)$ , Cauchy - Riemann Equations, Analytic Functions, Harmonic Functions, Orthogonal Systems, Applications to Flow Problems, Integration of Complex Functions, Cauchy's Theorem, Cauchy's Integral Formula, Statements of Taylor's and Laurent's Series without Proofs, Singular Points, Residues and Residue Theorem, Calculations of Residues, Evaluation of Real Definite Integrals, Geometric Representation of  $f(z)$ , Conformal Transformation, Some Standard Transformations:- (1)  $w = z+c$ , (2)  $w = 1/z$ , (3)  $w = (az+b)$  (4)  $w = z^2$ , (6)  $w = e^z$ .

#### 2. Statistical Methods

Review of Probability theory (not be examined), Addition law of probability, Independent events, Multiplication law of probability, Bay's theorem, Random variable, Discrete probability distribution, Expectation, Moment generation function, repeated trails, Binomial distribution, Poission distribution, Normal distribution, Prable error, Normal approximation to binomial distribution.

Sampling Theory: Sampling Distribution, Standard Error, Testing of Hypothesis, Level of Significance, Confidence Limits, Simple Sampling of Attributes, Sampling of Variables - Large Samples and Small Samples, Student's T-distribution,  $\chi^2$  - Distribution, F - Distribution, Fisher's Z - Distribution.

#### 3. Difference Equations and Z-Transforms

Z-transforms - Definition, Some Standard Z-transforms, Linear Property, Sampling Rule, Some Standard Results, Shifting Rules, Initial and Final Value Theorems, Convolution theorem, Evaluation of inverse transforms, definition, Order and Solution of Difference Equations, Formation of Difference Equations, Linear Difference Equations, Rules for finding C.F., Rule for finding P.L., Difference Equation Reducible to Linear Form, Simultaneous Difference Equations with Constant Coefficients, Application to Deflection of a Loaded String, Applications of Z-transform to Difference Equations.

#### Text Books :

1. Higher Engineering Mathematics, Dr. B. S. Grewal, Khanna Publisher - N. Delhi, 34<sup>th</sup> Edition, 1998.

#### Reference Books :

1. Higher Engineering Mathematics, Dr. M. K. Venkataraman, National Pub. and Co. - Madras.

## ECE 222 ELECTROMAGNETIC FIELD THEORY & TRANSMISSION LINES

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### **Electrostatics**

Introduction, Applications of electrostatic fields, Different types of charge distributions, Coulomb's law, Applications of coulomb's law, Limitation of coulomb's law, Electric field strength due to point charge, Salient features of electric intensity, Electric field due to line charge density, Electric field strength due to an infinite line charge, Field due to surface charge density, Field due to volume charge density, Potential, Potential at a point, Potential difference, Salient features of potential difference, Potential gradient, Salient features of potential gradient, Equipotential surface, Potential due to electric dipole, Electric field due to dipole, Electric flux, Salient features of electric flux, Faradays experiment to define flux, Electric flux density, Salient features of electric flux density, Gauss's law and applications, Proof of Gauss's law, Gauss's law in point form, Divergence of a vector, Applications of Gauss's law, Limitations of Gauss's law, Salient features of Gauss's law, Poisson's and Laplace's equations, Applications of Poisson's and Laplace's equations, Uniqueness theorem, Boundary conditions on E and D, Proof of boundary conditions, Conductors in electric field, Properties of conductors, Electric current, Current densities, Equation of continuity, Relaxation time, Relation between current density and volume charge density, Dielectric materials in electric field, Properties of dielectric materials, Dipole movement, Polarization, Capacitance of different configurations, Energy stored in an electric field, Energy in a capacitor.

### **Steady Magnetic Fields**

Introduction, Applications of magnetic fields, Fundamentals of steady magnetic fields, Faradays law of induction, Magnetic flux density, Ampere's law of current, Element or Biot-Savart law, Field due to infinitely long current element, Field due to a finite current element, Ampere's work law or Ampere's circuit law, Differential form of Ampere's circuit law, Stock's theorem, Force on a moving charge due to electric and magnetic charge, Applications of Lorentz force equation, Force on a current element in a magnetic field, Ampere's force law, Boundary conditions on H and B, Scalar magnetic potentials, Vector magnetic potentials, Force and torque on a loop or coil, Materials in magnetic fields, Magnetization in materials, Inductance, Standard inductance configurations, Energy density in a magnetic field, Energy stored in inductor, Expression for inductance, L in terms of fundamental parameters, Mutual inductance, Comparison between electric and magnetic fields / circuits / parameters.

## Maxwell's Equations

Introduction, Equation of continuity for the varying fields, Maxwell's equations for time varying fields, Meaning of Maxwell's equations, Conversion of differential form of Maxwell's equations to integral form, Maxwell's equations for static fields, Characteristics of free space, Maxwell's equations for free space, The Maxwell's equations for static fields in free space, Proof of Maxwell's equations, Sinusoidal time varying fields, Maxwell's equations in phasor form, Influence of medium on the fields, Types of media, Summary of Maxwell's equations for different cases, Boundary conditions, Proof of boundary conditions on E, D, H and B, Complete boundary conditions in scalar form, Boundary conditions in vector form, Time varying potentials, Retarded potentials, Maxwell's equations approach to relate potentials, Fields and their sources, Helmholtz theorem, Lorentz gauge condition.

## Electromagnetic Waves

Introduction, Applications of EM waves, Wave equations in free space, Wave equations for a conducting medium, Uniform plane equation, General solutions of uniform plane wave equations, Relation between E and H in a uniform plane wave, Proof of E and H wave are perpendicular to each other, Wave equations in phasor form, Wave propagation in a lossless medium, Propagation characteristics of EM waves in free space, Propagation characteristics of EM waves in a conducting medium, Summary of propagation, Characteristics of EM waves in conducting medium, Conductors and dielectrics, Wave propagation characteristics in good dielectrics, Summary of the propagation characteristics in good dielectrics, Wave propagation characteristics in good conductors, Summary of characteristics of wave propagation in good conductors, Depth of penetration, Polarization of a wave, Sources of different polarized EM waves, Direct cosines of vector field, Waves on a perfect conductor - Normal incidence, Waves on dielectric -Normal incidence, Oblique incidence of a plane wave on a boundary plane, Oblique incidence of a wave on perfect conductor, Oblique incidence of a plane wave on dielectric, Brewster angle, Total internal reflection, Surface impedance, Poynting vector and flow of power, Complex poynting vector.

## Guided Waves

Induction, Waves between parallel plates, Derivation of field equations between parallel plates and propagation parameters, Field components for TE waves ( $E_z = 0$ ), Field components of TM waves ( $H_z = 0$ ), Propagation parameters of TE and TM waves, Guide wavelength, Transverse electromagnetic waves (TEM wave), Velocities of propagation, Attenuation in parallel plane guides, Wave impedances, Waves in rectangular waveguides, Derivation of field equations in rectangular hollow waveguides, Propagation parameters of TE and TM waves in rectangular waveguides, TEM does not exist in waveguides, Excitation methods for different TM and TE modes, Evanescent wave or mode, Wave impedance in waveguide, Power transmitted in a lossless waveguide, Waveguide resonators, Salient features of cavity resonators, Circular waveguides, Salient features of circular waveguides.

## **Transmission Lines**

Types of transmission lines, Applications of transmission lines, Equivalent circuit of pair of transmission lines, Primary constants, Transmission line equations, Secondary constants, lossless transmission lines, Distortionless line, Phase and group velocities, Loading of lines, Input impedance of transmission lines, RF lines, Relation between reflection coefficient, Load and characteristic impedance, Relation between reflection coefficient and voltage standing wave ratio (VSWR), Lines of different lengths -  $\lambda/8, \lambda/4, \lambda/2$  lines, Losses in transmission lines, Smith chart and applications, Stubs, Double stubs.

## **Textbook**

1. Electromagnetic Field Theory and Transmission Lines, G.S.N. Raju, Pearson Education (Singapore) Pvt., Ltd., New Delhi, 2005.
2. Electromagnetic Field Theory and Transmission Lines, Gottapu Sasibhushana Rao, Wiley Publications , 2013.

## **References:**

1. Engineering Electromagnetics, W. H. Hayt Jr., McGraw Hill - New York.
2. EM Waves and Radiating Systems, E. C. Jordan, PHI, 1997.
3. Electromagnetics with Applications, Kraus and Fleisch, McGraw Hill, 1999.
4. Time Harmonic EM Fields, R. F. Harrington, McGraw Hill.

## ECE 223 ANALOG ELECTRONIC CIRCUITS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### **Multistage Amplifiers**

BJT and FET RC Coupled Amplifiers – Frequency Response. Cascaded Amplifiers. Calculation of Band Width of Single and Multistage Amplifiers. Concept of Gain Bandwidth Product.

### **Feed back Amplifiers**

Concept of Feedback Amplifiers – Effect of Negative feed back on the amplifier Characteristics. Four Feedback Amplifier Topologies. Method of Analysis of Voltage Series, Current Series, Voltage Shunt and Current Shunt feedback Amplifiers.

### **Sinusoidal Oscillators**

Condition for oscillations –LC Oscillators – Hartley, Colpitts, Clapp and Tuned Collector Oscillators – Frequency and amplitude Stability of Oscillators – Crystal Oscillators – RC Oscillators -- RC Phase Shift and Weinbridge Oscillators.

### **Power Amplifiers**

Classification of Power Amplifiers – Class A, Class B and Class AB power Amplifiers. Series Fed, Single Ended Transformer Coupled and Push Pull Class A and Class B Power Amplifiers. Cross-over Distortion in Pure Class B Power Amplifier, Class AB Power Amplifier – Complementary Push Pull Amplifier with trickle Bias, Derating Factor – Heat Sinks.

### **Tuned Voltage Amplifiers**

Single Tuned and Stagger Tuned Amplifiers – Analysis – Double Tuned Amplifier – Bandwidth Calculation.

### **Operational Amplifiers**

Concept of Direct Coupled Amplifiers. Ideal Characteristics of an operational Amplifier – Differential Amplifier – Calculation of common mode Rejection ratio – Differential Amplifier supplied with a constant current – Normalized Transfer Characteristics of a differential Amplifier – Applications of OP-Amp as an Inverting and Non-Inverting Amplifier, Integrator, Differentiator Summing and Subtracting Amplifier and Logarithmic Amplifier. Parameters of an Op-Amp, Measurement of OP-Amp Parameters.

### **Books :**

1. Electronic Circuit Analysis, B.V.Rao, K.Raja Rajeswari et.al, Pearson Publishers
2. Integrated Electronics – Millman and Halkias
3. Electronic Devices and Circuits, G.S.N. Raju, IK International Publications, New Delhi, 2006.
4. Electronic Devices and Circuits – Mottershead
5. Op-Amps and Linear Integrated Circuits – Gayakwad.

## ECE 224 PROBABILITY THEORY & RANDOM PROCESS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### **Probability Theory**

Definitions of Probability, Axioms of Probability, Probability Spaces, Properties of Probabilities, Joint and Conditional Probabilities, Independent Events.

### **Random Variables**

Probability Distribution Functions, Probability Density Functions, Joint Distribution of Two Variables, Conditional Probability Distribution and Density, Independent Random Variables.

### **Statistical Averages**

Functions of Random Variables and Random Vectors, Statistical Averages, Characteristic Function of Random Variables, Inequalities of Chebyshev and Schwartz, Convergence Concepts, Central Limit Theorem.

### **Random Processes**

Stationarity, Ergodicity, Covariance Function and their Properties, Spectral Representation, Wiener-Kinchine Theorem, Linear operations, Gaussian Function, Poisson Processes, Low-pass and Band-pass Noise Representation.

### **Textbook :**

1. Probability Theory and Random Processes, S. P. Eugene Xavier, S. Chand and Co. New Delhi, 1998 (2<sup>nd</sup> Edition).
2. Probability Theory and Random Signal Principles, Peebles, Tata McGraw Hill Publishers.

### **References :**

1. Signal Analysis, Papoulis, McGraw Hill N. Y., 1977.
2. Introduction to Random Signals and Noise, Davenport W. B. Jrs. and W. I. Root, McGraw Hill N.Y., 1954.

## ECE 225 SIGNALS AND SYSTEMS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

Signals, Transformations of Independent Variables, Basic Continuous Time Signals, Basic Discrete Time Signals, Systems, Properties of Systems, Linear Time - invariant Systems.

### **Linear Time - Invariant (LTI) Systems**

Representation of Signals in terms of Impulses, Discrete Time LTI Systems, the Convolution Sum, Continuous Time LTI Systems, the Convolution Integral. Properties of LTI Systems, Systems Described by Differential and Difference Equations. Block Diagram Representation of LTI Systems Described by Differential Equations and, Singularity Functions.

Analogy between Vectors and Signals, Orthogonal Vector and Signal Spaces. Approximation of a Function by a Set of Mutually Orthogonal Functions, Fourier Analysis of Continuous Time Signals and Systems. The Response of Continuous Time LTI Systems to Complex Exponentials, the Continuous Time Fourier series. Convergence of Fourier series, A-periodic Signals and Continuous Fourier Transform. Periodic Signals and Continuous Fourier Transform. Convolution and Modulation Property. Polar Representation of Continuous Fourier Transform. Frequency Response Characterized by Linear Constant Coefficient Differential Equations. First-order and Second-order Systems.

Fourier Analysis of Discrete Time Signals and Systems Response of Discrete Time LTI Systems to Complex Exponential. Fourier Series, DTFT, Periodic Signals and DTFT, Properties of DTFT, Convolution, Modulation and Duality Property. Polar Representation of DTFT, First-order and Second-order Systems.

### **Concept of Z**

Sampling Theorem, Reconstruction of a Signal from Samples, the Effect of Under-sampling, Discrete Time Processing of Continuous Time Signals. Sampling in Frequency Domain, Sampling of Discrete Time Signals. Z-transform of a Discrete Sequence, Region of Convergence for the Z-transform. Inverse Z-transform, Properties of Z-transform, Relation Between Z and Fourier Transform.

### **Textbook :**

1. Signals and Systems, K. Raja Rajeswari and B. V. Rao, Prentice Hall of India.
2. Signals and Systems, Alan V. Oppenheim, Alan S. Willsky and Ian T. Young, PHI.

### **References :**

1. Communication Systems, B. P. Lathi
2. Signals Systems and Communication, B. P. Lathi, BS Publication

## ECE 226 ADVANCED NETWORK THEORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### **Fourier Transforms**

Definitions and Properties, Transforms for Simple Time Domain Functions, Transforms of General Periodic Time Functions, Convolution and Response in Time Domain, Response in Frequency Domain, Relationship between Fourier and Laplace Transforms.

### **Network Functions**

Network Functions for Single Port and Two Port, Calculation of Network Functions for Ladder and General Networks, Poles and Zeroes, Restriction of Poles and Zeroes for Driving point and Transfer Functions, Time Domain Behavior from Pole Zero Plot, Transfer Functions in terms of Y and Z functions, Scaling Network Functions.

Positive Real Function and Other Properties, Herwitz Polynomials, Computation of Residues, Even and Odd Functions, Test for Positive Real Functions.

### **Network Synthesis**

Elementary Synthesis Operation, LC Network Synthesis, Properties of RC Network Functions, Foster and Cauer Forms of RC and RL Networks.

### **RLC Networks**

Minimum Positive Real Functions, Brune's Method of RLC Synthesis, Realization Difficulties.

### **Textbooks :**

1. Network Analysis, M. E. Van Valkenburg, 3<sup>rd</sup> Edition, PHI.
2. Modern Network Synthesis, M. E. Van Valkenburg, Wiley Eastern.

### **Reference :**

Engineering Circuit Analysis, William H. Hayt Jr. and Jack E. Kemmerley, 5<sup>th</sup> Edition, McGraw Hill International Edition.

## ECE 227 ENVIRONMENTAL STUDIES

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
3	3	-	-	3	30	70	100

### **Module 1 : Introduction**

Definition, Scope and importance, Measuring and defining environmental development : Indicators

### **Module 2 : Ecosystems**

Introduction, Types, Characteristic features, Structure and functions of ecosystems, Forest, Grassland, Desert, Aquatic (lakes, rivers and estuaries).

### **Module 3 : Environment and Natural Resources Management**

Land Resources : Land as a resource, Common property resources, land degradation, Soil erosion and desertification, Effects of modern agriculture, fertilizer-pesticide problems, Forest Resources : Use and over-exploitation, Mining and dams - their effects on forest and tribal people, Water resources : Use and over-utilization of surface and ground water, Floods, Droughts, Water logging and salinity, Dams - benefits and costs, Conflicts over water, Energy Resources : Energy needs, Renewable and non-renewable energy sources, Use of alternate energy resources, Impact of energy use on environment.

### **Module 4 : Bio-Diversity and its Conservation**

Value of bio-diversity - Consumptive and productive use, Social, Ethical, Aesthetic and option values, Bio-geographical classification of India - India as a mega diversity habitat, Threats to biodiversity - Hot-spots, habitat loss, poaching of wildlife, loss of species, seeds etc., Conservation of biodiversity - in - situ and ex-situ conservation.

### **Module 5 : Environmental Pollution - Local and Global Issues**

Causes, Effects and control measures of : Air pollution, Indoor air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Solid waste management, Compositing, Vermiculture, Urban and industrial wastes, Recycling and re-use, Nature of thermal pollution and nuclear hazards, Global warming, Acid rain, Ozone depletion.

### **Module 6 : Environmental Problems in India**

Drinking water, Sanitation and public health, Effect of activities on the quality of environment : Urbanization, Transportation, Industrialization, Green revolution, Water scarcity and ground water depletion, Controversies on major dams -

Resettlement and rehabilitation of people problems and concerns, Rain water harvesting, Cloud seeding and watershed management.

### **Module 7 : Economy and Environment**

The economy and environment interaction, Economics of development, Preservation and conservation, Sustainability : Theory and practice, Limits to growth, Equitable use of resources for sustainable lifestyles, Environmental impact assessment.

### **Module 8 : Social Issues and the Environment**

Population growth and environment, Environmental education, Environmental movements, Environment Vs development.

### **Module 9 : Institutions and Governance**

Regulation by Government, Monitoring and enforcement of environmental regulation, Environmental acts : Water (Prevention and control of pollution) act, air (Prevention and control of pollution) act, Environmental Protection Act, Wild life protection act, Forest conservation act, Coastal zone regulations, Institutions and policies relating to India, Environmental Governance.

### **Module 10 : International Conventions**

Stockholm Conference 1972, Earth Summit 1992, World Commission for Environmental Development (WCED).

### **Module 11 : Case Studies**

Chipko movement, Narmada bachao andolan, Silent valley project, Madhura refinery and Taj Majal, Industrialization of pattancheru, Nuclear reactor at Nagarjuna Sager, Tehri Dam, Ralegaon Siddhi (Anna Hazare), Kolleru lake - Acquaculture, Florosis in Andhra Pradesh.

### **Module 12 : Field Work**

Visit to a local area to document and mapping environmental assets - River / forest / grassland / hill / mountain, Study of local environment - Common plants, Insects, Birds, Study of simple ecosystems - Pond, river, hill, slopes etc. Visits to industries, Water treatment plants, Effluent treatment plants.

**Textbooks :** Kaushik - Kaushik, Anubha

**Reference :** Deswal & Deswal, Raja Gopal, Dharmaraj Publishers.

ECE 228 ELECTRICAL MACHINES LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

Ten Experiments based on Electrical Machines Theory.

## ECE 229 ANALOG ELECTRONIC CIRCUITS LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

1. Feedback Amplifier - Calculation of Gain without Input Resistance, Output Resistance and Frequency Response Characteristic.
2. Current series feedback amplifier
3. Voltage series feedback amplifier
4. Colpitt's Oscillator
5. RC Phase - Shift Oscillator
6. Wein - Bridge Oscillator
7. Class B Push - Pull Power Amplifier
8. Operational Amplifier - as an Inverting and Non-inverting Amplifier and Frequency Response Characteristics
9. Measurement of Op-Amp Parameters
10. Multistage Amplifier
11. Tuned Voltage Amplifier
12. Class A Transformer - Coupled Amplifier

### **Textbooks**

1. Electronic Devices and Circuits (Chapter 14), G.S.N. Raju, IK International Publications, New Delhi, 2006.
2. Bernard Grob, "Basic Electronics", McGraw Hill Book Company

**B.E. 3<sup>rd</sup> Year 1<sup>st</sup> Semester (Credit Based Grading System)  
With effect from the admitted batch of 2006 - 2007**

**ECE 311 PULSE AND DIGITAL CIRCUITS**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

**1. Linear Wave Shaping:**

High Pass and Low Pass RC Circuits and their Response for Sinusoidal, Step Voltage, Pulse, Square Wave and Ramp Inputs. High Pass RC Circuit as a Differentiator. Low Pass RC Circuit as an Integrator. Attenuators and their Application as CRO Probe. RL and RLC Circuits and their response for step input. Ringing circuit.

**2. Non-Linear Wave Shaping:**

Diode clippers. Transistor Clippers. Clipping at two independent levels. Comparator - Applications of voltage Comparators - Diode Comparator. Clamping Operation. Clamping Circuits using Diode with Different Inputs. Clamping Circuit Theorem. Practical Clamping circuits. Effect of diode Characteristics on Clamping Voltage.

**3. Multivibrators:**

Transistor as a Switch - Switching times of a transistor. Astable, Monostable and bistable Multivibrators using Transistors. Resolution time of a Binary. Methods of improving Resolution time - Methods of Triggering a binary. Schmitt Trigger.

**4. Sweep Circuits:**

Voltage sweep -- Simple Exponential sweep Generator. Errors that define Deviation from linearity, UJT Relaxation Oscillator - Methods of linearising a Voltage Sweep - Bootstrap and Miller Circuits - Current Sweep - Linearising a current Sweep by Adjusting the driving Waveform.

**5. Synchronization and Frequency Division:**

Principles of Synchronization - Synchronization of Astable Multivibrators. Synchronization of Sweep Circuits with Symmetrical Signals.

**6. Logic Gates:**

IC Families, TTL, CMOS, ECL, FFs and Circuits.

**7. Blocking Oscillator:**

Base Timing. Emitter Timing, and Astable Blocking Oscillator.

**Books:**

1. Pulse, Digital and Switching Waveforms - Millman and Taub.
2. Wave Generation and Shaping - L. Strauss.

## ECE 312 LINEAR ICS AND APPLICATIONS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Operational Amplifiers:  
Design Aspects of Monolithic Op-Amps, Ideal Characteristics, Specifications, Offset Voltages and Currents, Frequency Compensation Techniques, Measurement of Op-Amp Parameters,
2. Applications of Op-Amps, Inverting and Non-inverting Amplifiers, Integrators, Function Generators, Logarithmic Amplifiers, Instrumentation Amplifiers,
3. Signal Conditioning Circuits, Multivibrators, Square Wave Generators, Rectifiers, Peak Detection and Voltage Regulation.
4. 555 Timers, 556 Function Generator ICs and their Applications. Three Terminal IC Regulators,
5. IC 1496 (Balanced Modulator), IC 565 PLL and its Applications.
6. Active Filters – LPF, HPF, BPF, BEF, All-pass Filters, Higher Order Filters and their Comparison.
7. Op-Amp Phase Shift, Wein-bridge and Quadrature Oscillator, Voltage Controlled Oscillators, Voltage to Frequency and Frequency to Voltage Converters, Voltage to Current and Current to Voltage Converters. Switched Capacitance Filters, Analog Multiplexers, Sample and Hold Circuits.

### **Books:**

1. Microelectronics, Jacob Millman
2. Op-Amps and Linear ICs, Ramakanth Gayakwad.
3. Integrated Circuits, Botkar, Khanna Publications.
4. Applications of Linear ICs, Clayton.

## ECE 313 ANALOG COMMUNICATION

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

**1. Linear Modulation Systems:**

Need for Modulation, Frequency Translation, Method of Frequency Translation, Amplitude Modulation, Modulation Index, Spectrum of AM Signal, Modulators and Demodulators (Diode detector), DSB-SC Signal and its Spectrum, Balanced Modulator, Synchronous Detectors, SSB Signal, SSB Generation Methods, Power Calculations in AM Systems, Application of AM Systems.

**2. Angle Modulation Systems:**

Angle Modulation, Phase and Frequency Modulation and their Relationship, Phase and Frequency Deviation, Spectrum of an FM Signal, Bandwidth of Sinusoidally Modulated FM Signal, Effect of the Modulation Index on Bandwidth, Spectrum of Constant Bandwidth FM, Phasor Diagram for FM Signals,

**3. FM Generation:**

Parameter variation method, Indirect method of Frequency Modulation (Armstrong Method), Frequency Multiplication, PLL FM Demodulator, Pre - emphasis and De - emphasis, Comparison of FM and AM.

**4. Noise In AM and FM Systems:**

Sources of Noise, Resistor Noise, Shot Noise, Calculation of Noise in a Linear System, Noise in AM Systems, Noise in Angle Modulation Systems, Comparison between AM and FM with respect to Noise, Threshold Improvement in Discriminators, Comparisons between AM and FM.

**5. Radio Transmitters:**

Classification of Radio Transmitters, AM and FM Transmitters, Radio Telegraph and Telephone Transmitters, SSB Transmitters.

**6. Radio Receivers:**

Radio receiver Types, AM Receivers - RF Section, Frequency Changing and Tracking, Intermediate Frequency and IF Amplifiers, Automatic Gain Control (AGC); FM Receivers - Amplitude Limiting, FM Demodulators, Ratio Detectors, ISB Receiver, Comparison with AM Receivers.

**7. Communication Receivers:**

Extensions of the Super-heterodyne Principles, Additional Circuits.

**Text Books:**

1. Principles of Communication Systems, H. Taub and D. L. Schilling, McGraw Hill, 1971.
2. Communication Systems, Simon Haykins (2<sup>nd</sup> Edition).
3. Electronic Communication Systems, G. Kennedy, McGraw Hill, 1977 (2<sup>nd</sup> Edition).

**References:**

1. Modern Digital and Analog Communication Systems, B. P. Lathi (2<sup>nd</sup> Edition).
2. Electronic Communications Modulation and Transmission, Robert J. Schoenbeck, PHI N. Delhi, 1999.

## ECE 314 COMPUTER ARCHITECTURE AND ORGANIZATION

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

**1. Register Transfer and Micro operations:**

Register Transfer Language, Register Transfer, Bus and Memory Transfers, Arithmetic Micro operations, Logic Micro operations, Shift Micro operations, Arithmetic Logic Shift Unit.

**2. Basic Computer Organization:**

Instruction Codes, Computer Registers, Computer Instructions, Timing and Control, Instruction Cycle, Memory Reference Instructions, Input - Output and Interrupt, Complete Computer Description.

**3. CPU Organization:**

Introduction, General Register Organization, Instruction Formats, Addressing Modes, Data Transfer and Manipulation, Program Control, Reduced Instruction Set Computer (RISC), Stack Organization.

**4. Micro programmed Control:**

Control Memory, Address Sequencing, Microinstruction Formats, Micro program Example, Design of Control Unit.

**5. Memory Organization:**

Memory Hierarchy, Main Memory, Auxiliary Memory, Associative Memory, Cache Memory, Virtual Memory.

**6. Input - Output Organization:**

Peripheral Devices, Input - Output Interface, Asynchronous Data Transfer, Modes of Transfer, Priority Interrupt, Direct Memory Access (DMA),

**7. Introduction to Multiprocessor System.**

**Text Book:**

Computer System Architecture, M. Morris Mano, PHI Publications, (3<sup>rd</sup> Edition May 1996).

**References:**

1. Computer Organization, V. Carl Hamacher, Zvonko G. Vranesic and Safwat G. Zaky, McGraw Hill International, (4<sup>th</sup> Edition).
2. Digital Computer Fundamentals, Thomas C. Bartee.

## ECE 315 SWITCHING THEORY AND LOGIC CIRCUITS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

- 1. Introductory Concepts:**  
Number Systems, Base Conversion Methods, Complements of Numbers, Codes, Error detecting and Error Correcting Codes.
- 2. Minimization of Boolean Functions:**  
Standard forms of Boolean Functions, Simplification of Functions – Karnaugh map and Quine McClusky methods, multiple output functions.
- 3. Logic Gates:**  
Symbols and Truth Tables of Gates – AND, OR, NOT, NAND, NOR, XOR, Multiplexers, Demultiplexers, Encoders, Decoders, Flip-flops, Counters and Registers.
- 4. Combinational Logic:**  
Logic Design of Combinational circuits – Binary addition, Subtraction, Code Conversion, Priority Encoders, Decoders, Seven – segment Displays, Comparators, PLAs.
- 5. Sequential Machine Fundamentals:**  
The Flip-flop – RS, JK and D Flip-flops, the Design of Clocked Flip-flop, Flip-flop conversion from one type to another.
- 6. Traditional Approaches to Sequential Analysis and Design:**  
Analysis and Design of Finite State Machines, State Reduction, Design of Flip-flops, Counters and Shift Registers.
- 7. Asynchronous Finite State Machines:**  
Analysis and Design of Asynchronous Machines, Cycles, Races and Hazards.

### Books:

1. Switching and Finite Automata Theory, 2<sup>nd</sup> Edition, Zvi Kohavi, Tata McGraw-Hill, 1978.  
(For syllabus items 1, 3, and 4)
2. Introduction to Switching Theory and Logical Design, 3<sup>rd</sup> Edition, Frederick J. Hill and Gerald R. Peterson, John Wiley and Sons, 1981.  
(For syllabus item 2)
3. An Engineering Approach to Digital Design, William I. Fletcher, PHI, 1980.  
(For syllabus items 5, 6, and 7)

## ECE 316 ANTENNAS AND WAVE PROPAGATION

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### 1. Radiation and Antennas

Antenna definition, Functions of antennas , Network theorems, Properties of antennas, Antenna parameters , Polarization, Basic antenna elements , Radiation mechanism, Radiation fields of alternating current element, Radiated power and radiation resistance of current element, Radiation, induction and electrostatic fields, Hertzian dipole, Different current distributions in linear antennas, Radiation from half-wave dipole, Radiation from quarter wave monopole , Radiation characteristics of dipoles.

### 2. Analysis of Linear Arrays

Directional characteristics of dipole antennas, Radiation pattern of alternating current element, Radiation pattern expressions of centre-fed vertical dipoles of finite length, Radiation patterns of centre-fed vertical dipoles, Radiation patterns of centre-fed horizontal dipoles, Radiation patterns of vertical dipoles, Two-element uniform array, Uniform linear arrays, Field strength of a uniform linear array, First sidelobe ratio (SLR), Broadside and End-fire arrays, Patterns of array of non-isotropic radiators, Multiplication of patterns, Generalized expression for principle of pattern multiplication, Radiation pattern characteristics, Binomial arrays, Effect of earth on vertical patterns, Effect of earth on radiation resistance, Methods of excitation, Impedance matching techniques, Transmission loss between transmitting and receiving antennas - FRIIS formula, Antenna temperature and signal-to-noise ratio.

### 3. Array Synthesis

Introduction, Synthesis methods, Fourier transform method, Linear array design by Woodward-lawson method, Dolph-chebychev method (Tschebyscheff distribution), Taylor method, Laplace transform method, Standard amplitude distributions.

### 4. HF, VHF and UHF Antennas

Introduction, Isotropic radiators, Directional antennas, Omni-directional antennas, Resonant antennas, Non-resonant antennas, LF antennas, Antennas for HF, VHF and UHF, Dipole arrays, Folded dipole, V-Antennas, Inverted V-antennas, Rhombic antenna, Yagi-Uda antenna, Log-periodic antennas, Loop antenna, Helical antenna, Whip antenna, Ferrite rod antenna, Turnstile antennas, Discone antennas, Notch antenna.

## **5. Microwave Antennas**

Introduction, Rod reflector, Plane reflector, Corner reflector, Parabolic reflector, Types of parabolic reflectors, Feed systems for parabolic reflectors, Shaped beam antennas, Horn antennas, Corrugated horns, Slot antennas, Impedance of a few typical dipoles, Slots in the walls of rectangular waveguides, Babinet's principle, Lens antennas, Microstrip antennas.

## **6. Antenna Measurements**

Introduction, Drawbacks of measurements of antenna parameters, Methods to overcome drawbacks in measurements, Methods for accurate measurements, Measurement ranges, Indoor and outdoor ranges, Antenna impedance measurements, Measurement of radiation resistance, Gain measurements, Measurement of antenna bandwidth, Directivity measurement, Measurement of sidelobe ratio, Measurement of radiation efficiency, Measurement of antenna aperture efficiency, Measurement of polarization of antenna, Phase measurement.

## **7. Wave Propagation**

Propagation characteristics of EM Waves, Factors involved in the propagation of radio waves, Ground wave propagation, Ground wave field strength by Maxwell's equations, Reflection of radio waves by the surface of the earth, Roughness of earth, Reflection factors of earth, Wave tilt of the ground wave, Tropospheric wave propagation, Atmospheric effects in space wave propagation, Duct propagation, Radio horizon, Troposcatter, Fading of EM waves in Troposphere, Line of sight (LOS), Ionospheric propagation, Characteristics of ionosphere, Refractive index of ionosphere, Phase and group velocities, Mechanism of Ionospheric propagation, reflection and refraction, Characteristic parameters of Ionospheric propagation, Sky wave field strength, Fading and diversity techniques, Faraday's rotation, Effect of earth's magnetic field.

### **Text Book :**

1. Antennas and Wave Propagation, G.S.N. Raju, Pearson Education (Singapore) Pvt., Ltd., New Delhi, 2007.

### **References:**

1. EM Waves and Radiation Systems, E. C. Jordan and K. G. Balmain, PHI - N. Delhi, 1997.
2. Antennas, J.D. Kraus, McGraw Hill, NY.
3. Antenna theory, C.A. Balanis, John Wiley & Sons, NY, 1982.

## ECE 317 Free Elective – I: BASIC ELECTRONIC DEVICES AND APPLICATIONS

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	1	3	30	70	100

### I. Electrostatics and CRO

Cathode ray tube, Cathode ray oscilloscope (CRO), Applications of CRO, Types of CROs

#### Diode Characteristics and Applications

Basic applications of PN diode, Characteristics of a PN diode, Diode equivalent circuits, Diode specifications, Volt-ampere characteristics of PN diode, Diode testing, Varactor diode, Applications of varactor diode, Salient features of varactor diode, Zener diode, Applications of zener diode, Salient features of zener diode, Light Emitting Diode, Salient features of LED, Applications of LED, Varistor diode, Photo diode, Applications of photo diode

### II. Rectifiers and DC Power Supplies

Introduction, Half-wave rectifier , Full-wave rectifier , Bridge rectifier , Comparative characteristics of rectifier circuits, Filter circuits , Inductor filter in half-wave rectifier, Inductor filter with full-wave rectifier, Half-wave rectifier with capacitor filter, Full-wave rectifier with capacitor filter.

### III. Transistor characteristics and applications

Introduction, Operation of the transistor, Transistor configurations, Current amplification factor,  $\alpha$ , Relation between  $\alpha$  and  $\beta$ , Differences among the parameters of CE, CB and CC transistor configurations, Switching times in transistors, Applications of transistors, Testing of transistors, Transistor terminal identification

#### Field Effect Transistors

Classification of field effect transistors, Junction field effect transistors (JFET), The salient features of JFET, Comparative characteristics of JFET and BJT, Merits of JFET, JFET characteristics, Drain characteristics, Comparison of CS, CD and CG JFET amplifier, Applications of JFETs, Metal oxide semiconductor field effect transistor (MOSFET), Enhancement type MOSFET, Depletion type MOSFET, Salient features of enhancement and depletion type of MOSFET, Comparison between JFET and MOSFET.

#### **IV. Feedback Amplifiers**

Introduction, Expression of gain with feedback, First classification of feedback amplifiers, Negative feedback amplifier, Positive feedback, Second classification of feedback amplifiers, Characteristics of negative feedback amplifier, Characteristics of positive feedback, Effect of negative feedback on gain stability, Effect of negative feedback on bandwidth, Effect of negative feedback on distortion, Effect of negative feedback on non-linear distortion, Effect of negative feedback on noise, The net effects of feedback circuits, Comparative characteristics of feedback and non-feedback amplifiers, Applications of negative feedback, Typical feedback circuits, Comparison between the parameters of voltage and current feedback circuits.

#### **V. Power Amplifiers**

Introduction, Classification of power amplifiers, Class A amplifier, Class B amplifier, Class AB amplifier, Class C amplifier, Class D amplifier, Class A large signal power amplifier, Efficiency of class A power amplifier, Transformer coupled class A power amplifier, Efficiency of transformer coupled class A power amplifier, Class B power amplifier, Push-pull amplifier, Merits of push-pull amplifier, Demerits, Class B push-pull amplifier, Operation of class B push-pull amplifier, Class AB push-pull amplifier, Performance of power amplifiers, Characteristics of power amplifier, Complementary symmetry push-pull class B power amplifier, Heat sinks, Definition of derating factor

#### **Power Devices**

Unijunction transistor (UJT), Construction, Principle of operation, Definition of stand-off ratio, Application of UJT, Silicon controlled rectifier (SCR), Construction and operation, Equivalent circuit, Volt-ampere characteristics of SCR, Features of SCR, Applications of SCR, The diac, Construction of diac, Salient features of diac, Volt-ampere characteristics of diac, Applications, Triac, Symbol of triac, Construction, Equivalent circuit, Operation, V-I characteristics of triac

#### **VI. Oscillators**

Definition of oscillator, Definition of generator, Conditions for oscillators, Barkhausen criteria, The characteristics of oscillators, Classification of oscillators, Sinusoidal oscillators, Relaxation oscillators, RC phase shift oscillator, Salient features of RC phase oscillator, Wein bridge oscillator, Expression for frequency of oscillation, Salient features of wein bridge oscillator, Colpitts oscillator, Expression for the frequency of oscillation, Salient features of colpitts oscillator, Hartley oscillator, Expression for frequency, The crystal oscillator, Differences between rectifiers, amplifiers and oscillators

## **VII. Operational Amplifiers and Applications**

Introduction to integrated circuits (ICs), Salient features of op-amps, Symbol of op-amp, Classification of integrated circuits, Differences between linear and digital ICs, Characteristics of an ideal op-amp, Applications of operational amplifiers, The equivalent circuit of op-amp, Definitions of op-amp parameters, Frequency sensitive parameters of op-amp, Temperature sensitive parameters, Applications of linear ICs, Typical op-amps, Salient features of op-amp series, Specifications of  $\mu\text{A} 741$ , Virtual ground concept, Applications of op-amp, Typical pin designations of op-amp.

### **Textbooks**

5. ELECTRONIC DEVICES AND CIRCUITS, G.S.N. RAJU, I.K. INTERNATIONAL PUBLICATIONS, NEW DELHI, 2006.
6. ELECTRONIC DEVICES AND CIRCUITS THEORY, BOYLSTED, PRENTICE HALL PUBLICATIONS.

### **REFERENCES**

1. INTEGRATED ELECTRONICS ANALOG DIGITAL CIRCUITS, JACOB MILLMAN AND D. HALKIAS, MCGRAW HILL.

## ECE 318 LINEAR ICS AND PULSE CIRCUIT LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

1. Applications of Op-Amps.
2. 555 Timer as Monostable and Astable Multivibrator.
3. Three terminal IC Voltage Regulator.
4. Linear Wave Shaping - RC Circuits.
5. Non-linear wave Shaping - Clipping and Clamping Circuits.
6. Fixed - Bias Binary.
7. Self - Bias Binary.
8. Schmitt Trigger.
9. UJT Sweep Generator.
10. Miller and Bootstrap Sweep Circuits.

## ECE 319 DIGITAL ICS LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

1. Minimization and Realization of a given Function using Basic Gates (AND, OR, NOR, NAND, EXOR).
2. Function Generation using Decoders and Multiplexers.
3. Experiments on Priority Encoder using 74LS148.
4. Application of Multiplexers.
5. Seven - segment Display experiments.
6. Four bit and eight bit adders and subtractors.
7. Experiments using 74LS181 and 74LS182 ICs (ALU and Carry Look Ahead Adders).
8. Experiments on SR Latch and Master - slave JK Flip-flops using SSI gates.
9. Design and testing of Ripple Counters using ICs.
10. Design and testing of Mod-K Synchronous Counters.
11. Design and testing of Shift Registers.
12. Experiments using ROMs.
13. A PCM Companded encoder using 27512.
14. PLAs to realize SOP function using IC828100.
15. To realize Binary - Select Multiplexer using PAL 16L8.

ECE 320 Soft Skills

**B.E. 3<sup>rd</sup> Year 2<sup>nd</sup> Semester (Credit Based Grading System)  
with effect from the admitted batch of 2006 - 2007**

**EEE 321 CONTROL SYSTEMS**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Transfer Functions of Linear Systems – Impulse Response of Linear Systems – Block Diagrams of Control Systems – Signal Flow Graphs (Simple Problems) – Reduction Techniques for Complex Block Diagrams and Signal Flow Graphs (Simple Examples).

Pages (65 – 100)

2. Introduction to Mathematical Modeling of Physical Systems – Equations of Electrical Networks – Modeling of Mechanical Systems – Equations of Mechanical Systems.

Pages (127 – 150)

3. Time Domain Analysis of Control Systems – Time Response of First and Second Order Systems with Standard Input Signals – Steady State Error Constants – Effect of Derivative and Integral Control on Transient and Steady State Performance of Feedback Control Systems.

Pages (296 – 350)

4. Concept of Stability and Necessary Conditions for Stability – Routh-Hurwitz Criterion, Relative Stability Analysis, the Concept and Construction of Root Loci, Analysis of Control Systems with Root Locus (Simple Problems to understand theory).

Pages (355 – 428)

5. Correlation between Time and Frequency Responses – Polar Plots – Bode Plots – Log Magnitude versus Phase Plots – All Pass and Minimum Phase Systems – Nyquist Stability Criterion – Assessment of Relative Stability – Constant M and N Circles.

Pages (552 – 624)

**Text Book:**

Automatic Control Systems, Benjamin C. Kuo, PHI Publication (5<sup>th</sup> Edition).

**Reference Books:**

1. Modern Control Engineering, Ogata, PHI.
2. Control Systems Engineering, I. J. Nagrath and M. Gopal, Wiley Eastern Ltd.

## ECE 322 MICROPROCESSORS AND APPLICATIONS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Internal Architecture and Functional Description of INTEL 8085, Microprocessor Interrupt Structure of 8085, Instruction Set and Timing Diagrams.
2. Programming The 8085:  
Introduction to 8085 Assembly Language Programming, Sample Programs - Stack and Subroutines.
3. Interfacing Semiconductor Memory Devices To 8085:  
Classification and Internal Organization of Semiconductor Memory Devices, Interfacing of SRAMs, DRAMs and EPROMs.
4. Interfacing I/O Devices to 8085:  
Parallel I/O (8255A), Timer/Counter (8253), Serial I/O (8251A), Keyboard/Display Interface.
5. Data Converters:  
ADC, DAC, and their Interfacing to 8085.
6. Elementary Concepts of 16Bit and 32Bit Microprocessors, like INTEL 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro.

### **Text Book:**

Architecture Programming and Applications, Ramesh S. Gaonkar, New Age International Pvt. Ltd., (3<sup>rd</sup> Edition).

### **References:**

1. Microcomputer and Microprocessors - The 8080, 8085 and Z-80 Programming, Interfacing and Troubleshooting, John Uffenbeck, PHI (2<sup>nd</sup> Edition).
2. Introduction to Microprocessors, A. K. Mathur, TMH (3<sup>rd</sup> Edition).
3. The Intel Microprocessors 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium and Pentium Pro Processor, Architecture, Programming and Interfacing, Barry B. Brey, 4<sup>th</sup> Edition, PHI.

## ECE 323 DATA STRUCTURES (Common with Metallurgy)

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Revision of C Language Overview only (no questions to be set on this).
2. Arrays and Functions:  
Organization and use of One Dimensional, Two Dimensional and Multi Dimensional Arrays, Handling of Character Strings, String Operation, Concept of Function, Parameter Passing, Recursion.
3. Structures, Pointers and Files:  
Definition of Structure and Union, Programming examples; Pointers, Pointer Expressions, Programming examples; File Operations, Preprocessor.
4. Linear Data Structures:  
Stack Representation, Operation, Queue Representation, Operations, Circular Queue, List, Representation, Operations, Double Linked and Circular Lists.
5. Non-Linear Data Structures:  
Trees, Binary Tree Representation, Tree Transversals, Conversion of a General Tree to Binary Tree, Representation of Graphs.
6. Searching Techniques:  
Basic Search Techniques, Tree Searching Graphics, Linked Representation of Graphics, Graph Transversal and Spanning Trees.

### Text Books:

1. Programming In ANSI C, by E. Balaguruswamy.
2. Data Structures Using C, by A. M. Tanenbaum and others.

### Reference Books:

1. An Introduction To Data Structures With Applications, Trembly and Sorenson.
2. The C - Programming Language, Kerningham and others.

## ECE 324 COMPUTER NETWORKS ENGINEERING

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Introduction:

Uses of Computer Networks, Network Structure, Architectures, Services, Standardization, Functions of Various Network Layers, Network examples.

2. Physical layer:

Theoretical Basis for Data Communication, Transmission Media, Analog and Digital Transmission, Transmission and Switching ISDN.

3. Medium Access Sub-layer:

LAN, MAN, Protocol, ALOHA, IEEE Standard for 802 for LANs, Fiber Optic Networks, Satellite Networks.

4. Data Link layer:

Design Issues, Error Detection and Correction, Protocols and their Performance, Specifications and Examples.

5. Network layers:

Design Considerations, Difference between Gateway, Ethernet Switch, Router, Hub, Repeater, Functions of Router, Congestion Control Internetworking and Examples, Details of IP addressing schemes, TCP/IP Protocol details.

**Books:**

1. Data Communications and Networking by Behrouz A. Forouzan, 2<sup>nd</sup> Edition, Tata McGraw Hill.

**References:**

1. Computer Networks, A. S. Tannenbaum, PHI - New Delhi.
2. Computer Networking Terminology Products and Standards, R. P. Suri and J. K. Jain, Tata McGraw Hill.

## ECE 325 DIGITAL COMMUNICATION

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Analog-to-Digital Conversion: Pulse modulation techniques, Sampling, Time Division Multiplexing, Pulse Amplitude Modulation, Pulse Width Modulation, Pulse Position Modulation, Digital Modulation Techniques: Pulse Code Modulation, Differential Pulse Code Modulation, Delta Modulation, Adaptive Delta Modulation, Continuously Variable Slope Delta Modulation, Companding, Noise in Pulse-Code and Delta-Modulation Systems.
2. Binary Phase-Shift Keying, Differential Phase-Shift Keying, Differentially-Encoded PSK (DEPSK), Quadrature Phase-Shift Keying (QPSK), M-ary PSK, Quadrature Amplitude Shift Keying (QASK), Binary Frequency Shift-Keying, Similarity of BFSK and BPSK, M-ary FSK, Minimum Shift Keying (MSK), Duo-binary Encoding.
3. Mathematical Representation of Noise: Some Sources of Noise, Frequency-Domain Representation of Noise, The Effect of Filtering on the Probability Density of Gaussian Noise, Spectral Components of Noise Response of a Narrowband Filter to Noise, Effect of a Filter on the Power Spectral Density of Noise, Superposition of Noises, Mixing Involving Noise, Linear Filtering, Noise Bandwidth, Quadrature Components of Noise, Power Spectral Density of  $n(t)$  and  $\dot{n}(t)$ , Probability Density of  $n(t)$ ,  $\dot{n}(t)$ , and their Time Derivatives, Representation of Noise Using Orthonormal Coordinates, Irrelevant Noise Components
4. Data Transmission: A Base-band Signal Receiver, Probability of Error, The Optimum Filter, White Noise: The Matched Filter, Probability of Error of the Matched Filter, Coherent Reception: Correlation, Phase-Shift Keying, Frequency-Shift Keying, Non-coherent Detection of FSK, Differential PSK, Four Phase PSK (QPSK), Error Probability for QPSK, Probability of Error of Minimum Shift Keying (MSK), Comparison of Modulation Systems.
5. Spread Spectrum Modulation: Direct Sequence (DS) Spread Spectrum, Use of Spread Spectrum with Code Division, Multiple Access (CDMA), Ranging using DS Spread Spectrum, Frequency Hopping (FH) Spread Spectrum, Generation and Characteristics of PN Sequences, Acquisition (Coarse Synchronization) of a FH Signal, Tracking (Fine Synchronization) of a FH Signal, Acquisition (Coarse Synchronization) of a DS Signal, Tracking of a DS Signal.

### **Text Books:**

1. Analog and Digital Communication Systems by Martin S. Roden, 3<sup>rd</sup> edition, Prentice Hall, 1994;
2. Principles of Communications By Taub and Schilling

ECE 326 Elective - II(1) : EMI / EMC

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Introduction to EMI/EMC:

EMI Sources, EMI Coupling, Noise Path, Models of Noise Coupling, EMC Regulations, Designing for EMC, Compliance Tests, Elimination of EMI, EMI Testing, Compliance Test and Engineering Tests.

2. Grounding Techniques, Shielding Techniques, Cabling Techniques.

3. Conducted EMI/EMC:

Origin of Conducted EMI, Common and Normal mode Noise, Noise from Power Electronic Systems, Spectra of Pulse Noise Sources, Modeling of EMI Noise Sources, Transient Disturbance Simulation Signals, EMI Filters for Mains Noise.

4. Choice of Passive Components:

EMC Design Components

5. EMI Measurement Technology:

EMI Measuring Instruments, Pitfalls of EMI Measurements, Test Instrumentation Accessories and their Characteristics, Measurement of Pulsed EMF, EMI Patterns from Different List Objects, EMI Immunity Test System, Software in EMI/EMC Measurements, Recent Trends in Susceptibility Measurement, Cost Effective EMI/EMC Measurements, Setup and its Maintenance.

**Text Books:**

1. IMPACT Learning Material Series Modules 1 - 9, IIT New Delhi, Published by RSTE.
2. Electromagnetic Compatibility, R. C. Paul.

## ECE 326 Elective - II(2) : MICROELECTRONICS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Integrated- Circuit Fabrication:

Monolithic Integrated - Circuit (microelectronics) technology- The planar processes - Bipolar Transistor Fabrication - Fabrication of FETs - CMOS Technology - Monolithic Diodes - The Metal - Semiconductor Contact - IC Resistor - IC Capacitors - IC Packaging - Characteristics of IC Components - Microelectronic circuit layout.

2. Basic Digital circuits:

MOS Technology - NMOS, CMOS, Inverters, Logic gates - ECL circuits.

3. Combinational Circuits:

Arithmetic functions - Comparators - Multiplexers - Demultiplexers - Memory - Memory applications - PAL - PLAs.

4. Sequential Circuits:

A1 - Bit memory - The circuit properties of biastable latch - The clocked SR Flip-Flop - J-K, T, and D-type Flip-flops. Shift-registers - Ripple Counters - synchronous counters - Applications of counters.

**Text Book:**

Microelectronic by Jacob Milliman, Arbin Grabel second edition, TMH.

**References:**

1. Part 2 of Integrated Circuits, Design Principles and Fabrications by editors, Warner and Fordemwalt, 1965, Motorola Series, McGraw Hill.
2. MOS LSI Design and Applications by Dr. William N. Carr and Dr. Jack P. Mize, McGraw Hill, 1972.
3. Micro electronic circuits and devices second edition Horenstien, PHI.

**ECE 326 Elective - II(3) : ELECTRONIC MEASUREMENTS AND  
INSTRUMENTATION**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Measurement of Physical Systems:

Objectives of Engineering Measurement - Types of Data, Analog vs. Digital Measurement - measurement of Accuracy, Precision and Uncertainty.

2. Transducers:

Electrical Transducers - Selecting a Transducer - Strain Gauges, Linear Variable Differential Transducer (LVDT), Piezo Electric Transducers, Photo Electric Transducer, Frequency Generating Transducers, Digital Transducers.

3. Data Indication and Recording:

Analog Display and Recorders, Digital Input - Output Devices - Displays - Display Multiplexing and Zero Suppression.

4. Signal Transmission and Processing:

Data Transmission Systems, Modulation Techniques for Digital and Data Transmission, Serial Data Communication - Telemetry Systems, Digital Signal Processing.

**References:**

1. Instrumentation For Engineering Measurement, R. H. Cerni and L. E. Foster.
2. Electronic Instrumentation, H. S. Kalsi, TMH.
3. Instrumentation Devices and Systems, 2<sup>nd</sup> Edition, C. S. Rangan, G. R. Sarma and V. S. V. Mani, TMH.
4. Intelligent Instrumentation, Microprocessor Application in Measurement and Control, 2<sup>nd</sup> Edition, George C. Barney, PHI.
5. Transducers and Instrumentation, D.V.S. Murthy, PHI.

ECE 326 Elective - II(4) : SOFTWARE ENGINEERING

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

## ECE 327 ANALOG COMMUNICATION LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

Generation of AM Signal and measurement of Modulation Index.

Diode Detector for AM Signals.

Generation of FM Signal.

FM Detector.

Receiver Measurements.

Balanced Modulator.

Passive Filters (LPF, HPF, BPF).

Active Filters.

Attenuator.

Equalizer and Twin-T-Network.

Frequency Multiplier/Limiter.

SSB Generation and Detection.

Pre-emphasis and De-emphasis.

PLL.

IF Amplifier.

## ECE 328 MICROPROCESSORS & APPLICATIONS LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

- 1) Write a program, which loads Registers, A, B, C, and D with the same constant. Try to optimize the program in such a way that the smallest numbers of program bytes are used. Test the program in single step mode. After each step, test the register of interest.
 

Assume that 4 bytes of data are stored at consecutive locations of the data-memory starting at (x). Write a program, which loads Register E with (x), D with (x+1), C with (x+2) and A with (x+3).

  - a. Assume that 1 byte of data is stored at data memory location (x). Write a program which tests bit 5 of (X). Write 'FF' in (x+1), if bit 5=0 and write '00' at the same location if bit 5=1.
  - b. Write a program which tests the zero-condition of a data byte specified at data memory location (x). If it is zero '00' should be stored at (x+1) location, if non-zero 'FF' should be stored at the same location.
  - c. A binary number is stored at data-memory location (x) Compute the number of its logical 1's and store the result at y.
  - d. Comment on the instructions used in the above three programs and write about the effect of flags with the instructions used.
- 2) Two unsigned binary numbers are stored at data-memory locations (x) and (x+1).
  - a) Compute the sum of the two numbers and store the result at y, ignoring the possible overflow.
  - b) Write a program to compute (x+1) - (x). The magnitude of the result should be stored at (y) and the sign (00 if positive, 01 if negative) at (y+1). Understand the 2's complement Arithmetic.
- 3)
  - a) A double precision number is stored at (x) and (x+1) (lower order byte at (x). Add another double precision number stored at (y) and (y+1) (lower order byte at (y)]. Store the result at (w) and (w+1).
  - b) Same as above: subtract the number (y+1) (y) from (x+1) (x) and store the result at (w) and (w+1).
- 4)
  - a) Two 2-digit BCD numbers are stored at consecutive memory locations (x) and (x+1). Write a program for computing the sum and store the result at loc. (y)
  - b) Write a program to compute the difference and store the result at (y).
- 5) Implement a time-delay loop for the generation of milli seconds. Determine the exact time-delay by adding the states of the instructions executed in the program.
- 6)
  - a) Write a program for a decimal counter (00-99) with programmable clock frequency [Eg. Frequency specified at data memory locations (x)] and display the count in the data field using the corresponding monitor subroutine.
  - b) Reset the decimal counter at a predefined number and start the count again.
- 7) N binary numbers stored at consecutive data memory locations starting at (x) where N is defined at data memory location 'NUMBER'.
  - a) Find the largest number and display it in the data field and arrange them in ascending order.

- b) Find the smallest number and display it in the data field and arrange them in descending order.
- 8) Two 8-bit binary numbers are stored at data memory locations (x) and (x+1) compute the product of the two numbers using, a). Successive addition method. b). Shifting and adding method store the result in (y) and (y+1).
- 9) Divide the 16-bit unsigned number in memory location (x) and (x+1) [Most significant byte in (x+1)] by the 8-bit unsigned number in memory location (x+2). Store the quotient in memory location (x+3) and remainder in memory location (x+4). [Choose the data such that the quotient must be contained in 8 bits].
- 10) a) A 2-digit BCD number is stored at data-memory location (x). Convert the number into binary and display the result in data field.  
b) Convert a binary number in memory location (x) to two BCD digits in memory locations (x+1) and (x+2) [most significant digit in (x+1)]. The number in memory location (x) is unsigned and less than  $(64)_{10}+1$ .
- 11) Write a program to do the operation specified at a data memory location (x). The operations are specified as follows:  
00-Test the parity of the data at (x+1) and store DD for odd parity, EE for even parity at (y).  
01-To operate a staircase lamp, 02-Test the zero condition of the data and store 00 if zero and FF if not, 03-Test if the data is positive or negative.
- 12) Hardware experiments:  
a) A/D and D/A Converters.  
b) DPSK Modulator and Demodulator.  
c) Seven Segment Display interface.  
d) Keyboard interface.

**B.E. 4<sup>th</sup> Year 1<sup>st</sup> Semester (Credit Based Grading System)  
with effect from the admitted batch of 2006 - 2007**

**ECE 411 DIGITAL SIGNAL PROCESSING**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Discrete - Time Signals and Systems:

Discrete - Time Signals – Sequences, Linear Shift – Invariant Systems, Stability and Casuality, Linear Constants – Coefficient Difference Equations, Frequency Domain Representation of Discrete – Time Signals and Systems.

2. Applications of Z – Transforms:

System Functions  $H(z)$  of Digital Systems, Stability Analysis, Structure and Realization of Digital Filters, Finite Word Length Effects.

3. Discrete Fourier Transform (DFT):

Properties of the DFS, DFS Representation of Periodic Sequences, Properties of DFT, Convolution of Sequences.

4. Fast – Fourier Transforms (FFT):

Radix – 2 Decimation – In – Time (DIT) and Decimation – In – Frequency (DIF), FFT Algorithms, Inverse FFT.

5. IIR Digital Filter Design Techniques:

Design of IIR Filters from Analog Filters, Analog Filters Approximations (Butterworth and Chebyshev Approximations), Frequency Transformations, General Considerations in Digital Filter Design, Bilinear Transformation Method, Step and Impulse Invariance Technique.

6. Design of FIR Filters:

Fourier Series Method, Window Function Techniques, Comparison of IIR and FIR Filters.

7. Applications:

Applications of FFT in Spectrum Analysis and Filtering, Application of DSP in Speech Processing.

**Text Book:**

Alan V. Oppenheim and Ronald W. Schaffer: Digital Signal Processing, PHI.

**References:**

1. Sanjit K. Mitra, Digital Signal Processing “A – Computer Based Approach”, Tata Mc Graw Hill.
2. Raddar and Rabiner, Application of Digital Signal Processing.
3. S. P. Eugene Xavier, Signals, Systems and Signal Processing, S. Chand and Co. Ltd.
4. Antonio, Analysis and Design of Digital Filters, Tata Mc Graw Hill.

## ECE 412 INFORMATION THEORY AND CODING

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Information measure and source coding, Information measure, Entropy and Information rate, Coding for a discrete memory less source, Predictive coding for sources with memory, Information transmission on discrete channels, Mutual information.

Discrete channel capacity, coding for the binary symmetric channel, Continuous channels and system comparisons , continuous information, continuous channel capacity, Ideal communication system , system comparisons.

2. Rationale for coding , and types of codes, Discrete memory less channels, linear block codes , cyclic codes, convolution codes, Maximum likely hood Decoding of Convolution codes, Distance properties of convolution codes.

Sequential Decoding of Convolution codes, Trellis codes, Applications , Algebraic codes, Burst error correcting, Parity check bit coding for error detection, comparison of error rates in coded and un coded transmission, Automatic repeat request.

### **Text Books:**

- 1) Communication Systems,3/e, by A.B. Carlson, Mc. Graw Hill Publishers(for topic 1)
- 2) Digital Communications by Simon Haykin , John Wiley & Sons(for topic 2)

### **References:**

- 1) Principles of Digital Communications, Signal representation, Detection , Estimation &Information
- 2) Coding by J Das, S.K. Mullick, P.K.Chatterjee, New Age Int. Ltd.
- 3) Principles of Communication Systems, Taub &Schilling, 2/e, TMH Publishers

## ECE 413 TV AND SATELLITE COMMUNICATION

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### Television

Basic Television System:

Sound and Picture Transmission, the Scanning Process, Interlaced Scanning, Number of Scanning Lines, Vertical and Horizontal Resolution, Bandwidth of the Baseband Picture Signal.

Television Cameras:

Principle of working and constructional details of Image Orthicon, Vidicon, Plumbicon and Silicon diode array Vidicon and Solidstate Image Scanners.

Composite - Video Signal:

Video signal levels, Need for Synchronization, Details of Horizontal and Vertical Sync Pulses, Equalizing Pulses.

Signal Transmission and Channel Bandwidth:

AM and FM Channel Bandwidth, VSB Transmission, Complete Channel Bandwidth, Reception of Vestigial Sideband Transmission, Television Standards, Block Schematic study of a typical TV Transmitter.

The TV Picture Tube:

Monochrome Picture Tube, Picture Tube Characteristics and Picture Tube Control Circuits, Gamma Correction.

Television Receiver:

Block Schematic and Functional Requirements, VSB Correction, Vertical and Horizontal Deflection Circuits, E.H.T. Generation, Study of Video IF Amplifier Video Detector, Sound Channel Separation, Sync Separation Circuits.

Colour Television:

Principles of Additive and Subtractive Colour Mixing, Chromaticity Diagram, Compatibility and Reverse Compatibility of Colour and Monochrome TV Requirements, Colour Signal Transmission, Bandwidth for Colour Signal Transmission, Sub-carrier Modulation of Chroma Signals, NTSC Encoding (Y, I, Q signals), PAL Encoding (Y, U, V signals), NTSC and PAL Decoders, Types of Colour TV Picture Tubes (Delta-gun, PIL and Trinitron Picture Tubes), Convergence Techniques.

### Satellite Communication

Orbital Aspects, Tracking and Control of Communication Satellites, Launch Vehicles, Propagation Characteristics: Attenuation and Noise, Frequency Bands, Satellite Transponders, Earth Station: Configuration, High Power Amplifiers, Antennas, LNA, Link Design, Multiple Access: FDMA, TDMA, CDMA, SPADE, INTELSATs, INSAT.

**Text Books:**

Monochrome and Colour Television, R. R. Gulati, Wiley Eastern.

Global Navigation Satellite Systems with Essentials of Satellite Communications  
authored by G S Rao, Mc-Graw Hill Publication, New Delhi 2010.

**References:**

1. Television Engineering, A. M. Dhake, Tata - McGraw Hill.
2. Satellite Communication, D. C. Agarwal, Khanna Publishers.
3. Satellite Communication, T. Pratt and S. W. Bostian, John Wiley and Sons.

## ECE 414 MICROWAVE ENGINEERING

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Microwave Components:

Introduction to Microwaves and their applications, Coaxial Line Components, Wave-guide Components, Directional Couplers, Hybrid Tee Junction, Magic Tee, Attenuators, Ferrite Devices, Isolators, Circulators, Cavity Resonators, Re-entrant Cavities, Wave-meters, Microwave Filters, Detectors, Mixers.

2. Microwave Signal Generators and Amplifiers:

Vacuum Tube Triodes, Resonant Cavity Devices, Reflex Klystron, Two - Cavity Klystron, Multi - Cavity Klystron, Slow - Wave Devices, TWT, Crossed Field Devices, Magnetrons, Semiconductor Devices, Microwave BJTs, FETs, Tunnel Diodes, Gunn Diode, IMPATT, TRAPATT Diodes.

3. Microwave Circuits:

Scattering Matrix and its Properties, Scattering Matrix of directional coupler, circulator, E Plane Tee, H plane Tee and Magic Tee.

4. Microwave Integrated Circuits:

Materials, Substrate, Conductor, Dielectric and Resistive Materials, MMIC Growth, Fabrication Techniques, MOSFET Fabrication, NMOS Growth and CMOS Development, Thin Film Formation.

5. Microwave Measurements:

VSWR, Frequency, Guide Wavelength, Coupling and Directivity measurements.

**Text Books:**

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN - 978813179944 Pearson Education Chennai 2013.
2. Microwave Engineering, G.S.N. Raju, IK International Publishers,

**References:**

1. Foundations For Microwave Engineering, R. R. Collin, McGraw Hill.
2. Microwave Communications - Components and Circuits, E. Hund, McGraw Hill.
3. Microwave Devices and Circuits, S. Y. Liao, PHI.

4. Microwave Engineering, R. Chatarjee, East - West Press Pvt. Ltd.

ECE 415 Elective - III (1) : CELLULAR AND MOBILE COMMUNICATIONS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

**Introduction to Cellular Mobile Systems:**

A basic Cellular System, Performance Criteria, Uniqueness of Mobile Radio Environment, Operation of Cellular Systems, Planning and Cellular Systems, Analog & Digital Cellular Systems.

**Elements of Cellular Radio System Design:**

General description of the problem, Concept of Frequency Channels, Co-channel interference Reduction factor, Desired C/I from a normal case in an Omni-directional Antenna system, Cell splitting, consideration of the components of Cellular Systems.

**Interference:**

Introduction to Co-channel interference, Real time Co-channel interference, Co-channel measurement, Design of Antenna system, Antenna parameters and their effects, Diversity Receiver, Non Co-channel interference - different types.

**Cell Coverage for Signal and Traffic:**

General introduction, Obtaining the Mobile Point - to - Point model, Propagation over water or flat open area, Foliage loss, Propagation in near in distance, Long distance Propagation, Point - to - Point predication model - characteristics, Cell site, Antenna heights and signal coverage cells, Mobile - to - Mobile Propagation.

**Cell Size Antennas and Mobile Antennas:**

Characteristics, Antennas at Cell site, Mobile Antennas.

**Frequency Management and Channel Assignment:**

Frequency management, Fixed Channels assignment, Non Fixed Channel assignment, Traffic and Channel Assignment.

**Hand Off, Dropped Calls:**

Why Hand-Off, Types of Hand-Off and their characteristics, Dropped call rates and their evaluation.

**Operational Techniques:**

Parameters, Coverage hole filter, Leaky feeders, Cell Splitting and small cells, Narrow Beam concept.

**Text Books:**

Mobile Cellular Communication by Gottapu Sasibhushana Rao,  
Pearson International, 2012.

**Reference Books:**

Cellular and Mobile Communications by Lee, McGraw Hill.

Wireless Digital Communication by Dr. Kamilo Feher, PH.D.

## ECE 415 Elective – III (2) : VLSI DESIGN AND EMBEDDED SYSTEMS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Review of microelectronics and an introduction to MOS technology:  
Introduction to IC technology, MOS and related VLSI technology, NMOS, CMOS, BiCMOS Technologies, Thermal aspects of processing, Production of E beam marks.
2. MOS and BiCMOS circuit design processes:  
MOS layers, Stick diagrams, Design rules, and layout, 2 & 1.2 micro meter CMOS rules, Layout diagrams, Symbolic diagram.
3. Basic Circuit concepts:  
Sheet resistance, Area capacitances of layers, Delay unit, Wiring Capacitances, Choice of layers.
4. Scaling of MOS Circuits:  
Scaling models, Scaling function for device parameters, Limitations of scaling.
5. Sub system design and Layout:  
Architectural issues, Switch logic, Examples of Structural design(Combinational logic).
6. Sub system design process:  
Design of ALU subsystem, Some commonly used storage elements, Aspects of design tools, Design for testability, Practical design for test guidelines, Built in self test, CMOS project-an incrementer / decrementer, a comparator for two n-bit numbers.  
  
Ultra fast systems, Technology development, MOSFET based design.
7. Introduction to Embedded Systems  
Embedded Systems, Processor Embedded into a System, Embedded Hardware Units and Devices in a System, Embedded Software in a System, Examples of Embedded Systems, Embedded Systems on Chip, Complex Systems Design and Processors, Design Process in Embedded System, Formalization of System Design, Design Process and Design Examples, Classification of Embedded Systems, Skills required for an Embedded System Designer.
8. Embedded Software Development Process and Tools  
Introduction to Embedded Software Development Process and Tools, Host and Target Machines, Linking and Locating Software, Getting Embedded Software into the Target System, Issues in Hardware-Software Design and Co-design

**Text books:**

1. Basic VLSI Design by Douglas A, Pucknell, Kamran Eshraghian, Prentice-Hall, 1996, 3<sup>rd</sup> Edition.
2. Embedded Systems Architecture, Programming and Design, second edition by Raj Kamal, Tata McGraw Hill Publication (Chapter 1, Chapter 13)

**References:**

1. Mead, C.A and Conway, LA, "Introduction to VLSI Systems", Addison-Wesley, Reading, Massachusetts, 1980.

**ECE 415 Elective - III(3) : ADVANCED MICROPROCESSORS**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

8086 / 8088 microprocessor, architecture and addressing modes.

Instructions and assembly language programming.

Macroassembler MASM and advanced programming.

Interrupts of 8086 / 8088 and DOS Interrupt 21h functions.

Interfacing A/D converters to the PC and data acquisition. Interfacing D/A converters and waveform generation.

80286, 80386, 80486 and Pentium microprocessors.

Motorola 68000, 68020 and 68030 microprocessors.

**Text Books:**

1. Microprocessor and Interfacing by Douglas V. Hall, McGraw Hill International Edition, 1992.
2. The Intel Microprocessor 8086 / 8088, 80186, 80286, 80386 and 80486 by Barry B. Brey, PHI, 1998.
3. 68000 Microprocessors by Walter A. Tribel and Avtar Singh, PHI, 1991.

**Reference Books:**

Assembly Language Programming the IBM PC by Alan R. Miller, Sybex INC, 1987.

## ECE 415 Elective – III(4) : INFORMATION NETWORKS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Information and Communication:

Measure for Information, sources, source models and source encoding, coding for memory

less sources, coding for analog sources, channel model and channel capacity.

2. Communication Networks:

Existing Communications Networks, outlines of the associated hardware facilities,

Modules of the interfacing facilities, brief outlines of the characteristics of the networks.

3. Communication Methodologies.

4. Information based services:

Communication services, data analysis services, systems oriented services.

5. Information based forecasting MIS Establishing the Frame work, Information Research management, Data Base

**Books:**

1. Jevome Kanter: "Management Information Systems" Prentice-Hall, 1992
2. Andrew S. Tanenbaum: "Computer Networks" Prentice Hall, 1989
3. Taub and Schilling: Principles of Communication systems, McGraw Hill, 1971.

**ECE 415 Elective – III(5) : IMAGE PROCESSING AND PATTERN  
RECOGNITION**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

**Introduction:**

Digital Image Processing and Applications – Image Representation and Modeling – Image Enhancement – Image Restoration – Image Analysis – Image Data Compression.

**Digital Image Fundamentals:**

Elements of Visual perception – A simple Image Model – Sampling and Quantization – Some Basic Relationship between Pixels.

**Image Transforms:**

Two Dimensional Orthogonal and Unitary Transforms – Properties of Unitary Transforms – One Dimensional DFT – Two Dimensional DFT – Cosine Transforms – Sine transforms – Hadamard Transforms – Haar Transforms – Slant transforms.

**Image Enhancement:**

Point Operations – Histogram Modeling – Spatial Operations – Transform Operations.

**Image Restoration and Compression:**

Image observation models – Inverse and Wiener Filtering – Pixel Coding – Predictive techniques – Transform Coding of Images.

**Statistical and Non – Parametric Decision Making:**

Applications of Pattern Recognition – Baye’s Theorem – Multiple Features – Conditionality Independent Features – Decision Boundaries – Unequal Costs of Error – Estimation of Error Rates – Kernel and Window Estimator – Nearest Neighborhood Classification Techniques – Adaptive Decision Boundaries – Adaptive Discriminant Functions.

**Clustering:**

Introduction – Hierarchical Clustering – Partitional Clustering.

**Artificial Neural Networks:**

Introduction – Nets without Hidden Layers – Nets With Hidden Layers – The Back Propagation Algorithms – Hopfield Nets – Classifying Sex From Facial Images.

**Text Books:**

Fundamentals of Digital Image Processing, Anil K. Jain, PHI.

Pattern Recognition and Image Analysis, Earl Gose and Richard Johnsonbaugh  
Steve Jost, PHI.

Digital Image Processing, Rafael C. Gonzalez and Richard E. Woods, Addison – Wesley.

Image Processing Theory Algorithms and Architecture, M. A. SID – AHMED,  
McGraw Hill Inc.

## ECE 416 DIGITAL COMMUNICATION LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

1. Sample the given input signal for different sampling rates and recover the signal by means of appropriate low – pass filter.
2. Study the Pulse – Width Modulation for both AC and DC Modulating Signals and obtain the corresponding waveforms.
3. Study the Pulse – Position Modulation for both AC and DC Modulating Signals and obtain the corresponding waveforms.
4. Study the functioning of a given Analog to Digital Converter.
5. Study the functioning of a given Digital to Analog Converter.
6. Encode the given 4-Bit Data Word into 16-Bit Orthogonal Encoded Word using Hadamard Code.
7. Decode the 16-Bit Orthogonal Encoded Word to 4-Bit Data Word.
8. Study the performance of the given Continuously Variable Slope Delta Modulation (CVSD).
9. Obtain the characteristics of the Phase Shift Keying (PSK) Modulator.
10. Obtain the characteristics of the Frequency Shift Keying (FSK) Modulator.

## ECE 417 DIGITAL SIGNAL PROCESSING LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	3	3	50	50	100

Cycle – I: Signal Processing with MATLAB

1. Generation of Discrete-Time Sequences
2. Implementation of Discrete-Time Systems
3. Frequency Analysis of Discrete Time Sequences
4. Frequency Analysis of Discrete Time Systems
5. Infinite Impulse Response Filter Design
6. Finite Impulse Response Filter Design

Cycle – II: VHDL Experiments

1. Logic Gates
2. Full Adder
3. SR Latch and D Latch
4. 8 x 1 Multiplexer and Demultiplexer
5. Up/Down Counter, Universal Shift Register
6. Mealy & Moore Counters

**B.E. 4<sup>th</sup> Year 2<sup>nd</sup> Semester (Credit Based Grading System)  
with effect from the admitted batch of 2006 - 2007**

**ECE 421 ENGINEERING ECONOMICS AND MANAGEMENT**

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Fundamentals of Economics - Scarcity and Efficiency Market, Command and Mixed Economics.  
Basic Elements of Supply and Demand - Law of Demand - Elasticity of Demand.
2. Business Organizations - Individual Proprietorship - Partnership - The Corporation.  
Statement of Profit and Loss - The Balance Sheet - Break-Even Analysis - Cost Concepts - Elements of Costs.
3. Principles and Functions of Management - Evolution of Management Thought - Decision Making Process.  
Organization Theory and Process - Leadership - Motivation - Communication - Conflict Management in Organization.
4. Plant Location - Plant Layout - Production Planning and Control - Product Design and Development - Channels of Distribution. Materials Management - Inventory Control.
5. Industrial Disputes and their Settlement - Provision of Factories Act and Industrial Disputes Act.  
Recent Trends in Contemporary Business Environment.

**References:**

1. Economics - Paul A. Samuelson and William D. Nordhaus.
2. Engineering Economics - Vol. 1 - Tara Chand.
3. Financial Management - S. N. Maheswari.
4. Essentials of Management - Koontz and O' Donnel.
5. Production and Operation Management - B. S. Goel.
6. Modern Production / Operation Management - Elwood S. Buffa, Rakesh K. Sarin.
7. Industrial Law - S. P. Jain.
8. Industrial Law - R. P. Maheswari and S. N. Maheswari.
9. Labour and Industrial Laws - Singh, Agarwal and Goel.

## ECE 422 RADAR ENGINEERING AND NAVIGATIONAL AIDS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Radar Equation, Radar Block Diagram and Operation, Prediction of Range, Minimum Detectable Signal, Receiver Noise, Probability Density Functions, S/N, Integration of Radar Pulses, Radar Cross-section, Transmitter Power, PRF and Range Ambiguities, Radar Antenna Parameters, System Losses and Propagation Effects.
2. MTI and Pulse Doppler Radar: Introduction, Delay line Cancellers, Moving target Detector, Limitation to MTI performance, MTI from moving platform, Pulse Doppler Radar
3. Tracking Radar, Sequential Lobing, Conical Scan, Monopulse tracking Radar, Low angle tracking, Pulse compression,  
Block Diagrams of Synthetic Aperture Radar (SAR), Phased array Radars, MST Radar, ECM, ECCM
4. Radar Receiver, Mixers, Radar Displays, Receiver Protectors.
5. Principles of Direction Finders, Aircraft Homing and ILS, Radio Altimeter, LORAN, DECCA, OMEGA, Inland Shipping Aids.

### **Text Book:**

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN - 978813179944 Pearson Education Chennai 2013.
2. Radar Engineering and Fundamentals of Navigational Aids, G S N Raju, IK International Publishers, 2008

### **References**

Introduction to Radar Systems, Skolnik, McGraw Hill, 2007.

## ECE 423 DATA COMMUNICATIONS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

### Data Communication Concepts and Terminology:

Data Representation, Data Transmission, Modes of Data Transmission, Signal Encoding, Frequency Spectrum, Transmission Channel, Data Communication

### Transmission Media:

Transmission Line Characteristics, Transmission Line Characteristics in Time Domain, Cross talk, Metallic Transmission Media, Optical Fiber Base-band Transmission of Data Signals, Telephone Network, Long Distance Network

### Modems and Data Multiplexers:

Digital Modulation Methods, Multilevel Modulation, Differential PSK, Standard Modems, Limited Distance Modems and Line Drivers, Group Band Modems, Data Multiplexers, Statistical Time Division Multiplexers

### Error Control:

Transmission Errors, Coding for Error Detection and Correction, Error Detection Methods, Forward Error Correction Methods, Reverse Error Correction

### The Physical Layer, The Data Link Layer:

Need for Data Link Control, The Data Link Layer 196, Frame Design Considerations, Flow Control, Data Link Error Control, Data Link Management, HDLC-HIGH-LEVEL DATA LINK CONTROL

### The Network Layer:

The Sub network Connections, Circuit Switched Sub networks, Store and Forward Data Sub networks, Routing of Data Packets, Internetworking, Purpose of the Network Layer, Title of X.25 Interface, Location of X.25 Interface, Addressing in X.25, Packet Assembler and Disassembler (PAD), Asynchronous Character Mode Terminal PAD

### Local Area Networks:

LAN Topologies, Media Access Control and Routing, MEDIA ACCESS CONTROL IN LOCAL AREA NETWORKS, INTERNETWORKING, THE TRANSPORT AND UPPER OSI Layer, The Session Layer, The Presentation Layer, The Application Layer.

### **Text Book:**

Praksh C. Gupta 'DATA COMMUNICATIONS' Prentice Hall of India 1996.

## ECE 424 FIBER-OPTIC COMMUNICATIONS

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
4	3	1	-	3	30	70	100

1. Propagation: in Fibers:
  - Elementary discussion of propagation in fibers
  - Attenuation in Optical Fibers
  - E M wave propagation in step-Index Fibers
  - E M wave propagation in graded-Index Fibers.
2. Optical Fibers and Associated Components:
  - Fiber Properties
  - Splices, connectors, Couplers, and Gratings.
3. Transmitting and Receiving Devices:
  - Injection laser Characteristics
  - LED structures, Characteristics and modulation
4. Optical Transmitters, Receivers and Fiber-optic Link Design:
5. Concepts of Fiber-Optic Networks and wavelength – Division Multiplexing:

### **Books:**

For syllabus items 2,4 and 5

An Introduction to Fiber Optic Systems by John Powers, 2<sup>nd</sup> Edition, Irwin, 1997.

For syllabus item 1

Optical Communication Systems by John Gowar, PHI 1994

For syllabus item 3

Optical Fiber Communications, Principles and Practice by John M. Senior, Second Edition, PHI 1996.

## ECE425 Free Elective –II (1) FUNDAMENTALS OF MOBILE COMMUNICATIONS

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	1	3	30	70	100

### INTRODUCTION [1] [2]:

Evolution of Mobile Communications, Mobile Radio Systems around the world, First, Second, Third Generation Wireless Networks, Wireless Local Loop(WLL), Wireless LANs, Bluetooth, Personal Area Networks(PANs), Examples of Wireless Communication Systems, A Simplified Reference Model, Applications.

### WIRELESS TRANSMISSION TECHNIQUES [1]:

Frequencies for radio transmission, Signals, Antennas, Signal Propagation, Multiplexing, Modulation Techniques: ASK, PSK, FSK, Advanced ASK, Advanced PSK, Multicarrier, Spread Spectrum: Direct sequence and Frequency hopping, Medium Access control- SDMA, FDMA, TDMA, CDMA, Comparison of S/F/T/CDMA.

### THE CELLULAR CONCEPT [2]:

Introduction, Frequency reuse, Handoff strategies, Interference and System Capacity: Co- Channel Interference, Channel Planning, Adjacent Channel Interference, Power control for reducing interference, Trunking and Grade of Service, Cell Splitting, Sectoring, Repeaters for Range extension, A microcell zone concept.

### MOBILE RADIO PROPAGATION [2]:

Introduction, Free space propagation model, The three basic propagation models-Reflection, Diffraction and Scattering, Two-ray model, Outdoor propagation models, Indoor propagation models, Signal Penetration into building, Small scale multipath Propagation, Parameters of Mobile multipath channels, Types of small scale fading.

### TELECOMMUNICATION SYSTEMS [1]:

GSM: Mobile Services, System Architecture, Radio interface, Protocols, Localization and Calling, Handover, Security, New data services, UMTS and IMT-2000: Releases and Standardization, System Architecture, Radio interface, UTRAN, Handover.

### Textbooks:

Mobile Cellular Communication by Gottapu Sasibhushana Rao,  
Pearson International, 2012.

### References:

1. Mobile Communications-Jochen Schiller, Pearson education, 2<sup>nd</sup> Edn, 2004.
2. Wireless Communications: Principles and Practice-Theodore. S. Rapport, Pearson education, 2<sup>nd</sup> Edn, 2002.
3. Mobile Cellular Telecommunications-W.C.Y.Lee, Tata McGraw Hill, 2<sup>nd</sup> Edn, 2006.
4. Wireless and Mobile Communications-Lee, McGraw Hill, 3<sup>rd</sup> Edition, 2006.
5. Wireless Communications and Networks-William Stallings, Pearson Education, 2004.

## ECE425 Free Elective –II (2) BASICS OF GPS

<i>Credits</i>	<i>Periods</i>		<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial / Lab</i>				
4	3	-	3	30	70	100

### Introduction to Global Navigation Satellite Systems(GNSSs)

The History of GPS, The Evolution of GPS, Development of NAVSTAR GPS, Block I, Block II satellites, Block IIA, Block IIR and Block II R-M satellites..

GPS working principle, Trilateration,, Determination of where the satellites are, Determination of how far the satellites are, Determining the receiver position in 2D or X-Y Plane, Determining the receiver position in 3D or X-Y-Z Plane.

**Other Global Navigation Satellite Systems, GLONASS, GALILEO, Comparison of 3 GNSS (GPS, GALILEO, GLONASS) interms of constellation and services provided**

### GPS Satellite constellation and Signals

GPS system segments, Space segment, Control segment, User segment, GPS Signals, Pseudorandom noise (PRN) code, C/A code , P code Navigation data, Signal structure of GPS.

### Coordinate Systems:

Geoid, Ellipsoid, Coordinate Systems, Geodetic and Geo centric coordinate systems, ECEF coordinates, world geodetic 1984 (WGS 84) system, Conversion between Cartesian and geodetic coordinate frame

### Textbook :

1. G S RAO, **Global Navigation Satellite Systems**, McGraw-Hill Publications, New Delhi, 2010

### Reference Books:

1. Scott Gleason and Demoz Gebre-Egziabher, **GNSS Applications and Methods**, Artech House, 685 Canton Street, Norwood, MA 02062, 2009.
2. James Ba – Yen Tsui, ‘**Fundamentals of GPS receivers – A software approach**’, John Wiley & Sons (2001).

## ECE 426 MICROWAVE ENGINEERING AND ANTENNAS LABORATORY

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
2	-	-	4	-	50	50	100

- 1) Measurement of VSWR
- 2) V-I Characteristics of GUNN Diode
- 3) Measurement of Coupling Factor and Directivity of a 4-Port directional coupler
- 4) Measurement of Microwave frequency
- 5) Reflex Klystron Characteristics
- 6) Radiation Pattern of Horn Antenna
- 7) Fiber Optic Analog Link
- 8) Fiber Optic Digital Link

Other four experiments from the choice either from Microwave Engineering or from Antenna Theory

## ECE 427 PROJECT - II

<i>Credits</i>	<i>Periods</i>			<i>Exam Hrs.</i>	<i>Sessional Marks</i>	<i>Exam Marks</i>	<i>Total Marks</i>
	<i>Theory</i>	<i>Tutorial</i>	<i>Lab</i>				
8	-	-	12	-	50	50	100