Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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B.Tech. Course in

Electronics & Telecommunication Engineering

From 3rd Semester -8th Semester
(With effect from July 2017)

Dr. Babasaheb Ambedkar Technological University, Lonere, Raigad – 402103

Department of Electronics and Telecommunication Engineering

Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology for development of society.

Mission:

The Electronics and Telecommunication Engineering Department constantly aims at providing quality education and works towards the fulfillment of the goal and objectives in pace with the modern scientific and technological development.

Objectives:

1. To provide quality education
2. To create world class educational facility
3. To provide conducive atmosphere for higher studies and research amongst the students and faculty members
4. To provide the platform for filling patents, publication and books
5. To provide platform for achieving excellence in teaching, research and transfer of technology

Program Educational Objectives (PEOs) & Programme Outcomes (POs):

- To prepare students to excel in technical fields in order to pursue postgraduate programs or to succeed in industry/technical profession, R&D institutions through global and new

emerging areas in Electronics and Telecommunication engineering.

- To provide students with a solid foundation in mathematical, scientific and engineering fundamentals required to solve engineering problems.
- To train students with good scientific and engineering breadth in core subjects so as to comprehend and simulate to cater changing needs of society, analyze, design, and create novel products and solutions for the real life problems.
- To develop in students, professional and ethical attitude, effective communication skills, leadership, teamwork skills, multidisciplinary approach, and an ability to relate engineering issues to broader socioeconomic context.
- To provide students with conducive academic environment, awareness of excellence and the life-long learning needed for successful professional career.

Programme Outcomes (POs):

- The graduates will possess the knowledge of differential equations, vector calculus, complex variable, matrix theory, probability theory, physics, chemistry and electrical & electronics engineering
- The graduate will demonstrate an ability to identify, formulate and solve Electronics & Telecommunication engineering problems
- The graduates will have an ability to design electronic circuits and systems, analyze and interpret data.
- The graduates will have an ability to design digital and analog systems and components
- The graduates will possess the knowledge of advanced and emerging topics in the fields of Electronics, Signal Processing and Communication
- The graduates will demonstrate the skills to use modern engineering tools, software and equipment's to analyze and solve real-life problems
- The graduate will have broad understanding of the impact of Electronics and Telecommunication field in economic, environmental and social context and also will be aware of the contemporary issues
- The graduates will possess communication skills necessary to communicate engineering ideas. The skills set include verbal, written and listening skills.

- The graduates will demonstrate the ability to work and collaborate in heterogeneous teams.
- The graduates will demonstrate the awareness of professional and ethical responsibilities
- The graduates will develop self-confidence and ability for lifelong learning

Preface

The engineering education system in the State of Maharashtra has witnessed rapid progress in recent years under the guidance, direction and leadership of Dr. Babasaheb Ambedkar Technological University Lonere.

Considering the wide diversities in the system and the need to enhance its quality, standard and relevance so that the E&TC graduates passing out from the system can meet the 21st century challenges ahead of them, the Vice Chancellor, Dr. BATU, Lonere had desired that a Model Scheme of Instruction and Syllabi to be reviewed and reframed as per industry needs. After detailed deliberations and associating senior experts from leading institutions in the country, has proposed in this document, a Model Scheme of Instruction and Syllabi for UG (E & TC).

It is well known that E&TC professionals are key personnel in any country responsible for its economic progress and prosperity, leading to increased comfort and satisfaction levels of its people and the society at large. The developed countries have already benefitted from their knowledge and skills and have demonstrated the crucial role played by these professionals in strengthening their R&D, industries and economies. As India is now engaged in such an endeavour and has prepared a road map for becoming a developed nation by the year 2020, serious efforts are now going on in the country in this direction. In this context, the education and training of E & TC professionals are now receiving much attention here. But, there are challenges being faced by these professionals in the on-going 21st century, recognized as the Knowledge Age, like:

1) Rapidly changing technological scene worldwide, with a shrinking time scale for new developments and for obsolescence of old practices, leading to:
    - Increase in investment on R&D in industry and other sectors;

- Demand for innovative products and services, based on contemporary technologies; and,
- Growing need for enhancement of abilities to manage change, so frequent, now a days;

2) Globalization and liberalization of Indian industry, leading to:
   - Comprehensive restructuring of industry sector for enhancing efficiency;
   - Increase in world-wide mobility of E&TC professionals; and,
   - Growth of competitive environment globally and also in the country;
3) Emergence of new career opportunities for E&TC professionals, leading to:
   - Demand for broad-based, flexible education in multi/inter- disciplinary subjects;
   - Emphasis on PG courses, research training and institute-industry interaction; and,
   - Advances in learner-centric programmes and life-long learning opportunities;
4) Penetration of IT in all sectors of the E&TC profession, leading to:
   - Increased demand for IT-based solutions to industrial and societal problems;
   - Expertise in emerging IT developments to solve complex, E&TC problems; and,
   - Improved access to worldwide information/data bases and knowledge centres.
5) Increased social/environmental concerns in the E&TC context, leading to:
   - Effective means for protection of endangered environment and depleting energy sources;
   - Seeking environment- and energy- friendly solutions to E&TC problems; and.
   - Wealth generation using environmentally benign and energy efficient techniques;
   - These challenges require appropriate orientation of E&TC education and research throughout syllabus at all levels, particularly at UG and revitalizing the same as outlined below, so that E&TC professionals of the 21st century are equipped to face the challenges with determination and courage becoming ready in a short time to contribute to national development.

Approach to Curriculum:

As a major objective of E & TC education in the state of Maharashtra Dr. BATU now is to develop E & TC professionals having competencies, intellectual skills and knowledge equipping them to contribute to the society through productive and satisfying careers as

innovators, decision makers and leaders in the national and global economies of the 21st century, the Approach to Curriculum for UG E & TC Degree Programmes needs to lay special emphasis on educating/preparing the students well for being able to demonstrate the following abilities:

(a) Effective application of knowledge of mathematics, science and technical subjects;

(b) Planning and design to conduct scientific and technical experiments;

(c) Analysis and interpretation of scientific, technical and economic data collected;

(d) Design of parts, subsystems, systems and/or processes to meet specific needs;

(e) Identification, formulation and solving of problems using simulation or otherwise;

(f) Use of techniques/tools including software in all disciplines, as may be required;

(g) Effective communication skills and leadership/participation in team work;

(h) Fulfillment of professional, social and ethical responsibilities;

(i) Sensitivity to environmental and energy issues and concerns;

(j) Planning, development and implementation of strategies for life-long learning.

These requirements call for the following objectives to the Approach to Curriculum relating to UG students at E&TC Degree Programmes in the state of Maharashtra:

1) Preparation: To prepare the students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;

2) Core Competence: To provide the students with a solid foundation in mathematical, scientific and E&T fundamentals required to solve E&TC related problems;

3) Breadth: To train the students with a breadth of scientific and E&TC acknowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

4) Professionalism: To inculcate in the students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate E&TC issues to a broader context;

5) Learning Environment: To provide the students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long/productive career.

Dr. Babasaheb Ambedkar Technological University

Department of Electronics & Telecommunication Engineering

B.Tech (Electronics & Telecommunication Engineering)

Semester III

Sr. No.	Course Code	Course	Teaching Scheme			
			L	T	P	C
1.	EC 01	Engineering Mathematics III	3	1	0	4
2.	EC 02	Principles of Communication Engineering	3	1	0	4
3	EC 03	Electronic Devices and Circuits	3	1	0	4
4	EC 04	Digital Electronics	3	0	0	3
5	EC 05	Electronic Measuring Instruments & Tools	0	0	2	1
6	EC 06	Network Analysis	3	0	0	3
7	EC 07 (Ele-I) (Open)	Physics of Engineering Materials Engineering Chemistry-II Advanced Computer Programming Statistical Methods	3	0	0	3
8	ECL 08	Electronic Devices and Circuits Laboratory	0	0	2	1
9	ECL 09	Principles of Communication Engg. Laboratory	0	0	2	1
10	ECL 10	Digital Electronics Laboratory	0	0	2	1
Total			18	03	08	25

List of Electives

EC 07 (Ele-I) (Open)

A. Physics of Engineering Materials
B. Chemistry-II
C. Engineering Advanced Computer Programming
D. Statistical Methods

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Semester IV

Sr. No.	Course Code	Course	Teaching Scheme			
			L	T	P	C
1.	EC 11	Linear Integrated Circuits	3	0	0	3
2	BH01	Basic Human Rights	2	0	0	2
3.	EC 12	Signals and Systems	3	1	0	4
4.	EC 13	Numerical Methods	3	1	0	4
5	EC 14 (Ele-II) (Open)	Electrical Machines Open Source Technology Renewable Energy	3	0	0	3
6.	EC 15 (Ele-III)	Industrial Instrumentation Development Engineering Linear Algebra Nano Electronics NSS1	3	0	0	3
7	ECL 16	Analog Circuits Laboratory	0	0	2	1
8.	ECL 17	Numerical Methods Laboratory	0	0	2	1
9.	ECL 18	Signals & Systems Laboratory	0	0	2	1
10.	EC 19	Seminar & Presentation	0	0	4	2
11	MP 20	Mini-project	0	0	2	1
Total			17	02	12	25

List of Electives

EC 14 (Ele-II) (Open)

A. Electrical Machines
B. Open Source Technology
C. Renewable Energy

EC 15 (Ele-III)

A. Industrial Instrumentation
B. Development Engineering
C. Linear Algebra
D.NSS1

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Semester V

Sr. No.	Course Code	Course	Teaching Scheme			
			L	T	P	C
1.	EC 21	Probability and Random Processes	3	1	0	4
2.	EC 22	Electromagnetic Fields	3	0	0	3
3.	EC 23	Microprocessor and Microcontroller	3	0	0	3
4	EC 24	Digital Signal Processing	3	1	0	4
5	EC 25 (Ele-IV)	Digital Voice and Picture Communication	3	0	0	3
		Engineering Economics				
		Computer Organization & System Software				
6	EC 26 (Ele-V)	Telecomm. Network Management	3	0	0	3
		MEMS & NEMS				
		Embedded System Design				
		Project Management				
		NSS2				
		NSF COURSE I				
7	ECL 27	Microprocessor and Microcontroller Laboratory	0	0	2	1
8	ECL 28	Digital Communication Laboratory	0	0	2	1
9	ECL 29	Digital Signal Processing Laboratory	0	0	2	1
Total			18	2	6	23

List of Electives

EC 25 (Ele-IV)
- A. Digital Voice and Picture Communication
- B. Engineering Economics
- **C.** Computer Organization & System Software

EC 26 (Ele-V)
- A. Telecomm. Network Management
- B. MEMS & NEMS
- C. Embedded System Design
- D. Project Management
- E. NSS2
- F. NSF COURSE I

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Semester VI

Sr. No	Course Code	Course	Teaching Scheme			
			L	T	P	C
1	EC 30	Wireless Communication	3	1	0	4
2.	EC 31	Control System	3	1	0	4
3	EC 32	Digital Communication	3	0	0	3
4	*EC33	Employability & Skill Development	2	0	0	2
5	EC 34 (Ele-VI)	Image Processing Power Electronics Audio & Video Processing	3	1	0	4
6	EC35 (Ele-VII) (Open)	Data Structure Acoustic Engineering Rural Technology Digital System Design NSF COURSE II	3	0	0	3
7	ECL 36	Image Processing Laboratory Power Electronics Laboratory Audio & Video Processing Laboratory	0	0	2	1
8	EC CP 37	Community Project	0	0	4	2
Total			17	3	6	23

*EC33- Only Term Work, no final examination.

List of Electives

EC 34 (Ele-VI)
- A Image Processing
- B. Power Electronics
- C. Audio & Video Processing

EC35 (Ele-VII) (Open)
- A. Data Structure
- B. Acoustic Engineering
- C. Rural Technology
- D. NSF COURSE II

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Semester VII

Sr. No.	Course Code	Course	Teaching Scheme			
			L	T	P	C
1.	EC 38	Antenna and Wave Propagation	3	1	0	4
2.	EC 39	Optical Fiber Communication	3	1	0	4
3	EC 40	RF & Microwave Communication	3	1	0	4
4.	EC 41 (Ele-VIII)	Computer Network	3	1	0	4
		Cloud Computing				
		Electronics Product Design				
		Internet of Things				
5	EC 42 (Ele-IX)	Data Compression and Encryption/Cryptography	3	0	0	3
		VLSI Design				
		PLC and Automation				
		Speech Processing				
		NSF COURSE III				
6	ECL 43	Antenna and Wave Propagation Laboratory	0	0	2	1
7	ECL 44	Computer Network Laboratory	0	0	2	1
8	ECL 45	Optical Fiber Communication Lab	0	0	2	1
9	ECL 46	VLSI and Embedded Lab	0	0	2	1
10	EC 47	Industrial Training Seminar Laboratory	0	0	4	2
11	ECP1 48	Project	0	0	8	4
Total			15	4	20	29

List of Electives

EC 41 (Ele-VIII)
- A. Computer Network
- B. Cloud Computing
- **C.** Electronics Product Design
- D. Internet of Things

EC 42 (Ele-IX)
- A. Data Compression and Encryption/Cryptography
- B. VLSI Design
- C. PLC and Automation

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Semester VIII

Sr. No.	Course Code	Course	Teaching Scheme			
			L	T	P	C
1	EC 49 (Ele-X)	Wireless Sensor Networks	3	0	0	3
		Radar & Satellite Communication				
		Neural Network and Fuzzy logic				
		Advance Cellular Network				
2.	EC 50 (Ele-XI)	Analog and Mixed Signal Processing	3	0	0	3
		Advance 3G/4G				
		Telecom Regulation				
		Estimation and Detection Theory				
		Soft Computing				
3.	EC 51 (Ele-XII)	Multirate Digital Signal Processing	3	0	0	3
		RF Circuit Design				
		Biomedical Signal Processing				
		Robotics and automation				
		Software Defined Radio				
4	ECP2 52	Project	0	6	4	8
Total			9	6	4	17

List of Electives

EC 49 (Ele-X)
- A. Wireless Sensor Networks
- B. Radar & Satellite Communication
- C. Neural Network and Fuzzy logic
- D. Advance Cellular Network

EC 50 (Ele-XI)
- A. Analog and Mixed Signal Processing
- B. Advance 3G/4G
- C. Telecom Regulation
- D. Estimation and Detection Theory
- E. Soft Computing

EC 51 (Ele-XII)
- A. Multirate Digital Signal Processing
- B. RF Circuit Design
- C. Biomedical Signal Processing
- D. Robotics and automation
- E. Software Defined Radio

EC 01	Engineering Mathematics III	4 Credits

Prerequisites: Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Vector algebra, Algebra of complex numbers.

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

- Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
- Transforms such as Fourier transform Z-transform and applications to Communication systems and Signal processing.
- Vector differentiation and integration required in Electro-Magnetics and Wave theory.
- Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, student will be able to:

1. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
2. Solve problems related to Fourier transform, Z-transform and applications to Communication systems and Signal processing.
3. Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
4. Perform vector differentiation and integration, analyze the vector fields and apply to Electro-Magnetic fields.
5. Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

UNIT – 1

Laplace Transform

Definition - condition for existence; Transforms of elementary functions; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives; Evaluation of integrals by using Laplace Transform. Transforms of some special functions - periodic function, error function, unit step function.

UNIT - 2

Inverse Laplace Transform

Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

UNIT - 3

Fourier Transform

Definition - integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals. Fourier sine and cosine transforms; Properties of Fourier transforms: Convolution theorem for Fourier Transforms, Application to boundary value problems.

UNIT - 4

Series Solutions of Differential Equations and Special Functions

Validity of series solution; Series solutions about ordinary and singular point; Frobenius method; Series solution of Bessel equation; Recurrence relations for Bessel function; Generating function for Bessel function; Orthogonality of Bessel function.

UNIT - 5

Partial Differential Equations and Their Applications

Formation of Partial differential equations; Solutions of Partial differential equations - direct integration, linear equations of first order (Lagrange's linear equations), homogeneous linear equations with constant coefficients; Method of separation of variables - application to find solutions of wave equation, one dimensional heat equation and Laplace equation

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UNIT - 6

Calculus of Complex Functions

Limit and continuity of f(z); Derivative of f(z) - Cauchy-Riemann equations; Analytic functions; Harmonic functions – Orthogonal system; Conformal transformations: complex integration - Cauchy's theorem, integral formula; Residue theorem.

TEXT/REFERENCE BOOKS

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar & J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
3. A Text Book of Engineering Mathematics by N. P. Bali & N. Ch. Narayana Iyengar, Laxmi Publications (P) Ltd. , New Delhi.
4. A course in Engineering Mathematics (Vol II & III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
6. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
7. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd., Singapore.
8. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mc graw-Hill Publishing Company Ltd., New Delhi.

EC 02	Principles of Communication Engineering	4 Credits

Course Objectives:

The students are expected to demonstrate the ability to:

- Describe and analyze the mathematical techniques of generation, transmission and reception of amplitude modulation (AM), frequency modulation (FM) and phase modulation (PM) signals.
- Evaluate the performance levels (Signal-to - Noise Ratio) of AM, FM and PM systems in the presence of additive white noise.
- Convert analog signals to digital format and describe Pulse and digital Modulation techniques.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand and identify the fundamental concepts and various components of analog communication systems.
2. Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.
3. Describe analog pulse modulation techniques and digital modulation technique.
4. Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

UNIT - 1

Introduction to Communication Systems

Introduction to transmitter, the dB in communications, noise, noise designation &calculation, noise measurement, concept of modulation, Bandwidth requirement, Frequency allocation, Noise in modulation systems, Introduction to random processes and random signals as applicable to noise.

UNIT - 2

Linear Modulation

Amplitude modulation, DSB-SC modulation, Generation of AM and DSB-SC signals, Envelope detector, Theory of single sideband, Generation of SSB signals, Demodulation of SSB, Vestigial Side Band (VSB) Modulation, Envelope detection of VSB+C, Superheterodyne Receiver.

UNIT - 3

Angle Modulation

Introduction, Bandwidth of FM, Tone Modulation, Phase Modulation, Generation of FM, Demodulation of FM, Band pass Linear (BPL), Broadcast FM.

UNIT - 4

Digital Transmission of Analog Signals: PCM, DPCM AND DM

Introduction, The PCM system, Sampling, Quantization, Encoding, Electrical waveform representation of binary sequences, Bandwidth requirements of PCM, Differential Pulse Code Modulation (DPCM) and Delta Modulation.

UNIT - 5

Noise Performance of Various Modulation Schemes

Introduction, Receiver Model and Figure of Merit: Linear Modulation, Coherent Demodulation, Envelope Detection, Receiver Model: Angle Modulation, Calculation FOM, Pre-Emphasis and de-Emphasis in FM, Noise performance of a PCM system.

UNIT - 6

Communication Techniques

Introduction, Frequency conversion, Special techniques, receiver noise & sensitivity, dynamic range, Inter modulation distortion testing, Frequency synthesis, directs digital synthesis, FM communications transceivers. Review of telegraphy, Telephony and telemetry. Microphones and Loudspeakers: Concept, classifications & working and PA system.

TEXT/REFERENCE BOOKS

1. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8th Edition.
2. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5th Edition.
3. Kennedy, "Electronics Communications Systems", McGraw-Hill New Delhi-1997, 4th Edition.
4. R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill New Delhi-2008.

EC 03	Electronic Devices and Circuits	4 Credits

Prerequisites: Basic knowledge of Semiconductor Physics

Course Objectives:

- To introduce semiconductor devices FET and MOSFET, their characteristics, operations, circuits and applications.
- To introduce concepts of both positive and negative feedback in electronic circuits.
- To analyze and interpret FET and MOSFET circuits for small signal at low and high frequencies.
- To simulate electronics circuits using computer simulation software and verify desired results.
- To study the different types of voltage regulators.

Course Outcomes:

On completion of the course, student will be able to:

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.
3. Analyze small signal model of FET and MOSFET.
4. Explain behavior of FET at low frequency.
5. Design an adjustable voltage regulator circuits.

UNIT - 1

JFET

Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET (Self).FET as an amplifier and its analysis (CS) and its frequency response. Small signal model, FET as High Impedance circuits.

UNIT - 2

MOSFET& its DC Analysis

Basics of MOS Transistor operation, Construction of n-channel E-MOSFET, E-MOSFET characteristics & parameters, non-ideal voltage current characteristics viz. Finite output resistance, body effect, sub-threshold conduction, breakdown effects and temperature effects. Common source circuit, Load Line & Modes of operation, common MOSFET configurations: DC Analysis, constant current source biasing.

UNIT - 3

MOSFET AC Circuit Analysis

The MOSFET CS small signal amplifier, Small signal parameters, small signal equivalent circuit, Modeling, Body effect, Analysis of CS amplifier, Introduction to Bi CMOS technology, The MOSFET internal capacitances and high frequency model, Introduction to MOSFET as basic element in VLSI, V-I characteristic equation in terms of W/L ratio, MOSFET scaling and small geometry effects, MOSFET capacitances.

UNIT - 4

MOSFET Circuits

MOSFET as switch, diode/active resistor, Current sink and source, current mirror, Voltage references, Basic principle of band gap reference, CMOS Inverter as amplifier: Active load, Current source and Push pull configurations.

UNIT - 5

Feedback amplifiers and Oscillators

Four types of amplifiers, Feedback topologies, Effect of feedback on terminal characteristics of amplifiers. Examples of voltage series and Current series FET feedback amplifiers and their analysis. Barkhausen criterion, stability with feedback. General form of LC oscillator. FET RC Phase Shift oscillator, Wein bridge oscillator, Hartley and Colpitts oscillators.

UNIT - 6

Voltage Regulator

Block diagram of an adjustable three terminal positive and negative regulators (317,337) Typical connection diagram, current boosting. Low drop out voltage regulators. Introduction to Switch Mode Power supply (SMPS), Block diagram of SMPS, Types of SMPS. Comparison of Linear Power supply and SMPS.

TEXT/REFERENCE BOOKS

1. Millman Halkias, "Integrated Electronics-Analog and Digital Circuits and Systems", Tata McGraw Hill, 2000.
2. Donald Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill.
3. David A. Bell, "ElectronicDevicesandCircuits",5thEdition, Oxford press
4. R. L. Boylstad, L. Nashlesky, "Electronic Devices and circuits Theory", 9thEdition, Prentice Hall of India, 2006.
5. Anil K. Maini and Varsha Agarwal "Electronic Devices and Circuits", Wiley India

6. Phillip E. Allen, Douglas R. Holberg, "CMOS Analog Circuit Design", Second Edition, Oxford.
7. K. R. Botkar, "Integrated Circuits", 5th Edition, Khanna Publication.

EC 04	Digital Electronics	3 Credits

Course Objectives:

- To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
- To lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor.

Course Outcomes:

On completion of the course, student will be able to

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design combinational and sequential circuits.
3. Design and implement hardware circuit to test performance and application.
4. Understand the architecture and use of microcontrollers for basic operations and Simulate using simulation software.

UNIT - 1

Combinational Logic Design

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Multiplexers and their use in combinational logic designs, multiplexer trees, De-multiplexers and their use in combinational logic designs, Decoders, demultiplexer trees. Introduction to Quine-McCluskey method.

UNIT - 2

Sequential Logic Design

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops. Conversion of flip flops. Application of Flip flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs.

UNIT - 3

State Machines

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector. Introduction to Algorithmic state machines- construction of ASM chart and realization for sequential circuits.

UNIT - 4

Digital Logic Families

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L and DCTL.

UNIT - 5

Programmable Logic Devices and Semiconductor Memories

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM.

UNIT - 6

Introduction to Microcontroller 8051

Microprocessors and Microcontrollers comparison, 8051 architecture, Pin description, addressing modes, instruction set of 8051, concepts of Counters and Timers with the help of status registers, Port Structure and Interrupts. Simple programming examples – for addition, subtraction, multiplication and delay.

TEXT/REFERENCE BOOKS

1. R.P. Jain, “Modern digital electronics”, 3rd edition, 12th reprint Tata McGraw Hill Publication, 2007.
2. M. Morris Mano, “Digital Logic and Computer Design” 4th edition, Prentice Hall of India, 2013.

3. Anand Kumar, "Fundamentals of digital circuits" 1st edition, Prentice Hall of India, 2001.
4. Myke Predko, "Programming and customizing the 8051 microcontroller", Tata McGraw Hill 2003.
5. Muhammad Mazidi, Janice Mazidi and Rolin Mc Kinlay, 'The 8051 Microcontroller and Embedded Systems using Assembly and C', Pearson Education, 2nd edition.

EC 05	Electronic Measuring Instruments & Tools	1 Credits

Course Objective:

- To make student competent for handling measuring instruments and to able to select right instrument for the purpose of measurement under different conditions.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand fundamental of various electrical measurements.
2. Understand and describe specifications, features and capabilities of electronic instruments.
3. Finalize the specifications of instrument and select an appropriate instrument for given measurement.
4. Carry out required measurement using various instruments under different setups.
5. Able to compare measuring instruments for performance parameters.
6. Select appropriate instrument for the measurement of electrical parameter professionally.

Contents

It is expected that operating principle, block diagram and other details shall be taught in theory sessions. Teachers will explore these instruments in detail in respective laboratory sessions. Specification sheet / functions of the instrument should be listed and attached in file/journal.

Theory lectures shall cover following topics along-with discussion of practicals

1. Measurement: Necessity, units, ways of measurements.
2. Performance parameters for measuring instruments.
3. Information about OIML standards.
4. Statistical analysis (Definitions and Introductions only), sources of errors and remedies
5. Calibration and Maintenance of Instruments.
6. Techno-commercial Comparative Analysis and Ordering Information of Instruments.

TEXT/REFERENCE BOOKS

1. Instrument manuals published by respective Manufactures.
2. Kalsi H.S “Electronic Instrumentation”, Tata McGraw Hill, 2004.

EC 06 A	Network Analysis	3 Credits

Course Objectives:

- To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
- To understand the need of simplification techniques of complicated circuits.
- To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
- To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
- To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:

1. Learner will be able to apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze the same.
2. Learner will be able to design analog filters and attenuators theoretically and practically.
3. Learner will be able to design analog filters based on which they can further apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
4. Learner will get an ability to identify issues related to transmission of signals, analyze different RLC networks.
5. Learner will be able to find technology recognition for the benefit of the society.

UNIT - 1

Basic Circuit Analysis and Simplification Techniques

Voltage and Current laws (KVL/KCL).Network Analysis: Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting. Network Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems, Millers Theorem and its dual.

UNIT - 2

Frequency Selective Networks

Significance of Quality factor. Series Resonance: Impedance, Phase angle variations with frequency, Voltage and current variation with frequency, Bandwidth, Selectivity. Effect of Rg on BW & Selectivity. Magnification factor. Parallel resonance: Resonant frequency and admittance variation with frequency, Bandwidth and selectivity. General case: Resistance present in both branches. Comparison and applications of series and parallel resonant circuits. Twin T and Wein Bridge Networks as Notch Filters.

UNIT - 3

Filters and Attenuators

Classifications: Symmetrical and Asymmetrical networks. Properties of two port Network:(i) Symmetrical Networks (T and Π only). Z0 and γ in terms of circuit components, open and short circuit parameters (ii) Asymmetrical Networks: Image Impedance and Iterative Impedance (L-Section only).Filters: Filter fundamentals, Constant K-LPF, HPF, BPF and BSF, m derived LPF and HPF, Terminating half sections, Concept of composite filters Attenuators: Introduction to Neper and Decibel, Relation between Neper and Decibel, Symmetrical T and Π type attenuators.

UNIT - 4

Laplace Transform and Its Applications

Introduction to complex frequency, Definition of Laplace Transform, Basic Properties of Laplace Transform, Inverse Laplace Transform Techniques, Laplace Transform of Basic R, L and C components, Transient response of simple electrical circuits such as RL & RC.

UNIT - 5

Two Port Network Parameters and Functions

Terminal characteristics of network: Z, Y, h, ABCD Parameters; Reciprocity and Symmetry conditions, Applications of the parameters. Network functions for one port and two port networks, Pole-zeros of network functions and network stability.

UNIT - 6

Transmission Line Theory

Types of Transmission lines, Transmission Line Equation, Equivalent circuits, Primary and Secondary line constants, Terminations of transmission lines, VSWR and Reflection Coefficient.

TEXT/REFERENCE BOOKS

1. D Roy Choudary, “Network and Systems” 1st edition, New Age International, 1988.
2. John D. Ryder, “Network Lines and Fields” 2nd edition, PHI, 1955.
3. C. P. Kuriakose, “Circuit Theory Continuous and Discrete Time System, Elements of Network Synthesis” PHI.
4. W.H. Hayt Kemmerly, “Engineering Circuit Analysis”, 5th Edition, Tata McGraw Hill Publications, 1993.
5. M. E. Van Valkenburg, “Network Analysis”, 3rd Edition, Pearson, 2004.
6. Boylestead, “Introductory Circuit Analysis”, 4th edition, Charles & Merrill, 1982.
7. Royal Signal Handbook on Line Communication

EC 07 A	Physics of Engineering Materials	3 Credits

Course Objective:

- To understand and apply the Physics principles behind the development of Engineering Materials

Course Outcome:

The students will be able to understand fundamentals of Electrodynamics, Crystal structure, Semiconductors, Dielectrics, Nano materials, Magnetic and superconducting materials. It forms the base of many modern advance devices and technology.

UNIT - 1

Crystallography Crystal directions and planes, Diatomic Crystal (CsCl, NaCl, Diamond, $BaTiO_3$) Crystal imperfection, Point defects, Line defects, Surface and Volume defects, Structure properties relationship, structure determination by X-ray diffraction.

UNIT - 2

Magnetic Materials Origin of magnetization using atomic theory, classification of magnetic materials and properties, Langevin's theory of Dia, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Antiferromagnetic and Ferrimagnetic materials, Ferrites and Garnets, magnetic bubbles, magnetic recording.

UNIT - 3

Conducting and Superconducting Materials

Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy states and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductors, Application of superconductors (Cryotron, magnetic levitation)

UNIT - 4

Semiconducting Materials

Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductors, P-N junction diode, Preparation of single crystals, LED, Photovoltaic Cell.

UNIT - 5

Dielectric Materials

Dielectric constant and polarizability, types of polarization, temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials.

UNIT - 6

Nano Materials

Nanomaterials : Introduction and properties, synthesis of nanomaterials, Carbon Nano Tubes, Characterization techniques of nanomaterials- SEM, TEM, EDAX, FMR, Applications of nanomaterials.

TEXT/REFERENCE BOOKS

1. Introduction to Solid state Physics – C. Kittle
2. Science of Engineering Materials and Carbon Nanotubes - C.M. Srivastava and C. Srinivasan
3. Solid State Physics – A.J. Dekker
4. Material Science and Engineering – V. Raghavan
5. Electrical Engineering Materials – A.J. Dekker

EC 07 C	Engineering Chemistry-II	3 Credits

Course Objective:

- To understand and apply the Chemistry principles

Course Outcome:

The students will be able to understand fundamentals of corrosion, properties of metals, applications of polymer, spectroscopy etc.

UNIT - 1

Corrosion and its Control

Introduction, Fundamental reason, Electrochemical Corrosion, Direct Chemical Corrosion, Factors affecting the rate of corrosion, types of corrosion-Galvanic, Pitting Corrosion, Microbiological corrosion, Stress corrosion, methods to minimise the corrosion- Proper design, Cathodic and Anodic protection.

UNIT - 2

Metals and Alloys

Metals: Introduction, Properties of metals and alloys. Occurrence, extraction, properties and uses of Ni, Cr and Ti.

Alloys: Introduction, Need for alloying Steel, Application of Alloy Steel.

UNIT - 3

Polymers and its Characterization

Introduction, molecular weight determination by osmotic pressure and viscosity method, polymers in medicines and surgery, inorganic polymers: silicones. Classes of polymerisation (Synthesis and Characterization). Plastic, Moulding of plastic

UNIT - 4

Basic Techniques in Chemistry

Preparing substances for analysis, dissolving the samples, Precipitation, Filtration, Washing Precipitate, Drying and Igniting precipitate. Solvent Extraction: Aqueous and Organic phase liquid – liquid extraction.

UNIT - 5

Spectroscopy

Brief introduction to spectroscopy, UV – Visible Spectroscopy: Laws of absorption, instrumentation and application. IR spectroscopy: introduction, theory, instrumentation and application. Brief discussion on NMR Spectroscopy and its Applications. Brief introduction of AAS (Atomic Absorption Spectroscopy).

UNIT - 6

Instrumental Methods of Analysis

Introduction to Chromatography, Types of Chromatography (Adsorption and partition chromatography), Paper and Thin Layer Chromatography, Gas Chromatography – introduction, theory, instrumentation. Brief discussion of Thermo gravimetric analysis (TGA)

TEXT/REFERENCE BOOKS

1. Bhal and Bhal Advance Organic Chemistry, S. Chand & Company, New Delhi, 1995.
2. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai & Sons, Delhi, 1992.
3. Bhal & Tuli, Text book of Physical Chemistry (1995), S. Chand & Company, New Delhi.
4. Instrumental Methods of analysis by Chatwal Anand, Himalaya Publication.
5. Finar I.L., Organic Chemistry (Vol. I & II), Longman Gr. Ltd & English Language Book Society, London.
6. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
7. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015.
8. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
9. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
10. Instrumental Methods of analysis by Willard, Dean, Merrit, McGraw - Hill.
11. Physical Chemistry, Glasstone.
12. Physical Chemistry, Peter Atkins, W.H. Freeman & Co. 9th Edition, 2009.

EC 07 C	Advanced Computer Programming	3 Credits

Course Objectives:

- Make the students familiar with basic concepts and techniques of object oriented programming in C++ & Java.
- Develop an ability to write programs in C++ and Java for problem solving.

Course Outcomes:

Upon successful completion of this course, students should be able to:

1. Describe the principles of object oriented programming.
2. Apply the concepts of data encapsulation, inheritance in C++.
3. Understand basic program constructs in Java.
4. Apply the concepts of classes, methods and inheritance to write programs Java.
5. Use arrays, vectors and strings concepts and interfaces to write programs in Java.
6. Describe and use the concepts in Java to develop user friendly program.

UNIT - 1

Introduction to Object Oriented Programming

Principle s of OOP: Software crisis, Software evolution, OOP paradigm, Basic Concepts of OOP, Benefits & applications of OOP. Beginning with C++: What is C++, Applications of C++, A Simple C++ Program, More C++ statements, moving from C to C++: Declaration of variable, Reference variables, Scope resolution operator, Member dereferencing operator, memory management operators. Functions in C++: Function prototyping, Call by reference.

UNIT - 2

Concepts of Object Oriented Programming with C++

Classes & Objects: Specifying a class, Defining member functions, A C++ program with class, Making an outside function inline, Nesting of member function, Private member function, Arrays within class, Member allocation for objects, Arrays of objects, Objects as function arguments. Constructors & Destructors: Constructors, Parameterized constructors, Multiple constructors in a class, Constructors with default arguments. Operator overloading concept: Use of operator overloading, defining operator overloading, Binary operator overloading. Introduction to Inheritance: Concept and types of Inheritance, Defining derived classes, Single inheritance, Making a private member inheritable, multilevel inheritance.

UNIT - 3

Java Fundamentals

Evolution of Java, Comparison of Java with other programming languages, Java features, Java Environment, Simple Java Program, Java Tokens, Java Statements, Constants, variables, data types. Declaration of variables, Giving values to variables, Scope of variables, arrays, Symbolic constants, Typecasting, Getting values of variables, Standard default values, Operators, Expressions, Type conversion in expressions, Operator precedence and associatively, Mathematical functions, Control statements- Decision making & branching, Decision making & looping.

UNIT - 4

Classes, Methods & Objects in Java

Class Fundamentals, Declaring Objects, Assigning Object reference variables, Methods, Constructors, The This keyword, Garbage collection, finalize method, Overloading methods, using objects as parameters, Argument passing, returning objects, Recursion, access control, static, final, arrays, strings class, Command line arguments.

UNIT - 5

Inheritance, Packages and Interfaces

Inheritance basics, Using Super, Creating Multilevel hierarchy, Constructors in derived class, Method overriding, Dynamic method dispatch, Using Abstract classes, Using final with inheritance, Object class, Packages, Access protection, Importing packages, Interfaces: Define, implement and extend. Default interface methods, Use static method in interface.

UNIT - 6

Multithreading, Exception handling & Applets

Introduction to multithreading: Introduction, Creating thread and extending thread class. Concept of Exception handling: Introduction, Types of errors, Exception handling syntax, Multiple catch statements. I/O basics, Reading console input s, Writing Console output.

Applets: Concepts of Applets, differences between applets and applications, life cycle of an applet, types of applets, creating a simple applet.

TEXT/REFERENCE BOOKS

1. E Balagurusamy, Programming with C++, Tata McGraw Hill, 3rd Edition.
2. Herbert Schildt, Java: The complete reference, Tata McGraw Hill, 7th Editon.
3. Robert Lafore, "Object Oriented Programming in C++", Sams Publishing, 4th Edition.

T. Budd, Understanding OOP with Java, Pears

EC 07 D	Statistical Methods	3 Credits

Course Objectives:

The main objective of this course is to acquaint students with some basic concepts in Statistics. They will be introduced to some elementary statistical methods of analysis of data. At the end of this course students are expected to be able,

(i) to tabulate statistical information given in descriptive form.

(ii) to use graphical techniques and interpret.

(iii) to compute various measures of central tendency, dispersion, skewness and kurtosis.

(iv) to compute the correlation coefficient for bivariate data and interpret it.

(v) to analyze data pertaining to attributes and to interpret the results.

(vi) to summarize and analyze the data using computer.

vii) to apply statistics in the various fields.

viii) to predict the future values based on previously observed values using time series.

Course Outcomes:

1)How to calculate and apply measures of location and measures of dispersion grouped and ungrouped data cases.
2) How to apply discrete and continuous probability distributions to various business problems.
3) Perform Test of Hypothesis as well as calculate confidence interval for a population parameter for single sample and two sample cases. Understand the concept of p-values.
4) Learn non-parametric test such as the Chi-Square test for Independence as well as Goodness of Fit.
5) Compute and interpret the results of Bivariate and Multivariate Regression and Correlation Analysis, for forecasting and also perform ANOVA and F-test. Further, understand both the meaning and applicability of a dummy variable and the assumptions which underline a regression model. Be able to perform a multiple regression using computer software.

UNIT - 1

Statistics: Measures of Central Tendency : Concept of central tendency of statistical data : Arithmetic Mean, Mode, Median, Measures of Dispersion: Range, Quartiles, Mean deviation, mean square deviation, Variance and standard deviation, Moments about mean and point, Skewness: positive skewness, negative skewness, symmetric frequency distribution, Bowley's coefficient of skewness, karl Pearson's coefficient of skewness,Measures of skewness based on

moments (β1, γ1), Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions.

UNIT - 2

Regression and correlation : Correlation: Introduction,Scatter diagram, conclusion about the type of correlation from scatter diagram, Karl Pearson's coefficient of correlation (r) , Regression: lines of regression, fitting of lines of regression by the least squares method, interpretation of slope and intercept, Regression coefficient (b_{yx}, b_{xy}), Non-linear regression : (1) Second degree curve, (2) Exponential curve of type y = ab^x , fitting of such curves by the least square method after logarithmic transformation,

UNIT - 3

Probability: Definition of probability, Addition theorem of probability, Multiplication theorem of probability, Baye's theorem of inverse probability, Random Variable and Mathematical Expectation: Definition of random variables, Probability mass function, Probability density function.

UNIT - 4

Probability distribution: Theoretical Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, poisson and normal distributions, Relation between binomial and normal distributions, Relation between poisson and normal distributions, Importance of normal distribution, Examples.

UNIT - 5

Sampling and estimation theories: Introduction, Sampling distributions, the sampling distributions of means, the estimation of populations parameter based on a large size, Significances testing: hypothesis, Type I and type II errors.

UNIT - 6

Time series: Concepts and components of a time series. Representation of trend by Freehand Curve Method, Estimation of Trend using Moving Average Method and Least Squares Method (Linear Trend only). Estimation of Seasonal Component using Simple Arithmetic Mean for Additive Model only (For Trend free data only). Concept of Forecasting using Least Squares Method.

TEXT/REFERENCE BOOKS

1.Goon Gupta and Das Gupta: Fundamentals of Statistics, Vol. 1, The World Press Pvt. Ltd., Kolkata.

2. Miller and Fruend : Modern Elementary Statistics.

3. Snedecor and Cochran : Statistical Methods, Oxford and IBH Publishers.

4. Mukhopadhyay, P. : Mathematical Statistics (1996), New Central Book Agency, Calcutta, Introduction to Mathematical Statistics, Ed. 4 (1989), MacMillan Publishing Co. New York.

5. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.

6.S. C. Gupta, Fundamentals of Statistics, 46th edition, Himalaya publishing house, 2010.

7. G.V. Kumbhojkar, Probability and Random Processes, 14th edition, C. Jamnadas and co., 2010.

8. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, 6th edition, Laxmi publications, 2010.

9. Hoel, P. G. : Introduction to Mathematical Statistics (1962), John Wiley and Sons, New York.

10. Feller, W. : Introduction to Probability Theory and Its Applications, Vol. I (1963), Asian Publishing House, Bombay.

11. Mood, A. M. and Graybill, F. A. and Boes D.C. E. : Introduction to Theory of Statistics, Ed. 3 (1974), McGraw Hill and Kagakusha Ltd. London. 15

12. Mayer, P. N. : Introduction to Probability and Statistical Applications, Addison Wesley Publishing Co., Massachusetts).

13. Jhon Bird, Higher Engineering Mathematics by Elsevier

14. Applied Calculus: By Stephen Waner and Steven Constenoble, Brooks/Cole Thomson Learning, second edition.

EC 11	Linear Integrated Circuits	3 Credits

Course Objectives:

- To understand characteristics of IC and Op-Amp and identify the internal structure.
- To introduce various manufacturing techniques.
- To study various op-amp parameters and their significance for Op-Amp.
- To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
- To analyze and identify linear and nonlinear applications of Op-Amp.
- To understand functionalities of PLL and its use in various applications in communication and control systems.

Course Outcomes:

On completion of the course, student will be able to:

1. Understand the characteristics of IC and Op-Amp and identify the internal structure.
2. Understand and identify various manufacturing techniques.
3. Derive and determine various performances based parameters and their significance for Op-Amp.
4. Comply and verify parameters after exciting IC by any stated method.
5. Analyze and identify the closed loop stability considerations and I/O limitations.
6. Analyze and identify linear and nonlinear applications of Op-Amp.
7. Understand and verify results (levels of V & I) with hardware implementation.
8. Implement hardwired circuit to test performance and application for what it is being designed.
9. Understand and apply the functionalities of PLL to Frequency synthesizer, multiplier, FM, and AM demodulators.

UNIT - 1

OP-AMP Basics

Block diagram of OP-AMP, Differential Amplifier configurations, Differential amplifier analysis for dual-input balanced-output configurations using ‘r’ parameters, Need and types of level shifter, current mirror circuits. Voltage series and voltage shunt feedback amplifier and its effect on Ri, Ro, bandwidth and voltage gain.

UNIT - 2

Linear Applications of OP-AMP

Inverting and Non-inverting amplifier, voltage follower. Summing, averaging scaling amplifier, difference amplifier, Ideal integrator, practical integrator with frequency response, Ideal differentiator, practical differentiator with frequency response. Instrumentation amplifiers.

UNIT - 3

Non-linear Applications of OP-AMP

Comparator, characteristics of comparator, applications of comparator, Schmitt trigger (symmetrical/asymmetrical), clippers and clampers, voltage limiters, Square wave generator, triangular wave generator, Need of precision rectifier, Half wave, Full wave precision rectifiers, peak detectors, sample and hold circuits.

UNIT - 4

Converters using OP-AMP

V-F, I-V and V-I converter, DAC: types of DAC, characteristics, specifications, advantages and disadvantages of each type of DAC, ADC: types of ADC, characteristics, specifications, advantages and disadvantages of each type of ADC.

UNIT - 5

Phase Locked Loop & Oscillators

Block diagram of PLL and its function, PLL types, characteristics/parameters of PLL, and different applications of PLL. Oscillators principle, types and frequency stability, design of phase shift, wein bridge, Quadrature, voltage controlled oscillators.

UNIT - 6

Active filters

Design and frequency scaling of First order and second order Active LP, HP, BP and wide and narrow band BR Butterworth filters and notch filter. All pass filters.

TEXT/REFERENCE BOOKS

1. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
2. Salivahanan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India 2008.
3. George Clayton and Steve Winder, “Operational Amplifiers”, 5th Edition Newnes.
4. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGraw Hill.
5. Bali, “Linear Integrated Circuits”, McGraw Hill 2008.
6. Gray, Hurst, Lewise, Meyer, “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.

4. Matt Weisfeld, "The Object-Oriented Thought Process", Pearson.
5. Cox Brad, "Object –Oriented Programming: An Evolutionary Approach", Addison –Wesley.
6. E Balagurusamy, Programming with Java A Primer, Tata McGraw Hill, 3rd Edition.

BH01	Basic Human Rights	2 Credits

Course Objectives:

- To work for ensuring that basic human rights are respected everywhere.
- To cooperate to avoid compromising on human rights for economic or political expediency.
- To recognize democratic institutions as a fundamental human right.
- To work towards the sovereignty and self determination of entities with historical, cultural and ecological identity.
- To actively engage with the Government of India and other countries to promote human rights education.
- To bring diplomatic and commercial pressures on regimes that violates human rights, to ensure that they respect the basic rights of their citizens.
- To keep the interests of disempowered communities foremost in all dealings with countries in which human rights violations occur.
- To develop a more distinctive and effective role for the International Court of Justice in the field of human rights.
- To promote a culture for educating the citizenry that cultivation and promotion of human rights culture is the sine qua non for the smooth functioning of the organs of a democratic State and for the kind of development that results into overall development of the society.
- To train the young men and women for facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
- To study the effects of draconian laws and unlawful use of State's machinery and force by the enforcement agencies.

Course Outcomes:

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.
2. The strengthening of respect for human rights and fundamental freedoms.
3. The enabling of all persons to participate effectively in a free society.
4. Learning about human rights principles, such as the universality, indivisibility, and interdependence of human rights.
5. Learning about regional, national, state, and local law that reinforces international human rights law.
6. Learning and knowing about and being able to use global, regional, national, and local human rights instruments and mechanisms for the protection of human rights.

UNIT - 1

The Basic Concepts

Individual, group, civil society, state, equality, justice, Human Values: - Humanity, virtues, compassion.

UNIT - 2

Human rights and Human Duties

Origin, civil and political rights, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people, Fundamental rights and economic program, India's charter of freedom.

UNIT - 3

Society, religion, culture, and their inter-relationship

Impact of social structure on human behavior, Roll of socialization in human values, Scienceand Technology, modernization, globalization, and dehumanization.

UNIT - 4

Social Structure and Social Problems

Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour, Migrant workers and human rights violations, human rights of mentally and physically challenged.

UNIT - 5

State, Individual liberty, Freedom and Democracy

The changing of state with special reference to developing countries, Concept of development under development and social action, need for collective action in developing societies and methods of social action, NGOs and human rights in India: - Land, Water, Forest issues.

UNIT - 6

Human Rights in Indian Constitution and Law

The constitution of India:

(i) Preamble

(ii) Fundamental rights.

(iii) Directive principles of state policy.

(iv) Fundamental duties.

(v) Some other provisions.

Universal declaration of human rights and provisions of India, Constitution and law, National human rights commission and state human rights commission.

TEXT/REFERENCE BOOKS

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

EC 12	Signals and Systems	4 Credits

Course Objectives:

- To understand the mathematical description of continuous and discrete time signals and systems.
- To classify signals into different categories.
- To analyze Linear Time Invariant (LTI) systems in time and transform domains.
- To build basics for understanding of courses such as signal processing, control system and communication.
- To develop basis of probability and random variables.

Course Outcomes:

On completion of the course, student will be able to

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s- domain.
5. Understand the basic concept of probability, random variables & random signals and develop the ability to find correlation, CDF, PDF and probability of a given event.

UNIT - 1

Introduction to Signals and Systems

Introduction and Classification of signals: Definition of signal and systems, communication and control systems as examples. Sampling of analog signals, sampling theorem, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power.

Elementary signals used for testing: reasons for using standard test signals, exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc.

Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT - 2

Time domain representation of LTI System

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method for unit step to unit step, unit step to exponential, exponential to exponential, unit step to rectangular and rectangular to rectangular only. Computation of convolution sum. Properties of convolution. System interconnection, system properties in terms of impulse response, step response in terms of impulse response.

UNIT - 3

Fourier Series

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, orthogonality, basis functions, Amplitude and phase response, FS representation of CT signals using trigonometric and exponential Fourier series. Applications of Fourier series, properties of Fourier series and their physical significance, Gibbs phenomenon, Discrete Time Fourier Series, properties, convergence of DTFS.

UNIT - 4

Fourier transform

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Properties and their significance, Interplay between time and frequency domain using sinc and rectangular signals, Fourier Transform for periodic signals, introduction to Discrete Time Fourier Transform.

UNIT - 5

Laplace transform and its applications

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC, Laplace transform of standard periodic and aperiodic functions, properties of Laplace transform and their significance, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, stability considerations in S domain, Application of Laplace transforms to the LTI system analysis.

UNIT - 6

Probability and Random Signals

Probability: Experiment, sample space, event, probability, conditional probability and statistical independence, Bayes theorem, Uniform and Gaussian probability models. Random variables:

Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Statistical averages, mean, moments and expectations, standard deviation and variance.

Introduction to Correlation: Autocorrelation, Cross correlation, and their properties.

TEXT/REFERENCE BOOKS

1. Simon Haykins and Barry Van Veen, "Signals and Systems", 2nd Edition, Wiley India.
2. Charles Phillips, "Signals, Systems and Transforms", 3rd Edition, Pearson Education.
3. M.J. Roberts "Signal and Systems", Tata McGraw Hill 2007.
4. Shaila Apte, "Signals and Systems-principles and applications", Cambridge University press, 2016.
5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press, 2007.
6. Peyton Peebles, "Probability, Random Variable, Random Processes", 4th Edition, Tata McGraw Hill.
7. A. Nagoor Kanni "Signals and Systems", 2nd edition, McGraw Hill.
8. NPTEL video lectures on Signals and Systems.

EC 13	Numerical Methods	4 Credits

Course Objectives:

- To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
- To understand different numerical techniques used for solving algebraic and transcendental equations.
- To understand numerical methods to solve a system of linear equations.
- To understand numerical integration and differentiation techniques.
- To understand various difference operators and interpolation techniques.
- To understand object-oriented programming fundamentals and features.
- To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

1. Learner will be able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem.
2. Learner will be able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques.
3. Students will understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values.
4. With the basic knowledge of the NMCP course, students can prepare themselves to write computer programs for the numerical computational techniques.
5. Students will understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.
6. Students will understand procedure-oriented and object oriented programming concepts.
7. He/she will be capable of writing C and C++ programs efficiently.

UNIT - 1

Introduction to Computational Methods and Errors

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques. Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT - 2

Solution of Transcendental / Polynomial Equations and System of Linear Equation

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT - 3

Interpolation and Polynomial Approximation

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange's interpolation polynomials, Spline interpolation, Least square approximation.

UNIT - 4

Numerical Integration and Differentiation

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, Runge Kutta $2^{nd}$and 4^{th} order, Stability analysis of above methods.

UNIT - 5

Object Oriented Programming

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor, Destructors.

UNIT - 6

Operator Overloading and Type Conversions

Defining operator overloading, Overloading unary operators, Overloading binary operators, Manipulation of strings operators, Rules for overloading operators. Inheritance: Extending Classes: Defining derived classes, Single inheritance, multilevel inheritance, multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes, Member classes: Nesting of classes Pointers Virtual Functions and Polymorphism: Pointers to objects, Pointers to derived classes, Virtual functions, pure virtual functions Managing Console I/O Operations C++ Streams, C++ Stream Classes, Unformatted I/O Operations, Managing output with manipulators.

TEXT/REFERENCE BOOKS

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rd edition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rd Edition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi, 1996.
4. D. Ravichandran, "Programming with C++", TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2nd Edition
6. Yeshwant Kanetkar, "Let us C++, BPB Pub.", Delhi, 2002, 4th Edition.
7. Stroupstrup Bjarne, "C++ Programming Language", Addison Wesley, 1997, 3rd Edition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai, 1998.

EC 14 A	Electrical Machines	3 Credits

Course Objectives:

- To analyze AC and DC networks with network simplification techniques.
- To gain basic knowledge of transformers and their types.
- To conduct experimental procedures on different types of electrical machines.
- To understand the constructional details, characteristics, features and application areas of various types of electric motors.

Course Outcomes:

On completion of the course, student will be able to

1. Analyze basic AC & DC circuit for voltage, current and power by using KVL, KCL, and network theorems.
2. Explain the working principle of different electrical machines.
3. Select proper electrical motor for given application.
4. Design and analyze transformers.

UNIT - 1

Basic Circuit Analysis and Simplification Techniques

Kirchhoff's Current and Voltage Laws, Independent and dependent sources and their interconnection, power calculations. Network Analysis: Mesh, Super mesh, Node and Super Node analysis. Source transformation and source shifting. Network Theorems: Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems, Millers Theorem and its dual. (AC circuit analysis for all the topics of this unit).

UNIT - 2

Transformer

Types, Construction, Transformer on No-load (Transformation ratio, emf equation), impedance transformation, losses in transformer, regulation and efficiency, rating. Auto transformer, coupling transformer, Isolation transformer, C.T. and P.T., Design of single phase transformer for instrument power supply, High frequency transformers.

UNIT - 3

DC Machines

Construction of DC Machine, Motoring and generation action, types, EMF equation, Torque equation (Torque-armature current characteristics, Torque-speed characteristics, speed-armature current characteristics), Power flow diagram. Problems on speed, torque & losses. Different

methods of speed control, different types of starters for DC shunt motor. Permanent Magnet DC motors, Applications of DC Motors.

UNIT - 4

AC Motors

Three phase Induction motors, construction and principle of operation, types, slip and torque equation, Torque-slip characteristics, condition for maximum torque & ratios, types of starters, speed control, V/f control, Applications.

Synchronous motors: Construction, principle of operation, characteristics (V curves) and applications.

UNIT - 5

Special Motors 1

BLDC Motor, Construction, principle, characteristics, control circuit, sensors, applications. Construction, principle & applications of Reluctance Motor, Universal Motor.

UNIT - 6

Special Motors 2

Construction, types, principle, Characteristics, control circuit & applications of Stepper Motor and Servo motor. Construction, principle, characteristics, Types and applications of single phase Induction Motor.

TEXT/REFERENCE BOOKS

1. Abhijit Chakrabarti & Sudipta Debnath, "Electrical Machines", Tata McGraw-hill Publication.
2. William H Hayt, Jack E Kimmerly and Steven M. Durbin, "Engineering Circuit Analysis", Tata McGraw Hill.
3. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, "Electrical Machinery", Tata McGraw-hill Publication 6th Edition.
4. I.J Nagarath & D.P Kothari, "Electrical Machines", Tata McGraw-hill Publication 4th Edition.
5. T. J. E. Miller, "Brushless permanent-magnet and reluctance motor drives", Oxford University Press (1989).
6. Ned Mohan, "Electric Machines and Drives": A first course, Wiley.
7. B. L. Theraja, "Electrical technology" volume 2, S. Chand.

EC 14 B	Open Source Technology	3 Credits

Course Objectives:

- To introduce the concept of open Source Software.
- To enable students to learn Linux Environment.
- To make students well versed with Android and Shell Programming

Course Outcomes:

On successful completion of this course students should be able

1. To develop android applications.
2. To install and work on Linux.
3. To perform Shell Programming.

UNIT - 1

Over View of Open Source Software

Need of Open Sources, Advantages of Open sources, Applications, FOSS – FOSS usage, Free Software Movement, Commercial Aspect of Open Source Movement, Licensing, Certification, Open Source Software Development Model, comparison with close source / Proprietary software, Free Software, Open source vs source available Widely used open source software license :Apache License, BSD license, GNU General Public License, GNU Lesser General Public License, MIT License, Eclipse Public License and Mozilla Public License.

UNIT - 2

Open Source Operating System

Installation of Linux (Red hat – Cent OS): Theory about Multiboot Environment, Hardisk Partitioning, Swap space, LVM, and Boot loader Command Line: Basic File System Management Task, Working with files, Piping and Redirection, Working with VI editor, use of sed and understanding FHS of Linux.

UNIT - 3

Open Source Operating System: system Administrator task

Job management, Process Management, Mounting Open Source Devices and file system working with Linux, Backup, working with user, group and permission, Managing Operating System: Software. Understanding Boot process and related System files, Common kernel Management Task.

UNIT - 4

Open source Operating System: Network and Security Administration

Basic networking commands, Configuration of Apache Web servers, DNS servers, DHCP servers, mail Servers, NFS, FTP servers. Securing servers with IP tables. Setting up cryptographic services, SSL, Managing Certificate with Open SSL, working with the GNU Privacy guard.

UNIT - 5

Open source Operating System: Shell Programming

Bash Shell Scripting, Executing Script, Working with Variables and Input, Using Control Structures, Script control, handling with signals, Creating functions, working sed and gawk - Working with web using shell script: Downloading web page as formatted text file and parsing for data, working cURL etc.

UNIT - 6

Open source Tools Only in LAB

Version Control using RCS and CVS (hands on RCS in single Machine) Content management: Understanding working of Drupal (Basic Drupal components) Security assessment: Open VAS IDE: Working of Eclipse

Open Source Mobile Programming

Android programming: Setting up Android Environment (using Eclipse for android development), Activities and Intents, User Interface, Designing UI using views, Data Persistence, Conent Providers, messaging and networking, Location-based Services, Publishing Android Applications.

TEXT/REFERENCE BOOKS

1. Redhat Linux 6.0 Administration Wiley
2. Linux Shell scripting Cookbook: Sarath Lakshman PACKT
3. Linux Lab - Open source Technology :Ambavade Dreamtech
4. Beginning Adnorid Development Wrox Press.
5. Drupal guide to Planning and Building Web Site: Wrox Press

EC 14 C	Renewable Energy	3 Credits

Course Objectives:

- RENG 102 provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application.
- The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as solar, biomass (conversions), wind power, geothermal, and hydro.

Course Outcomes:

1. List and generally explain the main sources of energy and their primary applications in the US, and the world.
2. Describe the challenges and problems associated with the use of various energy sources, including fossil fuels, with regard to future supply and the environment.
3. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
4. List and describe the primary renewable energy resources and technologies.
5. Describe/illustrate basic electrical concepts and system components.
6. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.
7. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.

UNIT - 1

Statistics on Conventional Energy Sources and Supply in Developing Countries:
Definition, Concepts of NCES, Limitations of RES, Criteria for assessing the potential of NCES, Classification of NCES, Solar, Wind, Geothermal, Biomass, Ocean energy sources, Comparison of these energy sources.

UNIT - 2

Solar Energy: Definition, Energy available from Sun, Solar radiation data, solar energy conversion into heat, Flat plate and Concentrating collectors, Principle of natural and forced convection, Solar Engines: Stirling, Brayton engines, Photo voltaics: p-n junctions. Solar cells, PV systems, Standalone, Grid connected solar power satellite, Calculation of energy through photovoltaic power generation.

UNIT - 3

Wind Energy: Energy available from wind, General formula, Lift and drag. Basis of Wind energy conversion, Effect of density, Frequency variances, Angle of attack, Wind speed, Windmill rotors, Horizontal axis and Vertical axis rotors, Determination of torque coefficient, Induction type generators, Working principle of wind power plant.

UNIT - 4

Nature of Geothermal Sources: Definition and classification of resources, Utilization for electricity generation and direct heating, Wellhead power generating units. Basic features: Atmospheric exhaust and condensing, Exhaust types of conventional steam turbines. Pyrolysis of Biomass to produce solid, liquid and gaseous fuels. Biomass gasification, Constructional details of gasifier, Usage of biogas for chullas, various types of chullas for rural energy needs.

UNIT - 5

Wave, Tidal and OTEC energy, Difference between tidal and wave power generation. Principles of tidal and wave power generation, OTEC power plants, Operation of small open-cycle experimental facility, Design of 5 MW OTEC pro-commercial plant. Economics of OTEC, Environmental impacts of OTEC, Status of multiple product OTEC systems.

TEXT/REFERENCE BOOKS

1. Ashok Desai V, *Non-Conventional Energy,* Wiley Eastern Ltd, 1990.

2. Mittal K.M, *Non-Conventional Energy Systems,* Wheeler Publishing Co. Ltd, 1997.

3. Ramesh R, Kurnar K.U, *Renewable Energy Technologies,* Narosa Publishing House, New Delhi, 1997.

EC 14 C	Renewable Energy Systems

Course Objectives:

- In-depth understanding of specialist bodies of knowledge within the engineering discipline
- Knowledge of contextual factors impacting the engineering discipline.
- Understanding of the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the specific discipline.
- Fluent application of engineering techniques, tools and resources.
- Professional use and management of information.

Course Outcomes:

1. Identify issues facing the renewable energy industry
2. Describe factors to consider when selecting sites for wind power generation
3. Analyze wind speed data and wind turbine performance in a given wind regime
4. Identify the various components of a wind turbine and their functions and types
5. Identify planning and environmental issues related to wind power systems
6. Determine sun position and angles, and identify shading caused by obstacles
7. Describe main features and operation of solar hot water systems
8. Describe main features of and analyse simple photovoltaic systems
9. Evaluate the financial costs and benefits of a renewable energy project

UNIT - 1

Solar Energy , Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy –Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy. Hybrid wind energy systems - wind + diesel power, wind + conventional grid, wind + Photovoltaic system etc.

UNIT - 2

Bio-mass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc. Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages Concept of Bio-energy: Photosynthesis process, Bio-fuels, Biomass resources Bio based chemicals and materials Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification. Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc. Bio-fuels: Importance,

Production and applications. Bio-fuels: Types of Bio-fuels, Production processes and technologies, Bio fuel applications, Ethanol as a fuel for I.C. engines, Relevance with Indian Economy. 11 Bio-based Chemicals and Materials: Commercial and Industrial Products, Biomass, Feed stocks, Chemicals, Plastics, Fibres etc. Government Policy and Status of Bio fuel technologies in

UNIT - 3

Bio-methanation: Importance of biogas technology, Different Types of Biogas Plants. Aerobic and anaerobic bioconversion processes, various substrates used to produce Biogas (cow dung, human and other agricultural waste, municipal waste etc.) Individual and community biogas operated engines and their use. Removal of CO2 and H2O, Application of Biogas in domestic, industry and vehicles. Bio-hydrogen production. Isolation of methane from Biogas and packing and its utilization.

UNIT - 4

Wind Energy: Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, Various aspects of wind turbine design, Wind Turbine Generators: Induction, Synchronous machine, constant V & F and variable V & F generations, Reactive power compensation. Site Selection, Concept of wind form & project cycle, Cost economics & viability of wind farm.

TEXT/REFERENCE BOOKS

1. Biomass Renegerable Energy – D.O.hall and R.P. Overeed (John Wiley and Sons, New york, 1987) 12
2. Biomass for energy in the developing countries – D.O.Hall, G.W.barnard and P.A.Moss (Pergamon Press Ltd. 1982)
3. Thermo chemical processing of Biomass, Bridgurater A V.
4. Biomass as Fuel – L.P.White (Academic press1981)
5. Biomass Gasification Principles and Technology, Energy technology review No. 67, - T.B. Read (Noyes Data Corp. , 1981)
6. Wind energy Conversion Systems – Freris L.L. (Prentice Hall1990)
7. Wind Turbine Technology: Fundamental concepts of wind turbine technology Spera D.A. (ASME Press, NY, 1994)
8. Wind Energy Systems – G.L. Johnson (Prentice Hall, 1985)
9. Wind Energy Explained – J.F.Manwell, J.G. McGowan and A.L. Rogers (John Wiley & Sons Ltd.)

EC 15 A	Industrial Instrumentation	3 Credits

Course Objectives:

- This course covers the key aspects of industrial instrumentation and is designed to enable maintenance personnel to carry out commissioning, calibration and maintenance of the typical devices used for measurement in industrial systems.
- The course is ideal for those who presently possess some electrical knowledge, work in a maintenance environment and seek to expand their activities to include process control and instrumentation systems. It is the perfect complement to this course, as it explores how the instrumentation sensors would be used in a complete closed-loop control system.
- The course involves connecting various devices into current loops so that candidates learn about how current loops work and how devices are connected into them. They also calibrate these devices using a range of professional industrial Time Electronics current calibrators, used throughout the instrumentation engineering world.
- Candidates on the instrumentation course then learn about the various devices used in industrial temperature measurement systems - we concentrate on thermocouples and Pt100s and their associated cabling, connectors and transmitter heads. Candidates connect up various sensors, looking at the signals that they produce and build current loops around the relevant transmitters.
- The course notes are quite extensive and explain how the various devices are used, without getting involved in the underlying theory. For example, we would look in detail at what signals a thermocouple produces, but only very briefly at how it works.

Course Outcomes:

On completion of the course, student will be able to

1. To understand the construction and working of measuring instruments.
2. To equip the students with the basic knowledge of Pressure, Temperature, flow, level, density and viscosity measurements and Understand the equipment used in temperature, pressure, level and flow measurement
3. Correctly use a range of industrial calibration equipment
4. The student knows to calibrate the various instruments also he knows to apply the instrument in various fields.

UNIT - 1

Introduction

Basic terminologies (Range, Span, Settling time dead zone, input impedance ...) 1st order and 2nd order instruments with step, ramp and sinusoidal input/output characteristics, Transducer and types.

UNIT - 2

Measurement of force torque, velocity

Electric balance, different types of load cells, magnets, elastics load cell-strain gauge load cell-different methods of torque measurement, strain gauge, relative regular twist-speed measurement-revaluation counter- capacitive tacho-drag up type tacho D.C and A.C tacho generators – stroboscope.

UNIT - 3

Measurement of acceleration, vibration and density

Accelerometers - LVDT, piezo-electric, strain gauge and variable reluctance type accelerometers -mechanical type vibration instruments - seismic instrument as an accelerometer and vibrometer -calibration of vibration pickups - units of density, specific gravity and viscosity used in industries -Baume scale API scale - pressure head type densitometer - float type densitometer – ultrasonic densitometer Bridge type gas densitometer

UNIT - 4

Pressure measurement

Units of pressure - manometers - different types - elastic type pressure gauges - Bourde type bellows -diaphragms - Electrical methods - elastic elements with LVDT and strain gauges - capacitive type pressure gauge - piezo resistive pressure sensor - resonator pressure sensor - measurement of vacuum - McLeod gauge - thermal conductivity gauges - Ionization gauge cold cathode and hot cathode types - testing and calibration of pressure gauges - dead weight tester.

UNIT - 5

Temperature measurement

Definitions and standards - primary and secondary fixed points - calibration of thermometers different types of filled in system thermometer - sources of errors in filled in systems and their compensation -Bimetallic thermometers - Electrical methods of temperature measurement - signal conditioning of industrial RTDs and their characteristics -3 lead and 4 lead RTDs.

UNIT - 6

Thermocouples and pyrometers

Thermocouples, law of thermocouple, fabrication of industrial thermocouples, signal conditioning of thermocouple output, thermal block references functions, commercial circuits for cold junction compensation, response of thermocouple, special techniques for measuring high temperature using thermocouples, Radiation methods of temperature measurement, radiation

fundamentals, total radiation and selective radiation pyrometers, optical pyrometer, two colour radiation pyrometer.

TEXT/REFERENCE BOOKS

1. Ernest O. Doebelin, Measurement systems Application and Design, International Student Edition, IV Edition, McGraw Hill Book Company, 1998.
2. R. K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, New Delhi, 1999.
3. D. Patranabis, Principles of Industrial Instrumentation, Tata McGraw Hill Publishing Ltd., New Delhi, 1999.
4. A. K. Sawhney, A course in Electrical and Electronic Measurement and Instrumentation – Dhanpat Raj and Sons, New Delhi, 1999.
5. P. Holman, Experimental Methods for Engineers International Student Edition, McGraw Hill Book Company, 1971.
6. B. C. Nakra and K. K. Chaudary, Instrumentation Measurement and Analysis, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1985.

EC 15 B	Development Engineering	3 Credits

Course Objectives:

- To introduce Hardware Design and Development Cycle
- To introduce Software Application Design and Development Cycle
- To provide end to end understanding of Product development Echo-system.

Course Outcomes:

On completion of the course, student will be able to

1. Student will able to Design and Develop Embedded hardware product.
2. Student will able to Design and Develop Android based software.
3. Student will able to Design and Develop hardware & software part of product.

UNIT - 1

Hardware Development & Engineering Cycle

Differences between the PC and typical Embedded System, Examples of Embedded Systems-Major hardware and software modules of an embedded system-Product Specification, Hardware/Software Partitioning, Iteration and Implementation, Detailed Hardware and Software Design, Hardware Software Integration, Product Testing and Release, Maintenance and Upgrading Existing products.

UNIT - 2

Methods of Architecture Developments

CPU Core, Clock and Reset Generator, PLL, RTC, Program Memory, Data Memory, EEPROM, Parallel Ports, Timers/Counters, Watch-dog timers, input-Capture/Output Compare units, PWM unit, Interrupt Structure, Data converters, Serial communication using SCI, SPI, I2C, CAN and USB - Introduction to LIN and MOST - Development and debugging Support: JTAG and BDM, Host and Target Machines, Cross-Compilers, Cross-Assemblers, Linker/Locator for Embedded Software, Locator Maps, Intel hex file format/Motorola s-record format. Introduction to Integrated Development Environment (IDE)- programming concepts and embedded programming in C. Debugging and simulation techniques, Programming the target system. Peripheral Programing Developing device drivers, Configuring and programming of ports, timer / counter, data converters, interrupts and serial communication.

UNIT - 3

Real Time Operating Systems (Rtos)

Survey of software architectures, hard/soft real time systems, Tasks and Task States, Tasks and Data, Semaphores and Shared Data, Message Queues, Mailboxes and Pipes, Timer functions, Events, Memory Management, Interrupt Routines in RTOS Environment,Study and analysis of

generating low frequency bio signals, High power signal analysis using Mixed Signal oscilloscopes, FPGA Debugs and host of serial protocols like RS232/UART, CAN, RS485, USB, I²C, SPI, I²S ,Application development in micro controllers, Programming with RTOS.

UNIT - 4

Software Development & Engineering Cycle

A Little Background of Software Development Cycle, an Open Platform for Mobile Development, Native Android Applications, Android SDK Features, Introduction to the Open Handset Alliance, What Does Android Run On? Why Develop for Android?, Introducing the Development Framework, What Comes in the Box., Developing for Android, Developing for Mobile Devices ,Android Development Tools.

UNIT - 5

Creating Applications and Activities

What Makes an Android Application? , Introducing the Application Manifest, The Android Application Life Cycle, Understanding Application Priority and Process States, Externalizing Resources, A Closer Look at Android Activities. Creating User Interfaces. Fundamental Android UI Design. , Introducing Views, Introducing Layouts, Creating New Views, Creating and Using Menus, Intents, Broadcast Receivers, Adapters, and the Internet, Introducing Dialogs, Creating an Earthquake Viewer. Data Storage, Retrieval, and Sharing, Android Techniques for Saving Data, Saving Simple Application Data, Saving and Loading Files, Databases in Android, Introducing Content Providers.

UNIT - 6

Maps, Geocoding And Location Based Servics

Using Location-Based Services. Setting up the Emulator with Test Providers, Selecting a Location Provider, Finding Your Location, Using Proximity Alerts, Using the Geocoder, Creating Map-Based Activities. Mapping Earthquakes Example, Using Background Worker Threads. Introducing Notifications. Using Alarms, Using Alarms to Update Earthquakes, Introducing Android Instant Messaging, and Introducing SMS,Using the Media APIs. Using the Camera, Introducing the Sensor Manager, Using the Accelerometer and Compass, Android Telephony, Using Bluetooth, Managing Network and Wi-Fi Connections, Controlling Device Vibration, Paranoid Android, Using AIDL to Support IPC for Services, Using Internet Services. Building Rich User Interfaces.

TUTORIAL COMPONENT

1. Parallel Port programming and interfacing of I/O devices.
2. Interrupt programming: Timer interfacing and analyzing capture compare module.
3. Serial protocol analyzing: RS232 / RS485 / SPI / SCI / I2C / CAN / USB.
4. Programming and Interfacing of data converters.

TEXT/REFERENCE BOOKS

5. David E Simon, “An Embedded Software Primer” Pearson Education Asia, 2006.
6. Arnold Berger, “Embedded System Design: An Introduction to Processes, Tools, and Techniques” CMP Books, 2001.
7. Wayne Wolf, “Computers as Components: Principles of Embedded Computing System Design”, Morgan Kuafmann Publishers, 2005.
8. Rapid Prototyping of Digital Systems: SOPC Edition by James O. Hamblen, Tyson S. Hall, Michael D. Furman
9. Embedded SoPC Design with Nios II Processor and Verilog Examples from Wiley by Pong P. Chu
10. Professional Android Application Development from Wiley by Reto Meier
11. 7. Hello, Android (4th edition), Introducing Google's Mobile Development Platform by Ed Burnette.
12. 8. Murach’s Android Programming (Second Edition) by Joel Murach.
13. 9. Rapid Prototyping of Digital Systems: SOPC Edition by James O. Hamblen, Tyson S. Hall, Michael D. Furman
14. 10. Embedded SoPC Design with Nios II Processor and Verilog Examples from Wiley by Pong P. Chu

EC 15 B	Linear Algebra	3 Credits

Course Objectives:

- To introduce different methods of solving systems of linear equations Using Matrices and representation of geometric transformations by means of matrices.
- To provide students with a good understanding of the concepts and methods of linear algebra, described in detail in the syllabus.
- To help the students develop the ability to solve problems using linear algebra.
- To connect linear algebra to other fields both within and without mathematics.
- To develop abstract and critical reasoning by studying logical proofs and the axiomatic method as applied to linear algebra.

Course Outcomes:

1. At the end of this course the successful student will be familiar with the ideas of matrices and their applications in solving problems involving systems of linear equations and linear programming problems.
2. Also he/she will be capable of representing geometric transformations by means of matrices and to express the volume of certain figures and equation of line using determinants.
3. Students will be able to apply the concepts and methods described in the syllabus, they will be able to solve problems using linear algebra, they will know a number of applications of linear algebra.
4. They will be able to follow complex logical arguments and develop modest logical arguments.

UNIT - 1

Linear Equations

Systems of linear equations, Matrices, Elementary row operations, Row-reduced echelon matrices.

UNIT - 2

Vector Spaces

Groups, Fields, Rings, Vector spaces, Subspaces, Bases and dimension, ordered bases and coordinates.

UNIT - 3

Linear Transformations

Linear transformations, Rank-nullity theorem, Algebra of linear transformations, Isomorphism, Matrix representation, linear functionals, Annihilator, Double dual, Transpose of a linear transformation.

UNIT - 4

Elementary Canonical Forms

Characteristic values and characteristic vectors of linear transformations, Diagonalizability, Minimal polynomial of a linear transformation, Cayley- Hamilton theorem, Invariant subspaces, Direct-sum decompositions, Invariant direct sums, The primary decomposition theorem, Cyclic subspaces and annihilators, Cyclic decomposition, Rational, Jordan forms.

UNIT - 5

Inner Product Spaces

Inner product spaces, Orthonormal bases, Gram-Schmidt process, Linear Functional and Adjoints, Unitary Operators, normal Operators.

UNIT - 6

Bilinear Forms

Bilinear Forms, Symmetric Bilinear Forms, Skew Symmetric Bilinear Forms.

TEXT/REFERENCE BOOKS

1. K. Hoffman and R. Kunze, “Linear Algebra”, 2nd Edition, Prentice- Hall of India, 2005
2. M. Artin, "Algebra", Prentice-Hall of India, 2005

EC 15 C	Nano Electronics	3 Credits

Course Objectives:

- To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
- Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to design the recently developing VLSI applications.
- This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
- Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.
- The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

Course Outcomes:

1. Students will achieve basics knowledge of engineering in the field Nano electronics.
2. Basic knowledge of MOSFET, FINFET, SOI-MOSFET which are new generation transistor technology.
3. Students will get ability to research and development in field of Nano electronics Devices and Materials which is recent trends in technology.
4. With the knowledge of this course students will be the part of emerging trends of Nano electronics devices.
5. This provides information all the recent applications, Engineering Tools and research views to the students.

UNIT - 1

Overview Nano Technology

Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow.

UNIT - 2

MOS Scaling theory

MOS Scaling theory, Issues in scaling MOS, transistors: Short channel, effects, Description of a typical65 nm MOS technology. Requirements for Non classical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2

vs. High-k gate dielectrics, Integration, Issues of high-k .Interface states, bulk charge, band offset, stability, reliability - Qbd high field, possible candidates, CV and IV techniques.

UNIT - 3

SOI (Silicon on insulator)

Metal gate transistor: Motivation, requirements Integration Issues, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot, SOI - PDSOI and FDSOI, Ultrathin body SOI - double gate transistors, integration issues.

UNIT - 4

Properties of Nano devices

Vertical transistors -Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schotky functions on Silicon, Germanium and compound semiconductors -Work function pinning.

UNIT - 5

Nano electronics Semiconductor devices

Germanium Nano MOSFETs: strain, quantization, Advantages of Germanium over Silicon, PMOS versus NMOS, Compound semiconductors - material properties, MESFETs Compound Semiconductors MOSFETs in the context of channel quantization and strain, Hetero structure MOSFETs exploiting novel materials, strain, and quantization.

UNIT - 6

Characterization techniques for Nano materials

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self assembly.

TEXT/REFERENCE BOOKS

1. Fundamentals of Modern VLSI Devices, Y. Taur and T. Ning, Cambridge University Press.
2. Silicon VLSI Technology, Plummer, Deal, Griffin, Pearson Education India.
3. Encyclopedia of Materials Characterization, Edited by: Brundle, C. Richard; Evans, Charles A. Jr.; Wilson, Shaun; Elsevier

EC 15 D	NSS I	3 Credits

UNIT - 1

Introduction and Basic Concepts of NSS

History, Philosophy, Aims & objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps. Basis of adoption village/slums, Methodology of conducting Survey.

UNIT - 2

Youth and community mobilization

Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth , Youth as a agent of social change, Youth-adult partnership, Mapping of community stakeholders, Identifying methods of mobilization, Needs & importance of volunteerism.

UNIT - 3

Importance and Role of Youth Leadership

Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership.

UNIT - 4

Life Competencies and skill

Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self confidence and self esteem, Life goals, Stress and time management

UNIT - 5

Social Harmony and National Integration

Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building

UNIT - 6

Youth Development Programmes in India

National Youth Policy, Youth development programmes at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations

EC 21	Probability and Random Processes	4 Credits

Course Objectives:

- To develop basis of probability and random variables.
- The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

On successful completion of the course, students should be able to:

1. Explain fundamentals of probability theory, random variables and random processes.
2. Understand the mathematical concepts related to probability theory and random processes.
3. Understand the characterization of random processes and their properties.
4. Formulate and solve the engineering problems involving random processes.
5. Analyze the given probabilistic model of the problem.
6. Make precise statements about random processes.

UNIT - 1

Introduction to Probability

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes' rule and applications.

UNIT - 2

Random variables

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf);probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables, Function of random a variable, pdf of the function of a random variable; Function of two random variables; Sum of two independent random variables, mean, variance and moments of a random variable, Joint moments, conditional expectation; covariance and correlation, independent, uncorrelated and orthogonal random variables.

UNIT - 3

Random vector and distributions

Mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector-space representation of random variables, linear independence, inner product, Schwarz Inequality, Elements of estimation theory: linear minimum mean-square error and orthogonality principle in estimation; Moment-generating and characteristic functions and their applications, Bounds and approximations: Chebysev inequality and Chernoff Bound.

UNIT - 4

Sequence of random variables and convergence

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT - 5

Random process

Random process: realizations, sample paths, discrete and continuous time processes, examples, Probabilistic structure of a random process; mean, autocorrelation and auto-covariance functions, Stationarity: strict-sense stationary (SSS) and wide-sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross-correlation function, Ergodicity and its importance.

UNIT - 6

Spectral representation of a real WSS process

Power spectral density, properties of power spectral density, cross-power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, Linear time-invariant system with a WSS process as an input: sationarity of the output, auto-correlation and power-spectral density of the output; examples with white-noise as input; linear shift-invariant discrete-time system with a WSS sequence as input, Spectral factorization theorem, Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS

1. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
2. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.

EC 33	Electromagnetic Field	3 Credits

Course Objectives:

- Learners can be able to explore their knowledge in the area of EM field and its analysis.
- To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM fields.
- To understand the boundary conditions for different materials /surfaces.
- To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
- To get the basics of microwave, transmission lines and antenna parameters.
- Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

1. Learner will apply knowledge of mathematics to solve numerical based on Coulombs law, Gausss law, Biot Savarts law, Amperes circuital law etc.
2. The basic platform of EM helps students in future courses like wave theory and antenna, Microwave and Radar Engineering, Optical Fiber Communication etc.
3. Students will understand the Maxwell's Equations in different forms and hence EM analysis can be achieved for different materials.
4. Students will understand impact of the EM course in many engineering core subjects like Optical Fiber Communication, Microwave Engineering, Antenna engineering etc. and its impact on the technology used by the society.
5. This course understanding will encourage students to learn its usefulness in core domain areas like wave theory, antenna design and simulations, microwave theory, optical communication etc.

UNIT - 1

Mathematical Fundamentals and Static Electric Fields

Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density, Poisson's and Laplace's Equations, Uniqueness Theorem, Method of Images, Electrostatic boundary value problem.

UNIT - 2

Steady Electric Currents and Static Magnetic Fields

Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, Continuity Equation and Kirchhoff's Current Law, Power Dissipation and Joule's Law, Biot- Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Field.

UNIT - 3

Time Varying Field & Maxwell's Equations

Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields

UNIT - 4

Electromagnetic Waves

The Helmhotz Equation, Plane waves in Lossless medium, Plane waves in a lossy medium. Poynting Vector and Power Flow in Electromagnetic Fields, Polarization of plane wave, Behavior of Plane waves at the interface of two media.

UNIT - 5

Fundamental of Antennas and Radiating Systems

Introduction, Fundamentals of Radiation, Radiated field of an Herzian dipole, Basic Antenna Parameters, Half Wave Dipole Antenna, Quarter Wave Monopole Antenna, Small Loop Antennas, Introduction to Antenna Arrays

UNIT - 6

Introduction to Numerical Techniques in Electromagnetics

Introduction, Finite difference method, Basic Concepts of the Method of Moments, Method of Moment for Wire Antennas and Wire Scatterers.

TEXT/REFERENCE BOOKS

1. Sadiku, "Elements of Electromagnetics", Oxford.
2. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
3. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill , New Delhi , 1999.

4. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
5. Sarvate, "Electromagnetism", Wiley Eastern.

EC 23	Microprocessor and Microcontroller	3 Credits

Course Objectives:

- Objective of this course is to introduce to the students the fundamentals of microprocessor and microcontroller.
- After learning Microprocessor course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
- The learner can design microprocessor based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
- The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
- The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.
- The students will get acquainted with recent trends in microcontroller like pipelining, cache memory etc.
- To understand the applications of Microprocessors and Microcontrollers.
- To understand need of microcontrollers in embedded system.
- To understand architecture and features of typical Microcontroller.
- To learn interfacing of real world input and output devices.
- To study various hardware and software tools for developing applications.

Course Outcomes:

1. Learner gains ability to apply knowledge of engineering in designing different case studies.
2. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
3. Graduates will be able to design real time controllers using microcontroller based system.
4. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
5. Students can identify and formulate control and monitoring systems using microcontrollers.
6. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
7. This course understanding will enforce students to acquire knowledge of recent trends like superscalar and pipelining and thus finds recognition of continuous updation.
8. Learners get acquainted with modern tools like Programmers, Debuggers, cross compilers and current IDE i.e. integrated development environment tools.
9. Learn importance of microcontroller in designing embedded application.
10. Learn use of hardware and software tools.
11. Develop interfacing to real world devices.

UNIT - 1

Basics 8085

Basic 8085 microprocessor architecture and its functional blocks, 8085 microprocessor IC pin outs and signals, address, data and control buses. 8085 features. Interrupt system of 8085, Stack and subroutine. Types of memory and memory interfacing. Decoding techniques-absolute and partial. Mapping techniques -I/O mapped I/O and memory mapped-I/O. Serial I/O lines of 8085 and the implementation asynchronous serial data communication using SOD and SID.

UNIT - 2

Programming with 8085

Basic instruction set, timing states, machine cycles and instruction cycles. Instruction timing diagram and, interrupt process and timing diagram of interrupt instruction execution. Writing assembly language programs. Looping, counting and indexing operations related programs. Stacks and subroutines operations related programs. Conditional call and return instructions operations related programs. Debugging programs.

UNIT - 3

Study and Interfacing of peripherals 8155, 8255, 8253/8254, 8259 with 8085

UNIT - 4

Basics of 8051:

Comparison of microprocessor and microcontroller. Architecture and pin functions of 8051 chip controller. CPU timing and machine cycles. Internal memory organization. Program counter and stack. Input/output prots. Counters and timers. Serial data input and output interrupts. Power saving modes.

UNIT - 5

Programming with 8051

Instruction set, addressing modes. Immediate, registers, direct and indirect data movement and exchange instructions. Push and pop op-codes. Arithmetic and logic instructions, bit level operations, jump and call instructions, input/output port programming, programming timers, asynchronous serial data communications and hardware interrupt service routines interfacing of LCD display hex keyboard ADC0808. DAC0808 and stepper motor with 8051current trends in microprocessors and practical implementation.

UNIT - 6

Introduction to ARM Processor

ARM family architecture, register architecture, memory access and addressing modes, arithmetic and logical instructions, branching instructions.

Comparative study of salient features of 8051 and its derivatives like 89C51, 89C52, 89C2051 and 89C2052. Current processor and controller survey. (cost, availability, popularity).

TEXT/REFERENCE BOOKS

1. Mazidi & Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearson edu.
2. Microprocessor and interfacing 8085, Douglas V Hall, Tata Mc Gram Hill.
3. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
4. Crisp, introduction to microprocessor & microcontrollers, 2e Elsevier, 2007.
5. ARM system-on-chip architecture, 2e pearson education.
6. Calcut, 8051 microcontrollers: Applications based introduction, Elsevier.
7. D V kodavade, S. Narvadkar, 8085-86 microprocessors Architecture progg and interfaces, wiley.
8. Udyashankara V., Mallikarjunaswamy, 8051 microcontroller, TMH.
9. Han-way Huang, using The MCS-51 microcontroller, Oxford university press.
10. Ayala, 8051 microcontroller, cengage (Thomson).
11. Rout 8085 microcontroller-architecture, programming and application, 2nd edi, penram international.

EC 24	Digital Signal Processing	4 Credits

Course Objectives:

- To introduce students with transforms for analysis of Discrete time signals and systems.
- To understand the digital signal processing, sampling and aliasing.
- To use and understand implementation of digital filters.
- To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.

UNIT - 1

DSP Preliminaries

Sampling, DT signals, sampling theorem in time domain, sampling of analog signals, recovery ofanalog signals, and analytical treatment with examples, mapping between analog frequencies todigital frequency, representation of signals as vectors, concept of Basis function and orthogonality. Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

UNIT - 2

Discrete Fourier Transform

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm, Linear filtering using overlap add and overlap save method, Introduction to Discrete Cosine Transform.

UNIT - 3

Z transform

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

UNIT - 4

IIR Filter Design

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by approximation of derivatives, , IIR filter design by impulse invariance method, Bilinear transformation method, warping effect. Characteristics of Butterworth filters, Chebyshev filters and elliptic filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Finite word length effect in IIR filter design

UNIT - 5

FIR Filter Design

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form, Finite word length effect in FIR filter design.

UNIT - 6

Multirate DSP and Introduction to DSP Processor

Concept of Multirate DSP, Sampling rate conversion by a non-integer factor, Design of two stage sampling rate converter, General Architecture of DSP, Case Study of TMS320C67XX, Introduction to Code composer studio. Application of DSP to Voice Processing, Music processing, Image processing and Radar processing.

TEXT/REFERENCE BOOKS

1. John G. Proakis, Dimitris G. Manolakis, “Digital Signal Processing: Principles, algorithms and applications” Fourth edition, Pearson Prentice Hall.
2. S. Salivahanan, C. Gnanpriya, “Digital Signal processing”, McGraw Hill.
3. Ifaeachor E.C, Jervis B. W., “Digital Signal processing: Practical approach”, Pearson publication.
4. Dr. Shaila Apte, “Digital Signal Processing” Wiley India Publication, second edition.
5. K. A. Navas, R. Jayadevan, “Lab Primer through MATLAB”, PHI.
6. Li Tan, Jean Jiang, “Digital Signal Processing: Fundamentals and applications” Academic press.

EC 25 A	Digital Voice & Picture Communication	3 Credits

Course Objectives:

- This subject has become a very important one in today's technology this course will give the brief introduction about the voice communication and picture communication independently.

Course Outcome:

1. This will help the students as kind of technological growth that in order to effectively and efficiently disseminate the information pertaining to voice picture and the other Medias which are there very efficiently so there we need to use the digital technology.

UNIT - 1

Introduction Speech Processing

Speech Production Model, Speech Coding: Objectives and Requirements, Quantizers for Speech Signal, mew - Law and Optimum Quantizer, Adaptive Quantizer, Differential, Quantization, LDM and ADM ,Differential PCM and Adaptive Prediction, Linear Prediction of Speech, Computational Aspects of LPC parameters, Cholesky Decomposition, Lattice Formulation of LPC Coefficient, Linear Predictive Synthesizer, LPC Vocoder.

UNIT - 2

Image and Video Coding

Introduction to Image and Video Coding, Lossy Image Compression, Quantization and Limitations, Theory of Wavelets, Discrete Wavelet Transforms, DWT on the Images and its Encoding, - Embedded Zero Tree Wavelet Encoding.

UNIT - 3

Video Coding

Basic Building Blocks, Motion Estimate Techniques, Fast Motion Estimation Techniques, Video Coding Standards, Advanced Coding Aspects.

UNIT - 4

Audio Coding

Basic Concepts, Audio Coding AC, AC -3 Decoder, MPEG - 1 Audio Coding.

UNIT - 5

VoIP

Introduction to VoIP, VoIP Signaling: H.323 Protocol, H.323 Call Controls and Enhancements Interworking with PSTN Limitations and Solution.

UNIT - 6

Multiplexing Schemes

H.323: Multiplexing: Header Compression and BW, ISDN Video Conferencing, Video Conferencing: SIP Protocol, 4G Multimedia Conferencing.

TEXT/REFERENCE BOOKS

1. Introduction to Digital Audio Coding and Standards by Marina Bosi, Richard E. Goldberg, Springer, 2002.
2. Principles of Digital Audio by Pohlmann, Ken C. McGraw-Hill/TAB Electronics, 2005.
3. Voice Over IP Networks Marcus Goncalves McGraw-Hill Professional.
4. VoIP Standards and Protocols Faulkner Information Services.
5. Voice Over IP Technologies: Building the Converged Network Mark A. Miller John Wiley & Sons.
6. An Introduction to Speech Recognition by B. Plannerer.
7. Speech Processing: A Dynamic and Optimization-Oriented Approach by Li Deng.

EC 25 B	Engineering Economics	3 Credits

Course Objectives:

- The objective of this course is to familiarize the prospective engineers with elementary principles of economics.
- It also deals with acquainting the students with standard concepts and tools that they are likely to find useful in their profession when employed in the firm/industry/corporation in public or private sector.
- It also seeks to create and awareness about the status of the current economic parameters /indicators/ policy debates. All of this is apart of the quest to help the students imbibe soft skills that will enhance their employability.

Course Outcomes:

1. Prepare engineering students to analyze cost/revenue data and carry out make economic analyses in the decision making process to justify or reject alternatives/projects on an economic basis.
2. Be able to perform and evaluate present worth, future worth and annual worth analyses on one of more economic alternatives.
3. Be able to perform and evaluate payback period and capitalized cost on one or more economic alternatives.
4. Be able to carry out and evaluate benefit/cost, life cycle and breakeven analyses on one or more economic alternatives.

UNIT - 1

Basic Principles and Methodology of Economics

Demand/Supply – elasticity –Government Policies and Application. Theory of the Firm and Market Structure, Basic Macro-economic Concepts (including GDP/GNP/NI/Disposable Income) and Identities for both closed and open economies. Aggregate demand and Supply (IS/LM). Price Indices (WPI/CPI), Interest rates, Direct and Indirect Taxes.

UNIT - 2

Public Sector Economics

Welfare, Externalities, Labour Market, Components of Monetary and Financial System, Central Bank –Monetary Aggregates; Commercial Banks &their functions; Capital and Debt Markets. Monetary and Fiscal Policy Tools & their impacton the economy – Inflation and Phillips Curve.

UNIT - 3

Elements of Business/Managerial Economics and forms of organizations

Cost &Cost Control –Techniques, Types of Costs, Budgets, Break even Analysis, Capital Budgeting, Application of Linear Programming. Investment Analysis – NPV, ROI, IRR, Payback Period, Depreciation, Time value of money.

UNIT - 4

Business Forecasting

Elementary techniques, Statements – Cash flow, Financial, and Case Study Method.

UNIT - 5

Indian economy Brief overview of post independence period – plans.

Post reform Growth, Structure of productive activity. Issues of Inclusion – Sectors, States/Regions, Groups of people (M/F), Urbanization. Employment–Informal, Organized, Unorganized, Public, Private.

UNIT - 6

Challenges and Policy Debates

Challenges and Policy Debates in Monetary, Fiscal, Social, External sectors.

TEXT/REFERENCE BOOKS

1. Mankiw Gregory N.(2002), Principles of Economics, Thompson Asia.
2. V. Mote, S. Paul, G. Gupta (2004), Managerial Economics, Tata McGraw Hill.
3. Misra, S.K. and Puri (2009), Indian Economy, Himalaya.
4. Pareek Saroj (2003), Textbook of Business Economics, Sunrise Publishers.

EC 25 C	Computer Organization & System Software	3 Credits

Course Objectives:

- To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
- To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
- Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
- Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

1. An ability to design and conduct experiments, as well as to analyze and interpret data.
2. An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
3. An ability to identify, formulates, and solves engineering problems.
4. The broad education necessary to understand of the impact of engineering solutions in a global, economic, environmental, and societal context.
5. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.
6. Knowledge of mathematics through differential and integral calculus as well as complex variables, discrete mathematics, probability and statistics.
7. An ability to analyze and design complex electrical and electronic devices, software, and systems containing hardware and software component.
8. A breadth of knowledge over computer engineering (analog and digital circuit design and analysis, electronics, signals and systems, program design and abstraction, software engineering, computer organization and architecture, algorithm design and analysis, embedded systems, operating systems and compilers).

UNIT - 1

Processor Design

Processor organization, Information representation, Number formats, Instruction types, Fixed-point arithmetic: Addition, Subtraction, Multiplication and Division, ALU design: Basic ALU organization, Floating-point arithmetic, and Arithmetic processor.

UNIT - 2

Control Unit Design

Instruction sequencing, Instruction interpretation, hardwired control unit design, Micro programmed control unit design.

UNIT - 3

Memory Organization, Memory Technology and Classifications

Memory technology, Virtual memory concept, Segments, Pages and Files, Cache, Interleaved, Video, Dual Port memory.

UNIT - 4

Input/output Organization and Data Transfer Methods

Programmed I/O, DMA control and Interrupt based I/O, Serial transmission, Synchronization, Bus arbitration techniques, Bus architectures: ISA, EISA, VESA, PCI and SCS.

UNIT - 5

Parallel Processing and Assembly Level Programming Concepts

Basic concepts, Performance considerations, Assembly level programming, Concepts of one pass and two pass assemblers, Macros

UNIT - 6

Loaders and Linkers and Operating Systems

Relocating and Linking Loaders, Fundamentals of operating systems: MS-DOS, Windows and Linux, Case study of IBM PC or compatible.

TEXT/REFERENCE BOOKS

1. Donovan, "System Programming", TMH.
2. Hayes, "Computer Architecture and Organization", McGraw-Hill.
3. Moris Mano, "Computer system Architecture", PHI.

4. William Gear, "Computer Organization and Programming", TMH.
5. Dhamdhere, "Introduction to System Software", TMH.

EC 26 A	Telecomm. Network Management	3 Credits

Course Objectives:

- To familiarize the student with the design, analysis operation and management of modern data communications networks.
- To provide the student with a working knowledge of the types of communications network management systems and their strengths and limitations in solving various information network management problems.

Course Outcomes:

The students will be able to:

1. Demonstrate broad knowledge of fundamental principles and technical standards underlying.
2. Understand basic of telecommunication, networking and information technologies.
3. Architect and implement networked informative systems.
4. Continuously improve their technology knowledge and communication skills.
5. Anticipate the way technological change and emerging technologies might alter the assumptions underlying architectures and systems.

UNIT - 1

Overview of Network Management

Case histories on network, system and service management, challenges of IT managers, Network Management: Goals, organization and functions Network management architecture and organization network management perspectives.

UNIT - 2

OSI Network Management

Network management standards, Network management models, Organization model, Information model, Communication model and functional model, Abstract syntax notation – encoding structure, macros functional model CMIP/CMISE.

UNIT - 3

Internet Management (SNMP)

SNMP-organizational model, System overview, Information model, communication model, functional model, SNMP proxy server, Management information, Protocol, Remote monitoring, RMON.

UNIT - 4

Broadband Network Management

Broadband networks and services, ATM Technology – VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN, ATM Network Management – ATM network reference model, integrated, local management interface. ATM management information base, role of SNMP and ILMI in ATM management, M1, M2, M3, M4 interface. ATM digital exchange interface management.

UNIT - 5

Network Management Applications

Configuration management, Fault management, Performance management, Event correlation techniques, Security management, Accounting management, report management, policy based management, services, Level management.

UNIT - 6

Telecommunication Management Networks (TMN)

Need for TMN, Conceptual model, TMN standards, TMN management services architecture and TMN implementation.

TEXT/REFERENCE BOOKS

1. Mani Subramaniam, ―Network Management Principles and Practice", Addison Wisely, New York, 2000.
2. Lakshmi G. Raman, ― Fundamental of Telecommunications Network Management" Eastern Economy Edition, IEEE Press New Delhi.
3. Salh Aiidarons, Thomas Plevoyak ―Telecommunication Network Technologies and implementations" Eastern Economy Edition, IEEE press New Delhi-1998.

EC 26 B	MEMS & NEMS	3 Credits

Course Objectives:

- The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
- This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
- This will enables student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

1. This course provides the foundation education in MEMS through this subject study.
2. Students are provided learning experience that enables them to be familiar with the important concepts applicable to MEMS, their fabrication.
3. Be fluent with the design, analysis and testing of MEMS and application of the MEMS for different applications.

UNIT - 1

Introduction to MEMS

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers : transduction methods, accelerometers, gyroscopes ,pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT - 2

Control and Materials of MEMS

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals, Polymers.

UNIT - 3

Transducers

Chemical and Biological Transducers: basic concepts of cellular biology, chemical sensors, molecule-based biosensors, cell-based biosensors, chemical actuators, biological transducers, and electrophoresis: optical transducers, thermal transducers, magnetic transducers, RF transducers.

UNIT - 4

Overview Nano Technology:

Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow.

MOS Scaling theory:

MOS Scaling theory, Issues in scaling MOS, transistors: Short channel, effects, Description of a typical65 nm MOS technology. Requirements for Non classical MOS transistor, MOS capacitor, Role of interface quality and related process techniques, Gate oxide thickness scaling trend, SiO2 vs. High-k gate dielectrics, Integration, Issues of high-k .Interface states, bulk charge, band offset, stability, reliability - Qbd high field, possible candidates, CV and IV techniques.

UNIT - 5

SOI (Silicon on insulator)

Metal gate transistor: Motivation, requirements Integration Issues, Transport in Nano MOSFET, velocity saturation, ballistic transport, injection velocity, velocity overshoot, SOI - PDSOI and FDSOI, Ultrathin body SOI - double gate transistors, integration issues.

Properties of Nano devices

Vertical transistors -Fin FET and Surround gate FET. Metal source/drain junctions-Properties of schotky functions on Silicon, Germanium and compound semiconductors, Work function pinning.

UNIT - 6

Nano electronics Semiconductor devices:

Germanium Nano MOSFETs: strain, quantization, Advantages of Germanium over Silicon, PMOS versus NMOS, Compound semiconductors - material properties, MESFETs Compound Semiconductors MOSFETs in the context of channel quantization and strain, Hetero structure MOSFETs exploiting novel materials, strain, and quantization.

Characterization techniques for Nano materials:

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis, Self assembly.

TEXT/REFERENCE BOOKS

1. Kovacs, Gregory T. A. “Micromachined Transducers Sourcebook” McGraw-Hill.
2. Max J. Madou: “Fundamentals Of Micro Fabrication”- The science of miniaturization,

3. Nanogen Corporation, USA, CRC press, March 2002.
4. Sergey Edward Lyshevski: "Nano-And Micro Electro Mechanical Systems", Second edition, CRC press, Boca Ratron London.
5. Jan G Korvinik and Oliver Paul, "MEMS Practical Guide to Design, analysis and Applications" William Andrew, Inc Springer
6. G. K. Anantsuresh, K.J. Vinoy, S. Gopalkrishnan, K.N. Bhat, V.K. Atare, " Micro and Smart Systems" Wiley.

EC 26 C	Embedded Systems Design	3 Credits

Course Objectives:

- To understand the embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment.
- To learn embedded software development and testing process.

Course Outcomes:

1. Get insight of design metrics of embedded systems to design real time applications to match recent trends in technology.
2. Understand Real time systems concepts.
3. Understand Linux operating system and device drivers.
4. Get to know the hardware – software co design issues and testing methodology for embedded system.

UNIT - 1

Introduction to Embedded Computing

Introduction, Overview, Characteristics of Embedding Computing Applications, Concept of Real time Systems, Challenges in Embedded System Design, Design Process: Requirements, Specifications, Architecture Design, Designing of Components, System Integration.

UNIT - 2

Embedded System Architecture

Instruction Set Architecture, CISC and RISC instruction set architecture

Basic Embedded Processor/Microcontroller Architecture: CISC Examples (Motorola (68HC11) Example, 8051), RISC Example (ARM), DSP Processors, Harvard Architecture, PIC

Memory System Architecture: Caches, Virtual Memory, Memory Management Unit and Address Translation

I/0 Sub-system: Busy-wait I/0, DMA, Interrupt driven I/0, Co-processors and Hardware Accelerators

Processor Performance Enhancement: Pipelining, Super-scalar Execution, CPU Power Consumption

UNIT - 3

Designing Embedded Computing Platform

Using CPU Bus: Bus Protocols, Bus Organization

Memory Devices and their Characteristics: RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM

I/O Devices: Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices

Component Interfacing: Memory Interfacing, I/O Device Interfacing

Interfacing Protocols: GPIB, FIREWIRE, USB, IRDA

Designing with Processors: System Architecture, Hardware Design, FPGA Based Design **Implementation:** Development Environment, Debugging Techniques, Manufacturing and Testing

Design Examples: Data Compressor, Alarm Clock.

UNIT - 4

Programming Embedded Systems

Program Design: Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph

Programming Languages: Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Control, Multi- tasking and Task Scheduling, Timing Specifications, Run-time Exception handling

Use of High Level Languages: C for Programming embedded systems, Object Oriented Programming for Embedded Systems in C++, Use of Java for Embedded Systems Programming and Run-time Environment: Compiling, Assembling, Linking and Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing

UNIT - 5

Operating System

Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking.

Scheduling: Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling

Inter-process Communication: Signals, Shared Memory Communication, Message-Based Communication.

Real-time Memory Management: Process Stack Management, Dynamic Allocation **I/O:** Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time Transactions and Files.

Example Real-time OS: Vx Works, RT-Linux, Psos

Evaluating and Optimizing Operating System Performance: Response-time Calculation, Interrupt latency, Time-loading, Memory Loading Power Optimization Strategies for Processes.

UNIT - 6

Embedded System Development

Design Methodologies: UML as Design tool, UML notation, Requirement Analysis and Use case Modeling, Static Modeling, Object and Class Structuring, Dynamic Modeling **Architectural Design:** Hardware-Software Partitioning, Hardware-Software Integration **Design Examples:** Telephone PBX, Inkjet Printer, PDA, Set-top Box, Elevator Control System, ATM System

Fault-tolerance Techniques, Reliability Evaluation Techniques

Embedded control applications: Introduction, Open-loop and Closed Loop Control Systems,

Examples: Speed Control, PID Controllers: Software Coding of a PID Controller, PID tuning Fuzzy Logic Controller, Application Examples: Washing Machine, Automotive Systems, Auto-focusing digital camera, Air-conditioner.

TEXT/REFERENCE BOOKS

1. Wayne Wolf "Computers as components: Principles of Embedded Computing System Design", Morgan Kaufman publication 2000.
2. Andrew N. Sloss, Dominic Symes, Chris Wright," ARM System Developer's Guide, Designing and Optimizing System Software", Elseveir-2002.
3. John B. Peatman , "Design with PIC Microcontroller", Pearson Education Asia,2002.
4. Tim Wimshurt, "The design of small scale Embedded systems", Palgrave 2003.

EC 26 D	Project Management	3 Credits

Course Objectives:

- To understand the concepts of project definition, life cycle, and systems approach.
- To develop competency in project scooping, work definition, and work breakdown structure (WBS).
- To handle the complex tasks of time estimation and project scheduling, including PERT and CPM.
- To develop competencies in project costing, budgeting, and financial appraisal.
- To gain exposure to project control and management, using standard tools of cost and schedule variance analysis.
- To appreciate the elements of risk and quality in hi-tech projects.
- To learn project management by "practice", through the medium of "study projects"; and
- To appreciate and understand the use of computers in project management, especially a tool like MS Project.

Course Outcomes:

Upon completion of Project Management, you will be able to

1. Demonstrate professional level competencies in the following key areas of project management and project management leadership.
2. Manage the selection and initiation of individual projects and of portfolios of projects in the enterprise.
3. Conduct project planning activities that accurately forecast project costs, timelines, and quality. Implement processes for successful resource, communication, and risk and change management.
4. Demonstrate effective project execution and control techniques that result in successful projects.
5. Conduct project closure activities and obtain formal project acceptance.
6. Demonstrate a strong working knowledge of ethics and professional responsibility.
7. Demonstrate effective organizational leadership and change skills for managing projects, project teams, and stakeholders.

UNIT - 1

Introduction to project management

Importance, objectives & functions of management, Principles of Management, Categories of project, Project Failure, Project--- life cycle Concept and Cost Components ,Project Management Book of Knowledge {PMBOK} – Different Domain Areas, Project management Institute and

Certified Project Management Professionals (PMP) Importance of organizational Structure in Management- Authority / Responsibility Relation.

UNIT - 2

Project planning and scheduling

WBS – Work Breakdown Structure, Gantt/Bar chart & its limitations Network Planning, Network Analysis, C. P. M.- . Activity on Arrow (A.O.A.), Critical path and type of floats, Precedence network analysis (A.O.N.) P. E. R.

UNIT - 3

Project Monitoring and control

Resource Allocation – Resource Smoothening and levelling, Network Crashing – Time- Cost – Resource optimization, Project Monitoring- Methods, Updating and Earned Value Analysis

Introduction to use of Project Management Softwares – MS Project / Primavera ,Case study on housing project scheduling for a small project with minimum 25 activities.

UNIT - 4

Project economics

Introduction to project economics - Definition, principles, Importance in construction Industry, Difference between Cost, Value, Price , Rent, simple and compound interest, profit, Annuities, Demand, demand schedule, law of demand, demand curve, elasticity of demand, supply, supply schedule, supply curve, elasticity of supply Equilibrium, Equilibrium price, Equilibrium amount, factors affecting price determination. Law of Diminishing Marginal Utility, Law of substitution, Concept of Cost of Capital, Time value of money ,Sources of Project Finances – concepts of Debt Capital and Equity Capital. Types of Capital – Fixed and working. Equity shares and debenture capital.

UNIT - 5

Project Resources and safety aspects

Objectives of Materials management – Primary and secondary Material Procurement Procedures - material requirement- raising of indents, receipts, Inspection, storage, delivery, record keeping – Use of Excel sheets, ERP software ,Inventory control- ABC analysis, EOQ, Introduction to Equipment Management – Fleet Management, productivity studies, Equipment down time, sizing - matching ,Construction Safety norms – measures and precautions, implementation of safety programs.

UNIT - 6

Project appraisal

Types of Appraisals such as political, social, environmental, techno-legal, financial and Economical, Criteria for project selection - benefit - cost analysis, NPV, IRR, Pay-back period, Break Even analysis [Fundamental and Application Component ,Study of Project Feasibility report and Detailed Project Report (DPR) ,Role of Project Management Consultants – pre tender and Post tender.

TEXT/REFERENCE BOOKS

1. Construction Engineering and Management by S. Seetharaman, Umesh Publications, New Delhi.
2. Project Managemen—Khatua—Oxford University Unversity
3. Total Project Management – The Indian Context by P. K. Joy Macmillan India Ltd.
4. PERT and CPM Principles and Applications by L. S. Srinath, Affiliated East West Press Pvt Ltd. New Delhi.
5. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
6. Construction Management and Planning by B. Sengupta and H Guha, Tata McGraw Hill Publishing Company, New Delhi.
7. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
8. Financial Management by Prasanna Chandra, Tata McGraw – Hill Publication.
9. Engineering Economics, James Riggs, David Bedworth, Sabah Randhawa, McGraw Hill.
10. Engineering Economic Analysis, 10/e—Newnan--- Oxford University Unversity.
11. Engineering Economics by Pannerselvam – PHI Publications.
12. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.

EC 26 E	NSS II	3 Credits

UNIT - 1

Citizenship

Basic Features of Constitution of India, Fundamental Rights and Duties, Human Rights, Consumer awareness and the legal rights of the consumer, RTI

UNIT - 2

Health, Hygiene & Sanitation

Definition, Needs and scope of health education , Food and Nutrition , Safe drinking water, Water borne diseases and sanitation, National Health Programme, Reproductive health , Healthy Lifestyles ,HIV AIDS, Drugs and Substance abuse, Home Nursing , First Aid

UNIT - 3

Youth and Yoga

History, Philosophy and concept of Yoga , Myths and misconceptions about yoga , Different Yoga traditions and their Impacts Yoga as a preventive, promotive, and curative method, Yoga as a tool for healthy lifestyle.

UNIT - 4

Environment Issues

Environment conservation, Enrichment and Sustainability , Climate change, Waste management, Natural resource management , Rain water harvesting, Energy conservation, Waste land development, Soil conservations and forestation

UNIT - 5

Disaster a Management

Introduction to Disaster Management, Classification disaster, Role of youth in Disaster Management

UNIT - 6

Youth and crime

Sociological and psychological factors influencing youth crime, Peer mentoring in preventing crime, Awareness about anti-ragging, Cybercrime and its prevention, Juvenile justice

EC 31	Wireless Communication	4 Credits

Course Objectives:

- The objective of the course is to introduce the Concepts of basic wireless mobile communication systems.
- To learn and understand the basic principles of Telecommunication switching, traffic and networks.
- To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
- To learn and understand architecture of GSM and CDMA system.
- To understand mobile management, voice signal processing and coding in GSM and CDMA system

Course Outcomes:

After successfully completing the course students will be able to

1. Explain and apply the concepts telecommunication switching, traffic and networks.
2. Analyze the telecommunication traffic.
3. Analyze radio channel and cellular capacity.
4. Explain and apply concepts of GSM and CDMA system.

UNIT - 1

Introduction and Cellular Concept

Existing technology, Evolution in wireless systems, Trends in cellular system Frequency Reuse channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Cellular System, Design in worst case with an omni Directional Antenna, Co-Channel Interference Reduction with use of Directional Antenna, Improving Coverage and Capacity in Cellular systems, Trunking and Grade of service

UNIT - 2

Wireless Communication Systems GSM

GS Services and features, GSM Architecture and interfaces, GSM Radio Sub System, GSM Channel Types , Traffic Channels, Control Channels, Example of a GSM call, Frame structure for GSM , Signal Processing in GSM, GPRS.

UNIT - 3

Wideband Modulation Techniques and OFDM

Basic Principles, OFDM Signal Mathematical representation, Block Diagram, Selection Parameters for modulation, Pulse shaping, Windowing, Spectral Efficiency, Synchronization

UNIT - 4

Wireless Communication Systems CDMA IS95

Direct sequence Spread Spectrum, Spreading codes, Multipath Signal Propagation and RAKE receiver, Frame Quality and BER Requirements, Critical challenges of CDMA,TIA IS95 System, Physical and Logical Channels of IS95, CDMA IS95 call processing, soft hand off and power control in CDMA, Access and Paging Channel Capacity, Reverse and Forward Link Capacity of a CDMA System.

UNIT - 5

Wireless Communication Systems

CDMA 2000: CDMA layering structure, CDMA 2000 channels, logical channels, forward link physical, forward link features, reverse physical channels, CDMA 2000 Media Access control and LAC sub layer, Data services, Data services in CDMA 2000, mapping of logical channels to physicals, evolution of CDMA IS95 to CDMA 2000.

UNIT - 6

More Wireless Communication Systems

Bluetooth, Wi Fi Standards, WIMAX, Wireless Sensor Networks, Zigbee, UWB, IEEE 802.20 and Beyond.

TEXT/REFERENCE BOOKS

1. Wireless Communication: Principles and Practice ñ Theodare. S. Rappaport- Pearson Education.
2. Wireless Communication: Upena Dalal ñ Oxford Higher Education.
3. Wireless Network Evolution: 2G to 3G ñ Vijay. K. Garg ñ Pearson Education.
4. Principles and Application of GSM ñ Vijay Garg, Joseph. E. Wilkes ñ Pearson Education.
5. Mobile Cellular Telecommunications: Analog and Digital Systems, William C. Y. Lee, Tata McGraw ñ Hill Edition.
6. Introduction to Wireless Telecommunication Systems and Networks- Gary. J. Mullet, DELMAR CENGAGE Learning.

7. Wireless Communications and Networks: 3G and Beyond, ITI Saha Misra, Tata McGraw ñ Hill Edition.
8. Fundamentals of Wireless Communication: David Tse, Pramod Viswanath, CAMBRIDGE University Press.
9. Mobile Wireless communications, Mischa Schwartz, CAMBRIDGE University Press

EC 32	Control System	4 Credits

Course Objectives:

- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To introduce the concept of root locus, Bode plots, Nyquist plots.
- To introduce the state variable analysis method.
- To introduce concepts of PID controllers and digital and control systems.
- To introduce concepts programmable logic controller.

Course Outcomes:

On completion of the course, student will be able to:

1. Determine and use models of physical systems in forms suitable for use in the analysis and design of control systems.
2. Determine the (absolute) stability of a closed -loop control system.
3. Perform time domain and frequency domain analysis of control systems required for stability analysis.
4. Perform time domain and frequency domain correlation analysis.
5. Apply root-locus, Frequency Plots technique to analyze control systems.
6. Express and solve system equations in state variable form.

UNIT - 1

Control System Modeling

Basic Elements of Control System, Open loop and Closed loop systems, Differential equations and Transfer function, Modeling of Electric systems, Translational and rotational mechanical systems, Block diagram reduction Techniques, Signal flow graph.

UNIT - 2

Time Response Analysis

Standard input signals, Time response analysis of First Order Systems, Time response analysis of second order systems, Steady state errors and error constants, design specifications for second order systems.

UNIT - 3

Stability Analysis

Concept of Stability, Routh-Hurwitz Criterion, Relative Stability, Root Locus Technique, Construction of Root Locus, Dominant Poles, Application of Root Locus Diagram.

UNIT - 4

Frequency Response Analysis

Frequency domain Versus Time domain analysis and its correlation, Bode Plots, Polar Plots and development of Nyquist Plots. Frequency Domain specifications from the plots, Stability analysis from plots.

UNIT - 5

State Variable Analysis

State space advantages and representation, Transfer function from State space, physical variable form, phase variable forms: controllable canonical form, observable canonical form, Solution of homogeneous state equations, state transition matrix and its properties, computation of state transition matrix by Laplace transform method only, Concepts of Controllability and Observability.

UNIT - 6

Controllers and Digital Control Systems

Introduction to PLC: Block schematic, PLC addressing, any one application of PLC using Ladder diagram. Introduction to PID controller: P, PI, PD and PID Characteristics and concept of Zeigler-Nicholas method.

Digital control systems: Special features of digital control systems, Necessity of sample and hold operations for computer control, z-transform and pulse transfer function, Stability and response of sampled-data systems.

TEXT/REFERENCE BOOKS

1. N. J. Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2009.
2. Benjamin C. Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition,1995.
3. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
4. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill, 2007.
5. John J. D'Azzo& Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc., 1995.

6. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

EC 22	Digital Communication	3 Credits

Course Objectives:

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- To understand concept of spread spectrum communication system.

Course Outcomes:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

UNIT - 1

Digital Transmission of Analog Signal

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speech synthesis.

UNIT - 2

Baseband Digital Transmission

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

UNIT - 3

Random Processes

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process

through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

UNIT - 4

Baseband Receivers

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

UNIT - 5

Passband Digital Transmission

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.

UNIT - 6

Spread Spectrum Techniques

Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

TEXT/REFERENCE BOOKS

1. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, “A First Course in Digital Communication”, Cambridge University Press.
4. B P Lathi, Zhi Ding “Modern Analog and Digital Communication System”, Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications” Second Edition, Pearson Education.
6. Taub, Schilling, “Principles of Communication System”, Fourth Edition, McGraw Hill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

EC 34	Employability & Skill Development	2 Credits

Course Objectives:

- To develop analytical abilities.
- To develop communication skills.
- To introduce the students to skills necessary for getting, keeping and being successful in a profession.
- To expose the students to leadership and team-building skills.

Course Outcomes:

On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT - 1

Soft Skills & Communication basics

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills. Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT - 2

Arithmetic and Mathematical Reasoning

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).

UNIT - 3

Analytical Reasoning and Quantitative Ability

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy).

UNIT - 4

Grammar and Comprehension

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT - 5

Skills for interviews

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT - 6

Problem Solving Techniques

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016, Wiley.
2. Wren and Martin, "English grammar and Composition", S. Chand publications.
3. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
4. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
5. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
6. Eugene Ehrlich, Daniel Murphy, "Schaum’s Outline of English Grammar", McGraw Hills.
7. David F. Beer, David A. Mc Murrey, “A Guide to Writing as an Engineer”, ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

EC 34 A	Image Processing	4 Credits

Course Objectives:

- To learn the fundamental concepts of Digital Image Processing.
- To study basic image processing operations.
- To understand image analysis algorithms.
- To expose students to current applications in the field of digital image processing.

Course Outcomes:

After successfully completing the course students will be able to

1. Develop and implement algorithms for digital image processing.
2. Apply image processing algorithms for practical object recognition applications.

UNIT - 1

Fundamentals of Image Processing

Steps in image processing, Human Visual System, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures. Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation. Image Histogram. Color fundamentals & models – RGB, HSI YIQ.

UNIT - 2

Image Enhancement and Restoration

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain. Homomorphic filtering. Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering.

UNIT - 3

Image Compression

Types of redundancy, Fidelity criteria, Lossless compression – Runlength coding, Huffman coding, Bit-plane coding, Arithmetic coding. Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG.

UNIT - 4

Image Segmentation and Morphological Operations

Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative – Prewitt and Sobel. Second order derivative – LoG, DoG, Canny. Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu's Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

UNIT - 5

Representation and Description

Representation – Chain codes, Polygonal approximation, Signatures. Boundary Descriptors – Shape numbers, Fourier Descriptors, Statistical moments. Regional Descriptors – Topological, Texture, Principal Components for Description.

UNIT - 6

Object Recognition and Applications

Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing.

TEXT/REFERENCE BOOKS

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, - Pearson Education.
2. S Sridhar, "Digital Image Processing", Oxford University Press.
3. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, "Digital Image Processing Using MATLAB", Second Edition, - Tata McGraw Hill Publication.
4. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", Tata Mc Graw Hill Publication.

EC 34 B	Power Electronics	4 Credits

Course Objectives:

- To introduce students to different power devices to study their construction, characteristics and turning on circuits.
- To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
- To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

Course Outcomes:

After successfully completing the course students will be able to

1. Design & implement a triggering / gate drive circuit for a power device.
2. Understand, perform & analyze different controlled converters.
3. Evaluate battery backup time & design a battery charger.
4. Design & implement over voltage / over current protection circuit.

UNIT - 1

Power Devices

Construction, Steady state characteristics & Switching characteristics of SCR, Construction, Steady state characteristics Power MOSFET & IGBT. SCR ratings: IL, IH, VBO, VBR, dv/dt, di/dt, surge current & rated current. Gate characteristics, Gate drive requirements, Synchronized UJT triggering for SCR, triggering of SCR using IC-785, gate drive circuits for Power MOSFET / IGBT.

UNIT - 2

AC-DC Power Converters

Concept of line& forced commutation, Single phase Semi & Full converters for R, R-L loads, Performance parameters, Effect of freewheeling diode, Three phase Semi & Full converters for R load.

UNIT - 3

DC-AC Converters

Single phase bridge inverter for R and R-L load using MOSFET / IGBT, performance parameters, single phase PWM inverters. Three phase voltage source inverter for balanced star R load.

UNIT - 4

DC-DC converters & AC Voltage Controller

Working principle of step down chopper for R-L load (highly inductive), control strategies. Performance parameters, Step up chopper, 2-quadrant& 4-quadrant choppers, SMPS.Single-phase full wave AC voltage controller with R load.

UNIT - 5

Power Electronics Applications

ON-line and OFF line UPS with battery AH, back up time, battery charger rating. Electronic ballast: Characteristics of fluorescent lamps and advantages over conventional ballast. Single phase separately excited DC motor drive, stepper motor drive, BLDC motors. Variable voltage & variable frequency three phase induction motor drive.

UNIT - 6

Resonant Converters & Protection of Power Devices & Circuits

Need for resonant converters, SLR half bridge DC/DC converter in low frequency, Concept of zero current switching (ZCS) and zero voltage switching (ZVS) resonant converters. Cooling & heat sinks, over voltage conditions, over voltage protection circuits, over current fault conditions, over current protection. Electromagnetic interference: Sources, minimizing techniques.

TEXT/REFERENCE BOOKS

1. M. H. Rashid, “Power Electronics circuits devices and applications”, PHI 3rd edition, 2004 edition, New Delhi.
2. M. S. Jamil Asghar, "POWER ELECTRONICS", PHI, 2004, New Delhi.
3. Ned Mohan, T. Undeland & W. Robbins, “Power Electronics Converters applications and design” 2nd edition, John Willey & sons, Singapore.
4. U. R. Moorthi, "POWER ELECTRONICS, DEVICES, CIRCUITS &INDUSTRIAL APPLICATIONS", Oxford University Press, New Delhi, 2005.
5. P.C. Sen, “Modern Power Electronics”, S Chand & Co New Delhi.
6. "GE SCR MANUAL" 6th edition, General Electric, New York, USA.
7. Dr. P. S. Bimbhra, “Power Electronics”, Khanna Publishers, Delhi.
8. Nagrath Kothari, “Electrical Machines”, TMH.

EC 34 C	Audio & Video Processing	4 Credits

Course Objectives:

The objective is to provide students with a strong understanding of the fundamental principles and practical applications of audio and video engineering with latest updates.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand the concept of basic television signal processing.
2. Identify globally accepted colour TV standards.
3. Demonstrate the need of audio and video compression techniques in real life.
4. Acquire knowledge of latest digital TV systems and applications.
5. Describe the attributes of acoustics, sound engineering and storage media.

UNIT - 1

Fundamentals of Colour Television

Aspect, scanning, perception of brightness and colour, colour mixing, composite video signal, synchronisation details, digital TV camera, modulation of audio and video, terrestrial signal transmission, video displays: LCD vs LED.

UNIT - 2

Colour Standards and digital video

Standards: NTSC, PAL, SECAM colour system, generalized colour TV receiver block diagram, study of functionality of each block, alignment issues, sampling of video signal, colour sub sampling, composite vs component video, interlace vs progressive scan.

UNIT - 3

Digital TV

Digital video, resolution, notation, digital video formats, digital video quality measure, video restoration, video streaming, DTH, Video compression: MPEG 2, MPEG 4, comparison of SDTV, EDTV and HDTV.

UNIT - 4

Advanced TV Systems and Techniques

Introduction to UHDTV: 4K and 8K, IPTV/web TV, smart TV, Wi-Fi TV, digital surveillance, 3D TV concept, over view of H.264 features, camcorders, webcams, perspective of TV White spaces.

UNIT - 5

Acoustics

Human Hearing and sound, frequency range, dynamic range, masking, digital representation of sound wave, intensity, decibel sound level, sound waves in rooms, reverberation, room/studio acoustics as a component in speech system, PA systems, special types of microphones and speakers.

UNIT - 6

Audio and Video Recording Systems

Digital sound, sound recording, CD/ DVD player, MP3 player, Blue Ray DVD Player, ITU-T(G) compression standards, multichannel/Dolby 5.1sound in DTV.

TEXT/REFERENCE BOOKS

1. A. M. Dhake, Television and video Engineering, TMH Publication, 2nd Edition, 2001.
2. Kelth jack, Video Demystified: A Handbook for the Digital Engineer, 5th Edition, Newnes, 2007.
3. R.G. Gupta, Audio and Video Systems, McGraw Hill l Education (India), 2nd Edition, 2010.
4. S. P. Bali, Color Television Theory and Practice, McGraw Hill Education (India), 1994.
5. A. M. Tekalp, Digital Video, Prentice Hall, 1995.
6. R. P. Gulathi, Modern Television Practice, 4th edition, New Age International Publisher, 2014.

EC 35 A	Data Structure & Algorithm	3 Credits

Prerequisites: Basic knowledge of C language is required.

Course Objectives:

- To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To study the systematic way of solving problems, various methods of organizing large amounts of data.
- To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
- To employ the different data structures to find the solutions for specific problems

Course Outcomes:

On completion of the course, student will be able to:

1. Discuss the computational efficiency of the principal algorithms such as sorting &searching.
2. Write and understand the programs that use arrays & pointers in C.
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. Implement stacks & queues for various applications.
5. Understand various terminologies and traversals of trees and use them for various applications.
6. Understand various terminologies and traversals of graphs and use them for various applications.

UNIT - 1

Introduction to C and Algorithm

Constants, variables and keywords in C, operators and control structure in C (decision, loop and case), functions, macros, arrays and string manipulation, structure, union, enumeration, bitwise operations Functions: Parameter passing call by value and call by reference, scope rules, functions and pointers, function returning pointer, pointer to function, String manipulations using Arrays, pointer to pointer, Dynamic memory management.

Analysis of algorithm: frequency count and its importance in analysis of an algorithm, Time complexity & Space complexity of an algorithm, Big ‘O’ notation.

UNIT - 2

Searching and Sorting

Need of searching and sorting, why various methods of searching and sorting, Sorting methods: Linear, binary search and Fibonacci Search.

Sorting methods: Bubble, insertion, selection, merge, Time complexity of each searching and sorting algorithm, Hashing Techniques.

UNIT - 3

Stack and Queues

Stacks: Concept, Basic Stack operations, Array representation of stacks, Stack as ADT, Stack Applications: Reversing data, Arithmetic expressions conversion and evaluation.

Queues: Concept, Queue operations, Array representation of queues, Queue as ADT, Circular queues, Application of queues: Categorizing data, Simulation of queues.

UNIT - 4

Linked List

Concept of linked organization, singly linked list, stack using linked list, queue using linked list, doubly linked list, circular linked list, Linked list as ADT. Representation and manipulations of polynomials using linked lists, comparison of sequential linked organization with linked organization.

UNIT - 5

Trees

Introduction to trees: Basic Tree Concepts, Binary Trees: Concept & Terminologies, Representation of Binary Tree in memory, Traversing a binary tree, Binary Search Trees (BST): Basic Concepts, BST operations.

UNIT - 6

Graphs

Basic Concepts & terminology, Sequential representation of graphs; Adjacency matrix, Path matrix, Linked representation of a graph, Operations on graph, Traversing a graph, Spanning trees; Minimum Spanning tree, Kruskal's Algorithm, Prim's Algorithm. Dijkstra's Shortest Path Algorithm.

TEXT/REFERENCE BOOKS

1. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10: 0716782928.
2. Richard F. Gilberg & Behrouz A. Forouzan, Data Structures A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10: 0534390803.
3. Seymour Lipschutz, Data Structure with C, Schaum's Outlines, Tata Mc Graw Hill. ISBN-10: 1259029964.
4. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
5. Yedidyah Langsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10: 8120311779.

EC 35 B	Acoustic Engineering	3 Credits

Course Objectives:

The students obtain sufficient background and technical knowledge to understand contemporary issues in audio engineering.

Course Outcomes:

After completion of this course students will be able to

1. Understand the linear acoustic wave equation and explain the relationship between pressure and particle velocity for plane waves and spherical waves.
2. Calculate and interpret the near-field and far-field response of a circular piston radiator mounted in an infinite baffle.
3. Explain the basic physiology of the human hearing system and elementary psycho acoustical principles (e.g., sensitivity as a function of frequency, simultaneous masking, and difference limens).
4. Use geometrical measurements and material properties to calculate Sabine reverberation time for a room.
5. Explain the basic operation of dynamic (moving-coil) loudspeakers and condenser (capacitive) microphones.
6. Understand the principles of recording studio signal flow.
7. Discuss the strengths and weaknesses of modern perceptual audio coders such as MP3.
8. Describe the attributes of CD, DVD, Blue-Ray storage media.

UNIT - 1

Introduction

Introduction, audio and acoustics sub disciplines, survey Fundamental quantities, Fourier review, mass and vibration Damping, complex exponential solutions, forced oscillation, Resonance, electrical circuit analogies, Acoustic wave equation.

UNIT - 2

Harmonic plane waves

Harmonic plane waves, intensity, impedance Spherical waves, sound level, dB examples Radiation from small sources, Baffled simple source, piston radiation, Near field, far field Radiation impedance, speed of sound measurement.

UNIT - 3

Environmental acoustics and noise criteria

The ear, hearing, etc. hearing and detection, Environmental acoustics and noise criteria, OSHA, architectural isolation, Example calculations Architectural acoustics, reverb, Absorbing materials, direct-reverberant ratio

UNIT - 4

Relationships among music, audio, acoustics, and electronics

Audio engineering introduction, Audio engineering, units, concepts.

UNIT - 5

Applications and Studio electronics

Electrodynamic transducers, and Microphones, room acoustics, Analog storage history (tape, LP disc history), Loudspeakers.

UNIT - 6

Digital audio

CD and DVD principles, Audio DSP, Multimedia audio, MP3, etc., SMPTE and synchronization MIDI.

TEXT/REFERENCE BOOKS

1. Kinsler, Lawrence E., Frey, Austin R., Coppens, Alan B., and Sanders, James V., Fundamentals of Acoustics, 4th ed., Wiley & Sons, 1999.
2. Handouts and reprints (in class)

EC 35 C	Rural Technology

Course Objectives:

- To improve the living standards by providing food, shelter, clothing, employment and education.
- To Increase productivity in rural areas and reduce poverty.
- To involve people in planning and development through their participation in decision making and through centralization of administration.
- To ensure distributive Justice and equalization of opportunities in the society.
- Expertise in planning and management of rural development programmes with focus on participatory development and innovation
- Competence in reorienting the development delivery systems.

Course Outcomes:

- Students will come to know the role of Technology & its impact in the rural areas. Ex: Growing number of ATMs in the rural areas.

UNIT - 1

Theory of Rural Development: Concepts of Rural Development, Rural Development Theories, Rural Development Planning, Rural Development Policies and Strategies.

UNIT - 2

Rural Development in India:

Phases of Rural Development in India, Rural Development Approaches – Pre-Independence Namely- Martandam Experiment, Sriniketan Experiment, Gurgaon experiment, Gandhian Experiment, Bhoodan and Gramdan and other important experiments, Post-Independence: Different Approaches taken by the Government of India for Rural Development, Rural Development and in Five Year Plan

UNIT - 3

Theories of Economics related to Rural Development & Management: Basic Micro-Economic Theories and Concept, Theories of Growth, Income and Employment, Market, International Trade and Globalization, Fiscal policy and Financial Institution

UNIT - 4

Rural Management – Principles and Practices: Introduction to Management and Theory of Management, Planning, Organization Structure and Design, Management Control and Managerial Decision Making

UNIT - 5

Rural Infrastructure Management: Meaning and Concept of Infrastructure, Rural Urban differences, Component of Rural Infrastructure, Importance of Rural Infrastructure, Linkages with Livelihood, Economy and Rural Development, Impact of Rural Infrastructure, Government Programmes and Policies for infrastructure development in Rural Areas

UNIT - 6

Planning for Rural Development: Rural Development planning as an internal part of the planning at the national and state level (Maharashtra), Micro-level planning: Concept and Significance, District level planning machinery, Community Development Prog, IRDP from 1952 to 2012, SGSY.

TEXT/REFERENCE BOOKS

1. Rural Development and Planning in India by Dr. V. Nath.
2. Issues on Rural Finance Infrastructure and Rural Development by G. D. Banerjee
3. Rural Development: Principles, Policies and Management, by Katar Singh
4. Rural Development: Putting the Last First by Robert Chambers
5. Rural Development and Poverty Eradication in India by N. Mukundan
6. Handbook of Rural Development
7. Landscape Planning and Rural Development: Key Issues and Options by Carlo Rega

EC 36 D	Digital Systems Design	3 Credits

Course Objectives:

- The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
- The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
- This course will explore the basic concepts of digital electronics.

Course Outcomes:

Having successfully completed this course, the student will be able to:

1. Understand the basic logic gates and various variable reduction techniques of digital logic circuit in detail.
2. Understand, identify and design combinational and sequential circuits.
3. Design and implement hardware circuit to test performance and application for what it is being designed.
4. Simulate and verify using computer simulation software to obtain desired result.
5. Understand and verify simulated circuit model with hardware implementation.

UNIT - 1

Combinational Logic Design

Standard representations for logic functions, k map representation of logic functions (SOP m POS forms), minimization of logical functions for minterms and maxterms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to – 7 segment decoder, Code converters. Quine Mc-Cluskey methods. Adders and their use as subtractors, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Static and dynamic hazards for combinational logic. Multiplexers and their use in combinational logic designs, multiplexer trees, Demultiplexers and their use in combinational logic designs, Decoders, demultiplexer trees.

UNIT - 2

Sequential Logic Design

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops. Conversion of flip flops. Application of Flip flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence

Generators, ripple counters, up/down counters, synchronous counters, lock out, Clock Skew, Clock jitter. Effect on synchronous designs.

UNIT - 3

Introduction to HDLs

Library, Entity, Architecture, Modeling styles, Data objects, Concurrent and sequential statements, Design examples, using VHDL for basic combinational and sequential circuits, Attributes (required for practical) (Test benches and FSM excluded).

UNIT - 4

State Machines

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector, Introduction to algorithmic state machine.

UNIT - 5

Digital Logic Families

Classification of logic families, Characteristics of digital ICs-Speed of operation , power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL-operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic , open drain output. Interfacing CMOS and TTL. Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I2L, DCTL.

UNIT - 6

Programmable Logic Devices and Semiconductor Memories

A] Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs.

B] Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM, expanding memory size, Synchronous DRAM (SDRAM), Double Data Rate SDRAM, Synchronous SRAM, DDR and QDR SRAM, Content Addressable Memory.

TEXT/REFERENCE BOOKS

1. R.P. Jain, "Modern digital electronics", 3rd edition, 12th reprint TMH Publication, 2007.

2. Stephen Brown, "Fundamentals of digital logic design with VHDL" 1st edition, TMH Publication 2002.
3. Wakerly Pearon, "Digital Design: Principles and Practices", 3rd edition, 4th reprint, Pearon Education, 2004.
4. Anand Kumar, "Fundamentals of digital circuits" 1stedition, PHI publication, 2001.
5. Mark Bach, "Complete Digital Design", Tata MC Graw Hill, 2005.

EC 38	Antenna and Wave Propagation	4 Credits

Course Objectives:

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
- To analyze and understand the Uniform plane wave propagation in various media.
- To solve the electric field and magnetic fields for a given wire antenna.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communication system.

UNIT - 1

Uniform Plane Waves

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

UNIT - 2

Wave Propagation

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth's curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth's magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

UNIT - 3

Antenna Fundamentals

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.

UNIT - 4

Wire Antennas

Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

UNIT - 5

Antenna Arrays

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, nonuniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

UNIT - 6

Antennas and Applications

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

TEXT/REFERENCE BOOKS

1. C. A. Balanis, “Antenna Theory - Analysis and Design", John Wiley.
2. Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
4. K. D. Prasad, “Antenna & Wave Propagation”, Satya Prakashan, New Delhi.
5. John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill, 2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

EC 39	Optical Fiber Communication	4 Credits

Course Objectives:

- After learning OFC course, students will get advantage to pursue higher studies or employment in core engineering/communication engineering companies.
- To explore the knowledge in the area of LASERs and electro-optics.
- To get insight into different fiber types, fabrication methods, optical transmission characteristics, optical sources, optical detectors and optical amplifiers.
- To understand different design considerations in optical links involving link power budget and rise time budget.
- To mold students professionally and further it also acquaint with emerging trends in fiber, advanced optical systems, different optical sources and detectors.

Course Outcomes:

1. Learner will apply knowledge of mathematics to solve numerical based on step index and graded index fibers pertaining to MSI and MGI, SMSI.
2. Students will understand fiber performance parameters like NA, Group delay, Phase and Group velocity .They will understand optical transmission characteristics theoretically and practically.
3. Learners will understand analog and digital links, design consideration of optical links, WDM, fiber data transfer rates in social context.
4. With the basic knowledge of OFC course, students can peruse higher studies in LASEERs and electro-optics.
5. Students will apply the knowledge of optical key elements to understand optical fiber communication systems.
6. Students will understand impact of OFC in LAN, MAN, WAN, ISDN etc.
7. This course understanding will enforce students to work in communication engineering domain and will cope up the selves to work in professional environment.
8. This course understanding will enforce students to work in communication engineering domain and new emerging technology of sources and detectors to develop the optical fiber systems.

UNIT - 1

Optical communication fundamentals

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model. Different types of optical fibers, Modal analysis of a step index fiber. Signal degradation on optical fiber due to dispersion and attenuation.

UNIT - 2

Optical sources

LEDs: structure and its characteristics, Lasers: structure and its characteristics.

UNIT - 3

Optical detectors

Photo-detectors - pin- detectors, detector responsivity, noise, optical receivers

UNIT - 4

Fabrication Techniques

Fabrication of fibers and measurement techniques like OTDR

UNIT - 5

Optical link design

BER calculation, quantum limit, power penalties, Optical switches - coupled mode analysis of directional couplers, electro-optic switches, nonlinear effects in fiber optic links.

UNIT - 6

Optical Modulation

Concept of self-phase modulation, group velocity dispersion and solution based communication. Optical amplifiers - EDFA, Raman amplifier, and WDM systems.

TEXT/REFERENCE BOOKS

1. J. Keiser, Fiber Optic communication, McGraw-Hill, 2nd Ed. 1992.
2. J. E. Midwinter, Optical fibers for transmission, John Wiley, 1979.
3. T. Tamir, Integrated optics (Topics in Applied Physics Vol.7), Springer-Verlag, 1975.
4. J. Gowar, Optical communication systems, Prentice Hall India, 1987.
5. S. E. Miller and A.G. Chynoweth, eds., Optical fibers telecommunications, Academic Press, 1979.
6. G. Agrawal, Nonlinear fiber optics, Academic Press, 2nd Ed, 1994.
7. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York, 1992.
8. Jhon Senior, "Optical Fiber Communications-Principles & Practices", 2nd Edition, PHI-2001.

EC 48	RF & Microwave Communication	4 Credits

Course Objectives:

To teach the students

- Radio-frequency spectrum space, microwave communication.
- Microwave principles, working of microwave devices.
- RADAR and their applications.

Course Outcomes:

After Completing this course student will be able to

1. Analyze the microwave passive circuit components and design the tunning and matching networks.
2. Identify the state of art in microwave tubes and semiconductors and their uses in real life.
3. Apply the microwave devices and RADAR for industrial and scientific purposes.

UNIT - 1

Waveguides and Microwave Components

Frequency bands and characteristics of microwaves, Rectangular and circular waveguides, mode analysis, Resonators, reentrant cavities, scattering parameters, tees, hybrid ring, directional couplers, phase shifters, terminations attenuators, ferrite devices, such as isolators, gyrators, and circulators.

UNIT - 2

Impedance Matching and Tuning

Lumped element matching, Single stub tuning, double stub tuning, triple stub tuning,

Quarter wave transformer.

UNIT - 3

Generation and Amplification of Microwaves

Two Cavity Klystron and Reflex Klystron, Helix Travelling Wave Tube and Backward Wave Oscillator, Cross Field Amplifier, Cylindrical Magnetron, and Gyrotrons.

UNIT - 4

Semiconductor Microwave Devices (construction, working, equivalent circuit and performance characteristics)

Varactor, PIN, Tunnel, Point Contact, Schottky Barrier, Gunn, IMPATT, TRAPATT, and BARITT, BJT, Hetro junction BJT, MESFET, and HEMT Parametric Amplifiers.

UNIT - 5

RADAR

Basics of RADAR and RADAR range equation, Types of RADAR: Pulsed, Continuous wave and FMCW, Doppler, MTI, and Phased Array, Types of displays and Clutter, Tracking RADAR: Mono pulse, Conical, Sequential lobing

UNIT - 6

Microwave Applications

Microwave heating and bio-medical applications, Remote sensing RADAR, MSTRADAR, radiometer, instrumentation landing system, and RADAR based navigation.

TEXT/REFERENCE BOOKS

1. David M Pozar, —Microwave Engineering, John Wieley & Sons, Inc. Hobokenh, New Jersey, Fourth Edition, 2012.
2. Samuel Y Liao, —Microwave Devices and Circuits, Pearson Education, Third Edition
3. Merill Skolnik, —Introduction to RADAR Systems, Tata Mc graw Hill, Third Edition.
4. Annapurna Das and Sisir K Das, —Microwave Engineering, Tata McGraw Hill, New Delhi, Second Edition, 2009.
5. K. T. Matthew, —Microwave Engineering, Wieley india, 2011.

EC 40 A	Computer Network	4 Credits

Course Objectives:

- Understand state-of-the-art in network protocols, architectures, and applications.
- To provide students with a theoretical and practical base in computer networks issues.
- Define the basic terminology of computer networks.
- Recognize the individual components of the big picture of computer networks.
- Outline the basic network configurations.
- List the layers of the TCP/IP and OSI model and describe the duties of each layer.
- Understand the transmission methods underlying LAN and WAN technologies.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand fundamental underlying principles of computer networking.
2. Describe and analyze the hardware, software, components of a network and the interrelations.
3. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.
4. Have a basic knowledge of the use of cryptography and network security.
5. Have a basic knowledge of installing and configuring networking applications.
6. Specify and identify deficiencies in existing protocols, and then go onto select new and better protocols.

UNIT - 1

Physical Layer

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

UNIT - 2

Data Link Layer

Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT - 3

Wireless LANS & Virtual Circuit Networks

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, Connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

UNIT - 4

Network Layer

Network Layer Services, Packet Switching, Network layer performance, IPv4, addresses, Forwarding of IP packets, Network layer protocols: IP, ICMPv4, Mobile IP, Unicast Routing: Introduction, Routing Algorithms, Unicast Routing protocols, Multicast Routing Introduction, Next Generation IP:IPv6 Addressing, The IPv6 protocol, ICMPv6, Transition from IPv4 to IPv6.

UNIT - 5

Transport Layer

Introduction, Transport layer protocols and services, Port numbers User Datagram Protocol (UDP), Transmission Control protocol (TCP), SCTP, Quality of services: Dataflow characteristics, Flow Control.

UNIT - 6

Application Layer

Introduction, World Wide Web and HTTP, FTP, Electronic mail, Telnet, Name System (DNS), Cryptography and Network Security: Introduction, Symmetric key ciphers and Asymmetric Key Ciphers, Introduction to network security.

TEXT/REFERENCE BOOKS

1. Behrouz A. Foruzan, “Data communication and Networking”, Tata McGraw-Hill, 5th Edition.
2. James F. Kurouse & W. Rouse, “Computer Networking: A Top down Approach”, 6th Edition, Pearson Education.
3. Andrew S. Tannenbaum, “Computer Networks”, Pearson Education, Fourth Edition,2003.
4. Wayne Tomasi, “Introduction to Data Communication and Networking”, 1/e, Pearson Education.
5. Greg Tomsho, Ed Tittel, David Johnson. “Guide to Networking Essentials”, fifth edition, Thomson India Learning, 2007.

EC 40 B	Cloud Computing	4 Credits

Course Objectives:

- Discuss, with confidence, what is cloud computing and what are key security and control considerations within cloud computing environments.
- Identify various cloud services.
- Assess cloud characteristics and service attributes, for compliance with enterprise objectives.
- Explain the four primary cloud category "types".
- Evaluate various cloud delivery models.
- Contrast the risks and benefits of implementing cloud computing.
- Specify security threat exposure within a cloud computing infrastructure.
- Recognize steps and processes used to perform an audit assessment of a cloud computing environment.
- Summarize specific environments that would benefit from implementing cloud computing, contrasted against those environments that might not benefit.
- Weight the impact of improperly controlled cloud computing environments on organizational sustainability.

Course Outcomes:

1. To impart fundamental concepts in the area of cloud computing.
2. To impart knowledge in applications of cloud computing.
3. Understanding the systems, protocols and mechanisms to support cloud computing.
4. Develop applications for cloud computing.
5. Understanding the hardware necessary for cloud computing.
6. Design and implement a novel cloud computing application.

UNIT - 1

Introduction

Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IaaS, PaaS, SaaS; service oriented computing and cloud environment.

UNIT - 2

Cloud Computing Technology

Client systems, Networks, server systems and security from services perspectives; accessing the cloud with platforms and applications; cloud storage.

UNIT - 3

Working with Cloud

Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities. Software as a Service –conceptual model and working. Trends in Service provisioning with clouds.

UNIT - 4

Cloud Services

Using Cloud Services-Cloud collaborative applications and services – case studies with calendars, schedulers and event management.

UNIT - 5

Cloud applications

Cloud applications in project management.

UNIT - 6

Case studies

Case studies- Microsoft Azure, Google App Engine and Open source clouds-Open-Nebula and Eucalyptus.

TEXT/REFERENCE BOOKS

1. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010.
2. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011.
3. Resources from Internet.

EC 40 C	Electronics Product Design	4 Credits

Course Objectives:

- To understand the stages of product (hardware/ software) design and development.
- To learn the different considerations of analog, digital and mixed circuit design.
- To be acquainted with methods of PCB design and different tools used for PCB Design.
- To understand the importance of testing in product design cycle.
- To understand the processes and importance of documentation.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand various stages of hardware, software and PCB design.
2. Importance of product test & test specifications.
3. Special design considerations and importance of documentation.

UNIT - 1

Introduction to Electronic Product Design

Man machine dialog and Industrial design, user-centered design, five element of successful design, cognition, ergonomics. Packaging and factors, design for manufacture, assembly and disassembly, wiring, temperature, vibration and shock. Safety, noise, energy coupling, grounding, filtering and shielding.

UNIT - 2

Hardware Design & testing methods

Design process. Identifying the requirements, formulating specifications, design specifications, Specifications verses requirements, System partitioning, Functional design, architectural design, Functional model verses architectural model. Prototyping. Performance and Efficiency measures. Formulating a test plan, writing specifications, Test procedure and test cases, Egoless design, design reviews. Module debug and test: black box test, white box test, grey box test.

UNIT - 3

Software Design and Testing methods

Types of Software. Waterfall model of software development. Models, metrics and software limitations. Risk abatement and failure preventions. Software bugs and testing. Good programming practice. User interface. Embedded, Real time software.

UNIT - 4

PCB design

Fundamental Definitions, Standards. Routing Topology Configurations, Layer Stack upassignment, Grounding Methodologies, Aspect Ratio, Image Planes, Functional Partitioning, Critical frequencies, Bypassing and decoupling. Design techniques for ESD Protection, GuardBand implementation.

UNIT - 5

Product Debugging and testing

Steps of Debugging, Techniques for troubleshooting, characterization, Electromechanical components, passive components, active components, active devices, operational amplifier, Analog-Digital Conversion, Digital Components, Inspection and test of components, Simulation, Prototyping and testing, Integration, validation and verification and EMI & EMC issues.

UNIT - 6

Documentation

Definition, need, and types of documentation. Records, Accountability, and Liability. Audience. Preparation, Presentation, and Preservation of documents. Methods of documentation, Visual techniques, Layout of documentation, Bill of material.

TEXT/REFERENCE BOOKS

1. Kim Fowler," Electronic Instrument Design" Oxford university press.
2. Robert J. Herrick, "Printed Circuit board design Techniques for EMC Compliance", Second edition, IEEE press.
3. James K. Peckol, "Embedded Systems – A Contemporary Design Tool", Wiley publication.
4. J C Whitakar, "The Electronics Handbook", CRC press.

EC 41	Internet of Things	4 Credits

Course Objectives:

- Students will be explored to the interconnection and integration of the physical world and the cyber space.
- To provide ability to design and develop IOT devices.

Course Outcomes:

1. Student will understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2. Student will learn working IOT at transport layer with the help of various protocols
3. Student will understand of IOT concept at data link layer
4. Student will be able to apply the concept of mobile networking to the internet connected devices
5. Student will be able to measure and schedule the performance of networked devices in IOT
6. Student will analyze the challenges involve in developing IOT architecture

UNIT - 1

Internet in general and Internet of Things

Layers, protocols, packets, services, performance parameters of a packet network as well as applications such as web, Peer-to-peer, sensor networks, and multimedia.

UNIT - 2

Transport services

TCP, UDP, socket programming, Network layer: forwarding & routing algorithms (Link, DV), IP-addresses, DNS, NAT, and routers.

UNIT - 3

Local Area Networks

MAC level, link protocols such as: point-to-point protocols, Ethernet, WiFi 802.11, cellular Internet access, and Machine-to-machine.

UNIT - 4

Mobile Networkin

Roaming and handoffs, mobile IP, and ad hoc and infrastructure less networks.

UNIT – 5

Real-time networking

Soft and real time, quality of service/information, resource reservation and scheduling, and performance measurements.

UNIT - 6

IoT definitions

Overview, applications, potential & challenges, and architecture, IoT examples: Case studies, e.g. sensor body-area-network and control of a smart home.

TEXT/REFERENCE BOOKS

1. Kurose, James F.; Ross, Keith W. Computer networking: a top-down approach, 5th ed., international ed.: Boston, Mass.: Pearson, cop. 2010

EC 43 B	Data Compression and Encryption/Cryptography	3 Credits

Course Objectives:

- To teach the students Lossless and Lossy compression techniques for different types of data.
- To understand data encryption techniques.
- Network security and ethical hacking.

Course Outcomes:

Student will able to

1. Implement text, audio and video compression techniques.
2. Understand symmetric and asymmetric key cryptography schemes.
3. Understand network security and ethical hacking.

UNIT - 1

Data Compression

Compression Techniques: Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques Text Compression: Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW

UNIT - 2

Audio Compression

High quality digital audio, frequency and temporal masking, lossy sound compression, μ-law and A-law companding, and MP3 audio standard.

UNIT - 3

Image and Video Compression

PCM, DPCM JPEG, JPEG –LS, and JPEG 2000 standards, Intra frame coding, motion estimation and compensation, introduction to MPEG -2 H-264 encoder and decoder.

UNIT - 4

Data Security

Security goals, cryptography, stenography cryptographic attacks, services and mechanics. Integer arithmetic, modular arithmetic, and linear congruence, Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers, Data encryption standard, double DES, triple DES, attacks on DES, AES, key distribution center.

UNIT - 5

Number Theory and Asymmetric Key Cryptography

Primes, factorization, Fermat's little theorem, Euler's theorem, and extended Euclidean algorithm, RSA, attacks on RSA, Diffie Hellman key exchange , key management, and basics of elliptical curve cryptography, Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm.

UNIT - 6

System Security

Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.

TEXT/REFERENCE BOOKS

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann, 2000.
2. David Saloman, Data Compression: The complete reference, Springer publication.
3. Behrous Forouzen, ―Cryptography and Network Security, Tata McGraw–Hill Education 2011.
4. Berard Menezes, Network Security and Cryptography, learning publication Cengage.
5. William Stallings, Cryptography and Network Security, Pearson Education Asia Publication, 5th edition.

EC 43 C	VLSI Design	3 Credits

Course Objectives:

- To study HDL based design approach.
- To learn digital CMOS logic design.
- To nurture students with CMOS analog circuit designs.
- To realize importance of testability in logic circuit design.
- To overview SoC issues and understand PLD architectures with advanced features.

Course Outcomes:

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
2. Understand chip level issues and need of testability.
3. Design analog & digital CMOS circuits for specified applications.

UNIT - 1

VHDL Modeling

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM, Meta-stability.

UNIT - 2

PLD Architectures

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications. FPGA Architecture, Features, Specifications, Applications.

UNIT - 3

SoC & Interconnect

Clock skew, Clock distribution techniques, clock jitter. Supply and ground bounce, power distribution techniques. Power optimization. Interconnect routing techniques; wire parasitic, Signal integrity issues. I/O architecture, pad design, Architectures for low power.

UNIT - 4

Digital CMOS Circuits

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product. Transmission gate. CMOS combo logic design. Delays: RC delay model,

Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logical efforts.

UNIT - 5

Analog CMOS Design

Current sink and source, Current mirror. Active load, Current source and Push-pull inverters. Common source, Common drain, Common gate amplifiers. Cascode amplifier, Differential amplifier, Operational amplifier.

UNIT - 6

Testability

Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

TEXT/REFERENCE BOOKS

1. Charles H. Roth, "Digital systems design using VHDL", PWS.
2. Wyane Wolf, "Modern VLSI Design (System on Chip)", PHI Publication.
3. Allen Holberg, "Analog CMOS Design", Oxford University Press.
4. Neil H. E. Weste, David Money Harris, "CMOS VLSI Design: A Circuit & System Perspective", Pearson Publication.

EC 43 D	PLC and Automation	3 Credits

Course Objectives:

- Ability to recognize industrial control problems suitable for PLC control.
- An over view of technology of advanced topics such as SCADA, DCS Systems, Digital Controller, CNC Machines.
- The ability to select the essential elements and practices needed to develop and implement the Engineering Automation using PLC approach.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand PLC architecture, PLC addressing concepts.
2. Develop PLC ladder programs for simple industrial applications.
3. Design Automation systems for industrial applications.

UNIT - 1

Process Control & Automation

Process control principles, Servomechanisms, Control System Evaluation, Analog control, Digital control, Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness.

UNIT - 2

Transmitters and Signal Conditioning

Need of transmitters, Standardization of signals, Current, Voltage and Pneumatic signal standards, 2-Wire & 3-Wire transmitters, Analog and Digital signal conditioning for RTD, Thermocouple, DPT etc, Smart and Intelligent transmitters.

UNIT - 3

Controllers and Actuators

PID Controller, Cascade PID control, Microprocessor Based control, PAC (Programmable Automation controller), Mechanical switches, Solid state switches, Electrical actuators: Solenoids, Relays and Contactors, AC Motor, VFD, energy conservation schemes through VFD, DC Motor, BLDC Motor, Stepper Motor, Servo Motor, Pneumatic and hydraulic actuators.

UNIT - 4

PLC and Human Machine Interface (HMI)

Functions of PLC, Advantages, Architecture, working of PLC, Selection of PLC, Networking of PLCs, Ladder Programming, Interfacing Input and Output devices with PLC, PLC based automated systems. High frequency inputs.PLC programming standard IEC61131, Soft PLC techniques. IT Interfaces required: for ERP, MIS, MES. Supporting Applications interfaces: RFID, Barcode, Vision Systems. HMI: Block Diagram, Types, Advantages, Applications.

UNIT - 5

SCADA & Distributed control system

Elements of SCADA, Features of SCADA, MTU- functions of MTU, RTU- Functions of RTU, Applications of SCADA, Communications in SCADA- types & methods used, Mediums used for communication, Introduction to DCS, Architecture of DCS, Input and output modules, communication module, Specifications of DCS.

UNIT - 6

Automation and CNC (Computer Numeric Control) Machines

Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines. Industrial Communication: Device net, Inter bus, Device network: Foundation Field bus -H1,HART, CAN, PROFIBUS-PA, Control network: Control Net, FF-HSE, PROFIBUS-DP, Ethernet, and TCP/IP. Panel Engineering for Automation.

TEXT/REFERENCE BOOKS

1. Curtis Johnson, “Process Control Instrumentation Technology”; 8th Edition, Pearson Education.
2. Madhuchhanda Mitra, Samarjit Sen Gupta, “Programmable Logic controllers and Industrial Automation”; Penram International Publishing India Pvt. Ltd.
3. Stuart A. Boyer, SCADA supervisory control and data acquisition, ISA Publication.
4. John W. Webb, Ronold A Reis, “Programmable Logic Controllers, Principles and Applications”; 5th Edition, Prentice Hall of India Pvt. Ltd.
5. Kilian, “Modern control technology: components & systems, Delmar 2nd edition.
6. Bela G Liptak, Process software and digital networks, 3rd edition, 2002.
7. Pollack. Herman, W & Robinson., T. “Computer Numerical Control”, Prentice Hall. NJ.
8. Pabla, B.S. & Adithan, M. “CNC Machines”, New Age Publishers, New Delhi.

EC 43 E	Speech Processing	3 Credits

Course Objectives:

- To understand basic concepts and methodologies for the analysis and modeling of speech signal.
- To characterize the speech signal as generated by a speech production model
- To understand the mechanism of speech and audio perception
- To understand the motivation of short-term analysis of speech and audio
- To perform the analysis of speech signal using LPC
- To extract the information of the speech or audio signals in terms of cepstral features
- To provide a foundation for developing applications in this field.

Course Outcomes:

After successfully completing the course students will be able to

1. Design and implement algorithms for processing speech and audio signals considering the properties of acoustic signals and human hearing.
2. Analyze speech signal to extract the characteristic of vocal tract (formants) and vocal cords (pitch).
3. Write a program for extracting LPC Parameters using Levinson Durbin algorithm.
4. Formulate and design a system for speech recognition and speaker recognition.

UNIT - 1

Fundamentals of speech production

Anatomy and physiology of speech production, Human speech production mechanism, LTI model for speech production, Nature of speech signal, linear time varying model, articulatory phonetics, acoustic phonetics, Voiced and Unvoiced speech.

UNIT - 2

Human auditory system

Human auditory system, simplified model of cochlea. Sound pressure level and loudness. Sound intensity and Decibel sound levels. Concept of critical band and introduction to auditory system as a filter bank, Uniform, non uniform filter bank, mel scale and bark scale. Speech perception: vowel perception.

UNIT - 3

Time and frequency domain methods for audio processing

Time-dependent speech processing. Short-time energy, short time average magnitude, Short time average zero crossing rate. Speech Vs. silence discrimination using energy and zero crossing rate. Short-time autocorrelation function, short-time average magnitude difference function. Pitch period estimation using autocorrelation method. Audio feature extraction, Spectral centroid, spectral spread, spectral entropy, spectral flux, spectral roll-off. Spectrogram: narrow band and wide band spectrogram.

UNIT - 4

Linear prediction analysis

Basic principles of linear predictive analysis. Autocorrelation method, covariance method. Solution of LPC equations: Cholesky decomposition, Durbin's recursive solution, lattice formulations and solutions. Frequency domain interpretation of LP analysis. Applications of LPC parameters as pitch detection and formant analysis.

UNIT - 5

Cepstral Analysis

Homomorphic speech processing, Real Cestrum: Long-term real cepstrum, short-term real cepstrum, pitch estimation, format estimation, Melcepstrum. Complex cepstrum: Long-term complex cepstrum, short-term complex cepstrum.

UNIT - 6

Speech and Audio processing applications

Speech recognition: complete system for an isolated word recognition with vector quantization/DTW. Speaker recognition: Complete system for speaker identification, verification. Introduction to speech enhancement, Speech enhancement using spectral subtraction method, Introduction to Text to speech conversion, Introduction to Musical instrument classification, Musical Information retrieval.

TEXT/REFERENCE BOOKS

1. Deller J. R. Proakis J. G. and Hanson J. H., "Discrete Time Processing of Speech Signals", Wiley Interscience.
2. Ben Gold and Nelson Morgan, "Speech and audio signal processing" Wiley.
3. L. R. Rabiner and S.W. Schafer, "Digital processing of speech signals" Pearson Education.

4. Thomas F. Quateri, "Discrete-Time Speech Signal Processing: Principles and Practice" Pearson.
5. Dr. Shaila Apte, "Speech and audio processing", Wiley India Publication.
6. L. R. Rabiner and B. H. Juang, "Fundamentals of speech recognition".
7. Theodoros Giannakopoulos and Aggelospikrakis, "Introduction to audio analysis: A MATLAB Approach: Elsevier Publication.

EC 41 A	Wireless Sensor Networks	3 Credits

Course Objectives:

- To Understand the basic WSN technology and supporting protocols, with emphasis placed on standardization basic sensor systems and provide a survey of sensor technology
- Understand the medium access control protocols and address physical layer issues.
- Learn key routing protocols for sensor networks and main design issues.
- Learn transport layer protocols for sensor networks, and design requirements.
- Understand the Sensor management, sensor network middleware, operating systems.

Course Outcomes:

1. Learn to model radio signal propagation issues and analyze their impact on communication system performance.
2. Understand how the various signal processing and coding techniques combat channel uncertainties.
3. Understand the techniques of radio spectrum allocation in multi-user systems and their impact on networks capacity.
4. Introduce various wireless systems and standards and their basic operation cases.
5. Learn to simulate wireless networks and analyze the simulation results.

UNIT - 1

Introduction and Overview of Wireless Sensor Networks

Introduction, Brief Historical Survey of Sensor Networks, and Background of Sensor Network Technology, Ah-Hoc Networks, Applications of Wireless Sensor Networks: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications, Another Taxonomy of WSN Technology, Basic Sensor Network Architectural Elements, Home Control, Medical Applications, Basic Wireless Sensor Technology : Introduction, Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends, Wireless Network Standards: IEEE 802.15.4, ZigBee, IEE 1451.

UNIT - 2

Medium Access Control Protocols for Wireless Sensor Networks

Introduction, Background, Fundamentals of MAC Protocols, MAC Protocols for WSNs: Schedule-Based Protocols, Random Access-Based Protocols, Coordination, Schedule Synchronization, Adaptive Listening, Access Control and Data Exchange (B-MAC,Box-MAC, Bit-MAC, H-MAC, I-MAC, O-MAC, S-MAC. Ri-MAC, T-MAC, Q-MAC (Querry MAC), Q-MAC (QoS MAC), X-MAC)

UNIT - 3

Routing Protocols for Wireless Sensor Networks

Introduction, Data Dissemination and Gathering, Routing Challenges and Design Issues in Wireless Sensor Networks Network Scale and Time-Varying Characteristics, Resource Constraints, Sensor Applications Data Models, Routing Strategies in Wireless Sensor Networks: WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low-Energy Adaptive Clustering Hierarchy, Power-Efficient Gathering in Sensor Information Systems, Directed Diffusion, Geographical Routing,

UNIT - 4

Transport Control Protocols

Introduction, Traditional Transport Control Protocols: TCP (RFC 793), UDP (RFC 768), Mobile IP.

UNIT - 5

Middle wares for Wireless Sensor Networks

Introduction, WSN Middleware Principles, Middleware Architecture: Existing Middleware: Mi LAN (Middleware Linking Applications and Networks), Iris Net (Internet-Scale Resource-Intensive Sensor Networks Services).

UNIT - 6

Operating Systems for Wireless Sensor Networks

Introduction, Examples of Operating Systems: Tiny OS, Mate, Magnet OS.

TEXT/REFERENCE BOOKS

1. Wireless Sensor Network by Kazem Sohraby, Daniel Minoli, Taieb Znati Pub: Wiley.
2. Wireless Sensor Networks Signal Processing and Communications by Ananthram Swami, Qing Zhao, Yao-Win Hong, Lang Tong Pub: John Wiley & Sons.
3. Ad Hoc Wireless Networks: Architectures And Protocols By Murthy Pub: Pearson Education.
4. Wireless sensor networks Edited by C. S. Raghavendra Pub: Springer.
5. Fundamentals of Sensor Network Programming: Applications and Technology By Sridhar S. Iyengar, Nandan Parameshwaran, Vir V. Phoha, N. Balakrishnan, Chuka D. Okoye, Wiley

EC 42 B	Radar & Satellite Communication	3 Credits

Course Objectives:

- To provide students with good depth of knowledge in radar and Satellite communication.
- Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA, FDMA.
- This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

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

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT - 1

Radar Communication

Basic principles and fundamentals, block diagram of basic radar, classification, radar performance factors, radar range equation, f actors influencing maxi mum range, effects of noise, Pulsed radar systems, block diagram and description, antennas and scanning, display methods, moving target indication, radar beacons, other radar systems such as CW Doppler radar, FM CW Doppler radar, phased array radars, planar array radars, various applications of radar such as navigational aids, military, surveillance.

UNIT - 2

Basic Principles satellite communication systems

General features, frequency allocation for satellite services, properties of satellite communication systems, Earth Station: Introduction, earth station subsystem, different types of earth stations

Satellite Orbits

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping

UNIT - 3

Satellite Construction (Space Segment)

Introduction; attitude and orbit control system; telemetry, tracking and command; power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification

UNIT - 4

Satellite Links

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain

UNIT - 5

The Space Segment Access and Utilization

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods

UNIT - 6

The Role and Application of Satellite Communication

Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS

1. Skolnik, “Principles of Radar Engineering” MCH.
2. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons
3. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed. 2001
4. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice- Hall, Inc., NJ
5. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc. NY
6. Robert Gagliardi , "Satellite Communication" , CBS Publication
7. Ha, "Digital Satellite Communication", McGraw- Hill.

EC 42 C	Neural Network & Fuzzy logic	3 Credits

Course Objectives:

- This course covers basic concepts of artificial neural networks, fuzzy logic systems and their applications.
- Its focus will be on the introduction of basic theory, algorithm formulation and ways to apply these techniques to solve real world problems.
- It deals with Introduction and different architectures of neural network
- It deals with the Application of Neural Networks.
- It deals with Fuzzy Logic Controller.
- It deals with applications of Fuzzy logic

Course Outcomes:

1. The student will be able to obtain the fundamentals and types of neural networks.
2. The student will have a broad knowledge in developing the different algorithms for neural networks.
3. Student will be able analyze neural controllers.
4. Student will have a broad knowledge in Fuzzy logic principles.
5. Student will be able to determine different methods of Deffuzification

UNIT - 1

Introduction

Biological neurons, McCulloch and Pitts models of neuron, Types of activation function, Network architectures, Knowledge representation, Learning process: Error-correction learning, Supervised learning, Unsupervised learning, Learning Rules

UNIT - 2

Single Layer Perception

Perception convergence theorem, Method steepest descent - least mean square algorithms

UNIT - 3

Multilayer Perception

Derivation of the back-propagation algorithm, Learning Factors.

UNIT - 4

Radial Basis and Recurrent Neural Networks

RBF network structure theorem and the reparability of patterns, RBF learning strategies, K-means and LMS algorithms, comparison of RBF and MLP networks, Hopfield networks: energy function, spurious states, error performance.

UNIT - 5

Neuro-dynamics

Attractors, Neuro dynamical model, Adaptive Resonance theory, Towards the Self Organizing Feature Map. Brain-state-in- a-box model,

UNIT - 6

Fuzzy logic

Fuzzy sets, Properties, Operations on fuzzy sets, Fuzzy relation Operations on fuzzy relations, The extension principle, Fuzzy mean Membership functions, Fuzzification and defuzzification methods, Fuzzy controllers.

TEXT/REFERENCE BOOKS

1. Simon Haykin, "Neural Network a - Comprehensive Foundation", Pearson Education.
2. Dr. S. N. Sivanandam, Mrs S.N. Deepa Introduction to Soft computing tool Wiley Publication.
3. Satish Kumar Neural Networks: A classroom Approach Tata McGraw-Hill.
4. Zurada J.M., "Introduction to Artificial Neural Systems, Jaico publishers.
5. Thimothv J. Ross, "Fuzz V Logic with Engineering Applications", McGraw.
6. Ahmad Ibrahim, "Introduction to Applied Fuzzy Electronics', PHI.
7. Rajsekaran S, VijaylakshmiPai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI.
8. Hagan, Demuth, Beale, ëNeural Network Designí, Thomson Learning
9. Christopher M Bishop Neural Networks for Pattern Recognition, Oxford Publication.
10. William W Hsieh Machine Learning Methods in the Environmental Sciences Neural Network and Kernels Cambridge Publication.
11. Dr. S. N. Sivanandam, Dr. S. Sumathi Introduction to Neural Network Using Matlab Tata McGraw-Hill

EC 42 D	Advance Cellular Network	3 Credits

Course Objectives:

- To learn and understand the basic principles of Telecommunication switching, traffic and networks.
- To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network
- To learn and understand architecture of GSM and CDMA system.
- To understand mobile management, voice signal processing and coding in GSM and CDMA system

Course Outcomes:

After successfully completing the course students will be able to

1. Explain and apply the concepts telecommunication switching, traffic and networks.
2. Analyze the telecommunication traffic.
3. Analyze radio channel and cellular capacity.
4. Explain and apply concepts of GSM and CDMA system.

UNIT - 1

Telecommunication Switching & Traffic

Telecommunication switching: Message switching, Circuit switching, Manual System, Electronic Switching. Digital switching: Switching functions, Telecommunication Traffic: Unit of Traffic, Traffic measurement, A mathematical model, Lost- call systems: Theory, traffic performance, loss systems in tandem, traffic tables. Queuing systems: Erlang Distribution, probability of delay, Finite queue capacity, Systems with a single server, Queues in tandem, delay tables and application of Delay formulae.

UNIT - 2

Switching Networks and Signaling

Single Stage Networks, Gradings, Link Systems, Grades of service of link systems. Time Division Switching: Space and time switching, Time division switching networks, Synchronization, Call processing Functions, Common Control, Reliability, Availability and

Security. Signaling: Customer line signaling. FDM carrier systems, PCM signaling, Inter-register signaling, Common channel signaling principles, CCITT signaling No. 6, CCITT signaling No. 7, Digital customer line signaling.

UNIT - 3

Cellular Concepts

Evolution of Wireless systems, Introduction to cellular telephone system, Frequency reuse, Channel Assignment, Handoff strategies, Cell Splitting, Propagation Mechanism: Free space loss, Reflection, Diffraction, Scattering. Fading and Multipath: Small scale multipath propagation, Impulse response model of multipath channel. Multiple Access Techniques-TDMA, FDMA, CDMA

UNIT - 4

First and Second Generation Mobile Systems

First Generation Cellular Systems, AMPS, GSM Cellular Telephony: Introduction, Basic GSM Architecture, Basic radio transmission parameters in GSM system, Logical Channels, GSM time hierarchy, GSM burst structure, Description of call setup procedure, Handover, Modifications and derivatives of GSM.

UNIT - 5

GSM Services

GSM Physical layer: Speech Coding and decoding, GMSK modulation, Data transmission in GSM: Data Services, SMS, HSCSD, GPRS, EDGE.

UNIT - 6

CDMA Based Mobile Systems

Motivation for CDMA use, Spreading Sequences, Basic Transmitter and Receiver schemes, Rake Receiver, IS-95 system: Frequency Range, Downlink transmission, Uplink transmission, Power control, Introduction to 3G mobile systems: W-CDMA and cdma-2000.

TEXT/REFERENCE BOOKS

1. J. E. Flood, “Telecommunications Switching, Traffic and Networks”, Pearson Education.
2. Krzyszt of Wesolowski, “Mobile Communication Systems”, Wiley Student Edition.
3. Theodore S Rappaport, “Wireless Communications Principles and Practice” Second Edition, Pearson Education
4. John C. Bellamy, “Digital Telephony”, Third Edition; Wiley Publications.
5. Thiagarajan Vishwanathan, “Telecommunication Switching Systems and Networks”; PHI Publications.
6. Wayne Tomasi, “Electronic Communications Systems”; 5th Edition; Pearson Education.
7. Vijay K Garg, Joseph E Wilkes, “Principles and Applications of GSM” Pearson Education.

8. Vijay K Garg, Joseph E Wilkes, "IS-95CDMA and CDMA 2000 Cellular/PCS Systems Implementation" Pearson Education.
9. Mischa Schwartz, "Mobile Wireless Communications", Cambridge University Press

EC 49 D	Analog and Mixed Signal Processing	3 Credits

UNIT - 1

Switched Capacitor filters: Introduction to Analog and Discrete Time signal processing, sampling theory, Nyqist and over sampling rates, Analog filters, analog amplifiers, lock in amplifiers,

UNIT - 2

Analog integrated and discrete time switched capacitor filters, non idealities in switched capacitor filters, architectures for switched capacitor filters and their applications and design. Switched capacitor amplifiers.

UNIT - 3

Data converters: Basics of data converters, Types of data converters, types of ADCs, Successive approximation, dual slope, Flash type, pipelined ADCs, hybrid ADCs, high resolution ADCs, parallel path ADCs like time-interleaved and multi-channel converters.

UNIT - 4

Types of DACs and their architectures, binary weighted DACs. Performance metrics of data converters, SNR, SFDR, SNDR.

UNIT - 5

Background and foreground techniques to improve performance of data converters, Green data converters (low power design).

UNIT - 6

Frequency synthesizers and synchronization: Analog PLLs, Digital PLLs design and architectures, Delay locked loops design and architectures. Direct Digital Synthesis.

TEXT/REFERENCE BOOKS

1. CMOS mixed-signal circuit design by R. Jacob Baker Wiley India, IEEE press, reprint 2008
2. Switched-Current Signal Processing and A/D Conversion Circuits: Design and Implementation, R. Jacob Baker, Wiley India IEEE press 2008.
3. Mixed Signal Systems: a guide to CMOS circuit design, Andrzej Handkiewicz, IEEE computer Society Press.

4. Mixed Signal and DSP Design techniques, Engineering Analog Devices Inc, Engineering Analog Devices Inc, Walt Kester, Publisher Newnes.
5. Digital Frequency Synthesis Demystified, Bar-Giora Goldberg, Elsevier. Published by

EC 50 A	Advance 3G/4G	3 Credits

Course Objectives:

The objective of the course is that at the end of the course, the student should be able to learn:

- Concepts of GSM/EGPRS Networks.
- Architecture of GSM/EGPRS Networks.
- Concepts of CDMA IS 95/1XRTT/EVDO Networks.
- Concepts of 3rd Generation Network UMTS/WCDMA.
- 3G UMTS Network Architecture.
- 3G UMTS Radio Network Planning.
- 3G UMTS Radio Network Optimization.
- Concepts of LTE/4G.
- Network Architecture of LTE/4G.
- 3G Applications and deployment issues.
- LTE/ 4G Applications and deployment issues.
- Concepts of Wi MAX
- Architecture of Wi MAX
- Future trends in Mobile Communication/5G Networks
- Regulations in the era of convergence

Course Outcomes:

1. Get sufficient idea about migration path to 4G.
2. Understand fundamental of UMTS.
3. Get detailed insight into the technology used in UMTS , 3G LTE and 4G mobile radio networks
4. Understand the 3G LTE /4G architecture
5. Understand the different protocols involved in achieving high data rates in 3G , LTE/4G.
6. Learn how OFDM, MIMO and SDR work.
7. Learn all about the 3G LTE/4G air interface.
8. Learn the operation of handovers over heterogeneous networks.

UNIT - 1

Wireless Communications and Diversity

Fast Fading Wireless Channel Modeling, Rayleigh/Ricean Fading Channels, BER Performance in Fading Channels, Diversity modeling for Wireless Communications, BER Performance Improvement with diversity, Types of Diversity - Frequency, Time, Space.

UNIT - 2

Broadband Wireless Channel Modeling and Cellular Communications

WSSUS Channel Modeling, RMS Delay Spread, Doppler Fading, Jakes Model, Autocorrelation, Jakes Spectrum, Impact of Doppler Fading, Introduction to Cellular Communications, Frequency reuse, Multiple Access Technologies, Cellular Processes - Call Setup, Handover etc., Tele traffic Theory.

UNIT - 3

CDMA and OFDM

Introduction to CDMA, Walsh codes, Variable tree OVSF, PN Sequences, Multipath diversity, RAKE Receiver, CDMA Receiver Synchronization, Introduction to OFDM, Multicarrier Modulation and Cyclic Prefix, Channel model and SNR performance, OFDM Issues - PAPR, Frequency and Timing Offset Issues.

UNIT - 4

MIMO

Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen modes of the MIMO Channel, MIMO Spatial Multiplexing - BLAST, MIMO Diversity - Alamouti, OSTBC, MRT, MIMO - OFDM

UNIT - 5

UWB (Ultra wide Band)

UWB Definition and Features, UWB Wireless Channels, UWB Data Modulation, Uniform Pulse Train, Bit - Error Rate Performance of UWB.

UNIT - 6

3G and 4G Wireless Standards

GSM, GPRS, WCDMA, LTE, Wi MAX.

TEXT/REFERENCE BOOKS

1. Fundamentals of Wireless Communications - David Tse and Pramod Viswanath, Publisher - Cambridge University Press.
2. Wireless Communications: Andrea Goldsmith, Cambridge University Press.
3. Wireless Communications: Principles and Practice -Theodore Rappaport- Prentice Hall. MIMO.
4. Wireless Communications –Ezio Biglieri - Cambridge University Press

EC 50 B	Telecom Regulation	3 Credits

Course Objectives:

- The objective of this course is to introduce to the students the basic concepts of Economics & Management and give them exposure to Telecommunication Regulation in India/ in general.
- This course introduces the participants in the diverse aspects of the industrial telecommunications sector.

Course Outcomes:

1. To familiarize the participants with the technological changes and tendencies in the industry of telecommunications
2. familiarize to the participants with the different regulation models, usually used in the practice of the regulation of the systems of telecommunications
3. A wide spectrum of material has been selected, with the purpose of introducing the participants to the important changes that are happening in the telecommunications industry.

UNIT - 1

Introduction to telecommunications regulation

Introduction, Technology in Context, Brave New Words, Brave New Economy, ICT as Social and Economic Enabler, Innovative Technologies and Services, Why Regulate, Evolution of Regulatory Reforms, Benchmarking Competition, Regulatory Organizations, Elements for an Effective Regulator, Structural Independence, Financial Independence, Functionality, Organizational and Institutional Approaches to Regulation, International Frameworks, Multilateral Commitments, Regional Initiatives and Frameworks, Looking Ahead.

UNIT - 2

Going Mobile: Managing the Spectrum

Introduction, Changing Demands for Spectrum, The Radio Spectrum as Valuable Resource, The Need for Spectrum Management, Economic and Technical Objectives, National and international planning, Traditional Approaches and Recent Innovations, Transparent Regulation and Processes, Planning and Technical Standards, Spectrum Planning, Technical Standards, Mechanisms for Assigning and Pricing Spectrum, Spectrum Authorization, Regulatory Strategies for Allocation and Assignment, Technical Aspects of Assignment, Methods for Assignment, License Conditions, Spectrum Pricing, Monitoring Spectrum, Spectrum Efficiency, License Compliance, Resolving Interference Problems, Management Approaches, Spectrum Monitoring Technology, Designing Spectrum Monitoring Systems, Enforcing License Requirements, Flexibility in Spectrum Management Spectrum Trading, Unlicensed Spectrum, The Digital Dividend.

UNIT - 3

Capacity to Connectivity: Network Access and Interconnection

Introduction, Access and Interconnection, Defining Interconnection, The importance of access and interconnection, The Need for Regulation, Forms of Interconnection, One way and two way interconnection, Asymmetric interconnection, IP Interconnection, Unbundling, Sharing Infrastructure, Mobile Networks, Negotiating Agreements, Setting Interconnection Prices, why is the Interconnection Price Important, Long Run Incremental Cost Modeling, Benchmarking Interconnection Rates, Cross border Interconnection, The Accounting Rate System, International Mobile Roaming, New Paradigms and New Challenges, VoIP, Enhancing Public Safety, Other Challenges for Developing Countries, Dispute Resolution.

UNIT - 4

Universal Access and Service

Trends and Approaches, Definitions, approaches, Policy Rationale, Concepts and Definition, Rationale, Access Gaps and Required Intervention, Types of Universal Service Regimes, Traditional Approaches to Universal Service, Competing for Subsidies and Funds, Non-government and Community Initiatives, Reforming Universal Access, Changing Contexts and Trends, Technologies for UAS, Developing UAS policy, Digital Literacy and e-Inclusion.

UNIT - 5

Telecommunications Regulation

The Task of Regulation, Markets and market failure, the rules of regulation. -The Framework for Regulation, Legal frameworks, Instruments of regulation, Enforcement, Dangers of regulation and operational aspects. -Regulatory Strategy and Price Controls, Market strategies/ structures, Engineering and technology. -Regulation and the Future (John Buckley, Telecommunications Regulation)

UNIT - 6

Telecom Policy

National Telecom Policy 1994, New Telecom Policy 1999, Guidelines For Up-linking From India, Broadband Policy 2004, Guidelines For Obtaining License For Providing Direct-To-Home(DTH) Broadcasting Service In India. TRAI Act 1997, Cable Network Act, TRAI Regulation. ITU's role in global communications.

TEXT/REFERENCE BOOKS

1. John Buckley, Telecommunications Regulation, Institution of Electrical Engineers © 2003, Published by: The Institution of Electrical Engineers, London, United Kingdom. (ISBN:0852964447)
2. http://www.trai.gov.in/Default.asp
3. http://www.itu.int/net/home/index.aspx
4. http://www.itu.int/net/about/index.aspx
5. Black, Telecommunications Law In The Internet Age, 2002, Elsevier

EC 50 C	Estimation and Detection Theory	3 Credits

Course Objectives:

- To understand concepts of statistical decision theory and parameter estimation.
- To study application of detection and estimation theory in filtering, communication and radar.

Course Outcomes:

After successfully completing the course students will be able to

1. Apply suitable hypothesis testing criteria for signal detection problems.
2. Use parameter estimation in signal processing and communication problems.
3. Design an estimator and detector.

UNIT - 1

Statistical Decision Theory

Introduction, Bayes' Criterion-Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing, Sequential Detection.

UNIT - 2

Parameter Estimation-I

Introduction, Some Criteria for Good Estimators, Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Bayes' Estimation.

UNIT - 3

Parameter Estimation-II

Cramer-Rao Inequality, Multiple Parameter Estimation, Best Linear Unbiased Estimator, Least-Square Estimation, Recursive Least-Square Estimator.

UNIT - 4

Filtering

Introduction, Linear Transformation and Orthogonality Principle, Wiener Filters, Discrete Wiener Filters, Kalman Filter.

UNIT - 5

Detection and Parameter Estimation

Introduction, Signal Representation, Binary Detection, M-ary Detection, Linear Estimation.

UNIT - 6

Detection Theory in Radar

Introduction, Radar Elementary concepts- Range, Range Resolution, and Unambiguous Range, Doppler Shift, Principles of Adaptive CFAR Detection- Target Models, Review of Some CFAR Detectors.

TEXT/REFERENCE BOOKS

1. Mourad Barkat, "Signal detection and Estimation", Artec House, second edition
2. S M Kay, "Fundamentals of statistical Signal Processing, Estimation Theory" PHI Signal Processing Series.
3. S M Kay, "Fundamentals of statistical Signal Processing, Detection Theory" PHI Signal Processing Series.
4. H. Vincent Poor, "An Introduction to Signal Detection and Estimation", Springer, Second Edition.
5. Harry L., Van Trees, "Detection, Estimation and Modulation Theory", John Wiley & Sons.

EC 50 D	Soft Computing	3 Credits

Course Objectives:

- Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real world problems.
- Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
- To create awareness of the application areas of soft computing technique.
- Provide alternative solutions to the conventional problem solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

Having successfully completing the course students will be able to

1. Use a new tool /tools to solve a wide variety of real world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

UNIT - 1

Artificial Neural Network -I

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch- Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid)Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitations Draft.

UNIT - 2

Artificial Neural Network-II

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self- organizing Feature Maps, k- means clustering o Learning vector quantization Radial Basis Function networks: Cover's theorem, mapping functions(Gaussian, Multi-quadrics, Inverse multi quadrics, Application of RBFN for classification and regression o Hopfield network, associative memories.

UNIT - 3

Fuzzy Logic -I

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T-conorm) o Fuzzy if-then rules.

UNIT - 4

Fuzzy Logic -II

Fuzzification, Membership Value Assignment techniques, De-fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes-Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems -Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two-input single output FIS employing Mamdani model Computing.

UNIT - 5

Fuzzy Control Systems

CONTROL SYSTEM DESIGN PROBLEM 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

UNIT - 6

Adaptive Neuro-Fuzzy Inference Systems (ANFIS)

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

TEXT/REFERENCE BOOKS

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, Laurene Fausett, Pearson Education, Inc, 2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons, 2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons, 2007.

5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company, 1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall International Inc-1999.
7. Neural and Adaptive Systems: Fundamentals through Simulations, José C. Principe Neil R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
8. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
9. Pattern Recognition, Sergios Theodoridis, Konstantinos Koutroumbas, Fourth Edition, Academic Press, 2008.
10. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC, 2008.
11. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag, 2007.

EC 51 A	Multirate Digital Signal Processing	3 Credits

Course Objectives:

- This Multirate Signal Processing course covers advanced techniques for the design of digital filters, which are essential components in almost every digital signal processing system, as well as cyclostationary signals, so important to the understanding of modulation systems.
- The course then moves on to treat multi-rate systems and presents multi-rate processing of both deterministic and random signals, culminating in a full case study exercise.
- To analyze multi-rate systems and the effects of interpolation and decimation on deterministic signals.
- To analyze the effects of interpolation and decimation on random signals.
- To design interpolation and decimation filters to a given specification.

Course Outcomes:

1. Ability to understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.
2. Able to explain how the multirate implementation of ADC and DAC converters works.
3. Able to describe basic sampling rate conversion algorithms.
4. Able to draw and describe different kinds of interpolator and decimator.
5. Able to analyze how the interpolated FIR filter works.
6. Able to do sampling rate conversion.

UNIT - 1

Fundamentals of Multirate Systems

Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Mulstage implementation, Some application of multirate systems, Special filter and filter banks.

UNIT - 2

Maximally Decimaled Filter Banks

Introduction, Errors created in the QMF bank, A simple alias free QMFsystem, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Treestructured filter banks, Transmultiplexer.

UNIT - 3

Paranitary Perfect Reconstruction Filter Banks

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Tranformcoding and LOT.

UNIT - 4

Linear Phase and Cosine Modulated Filter Banks

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT - 5

The Wavelet Transform and its Relation to Multirate Filter Banks

Introduction, Background and outline, Short time fourier transform, The Wavelet transform, DT orthonomal Wavelets, Continuous time orthonormal Wavelet basis.

UNIT - 6

Multidimensional, Multivariable and Lossless Systems

Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals.Review of discrete time multi-input multi-output LTI System, ParaUNITary and lossless system.

TEXT/REFERENCE BOOKS

1. P.P.Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey,Multirate System and Filter Banks.
2. N.J.Fliege , John Wiley & Sons, Multirate Digital Signal Processing.
3. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application.
4. C. Sidney Burrus , R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

EC 51 B	RF Circuit Design	3 Credits

Course Objectives:

- To study RF issues related to active and passive components.
- To study circuit design aspects at RF
- To learn design and modeling of circuits at RF.

Course Outcomes:

After successfully completion of the course students will be able to

1. Understand behavior of passive components at high frequency and modeling of HF circuit.
2. Design HF amplifiers with gain bandwidth parameters.
3. Understand Mixer types and characteristics.
4. Gain the knowledge about PLLs and Oscillators with respect to their circuit topologies.

UNIT - 1

RF Behavior of Passive Components

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

UNIT - 2

Bandwidth Estimation

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC τs, Considerations, and Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Accuracy of SC τs, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation between Rise Time and Bandwidth.

UNIT - 3

High Frequency Amplifier Design

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and uni lateralization. Characteristics of RF amplifier. Amplifier power relations. Stability considerations. Stabilization methods.

UNIT - 4

Low Noise Amplifier Design

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

UNIT - 5

Oscillators

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS. Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.

UNIT - 6

Mixers

Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

TEXT/REFERENCE BOOKS

1. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design Theory and Applications”, Pearson Education.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Second Edition, Cambridge Publications.
3. T. Yettrdal, Yunhg Cheng, “Devices modeling for analog and RF COMS circuits design”, John Wiley publication.
4. Calvin Plett, “Radio frequency Integrated Circuits Design”, Artech house.

EC 51 C	Biomedical Signal Processing	3 Credits

Course Objectives:

- To understand the basic signals in the field of biomedical.
- To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation.
- To explore research domain in biomedical signal processing.
- To explore application of established engineering methods to complex biomedical signals problems.

Course Outcomes:

1. The student will be able to model a biomedical system.
2. The student will be able to understand various methods of acquiring bio signals.
3. The student will be able to understand various sources of bio signal distortions and its remedial techniques.
4. The students will be able to analyze ECG and EEG signal with characteristic feature points.
5. The student will have a basic understanding of diagnosing bio-signals and classifying them.

UNIT - 1

Biomedical Signals

Bioelectric Signals and Electrodes: Bio-potentials and their origin: ECG, EEG, EMG, ENG, ERG, EOG, MEG. Biomedical Instrumentation System, biomedical transducers, electrodes and their characteristics. Origin of bio potentials. Sources and contamination of Noise in bio signals. Motion artifacts and skin Impedance. Classification of biomedical signals.

UNIT - 2

Cardio Vascular and Nervous System

Cardio Vascular System: Cardiovascular system, Coronary and Peripheral Circulation, Electrical Activity of the heart, Lead configurations, ECG data acquisition, ECG recorder, Concept of Blood Pressure Measurement, Cardiac output, Heart Sounds. Nervous System: Nervous System, Structure and functions of Neurons, Electrical activity of nerve cell, Synapse, Reflex action and Receptors.

UNIT - 3

Analysis of Electrical Activity of Heart

ECG signal parameters & their estimation - Use of multiscale analysis for ECG parameters estimation, Noise & Artifacts, ECG Signal Processing: Baseline Wandering, Power line interference, Muscle noise filtering – QRS detection, Highlight the Feature points of ECG and its classification for Normal and Abnormal state using Multilayer Perceptron.

UNIT - 4

Analysis of Electrical Activity of Brain

Electroencephalogram – Structure of brain, EEG signal acquisition,10-20 electrode placement, EEG rhythms & waveform - categorization of EEG activity - recording techniques – EEG applications- Epilepsy, sleep disorders, brain computer interface. Use of Fourier Transform in EEG Signal Analysis.

UNIT - 5

Analog Signal Processing

Basics of Instrumentation Amplifier, Isolation amplifier, Grounding and shielding techniques. Integer Filters: Basic design Concept, Low Pass and High Pass Filters, Band Pass, Band Stop and Band Reject Filters. Its application in biomedical field. Adaptive Filters: Basic Concept, Principle noise cancellation model, removal of periodic events using adaptive cancellation, adaptive cancellation of maternal ECG from fetal ECG of Interest.

UNIT - 6

Digital Signal Processing

Characteristics, frequency domain representation; Stationary and non-stationary bio-signals, waveform detection, Sampling Theory, Finite data considerations (Edge effects), Z Transform, FIR and IIR filters specific to event detection of ECG. Computation of diagnostic signal parameters of ECG like Heart rate and QRS detection using Multivariate analysis like PCA and ICA.

TEXT/REFERENCE BOOKS

1. Joseph J. Carr and John M. Brown, “Introduction to Biomedical Equipment Technology”, 4th Edition, Prentice Hall, 2000.
2. R. Rangayan, “Biomedical Signal Analysis”, Wiley 2002.
3. John L Semmlow, “Bio-signal and Biomedical Image Processing”, Marcel Dekker.

4. R. S. Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 2003, Edition-II.
5. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", 4th Edition, Prentice Hall, 2000.
6. Bruce, "Biomedical Signal Processing & Signal Modeling," Wiley, 2001.
7. Sörnmo, "Bioelectrical Signal Processing in Cardiac & Neurological Applications", Elsevier.
8. C. Reddy "Biomedical Signal Processing: Principles and techniques", Tata McGraw Hill, New Delhi, 2005.
9. Willis J Tompkins, "Biomedical Signal Processing", ED, Prentice – Hall, 1993.

EC 51 D	Robotics and Automation	3 Credits

Course Objectives:

- To describe the history and early beginnings of automated manufacturing & Robotics.
- Ability to recognize industrial control problems.
- Aims to Develop understanding Robotics Components.
- To apply creative approaches to practical applications, identify technological opportunities in robotics.
- An over view of technology of advanced topics such as CNC Machines, Human Robot Interaction.
- The ability to provide Automation solution.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand Need of Automation.
2. Demonstrate use of engineering methods and problem solving towards design of the specified robot.
3. Compare and contrast various mechanical systems, and the industrial application of robotic and automation.
4. Identify prerequisites of Robotics for small industrial Applications.
5. Describe Robot control & its applications.

UNIT - 1

Introduction to Automation

Types of Automation; Architecture of Industrial Automation Systems, Advantages and limitations of Automation, Effects of modern developments in automation on global competitiveness. Introduction of CNC Machines: Basics and need of CNC machines, NC, CNC and DNC (Direct NC) systems, Structure of NC systems, Applications of CNC machines in manufacturing, Advantages of CNC machines.

UNIT - 2

Robotics

Robot anatomy-Definition, law of robotics, History and Terminology of Robotics-Accuracy and repeatability of Robotics-Simple problems Specifications of Robot-Speed of Robot-Robot joints and links-Robot classifications-Architecture of robotic systems-Robot Drive systems Hydraulic, Pneumatic and Electric system.

UNIT - 3

Robot Transformation, Sensors & End effectors

Transformation types: 2D, 3D. Translation- Homogeneous coordinates multiple transformation-Simple problems. Sensors in robot – Touch sensors-Tactile sensor – Proximity and range sensors Robotic vision sensor-Force sensor-Light sensors, Pressure sensors End effectors : Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, cam type-Magnetic grippers- Vacuum grippers-Air operated grippers-Gripper force analysis-Gripper design-Simple problems.

UNIT - 4

Kinematics

Rigid body Kinematics, Inverse Kinematics, Rotation matrix, Homogenous transformation matrix, Denavit - Hartenberg convention, Euler angles, RPY representation, Direct and inverse Kinematics for industrial robots for position and orientation Redundancy, Manipulator, Jacobian Joint, End effector, velocity – direct and inverse velocity analysis. Control: Individual joint computed torque.

UNIT - 5

Dynamics

Lagrangian Dynamics, link inertia tensor and manipulator inertia tensor, Newton-Euler Dynamics of Robot, Newton-Euler formulation for RR & RP manipulators, Dynamics of systems of Interacting Rigid Bodies, D-H Convention, Trajectory planning for Flexible Robot, Cubic polynomial linear segments with parabolic blending, static force and moment transformation, solvability, stiffness, Singularities.

UNIT - 6

Robot Control & Applications

Control approaches: oscillatory based time varying control law, control law based on vector field orientation approach. Advanced strategies of control: conventional aerial vehicle, Bidirectional X4-flyer. Applications of Fuzzy Logic and Neural network in Robot Control, Neural controllers, Implementation of Fuzzy controllers: Trajectory tracking controller. Applications of Robotic system: complex control system, vision system in complex control system. Human Robot Interaction: Architecture.

TEXT/REFERENCE BOOKS

1. Thomas R. Kurfess, _Robotics And Automation Handbook_, CRC Press, 2004, ISBN 0-8493-1804-1
2. Robotics: Appin Knowledge Solutions (Firm), Infinity Science Press, 2007, ISBN 978-1-934015-02-5.
3. Robot Motion and Control (Recent Developments) by M. Thoma & M. Morari.

EC 51 E	Software Defined Radio	3 Credits

Course Objectives:

- To understand "Modern Radio Communication System "that can be reconfigured.
- To understand GNU Radio
- To understand how SDR platform provides easy access to wireless network system
- To understand how unlike simulation in Communication Projects, SDR allows easy access to both PHY and MAC layer
- To understand the concept of Cognitive Radio and Spectrum sharing

Course Outcomes:

After successfully completing the course students will be able to

1. Compare SDR with traditional Hardware Radio HDR
2. Implement modern wireless system based on OFDM, MIMO & Smart Antenna
3. Build experiment with real wireless waveform and applications, accessing both PHY and MAC, Compare SDR versus MATLAB and Hardware Radio
4. Work on open projects and explore their capability to build their own communication system.

UNIT - 1

Software Defined Radio fundamentals

Introduction to SDR, Need of SDR, Principles of SDR, Basic Principle and difference in Analog radio and SDR, SDR characteristics, required hardware specifications, Software/Hardware platform, GNU radio -What is GNU radio, GNU Radio Architecture, Hardware Block of GNU,GNU software, MATLAB in SDR, Radio Frequency Implementation issues, Purpose of RF front End, Dynamic Range, RF receiver Front End topologies, Flexibility of RF chain with software radio, Duplexer, Diplexer, RF filter ,LNA ,Image reject filters , IF filters , RF Mixers Local Oscillator , AGC, Transmitter Architecture and their issues, Sampling theorem in ADC, Noise and distortion in RF chain, Pre-distortion Case study : AM/FM/BPSK/QPSK/OFDM Simulation in Matlab.

UNIT - 2

SDR Architecture

Architecture of SDR-Open Architecture, Software Communication Architecture, Transmitter Receiver Homodyne/heterodyne architecture, RF front End, ADC, DAC, DAC/ADC Noise Budget, ADC and DAC Distortion, Role of FPGA/CPU/GPU in SDR, Applications of FPGA in SDR, Design Principles using FPGA, Trade –offs in using DSP, FPGA and ASIC, Power Management Issues in DSP, ASIC, FPGA Case Study: JTRS –Goals of SCA, Architectural details, SDR forum Architecture.

UNIT - 3

Multi Rate Signal Processing

Sample timing algorithms, Frequency offset estimation and correction, Channel Estimation, Basics of Multi Rate, Multi Rate DSP, Multi Rate Algorithm, DSP techniques in SDR, OFDM in SDR.

UNIT - 4

Smart/MIMO Antennas using Software Radio

Smart Antenna Architecture, Vector Channel Modeling, Benefits of Smart Antenna Phased Antenna Array Theory, Adaptive Arrays, DOA Arrays, Applying Software Radio Principles to Antenna Systems, Beam forming for systems-Multiple Fixed Beam Antenna Array, Fully Adaptive Array , Relative Benefits and Trade-offs OF Switched Beam and Adaptive Array, Smart Antenna Algorithms , Hardware Implementation of Smart Antennas, MIMO -frequency, time, sample Synchronization, Space time block coding-Space Time Filtering, Space Time Trellis Coding, Case Study: Principles of MIMO-OFDM.

UNIT - 5

Cognitive Radio

Cognitive Radio Architecture, Dynamic Access Spectrum, Spectrum Efficiency, Spectrum Efficiency gain in SDR and CR, Spectrum Usage, SDR as a platform for CR, OFDM as PHY layer, OFDM Modulator, OFDM Demodulator, OFDM Bandwidth, Benefits of OFDM in CR, Spectrum Sensing in CR, CR Network.

UNIT - 6

Applications of SDR

Application of SDR in Advance Communication System-Case Study, Challenges and Issues,

Implementation, Parameter Estimation –Environment, Location, other factors, Vertical Handoff, Network Interoperability. Case Study: 1) CR for Public Safety –PSCR, Modes of PSCR, Architecture of PSCR 2) Beagle board based SDR 3) Embedded PCSR using GNU radio.

TEXT/REFERENCE BOOKS

1. Jeffrey H. Reed, Software Radio: A Modern Approach to Radio Engineering, Pearson, LPE.
2. Markus Dillinger, Kambiz Madani, Nancy Alonistioti, Software Defined Radio: Architectures, Systems and Functions, Wiley.
3. Tony. J. Rouphael, RF and DSP for SDR, Elsevier Newness Press, 2008.
4. Dr. Taj Struman, Evaluation of SDR –Main Document.
5. SDR –Handbook, 8th Edition, PENTEK.

6. Bruce a. Fette, Cognitive Radio Technology, Newness, Elsevier.

Lesson Plan

Semester – III

Course: Principles of Communication Engineering

Unit	Lect. No.	Topic
1.Introduction to Communication systems	1,2,3	Introduction to transmitter, the dB in communication, noise, noise designation and calculation
	4,5,6	Noise measurement, concept of modulation, Bandwidth requirement, Frequency allocation, noise in modulation systems
	6,7,8,9	Introduction to random processes and random signals as applicable to noise.
2.Linear Modulation	10,11	Amplitude Modulation
	12,13,14	DSB-SC modulation, Generation of DSB-SC and AM signals
	15,16	Generation of SSB signals, Demodulation of SSB
	17,18	Vestigial sideband(VSB) modulation, Envelope detection of VSB+C
	19,20	Superheterodyne receiver
3. Angle Modulation	20,21	Introduction , Bandwidth of FM
	22,23	Tone Modulation, Phase Modulation,
	24, 25	Generation of FM, Demodulation of FM
	26,27	Bandpass filter, Broadcast FM
4.Digital transmission of analog signals	28,29	Introduction , the PCM system
	30,31	Sampling, Quantization
	32,33	Encoding, Electrical waveform representation of binary sequences
	34,36	Bandwidth requirements of PCM
	37,38	Differential pulse code modulation(DPCM), Delta Modulation
5. Noise Performance of Various Modulation Schemes	39,40	Introduction, Receiver Model and Figure of Merit:
	41	Linear Modulation
	42,43	Coherent Demodulation, Envelope Detection,
	44,45	Receiver Model: Angle Modulation
	46,47	Calculation FOM, Pre-Emphasis and de-Emphasis in FM
	48,49	Noise performance of a PCM system
6.Communication Techniques	50,51	Introduction, Frequency conversion,
	52,53	Special techniques, receiver noise & sensitivity
	54	dynamic range, Intermodulation distortion testing

	55	Frequency synthesis, directs digital synthesis
		FM communications transceivers.
	56	Review of telegraphy, Telephony and telemetry.
	57,58	Microphones and Loudspeakers: Concept, classifications & working.
	59	PA system

Course: Network Analysis and Synthesis

Unit No.	Lecture number	Topic
1.	1	Independent & dependent voltage & current sources,
	2,3	R. L, C & mutual inductance circuit parameters, their mathematical modes, Voltage current power relations.
	4,5	Classification of elements: Lumped distributed, Linear & non-linear, Unilateral, Bilateral, time invariant & variant, Phase invariant & variant
2.	6,7	Network topology, Graph, Tree, Branches, Chords, Number of Network equation required
	8	Equilibrium equations on loop basis & node basis
	9,10	choice between nodal & loop analysis, Source transformation,
	11,12,13	Network mutual inductance, Dot conventions, Concept of Super mesh, Super node concept of duality & dual networks
3.	14,15,16, 17	Classification solution of first, second order differential equations of series & parallel R-L, R-C, R-L-C circuits, Initial conditions in network, Procedure of evaluality,
	18,19, 20,21	Conditions in network problems, Solution of DC resistive network & AC General & particular solutions, Particular integral & complimentary functions, Time constant, Mathematical analysis of circuit transients
	22, 23,24	sinusoidal steady state networks, Writing loop equations, Node equations directly in matrices form, Numerical
4.	25,26	Solution of differential equation using Laplace transform,
	27,28, 29	Unit step, impulse & ramp functions, Laplace transform of singular & shifted function, Convolution integral, Concept of complex frequency
	30, 31	Transform impedance & transform admittance, Series & parallel combination of these transform networks
5.	32,33	Super position, Thevenin's Theorem
	34,35	Norton's reciprocity, Maximum power transfer
	36,37	Substitution, Tellegen's theorem,

	38,39	Driving points & transfer admittance, Transfer functions, Concept of poles & zeros,
	40,41,42	Two port networks, Z, Y & the transmission parameters relationship between parameter set
6.	43,44,45	R-L-C series circuits, Series resonance variations of Z with frequency, Maximum value of VC & VL, Magnification, Bandwidth, Q-factor
	46,47,48	Parallel Resonance: Resonance frequency for tank circuit, Locus diagram of series R-L, R-C with variable R & X,
	49,50,51	Filter: Introduction, Classification, Low pass, High pass, Band pass & Band reject filter, Active & passive filters. Application of Fourier series, Expansion for periodic & non-sinusoidal waveforms

Semester – IV

Course: Linear Integrated Circuits

Unit	Lect. No.	Topic
1. Operational Amplifier	1,2,3	Operational Amplifiers, Difference Amplifiers
	4,5,6	Biasing of Differential Amplifiers
	7,8	Practical Operational Amplifier, Parameters of an OPAMP
	9,10	Open loop OPAMP Configuration
	11,12	Closed Loop Amplifier
	13,14	Voltage Shunt Feedback
2. OPAMP Applications	15,16,17	Applications of Operational Amplifiers
	18,19	Filters and Precision Diode
	20,21,22	Schmitt Trigger and Relaxation Oscillator
3. Oscillator	23,24	Oscillators
	25,26	Harmonic Oscillators
	27, 28	Tuned Oscillators
4. Voltage Regulators	29,30	Voltage Regulators
	31,32	Design of Series Voltage Regulator
	33,34	Series regulator with Current Pre- regulator
5. Specialized IC Applications	35,36	Audio power amplifiers
	37,38	IC 555
	39,40	IC LM 380
	41,42	Video amplifier IC LM 733
	43,44	Study of analog multiplier
6. Phase Lock Loop (PLL)	45,46	Study of VCO using IC 566
	47,48,49	Operating principles of PLL & its transfer characteristics, Lock range, Capture range
	50,51	Applications of PLL, Study of PLL IC 565

Semester V

Course: Microprocessor and Microcontroller

UNIT/TITLE	TOPIC	LECTURE NO.
1. Introduction to microprocessor & microcontroller	Introduction to the general structure of 8 and 16 bit Microprocessor	1,2
	Introduction to the general structure of 8 and 16 bit Microcontroller	3,4
2. Microcontrollers and Embedded Processors	Discussions on instruction sets, memory hierarchies of 8 bit Intel 8048 microcontrollers	5,6
	Discussions on instruction sets, memory hierarchies of 8 bit 8051 microcontrollers	7,8,9
	Discussions on instruction sets, memory hierarchies of 8 bitmicrocontrollers 8096	10,11
	Discussions on instruction sets,memory hierarchies of 8 and 16 bitMotorola microcontrollers	12,13
	Discussions on instruction sets, memory hierarchies of 8 bitMC68HC11Microcontroller	14,15
	Discussions on instruction sets, memory hierarchies of 8 and 16 bit PICMicrocontrollers	16,17
3. 8051 Assembly Language Programming	Development of system software in assembly language	18,19,20
	Debugging and troubleshooting	21,22

4. Interfacing	Interfacing of external Memory	23,24,25
	Interfacing of I/O devices	26,27,28
	Serial communication	29,30,31
5. System design with microcontrollers	Remote Terminal Unit (RTU)	32,33,34
	Prepayment Energy Meters	35,36,37
6. Advanced Microcontroller and design	Features of MCS-96 Family Microcontrollers	38,39
	Architecture	40,41,42
	Pin Configuration of 80c196	43,44,45
	Highlighting development ofschematic, circuit layout and PCBdesign	46-50

Course: Embedded System Design

Sr.	Day	Date	Lesson Plan
1	MON	2 January	Introduction, Overview, Characteristics of Embedding Computing Applications
2	TUE	3 January	Introduction, Overview, Characteristics of Embedding Computing Applications
3	WED	4 January	Concept of Real time Systems
4	THU	5 January	Challenges in Embedded System Design
5	MON	9 January	Challenges in Embedded System Design
6	TUE	10 January	Design Process: Requirements, Specifications, Architecture Design, Designing of Components, System Integration
7	WED	11 January	Design Process: Requirements, Specifications, Architecture Design, Designing of Components, System Integration
8	THU	12 January	Design Process: Requirements, Specifications, Architecture Design, Designing of Components, System Integration
9	MON	16 January	Design Process: Requirements, Specifications, Architecture Design, Designing of Components, System Integration
10	TUE	17 January	Instruction Set Architecture, CISC and RISC instruction set architecture
11	WED	18 January	Instruction Set Architecture, CISC and RISC instruction set architecture
12	THU	19 January	Instruction Set Architecture, CISC and RISC instruction set architecture
13	MON	23 January	CISC Examples (Motorola (68HC11) Example, 8051)
14	TUE	24 January	CISC Examples (Motorola (68HC11) Example, 8051)
15	WED	25 January	CISC Examples (Motorola (68HC11) Example, 8051)
16	MON	30 January	RISC Example (ARM), DSP Processors, Harvard Architecture, PIC
17	TUE	31 January	RISC Example (ARM), DSP Processors, Harvard Architecture, PIC
18	WED	1 February	RISC Example (ARM), DSP Processors, Harvard Architecture, PIC
19	THU	2 February	RISC Example (ARM), DSP Processors, Harvard Architecture, PIC
20	MON	6 February	Memory System Architecture: Caches, Virtual Memory, Memory Management Unit and Address Translation
21	TUE	7 February	Memory System Architecture: Caches, Virtual Memory, Memory Management Unit and Address Translation
22	WED	8 February	I/0 Sub-system: Busy-wait I/0, DMA, Interrupt driven I/0, Co-processors and Hardware Accelerators
23	THU	9 February	I/0 Sub-system: Busy-wait I/0, DMA, Interrupt driven I/0, Co-processors and Hardware Accelerators
24	MON	13 February	Processor Performance Enhancement: Pipelining, Super-scalar Execution, CPU Power Consumption
25	TUE	14 February	Processor Performance Enhancement: Pipelining, Super-scalar Execution, CPU Power Consumption

26	WED	15 February	Designing Embedded Computing Platform Using CPU Bus: Bus Protocols, Bus Organization
27	THU	16 February	Designing Embedded Computing Platform Using CPU Bus: Bus Protocols, Bus Organization
28	MON	20 February	Memory Devices and their Characteristics: RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM
29	TUE	21 February	Memory Devices and their Characteristics: RAM, ROM, UVROM, EEPROM, Flash Memory, DRAM
30	WED	22 February	I/O Devices: Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices
31	THU	23 February	I/O Devices: Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices
32	MON	27 February	I/O Devices: Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices
33	TUE	28 February	I/O Devices: Timers and Counters, Watchdog Timers, Interrupt Controllers, DMA Controllers, A/D and D/A Converters, Displays, Keyboards, Infrared devices
34	WED	1 March	Component Interfacing: Memory Interfacing, I/O Device Interfacing
35	THU	2 March	Component Interfacing: Memory Interfacing, I/O Device Interfacing
36	MON	6 March	Component Interfacing: Memory Interfacing, I/O Device Interfacing
37	TUE	7 March	Interfacing Protocols: GPIB, FIREWIRE, USB, IRDA
38	WED	8 March	Designing with Processors: System Architecture, Hardware Design, FPGA Based Design
39	THU	9 March	Designing with Processors: System Architecture, Hardware Design, FPGA Based Design
40	TUE	14 March	Implementation: Development Environment, Debugging Techniques, Manufacturing and Testing
41	WED	15 March	Design Examples: Data Compressor, Alarm Clock
42	THU	16 March	Program Design: Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph
43	MON	20 March	Program Design: Design Patterns for Embedded Systems, Models of Program, Control and Data flow Graph
44	TUE	21 March	Programming Languages: Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Control, Multi- tasking and Task Scheduling, Timing Specifications, Run-time Exception handling

45	WED	22 March	Programming Languages: Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Control, Multi- tasking and Task Scheduling, Timing Specifications, Run-time Exception handling
46	THU	23 March	Programming Languages: Desired Language Characteristics, Introduction to Object Oriented Programming, Data Typing, Overloading and Polymorphism, Control, Multi- tasking and Task Scheduling, Timing Specifications, Run-time Exception handling
47	MON	27 March	Use of High Level Languages: C for Programming embedded systems, Object Oriented Programming for Embedded Systems in C++, Use of Java for Embedded Systems Programming and Run-time Environment: Compiling, Assembling, Linking and Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing
48	WED	29 March	Use of High Level Languages: C for Programming embedded systems, Object Oriented Programming for Embedded Systems in C++, Use of Java for Embedded Systems Programming and Run-time Environment: Compiling, Assembling, Linking and Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing
49	THU	30 March	Use of High Level Languages: C for Programming embedded systems, Object Oriented Programming for Embedded Systems in C++, Use of Java for Embedded Systems Programming and Run-time Environment: Compiling, Assembling, Linking and Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing
50	MON	3 April	Use of High Level Languages: C for Programming embedded systems, Object Oriented Programming for Embedded Systems in C++, Use of Java for Embedded Systems Programming and Run-time Environment: Compiling, Assembling, Linking and Debugging, Basic Compilation Techniques, Analysis and Optimization of Execution Time, Analysis and Optimization of Energy and Power, Analysis and Optimization of Program Size, Program Validation and Testing
51	WED	5 April	Operating System Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking

52	THU	6 April	Operating System Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking
53	MON	10 April	Scheduling: Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling
54	TUE	11 April	Inter-process Communication: Signals, Shared Memory Communication, Message-Based Communication
55	WED	12 April	Real-time Memory Management: Process Stack Management, Dynamic Allocation I/O: Synchronous and Asynchronous I/O, Interrupt Handling, Device Drivers, Real-time Transactions and Files
56	THU	13 April	Example Real-time OS: VxWorks, RT-Linux, Psos Evaluating and Optimizing Operating System Performance: Response-time Calculation, Interrupt latency, Time-loading, Memory Loading Power Optimization Strategies for Processes
57	MON	17 April	Design Methodologies: UML as Design tool, UML notation, Requirement Analysis and Use case Modeling, Static Modeling, Object and Class Structuring, Dynamic Modeling
58	TUE	18 April	Architectural Design: Hardware-Software Partitioning, Hardware-Software Integration Design Examples: Telephone PBX, Inkjet Printer, PDA, Set-top Box, Elevator Control System, ATM System Fault-tolerance Techniques, Reliability Evaluation Techniques
59	WED	19 April	Embedded control applications: Introduction, Open-loop and Closed Loop Control Systems, Examples: Speed Control, PID Controllers: Software Coding of a PID Controller, PID tuning Fuzzy Logic Controller, Application Examples: Washing Machine, Automotive Systems, Auto-focusing digital camera, Air-conditioner

Semester VI

Course: Control System

Unit No.	UNIT	Date	Lecture number	Topic
1.	Introduction to control problem	JAN 2	1	Industrial Control examples, Types of control system
		JAN 4	2	Transfer function models of mechanical systems
		JAN 6	3	Transfer function models of, electrical systems
		JAN 6	4	Transfer function models of thermal systems
		JAN 9	5	Transfer function models hydraulic systems
		JAN 11	6	Control hardware and their models: servomotors, pneumatic actuators
		JAN 13, JAN 13	7,8	Block diagram analysis
		JAN 16, JAN 18	9,10	signal flow graph analysis
2.	Basic characteristics of feedback control systems	JAN 20, JAN 20	11,12	Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness,
		JAN 23	13	Basic modes of feedback control: proportional, integral and derivative.
		JAN 25	14	Feed-forward and multi-loop control configurations
		JAN 27	15	stability concept, relative stability
		JAN 27, JAN 30	16,17	Routh stability criterion
3.	Time Response Analysis of Control Systems	FEB 1, FEB 3	18,19	Time response of second-order systems
		FEB 3, FEB 6	20,21	steady-state errors and error constants
		FEB 10	22	Performance specifications in time-domain
		FEB 15, FEB 17, FEB 17	23,24,25	Root locus method of design
		FEB 20 FEB 22	26,27	Lead and lag compensation

4.	Frequency-response analysis	FEB 27, MAR1 MAR 3	28,29,30	Polar plots
		MAR3, MAR 6, MAR8, MAR 10	31,32,33, 34	Bode's plot,
		MAR 10, MAR 15, MAR 17	35,36,37	Nyquist plots,
		MAR 17	38	Nyquist stability criterion
		MAR20, MAR 22	39,40	Op-amp based and digital implementation of compensators.
5.	State variable Analysis	MAR 24	41	Concepts of state, state variable, state model
		MAR 24, MAR 27	42,43	state models for linear continuous time functions
		APR 3, APR 5	44,45	concept of controllability & observability
6.	Introduction to Optimal control & nonlinear control	APR7, APR 7	46,47	Optimal Control problem
		APR 17	48	Regulator problem
		APR 19 APR 21 APR 21	49,50, 51	Output Nonlinear system - Basic concept & analysis

Course: Digital System Design

UNIT NO.	UNIT NAME	LECT NO.	TOPICS
1	Introduction to Digital Design and Digital Logic (07 Hours)	1	Introduction of Digital System Design, Specification and Implementation of digital design
		2	Structured and Trial-Error methods in design, Digital Computer Aided Design (CAD) tools.
		3	Binary Number System, Octal, Hexadecimal and BCD Codes
		4	Number System Conversion, Use of different number systems in digital design
		5	Logic gates – AND, OR, NOT, NAND, NOR etc., NAND and NOR
		6	Implementation of real life digital circuits
		7	Problem Session-I
2	Boolean Algebra (07 Hours)	8	AND, OR and other relations, DeMorgan's law
		9	Karnaugh Maps
		10	Minimization of Sum of Products and Product of Sums
		11	Problem Session-II
		12	Design of minimal two-level gate networks
		13	Design of multiple output two level gate networks
		14	Problem Session –III
3	Combinational l Circuit Design (07 Hours)	15	Design Procedure: Design of Multiplexer
		16	Design of Decoder & Encoder
		17	Design of Comparator
		18	Design of Seven segment display
		19	Parity generator
		20	Design of large circuits
		21	Problem Solving
4	Synchronous Sequential Circuit Design (10 Hours)	22,23	Design of sequential modules – SR, D Flip flop-I
		24,25	Design of sequential modules – SR, D Flip flop-II
		26,27	Design of T and J-K Flip-flops

		28	Flip-flop applications – Clock generation
		29	Counters-I
		30	Counters-II
		31	Registers-I
		32	Registers-II
		33	Basic State machine concepts-I
		34	Basic State machine concepts-II
		35	Problem Session-IV
5	Design of Programmable Logic (08 Hours)	36	Introduction to Programmable circuits
		37	Design of Read-Only Memory (ROM)
		38	Programmable Logic Arrays (PLA)-I
		39	Programmable Logic Arrays (PLA)-II
		40	Programmable Logic Arrays (PLA)-III
		41	Programmable Array Logic (PAL)-I
		42	Programmable Array Logic (PAL)-II
		43	Programmable Array Logic (PAL)-III
		44	Problem Solving
6	Digital Computing (07Hours)	45	Introduction to digital computer, Introduction to design of arithmetic circuits
		46	Design of Arithmetic circuits-Adders
		47	Design of Arithmetic circuit- Multipliers
		48	Design of Memory- ROM/RAM-I
		49	Design of Memory- ROM/RAM-II
		50	Design of a simple CPU
		51	Problem Solving

Semester VII

Course: Antenna and Wave Propagation

Sr.	Day	Date	Topics
1	MON	2 January	Physical Concept of Radiation, Radiation Pattern
2	TUE	3 January	Near-and Far-Field Regions, Reciprocity
3	THU	5 January	Directivity and Gain, Effective Aperture
4	FRI	6 January	Polarization
5	MON	9 January	Polarization
6	TUE	10 January	Input Impedance, Efficiency
7	THU	12 January	Friis Transmission Equation
8	FRI	13 January	Radiation Integrals and Auxiliary Potential Functions
9	MON	16 January	Infinitesimal Dipole
10	TUE	17 January	Infinitesimal Dipole
11	THU	19 January	Finite-Length Dipole
12	FRI	20 January	Linear Elements Near Conductors
13	MON	23 January	Dipoles for Mobile Communication
14	TUE	24 January	Small Circular Loop
15	FRI	27 January	Small Circular Loop
16	MON	30 January	Huygens' Principle, Radiation From Rectangular and Circular Apertures, Design Considerations
17	TUE	31 January	Huygens' Principle, Radiation From Rectangular and Circular Apertures, Design Considerations
18	THU	2 February	Babinet's Principle
19	FRI	3 February	Radiation From Sectoral and Pyramidal Horns, Design Concepts
20	MON	6 February	Radiation From Sectoral and Pyramidal Horns, Design Concepts
21	TUE	7 February	Prime-Focus Parabolic Reflector and Cassegrain Antennas.
22	THU	9 February	Log-Periodic and Yagi Antennas
23	FRI	10 February	Frequency Independent Antennas
24	MON	13 February	Broadcast Antennas
25	TUE	14 February	Basic Characteristics of Microstrip Antennas
26	THU	16 February	Feeding Methods
27	FRI	17 February	Methods of Analysis
28	MON	20 February	Methods of Analysis
29	TUE	21 February	Design of Rectangular and Circular Patch Antennas
30	THU	23 February	Design of Rectangular and Circular Patch Antennas
31	MON	27 February	Analysis of Uniformly Spaced Arrays with Uniform and Non-Uniform Excitation Amplitudes
32	TUE	28 February	Analysis of Uniformly Spaced Arrays with Uniform and Non-Uniform Excitation Amplitudes

33	THU	2 March	Analysis of Uniformly Spaced Arrays with Uniform and Non-Uniform Excitation Amplitudes
34	FRI	3 March	Analysis of Uniformly Spaced Arrays with Uniform and Non-Uniform Excitation Amplitudes
35	MON	6 March	Analysis of Uniformly Spaced Arrays with Uniform and Non-Uniform Excitation Amplitudes
36	TUE	7 March	Analysis of Uniformly Spaced Arrays with Uniform and Non-Uniform Excitation Amplitudes
37	THU	9 March	Extension to Planar Arrays
38	FRI	10 March	Extension to Planar Arrays
39	TUE	14 March	Extension to Planar Arrays
40	THU	16 March	Synthesis of Antenna Arrays using Schelkunoff Polynomial Method
41	FRI	17 March	Synthesis of Antenna Arrays using Schelkunoff Polynomial Method
42	MON	20 March	Woodward-Lawson Method
43	TUE	21 March	Concept and Benefits of Smart Antennas
44	THU	23 March	Fixed Weight Beamforming Basics
45	FRI	24 March	Adaptive Beamforming

Course: Optical Communication

Unit	Lect. No.	Topic
1.Optical Communication Fundamentals	1,2	Introduction to vector nature of light, propagation of light
	3,4	Propagation of light in cylindrical dielectric rod
	5,6	Ray model, Wave model
	7,8,9,	Different types of optical fibers, Modal analysis of step index fiber
	10,11,12	Signal degradation due to dispersion and attenuation
2.Optical Sources	13,14,15	LED: structure and its characteristics
	16,17,18	Lasers: structure and its characteristics
3. Optical detectors	19,20	Pin detectors
	21,22	Detector responsivity, noise
	23,24,25	Optical receivers
4.5.Fabrication Techniques, Optical link design	26,27,28	BER calculation
	29,30,31	Quantum limit
	32,33,34	Power penalties
	35,36	Optical switches- coupled mode analysis of directional couplers
	37,38,39	Electro-optic switches, nonlinear effects in fiber optic links
6. Optical modulation	40,41	Concept of self-phase modulation
	42,43,44	Group velocity dispersion and solution based communication
	46,47,48	Optical amplifiers-EDFA, Raman amplifiers and WDM systems

Course: RF & Microwave Communication

UNIT NO.	CHAPTER NAME	LECT NO.	Topics
1	**Introduction to Microwaves Mathematical model of Microwave Transmission**	**1**	Introduction to Microwaves
		2	History of Microwaves
		3	Microwave Frequency bands,
		4	Applications of Microwaves: Civil and Military, Medical, EMI/ EMC.
		5	Mathematical model of Microwave Transmission: Concept of Mode, Characteristics of TEM, TE and TM Modes,
		6	Mathematical model of Microwave Transmission: Concept of Mode, Characteristics of TEM, TE and TM Modes,
		7	Losses associated with microwave transmission
		8	Concept of Impedance in Microwave transmission
2	**Analysis of RF and Microwave Transmission Lines Microwave Network Analysis**	**9**	Analysis of RF and Microwave Transmission Lines
		10	Coaxial Line, Rectangular Waveguide, Circular waveguide, Stripline, Microstrip Line
		11	Coaxial Line, Rectangular Waveguide, Circular waveguide, Stripline, Microstrip Line
		12	Coaxial Line, Rectangular Waveguide, Circular waveguide, Stripline, Microstrip Line
		13	Microwave Network Analysis: Equivalent Voltages and currents for non-TEM lines

		14	Microwave Network Analysis: Equivalent Voltages and currents for non-TEM lines
		15	Network parameters for microwave Circuits
		16	Network parameters for microwave Circuits
3	**Scattering Parameters Passive and Active microwave Devices Microwave Measurements**	**17**	Scattering Parameters Passive and Active microwave Devices: Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, attenuator, resonator.
		18	Microwave Active components: Diodes, Transistors, Oscillators, mixers. Microwave Semiconductor Devices: Gunn Diodes, IMPATT diodes, Schottky Barrier diodes, PIN diodes. Microwave tubes: Klystron, TWT, Magnetron
		19	Microwave Measurements: Power, Frequency and impedance measurement at microwave frequency
		20	Network Analyzer and measurement of scattering parameters
		21	Spectrum Analyzer and measurement of spectrum of a microwave signal
		22	Noise at microwave frequency and measurement of noise figure, Measurement of Microwave antenna parameters
4	**Microwave Design Principles**	**23**	Microwave Design Principles
		24	Impedance transformation
		25	Impedance Matching
		26	Microwave Filter Design
		27	RF and Microwave Amplifier Design

		28	Microwave Power amplifier Design
		29	Low Noise Amplifier Design
		30	Microwave Mixer Design
		31	Microwave Oscillator Design
5	**Microwave Antenna**	**32**	Microwave Antenna
		33	Microwave Antenna Parameters
		34	Microwave antenna for ground based systems
		35	Microwave antenna for airborne based systems
		36	Microwave antenna for satellite borne systems,
		37	Microwave Planar Antenna
6	**Microwave Systems** **Modern Trends in Microwaves Engineering**	**38**	Microwave Systems
		39	Radar Systems
		40	Cellular Phone
		41	Satellite Communication
		42	RFID
		43	GPS
		44	Modern Trends in Microwaves Engineering: Effect of Microwaves on human body, Medical and Civil applications of microwaves
		45	Modern Trends in Microwaves Engineering: Effect of Microwaves on human body, Medical and Civil applications of microwaves
		46	Electromagnetic interference / Electromagnetic Compatibility (EMI/EMC)
		47	Monolithic Microwave IC fabrication

		48	RFMEMS for microwave components
		49	Microwave Imaging

Course: Computer Networks

Unit No.	Lecturer No.	Topic
1. Physical Layer	1,2	Data communications, type of networks, protocol & standards
	3,4	the OSI model
	5,6	TCP/IP suite
	7	addressing schemes, data & signals, transmission impairments
	8,9	transmission media, data rate limits, digital to digital conversion
	10,11	transmission modes, switching techniques
2. Data Link Layer	12,13	Error detection & correction block coding, cyclic codes
	14,15	checksum, data link layer design issues, protocols for noiseless & noisy channels, random access, controlled access
	16,17,18,19	Connecting Devices: passive hubs, repeaters, active hubs, bridges, routers, two/three layer switches and gateways
3. Network Layer	20,21	Concept of datagram & VC, ICMP, IGMP, Delivery, Forwarding
	22,23	Unicast & Multicast Routing Protocols
4. Transport Layer	24,25,26	Process to Process Delivery, UDP, TCP, Data Traffic, Congestion Control
	27,28,29	QoS, Techniques to improve QoS, Integrated Services
5. Application Layer	30,31,32	Name Space, DNS, Distribution of Name Space, DNS in Internet
	33,34,35	Resolution, TELNET, FTP, E-MAIL
6. Network Security	36,37,38	Introduction, systematic & asystematic key cryptography
	39,40,41	security services, digital signature
	42,43,44	entity authentication, key management

Course: VLSI Design

Unit	Lecture No.	Topic
1. Review of digital design	1,2 3,4 5,6 7 8,9	MUX based digital design, Design using ROM Programmable Logic Arrays (PLA) and Programmable Array Logic (PAL) Sequential circuits and timing - Setup and hold times, Sequential circuit design - design of Moore and Mealy circuits Design of a pattern sequence detector using MUX, ROM and PAL Design of a vending machine controller using PAL.
2. Introduction to Verilog coding	10,11 12,13,14	Introduction to Verilog, Realization of Combinational and sequential circuits RTL coding guidelines, Coding organization and writing a test bench
3. Simulation, Synthesis, Place and Route, and Back Annotation	15,16 17,18 19	Design flow, Simulation using Modelsim Synthesis using Synplify, Place and Route Back Annotation using Xilinx
4, 5. Design Applications	20,21,22 23,24 25,26,27 28,29 30,31	Design using Algorithmic State Machine Charts Design of memories Design of Arithmetic functions Design for testability Design Applications
6. Hardware implementation using FPGA board	32,33 34,35 36,37	Features of FPGA board Demonstration of traffic light controller design Universal, asynchronous, receiver-transmitter design using FPGA board

Semester VIII

Course: Radar & Satellite Communication

UNIT NO.	CHAPTER NAME	LECT NO.	Topics
1	Basic Principles Earth Station	1	Basic Principles General features, frequency allocation for satellite services,
		2	Basic Principles General features, frequency allocation for satellite services,
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