ELECTRONICS AND TELECOMMUNICATION ENGINEERING

Final Year B.Tech.
Effective from A. Y. 2014-15

INDEX

List of Abbreviations

Sr. No.	Abbreviation	Stands for:
1	DEC	Departmental Elective Course
2	PCC	Program Core Course
3	LC	Laboratory Course
4	HSSC	Humanities and Social Science Course
5	MLC	Mandatory Learning Course
6	LLC	Liberal Learning Course
7	OEC	Open Elective Course
8	SEC	Science Elective Course

Program Educational Objectives (PEOs):

1. To create graduates with sound knowledge of fundamentals of computer science and technology, who can contribute towards advancing science and technology.
2. To create graduates with sufficient capabilities in computer science and scientific computing who can become researchers and developers to satisfy the needs of the core computer technology industry.
3. To develop among students ability to formulate, analyse and solve real life problems faced in software industry.
4. To provide opportunity to students to learn the latest trends in computer technology and make them ready for life-long learning process.
5. To make the students aware of professional ethics of the Software Industry, and prepare them with basic soft skills essential for working in community and professional teams.
6. To prepare the students for graduate studies through competitive examinations, enabling them to reach higher echelons of excellence.

Program Outcomes (POs):

a. Graduates will demonstrate basic knowledge in fundamentals of programming, algorithms and programming technologies and fundamentals of Computer Science.

b. Graduates will demonstrate knowledge of fundamentals of hardware technology relevant to understanding Computer Science basics.

c. Graduates will have knowledge of the best practices in software development in industry.

d. Graduates will demonstrate the ability to design creative solutions to real life problems faced by the industry.

e. Graduates will demonstrate capability to work in teams and in professional work environments

f. Graduates will be able to communicate technical topics in written and verbal forms.

g. Graduates will demonstrate an understanding of the problems most relevant in time to Computer Engineering.

h. Graduates will demonstrate their ability to use the state of the art technologies and tools including Free and Open Source Software (FOSS) tools in developing software.

i. Graduates will demonstrate good performance at the competitive examinations like GATE, GRE, CAT for higher education.

j. Graduates will demonstrate their qualities of learning and demonstrating latest technology

k. Graduates will have developed the capability for self-learning.

CURRICULUM STRUCTURE OF B.TECH (E & TC)

Effective from A. Y. 2014-2015

Semester VII

Sr. No	Course Type/Code	Subject Title	Contact Hour			Credits
			L	T	P	
01	OEC or SEC	**Open Elective/ Science Elective Course	3	-	--	**3**
02	PCC	Microwave and Optical Communication	3	--	--	**3**
03	PCC	Computer Network	3	--	--	**3**
04	EC	Department Elective - I	3	--	--	**3**
05	LC	Microwave and Optical Communication Lab	--	--	2	**1**
06	LC	Computer Network Lab	--	--	2	**1**
07	LC	Department Elective – I Lab	--	--	2	**1**
08		Project Stage - 1	--	--	8	**4**
09	LLC	Liberal Learning Course	--	--	--	**1**
		Total	**12**	**0**	**14**	**20**

** Broadband Communication – offered by E & TC dept.

Department Elective – I:

- Image Processing
- Speech Processing
- Multi Rate and Adaptive DSP
- RISC Microcontrollers and DSP Processors
- CMOS VLSI Design
- Modeling and Simulation Techniques

Semester VIII

Sr. No	Course Type/Code	Subject Title	Contact Hours			Credits
			L	T	P	
01	OEC or SEC	**Open Elective/ Science Elective Course	3	--	--	**3**
02	PCC	Audio Video Engineering	3	--	--	**3**
03	PCC	Mobile Communication	3	--	--	**3**
04	EC	Department Elective - II	3	--	--	**3**
05	LC	Audio Video Engineering Lab	--	--	2	**1**
06	LC	Mobile Communication Lab	--	--	2	**1**
07	LC	Department Elective – II Lab	--	--	2	**1**
08		Project Stage - II	--	--	12	**6**
09	MLC	Intellectual Property rights	1	--	--	**1**
		Total	**13**	**0**	**18**	**22**

** Remote Sensing – offered by E & TC dept.

Department Elective – II:

- Joint Time Frequency Analysis
- Embedded Software and RTOS
- System Programming and Operating System
- RF Circuit Design
- Antennas Radiating System
- Satellite Communication
- Error Control Coding Techniques

EC Broadband Communication

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**
Mobile Communication: Mobile Communication principles, Architecture of GSM, Introduction to 2G to 4G systems such as GSM, HSCSD, GPRS, EDGE etc, principles of CDMA.

Unit 2 **(06)**
Satellite Communication: Satellite technology evolution, LEO, MEO, GEO satellites and their special services, orbital equations, link budget for C-band satellite, impact of satellite in Indian scenario

Unit 3 **(06)**
Fixed Wireless Systems: Microwave links, Private unlicensed links (Spread spectrum), MMDS (Multi-channel Multi-point distribution Service), LMDS (Local multipoint Distribution Service) (MMDS and LMDS are Video and Internet signal distribution services by wireless means.)

Unit 4 **(06)**
Wi-Fi and Wi-MAX technologies: introduction to Wi-Fi and Wi-MAX, Principles and parameters for Wireless LAN (IEEE 802.11 standards), operating principles for Wi-MAX (IEEE 802.16 standard), Comparison of Wi-Fi and Wi-MAX.

Unit 5 **(06)**
Optical Fiber Communication: Principles of optical fiber communication, significant features and advantages of optical fiber communication, Recent trend - FTTH (Fiber-To-The-Home) System.

Unit 6 **(04)**
Quality-of-Service (QoS) in Broadband: QoS issues in broadband communication, A case study of broadband service regulations for maintaining QoS by telecom regulatory bodies such as TRAI.

Text Books:

1. Theodore S. Rappaport, "Wireless Communications – Principles and Practice", PHI.
2. Louis E. Frenzel, "Principles of Electronic Communication Systems", Tata McGraw Hill.

Reference Books:

1. Timothy Pratt and Others, "Satellite Communications", Wiley India.
2. Recent QoS regulations released by TRAI (available on website of TRAI).

Course Outcomes:

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

- Compare cellular (mobile) communication systems from 2G to 4G and their impact on the society.
- Visualize the architecture of satellite systems as a means of broadband communication and also the Indian scenario in the satellite area.
- State key features and operating principles of Wi-Fi and Wi-MAX systems.
- State key features of optical fiber communication and its advantages, and appreciate the revolution brought by the systems such as FTTH.

PCC Microwave and Optical Communication

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Introduction to Microwaves: Microwave band designations, Advantages and applications of Microwaves, Propagation of microwave rectangular waveguides, TE and TM modes, Guide wavelength, Group and Phase Velocity, Power losses and power handling capacity of rectangular waveguide, Cavity Resonators.

Unit 2 **(06)**

Microwave Components: Scattering Parameters, Microwave T junctions, Directional Couplers, Ferrite devices, Microwave Filters, Microwave Tubes : Klystron and Magnetron, Solid state microwave devices: Varactor diodes, PIN diode, Gunn diode , Avalanche Transit time devices with their typical applications .

Unit 3 **(08)**

Microwave Communication systems: Analog Microwave Communication, Satellite Communication, Digital Microwave Communication, Microwave Antennas, and Radars. Microwave Hazards.

Unit 4 **(08)**

Optical fibers Structures, wave guiding and Fabrication: Optical Spectral bands, Basic optical laws and definitions, Optical fibers Modes and configurations, Single mode fibers, Graded index fiber structure, Photonic Crystal fiber, Fiber materials and fabrication. Signal Degradation in optical fiber: Attenuation, Dispersion.

Unit 5 **(06)**

Optical Sources and Detectors : Direct and Indirect band gap materials, Light Emitting Diodes(LED's),LED Structures, Laser Diodes, Laser diode rate equations, Structures and radiation patterns, Single mode laser, Properties of photo diodes, photo detector noises,

Fundamentals of Receiver operation, Digital receiver performance, Eye diagram, Coherent detection.

Unit 6 **(08)**

Digital Links: Point to point links, system consideration, power budget, Rise time budget, Power Penalties, Error control.

Text Books:

1. Gerd Keiser: Optical Fiber Communication 4th Edition: TMH.
2. M.Kulkarni" Microwave and Radar Engineering" Umesh Publications

Reference Books:

1. John M Senior: Optical Fiber Communications 2nd Edition: EEE
2. David M Pozar, "Microwave Engineering" Wiely 3rd Edition

Course Outcomes:

At the end of this course students will demonstrate the ability

- To understand and visualize the different modes of microwave and light wave propagation.
- To compare merits and demerits of various microwave and optical sources and detectors.
- To contribute in the areas of microwave and optical communication link design.
- To implement simple microwave and optical communication system and will be in a position to understand the developments in the technology of advanced communication.
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PCC Computer Network

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1

Introduction to computer networks and the Internet **(06)**

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

Unit 2 **(08)**

Switching in networks: Classification and requirements of switches, a generic switch, Circuit Switching, Time-division switching, Space-division switching, Crossbar switch and evaluation of blocking probability, 2-stage, 3-stage and n-stage networks, Packet switching, Blocking in packet switches, Three generations of packet switches, switch fabric, Buffering, Multicasting, Statistical Multiplexing.

Unit 3 **(08)**

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

Unit 4 **(06)**

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

Unit 5 **(08)**

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

Unit 6 **(06)**

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

Text books:

1. J.F. Kurose and K. W. Ross, "Computer Networking – A top down approach featuring the Internet", Pearson Education, 5th Edition
2. L. Peterson and B. Davie, "Computer Networks – A Systems Approach" Elsevier Morgan Kaufmann Publisher, 5th Edition.
3. T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall

Reference books:

1. S. Keshav, "An Engineering Approach to Computer Networking" , Pearson Education
2. B. A. Forouzan, "Data Communications and Networking", Tata McGraw Hill, 4th Edition
3. Andrew Tanenbaum, "Computer networks", Prentice Hall
4. D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall
5. William Stallings, "Data and computer communications", Prentice Hall

Course Outcomes:

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

- Understand the concepts of networking thoroughly.
- Design a network for a particular application.
- Analyze the performance of the network.

EC Image Processing

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(04)**

Introduction to image processing: Applications and fields of image processing, Fundamental steps in Digital image processing, Elements of visual perception, Image sensing and acquisition, Basic Concepts in Sampling and Quantization, representing digital images.

Unit 2 **(06)**

Image Enhancement in the Spatial Domain: Some basic gray level transformations, Histogram Processing, Histogram modification, Image subtraction, spatial filtering, Sharpening Spatial filters, use of first and second derivatives for enhancement ; LoG, Image Enhancement in the Frequency Domain, Gaussian filters, Homomorphic filtering, Pseudocolouring : intensity slicing, gray level to color transformation.

Unit 3 **(06)**

Image Segmentation : Some Basic Relationships between pixels, point, line and edge detection, Gradient operators, Canny edge detection, pyramid edge detection. Edge linking and boundary detection. Hough transform, Chain codes, boundary segments, skeletons, Boundary descriptors, Fourier descriptors, morphological operations.

Unit 4 **(06)**

Thresholding: The role of illumination, global thresholding, adaptive thresholding, use of boundary characteristics for histogram improvement and local thresholding, Region based segmentation, Region growing, region splitting and merging. Texture based segmentation.

Unit 5 **(08)**

Image Compression: Data redundancies Elements of information, variable-length coding uniform and non uniform Quantizers, predictive coding, Transform coding, Image compression standards; Wavelets and Multi- resolution processing: - Image pyramids, sub-band coding.

Unit 6 **(06)**

Basics of Image restoration, Color image processing, Applications of Image Processing: Finger print analysis, Digital watermarking, Optical character recognition etc.

Text Books:

1. Gonzalez & Woods, "Digital Image Processing", Second Edition, Pearson Education, 2003
2. Pratt W.K, "Digital Image Processing", Third Edition, John Wiley & Sons, 2001

Reference Book:

1. Milan Sonka et al, "Image Processing, Analysis and Machine Vision", Second Edition, Thomson Learning, 2001
2. B. Chanda & D. Dutta Majumder, " Digital Image Processing and Analysis", 2001

Course Outcomes:

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

- Understand and apply knowledge of various transforms (Walsh, Hadamard, Fourier, DCT etc) and probability theory in image processing
- Understand digital image processing fundamentals like enhancement, encoding, feature extraction, segmentation and restoration.
- Analyze, apply and critically evaluate various image processing algorithms appropriate for practical applications

EC RISC Microcontrollers and DSP Processors

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

The Cortex-M3 processor: Applications, Simplified view – block diagram, programming model – Registers, Operation modes, Exceptions and Interrupts, Reset Sequence.

Unit 2 **(08)**

Instruction Set, Unified Assembler Language, Memory Maps, Memory Access Attributes, Permissions, Bit-Band Operations, Unaligned and Exclusive Transfers. Pipeline, Bus Interfaces.

Unit 3 **(08)**

Exceptions, Types, Priority, Vector Tables, Interrupt Inputs and Pending behavior, Fault Exceptions, Supervisor and Pendable Service Call, Nested Vectored Interrupt Controller, Basic Configuration, SYSTICK Timer, Interrupt Sequences, Exits, Tail Chaining, Interrupt Latency.

Unit 4 **(08)**

LPC 17xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT .

Unit 5 **(02)**

Programmable DSP (P-DSP) Processors - Harvard architecture, Multi port memory, architectural structure of P-DSP- MAC unit, Barrel shifters, Introduction to TI DSP processor family.

Unit 6 **(05)**

VLIW architecture and TMS320C6000 series, architecture study-, data paths, cross paths, Introduction to Instruction level architecture of C6000 family, Assembly Instructions memory

addressing, for arithmetic, logical operations, Assembly instructions for single precision, SUBC, CCS, C programming, Assembly routine call from C program, Code Composer Studio for application development for digital signal processing, On chip peripherals.

Unit 7 **(03)**

Introduction to Fuzzy Logic, Fuzzy relations, Fuzzy Inference process, Fuzzy controller and stability considerations, and Fuzzy controllers on DSP 6713 kit - Implementation issues.

Text Books:

1. Joseph Yiu, "The definitive guide to ARM Cortex-M3", Elsevier, 2nd Edition.
2. Venkatramani B. and Bhaskar M. "Digital Signal Processors: Architecture, Programming and Applications" –Second Edition TMH.
3. Ahmad M Ibrahim," Fuzzy Logic for Embedded Systems Applications", Elsevier.

Reference books:

1. NXP Semiconductor 1768 Microcontroller datasheet and User Manual.
2. Sloss Andrew N, Symes Dominic, Wright Chris, "ARM System Developer's Guide: Designing and Optimizing", Morgan Kaufman Publication.
3. Steve furber, "ARM System-on-Chip Architecture", Pearson Education.
4. Frank Vahid and Tony Givargis, "Embedded System Design", Wiley.
5. Lapsley P., Bier J., Shoham A., Lee E.A. "DSP Processor Fundamentals-Architecture and Features" (IEEE Press).
6. Dag Stranneby and William Walker, "Digital Signal Processing and Applications", second edition, Elsevier.
7. Technical references and user manuals on www.arm.com and Texas Instruments www.ti.com

Course Outcomes:

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

- Know architecture and programmer's model of ARM cortex-M3 processor core.
- Utilize GNU software tool chain for programming the LPC 17xx microcontroller.
- Become proficient in programming of embedded platforms based on NXP Semiconductor's LPC 17xx microcontroller processor and the peripheral support available on the chip.
- Identify and formalize architectural level characterization of Programmable DSP Processors.
- Design, program, and testing (assembly and C) code using Code Composer Studio environment for TMS320C6713 DSP Processor.
- Deploy DSP hardware for Fuzzy Logic controller and Signal processing applications.

EC CMOS VLSI Design

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(07)**

Unit Processes in IC Fabrication: Technology Scaling and Road map, Scaling issues, Standard
4 mask nMOS and 16 mask CMOS Fabrication process, Clean room, Wafer Cleaning Technology, Unit Processes in IC Fabrication, Advanced CMOS Technologies: Gigascale Dilemma, Short Channel Effects, High–k, Poly Gate, Metal Gate Technology, FinFET, TFET.

Unit 2 **(06)**

Introduction to design Basic MOS structure and its static behavior; Quality metrics of a digital
design: Cost, functionality, robustness, power, and delay, Stick diagram and Layout, Electrical wire models.

Unit 3 **(07)**

CMOS Inverter Static CMOS inverter, switching threshold and noise margin concepts and their evaluation, dynamic behavior, power consumption.

Unit 4 **(08)**

Designing Combinational Logic gates in CMOS Static CMOS design issues, ratioed logic, pass transistor logic, dynamic logic, speed and power dissipation in dynamic logic, cascading dynamic gates, CMOS transmission gate logic.

Unit 5 **(07)**

Designing Sequential Logic Circuits in CMOS Static latches and registers, bi-stability principle, MUX based latches, static SR flip-flops, master-slave edge-triggered register, dynamic latches and registers, concept of pipelining, pulse registers, non-bistable sequential circuit.

Unit 6 **(06)**

Design of SoC based components Concept, Interconnection and challenges. Overview of SoC
Physical Design flow: Floor planning, Placement, Clock tree synthesis, Routing, Physical verification. Power analysis and IR drop estimation - static and dynamic, ESD protection-human body model, machine model.

Text Books

1. J P Rabaey, A P Chandrakasan, B Nikolic, "Digital Integrated circuits: A design perspective", 2nd edition, Prentice Hall electronics and VLSI series.

References

1. http://bwrc.eecs.berkeley.edu/IcBook/index.htm
2. R J Baker, "CMOS circuit Design, Layout and Simulation", 2008, IEEE Inc.
3. Kang, S. and Leblebici, Y., "CMOS Digital Integrated Circuits, Analysis and Design", 3rdEd., Tata McGraw-Hill.
4. http://edu.cs.tut.fi/soc-sme/SoC_intro2003.pdf

Course Outcomes:

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

- Design simple and complex digital circuits using CMOS keeping in view the design metrics.
- Analyze and optimize process at the individual gate level and how these gates can be connected together to form the building blocks of a system.

EC Multi Rate and Adaptive DSP

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Multi rate DSP, Sampling rate conversion, poly phase filters, multistage decimator & interpolator, QMF, digital filter banks Multi rate DSP.

Unit 2 **(06)**

DFT in spectral estimation, Adaptive filters & spectral estimation.

Unit 3 **(06)**

Filter Structures: Direct form IIR and FIR filter structure, Lattice structure.

Unit 4 **(06)**

The Task of an Adaptive Filter, Applications of Adaptive Filters, System Identification, Inverse Modeling, Linear Prediction, Feed-forward Control.

Unit 5 **(06)**

Gradient-Based Adaptive Algorithms, General Form of Adaptive FIR Algorithms, The Mean-Squared Error Cost Function, The Wiener Solution, The Method of Steepest Descent, The LMS Algorithm, Other, Stochastic Gradient Algorithms. Finite-Precision Effects and Other Implementation Issues, System Identification Example. Minimum mean square criterion, , LMS algorithm, Recursive least square algorithm.

Unit 6 **(04)**

Application of DSP & Multi rate DSP. Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.

Text Books:

1. J.G. Proakis and D.G .Manolakis Digital signal processing: Principles, algorithm and applications, Macmillan publishing
2. Ifeachor E.C., Jervis B.W. Digital signal processing, a Practical approach, 2 nd ed. Pearson edu. 2003.
3. Salivahanan, Vallavaraj & Gnanpriya Digital signal processing:: Tata Mcgraw Hill

Reference Books:

1. S.W.Smith Digital signal processing: A practical guide for engineers and scientists, Elsevier
2. S.K.Mitra , Digital signal processing:: Tata Mcgraw Hill
3. Adaptive signal processing, Bernard Widrow, S.D. Stearns, Prentice Hall 1985
4. Multirate digital signal processing, Crochiere, Prentice Hall,1983.

Course Outcomes:

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

- Understand theory of adaptive filters and algorithms
- Understand theory of multi-rate DSP, solve numerical problems and write algorithms
- Understand theory of prediction and solution of normal equations
- Know applications of adaptive filters and multi rate DSP at block level.

EC Speech Processing

Teaching Scheme
Lectures : hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Principle Characteristics of Speech: Linguistic information, Speech and Hearing, Speech production mechanism, Acoustic characteristic of speech Statistical Characteristics of speech. Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model.

Unit 2 **(06)**

Speech Analysis and Synthesis Systems: Digitization, Sampling, Quantization and coding, Spectral Analysis, Spectral structure of speech, Autocorrelation and Short Time Fourier transform, Window function, Sound Spectrogram, Mel frequency Cepstral Coefficients, Filter bank and Zero Crossing Analysis, Analysis –by-Synthesis ,Pitch Extraction.

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Unit 3 **(06)**

Linear Predictive Coding Analysis: Principle of LPC analysis, Maximum likelihood spectral estimation, Source parameter estimation from residual signals, LPC Encoder and Decoder, PARCOR analysis and Synthesis, Line Spectral Pairs, LSP analysis and Synthesis.

Unit 4 **(06)**

Speech Coding: Reversible coding, Irreversible coding and Information rate distortion theory, Coding in time domain: PCM, ADPCM, Adaptive Predictive coding, Coding in Frequency domain: Sub band coding, Adaptive transform coding, Vector Quantization, Code Excited Linear Predictive Coding (CELP).

Unit 5 **(06)**

Speech Recognition: Principles of speech recognition, Speech period detection, Spectral distance measure, Structure of word recognition system, Dynamic Time Warping (DTW), Theory and implementation of Hidden Markov Model (HMM).

Unit 6 **(06)**

Speaker recognition: Human and Computer speaker recognition Principles, Text dependent and Text Independent speaker recognition systems. Applications of speech Processing.

Text Books:

1. Rabiner and Schafer, "Digital Processing of Speech Signals", Pearson Education.
2. Shaila D. Apte "Speech and Audio Processing" Wiely Precise.

Reference Books:

1. Rabiner and Juang, "Fundamentals of Speech Recognition", Pearson Education.
2. Sadaoki Furui, "Digital Speech Processing, ,Synthesis and Recognition" 2/e.

Course Outcomes:

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

- Analyze speech signal and use it for development of interactive voice response systems.
- Design a reliable isolated speech recognition system for a limited vocabulary.
- Participate in the research area of automatic speech recognition and speech coding.

EC Modeling and Simulation Techniques

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Introduction to Computer Simulation: Principle of Computer Modeling and Simulation - Monete Carlo Simulation - Nature of Computer Modeling and Simulation, , types of simulation, Simulation as a decision making tool.

Unit 2: **(07)**

Random Numbers and Random Variables: Pseudo Random Numbers - Techniques for Generating Random Numbers - Tests for Random Numbers - Inverse transform technique - exponential distribution - uniform distribution - Weibull distribution.

Unit 3 **(07)**

Distributions: Empirical Discrete Distribution - Discrete Uniform Distribution - Poisson Distribution - Geometric Distribution - Acceptance - Rejection Technique for Poison Distribution - Gamma Distribution.

Unit 4 **(08)**

Verification and Validation: Variance reduction technique, Verification and Validation of Simulation models, Discrete Event Simulation - Concepts in Discrete - Event Simulation, Manual Simulation using event Scheduling, Single Channel Queue, two server queue.

Unit 5 **(06)**

Continuous and Discrete event modeling and simulation: Representing complex behavior through computer program framework using core concepts of entities, events, resources, queues and time.

Unit 6 **(06)**

Introduction to Simulation Languages: Development of simulation models using simulation languages like GPSS – SIMSCRIPT. Agent based modeling methodologies.

Text Books:

1. Jerry Banks and John S.Carson, Barry L. Nelson, David M. Nicol, "Discrete Event System Simulation", Prentice Hall, India, 3rd Edition 2002.
2. Narsingh Deo, "System Simulation with Digital Computer", PHI, 2001.

Reference Books:

1. B.P. Zeigler, H. Praehofer, T.G. Kim, "Theory of Modeling and Simulation"
2. Introduction to System Modeling & Simulation, Introduction to System Modeling & Simulation, Elsevier

Course outcomes:

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

- Understand the steps of modeling and experimenting simulation.
- Apply statistical knowledge and modeling techniques to construct simulation models
- Interpret and analyze and simulation results

LC Microwave and Optical Communication Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Study of X –band Microwave Bench.
2. Verifying the properties of microwave components and finding their scattering matrix.
3. Study of Gunn diode and PIN diode characteristics.
4. Finding the radiation pattern of microwave horn antenna.
5. Measurement of attenuation of fiber and observing effect of bending losses.
6. Fiber optic Communication: Analog Link & Digital Link.
7. Optical Power Vs Drive Current Characteristics of Laser Diode.
8. OPTSIM 1:Power Budget Simulation
9. Wavelength Division Multiplexing (WDM)
10. Optical Time Domain Reflectometer(OTDR)

Course Outcomes:

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

- Study and Utilize microwave bench and equipments in detail.
- Use optical devices in the appropriate applications.

LC Computer Network Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. To develop C/C++ code for PC to PC communication using serial port – Emulation of TALK and Simple File Transfer
2. To install and study network simulation tool NS2
3. To simulate networks and analyze performance in NS2
4. To capture packets using Wireshark and analyze them at all the layers of network
5. Dijkstra's shortest path algorithm for routing table updation
6. To write C/C++ code for socket programming to implement file transfer
7. To implement 1-bit sliding window protocol in C/C++
8. Case study of existing networks and components, ways to connect to internet

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

- Understand the working principle of standard network applications and their implementation on network edge devices.
- Assess intricacies and develop 'C/C++' codes for certain network applications
- Analyze protocols at different layers of networks with the help of packet capturing tool such as Wireshark.
- Understand and use network simulation tool NS2 for simulating different networks and analyze their performance.

LC Image Processing Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work : 50 Marks
Practical : 50 Marks

List of Experiments:

1. To plot Histogram and profile for a given gray scale image and compute mean, variance and standard deviation for a given gray scale image.
2. To implement spatial filtering on image by using LPF, HPF and Median filter.
3. To implement histogram equalization.
4. To implement Canny Edge Detection algorithm.
5. To implement Pseudocolor image processing by using intensity slicing.

6. To implement region growing algorithm.
7. To study bitmap format of an image.
8. To implement quantization and compression of an image.
9. To implement Edge thinning algorithm.

Course Outcomes:

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

- Understand and implement the principles of Image Processing.
- Develop 'C/C++/MATLAB' codes for certain Image Processing Applications.

LC RISC Microcontrollers and DSP Processors Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments based on RISC Microcontroller:

1. Blink an LED.
2. Blink an LED using delay generated using the SysTick timer.
3. Blink LEDs in a controlled pattern.
4. System clock real time alteration using the PLL modules.
5. Control intensity of an LED using PWM implemented in software.
6. Control intensity of an LED using PWM implemented in hardware.
7. Control intensity of an RGB LED to generate composite colors using PWM implemented in software.
8. Control intensity of an RGB LED to generate composite colors using PWM implemented in hardware.
9. Control an LED using switch by polling method.
10. Control an LED using a switch by interrupt method and flash the LED once every five switch presses.
11. UART Echo Test.
12. Control intensity of an LED on parameters received over UART.
13. Take analog readings on rotation of rotary potentiometer connected to an ADC channel.
14. Temperature indication on an RGB LED.
15. Display temperature on PC by sending values over UART.
16. Mimic light intensity sensed by the light sensor by varying the blinking rate of an LED.
17. Plot light intensity sensed by light sensor on PC.
18. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.
19. System reset using watchdog timer in case something goes wrong.

20. Sample sound using a microphone and display sound levels on LEDs.
21. Filter the sound input using three filters of high, medium and low frequencies and show output on LEDs, one for each filter.
22. Sample sound and plot amplitude v/s time on PC.
23. Sample sound and analyze its spectrum using FFT and plot amplitude v/s frequency results on PC.
24. Generate a Real time clock using the 32-bit timers and output time over UART.

List of Experiments based on DSP Processors

The practical laboratory focuses on the TI DSP6000 platform tools using the Code Composer Studio (CCS) –Ver. 5 onwards under Windows 7 and the DSK6713 kit.

Phase I: Preliminaries of Code Composer Studio and DSK6713 Kit

The experiments in this phase are oriented to familiarize students with the basics of C6713 processor interface through Code Composer Studio, Simulation and DSK6713 kit exposure.

1. Installation of the Code Composer Studio Tool
2. Creating a new project and addition of include files to the project
3. Compilation and Execution of C programs and checking the results using the Simulator mode of CCS
4. Study and familiarity with the DSK 6713 kit
5. On-Line diagnostic for the DSP 6713 kit
6. Practice C programming in Simulator mode
7. Practice C programming in Simulator mode for Fuzzy logic operations

Phase II: TMS320C6713 Architecture, Instruction Set Studies

The experiments in this phase are oriented to familiarize students with the basics of C6713 processor Architecture, Assembly language Instruction set, and the register usage of the C runtime model using Code Composer Studio Version 5 in Windows 7 platform. It is organized as C6713 Processor, Assembly Language Programming, Application Programming using C Language, Use of Pseudo Instructions: Impact of NOP instructions and IDLE instructions, Timing Analysis for C6713 processor using on chip timer registers and DSK Board /Kit. At least one experiment on each of these modules.

(A) DSKC6713 Kit

(B) Assembly Language Programming: Assembler Directives like .set . data , .equ and Simply Assembly programming practice.

(C) Application Programming using C Language: Use of Code Compiler Studio Version 5 with C Compiler and Assembly routines, setting of paths, include, linker options, disassembly, verification of variables, registers and memory locations

(D) Use of Pseudo Instructions: Impact of NOP instructions and IDLE instructions.

(E) Timing Analysis for C6713 processor using on chip timer registers.

(F) DSK Board /Kit

1. Functional unit assignments:
2. Verify the contents of core data path registers (DSP processor set in little endian mode)
3. Computation of two complex number multiplication using assembly code. Assume the complex numbers C1 = 3 + j4 and C2 = 6 + j8
4. Write an assembly code to compute Euclidian distance between two points (3, 4) and (6, 8). Write a C program to use this assembly code as a function.
5. Write an assembly function for *min*-fuzzy operation and use it in a C-program code to compute a fuzzy relation for the fuzzy sets.
6. Explore the assembly code for NOP / IDLE effectiveness.
7. Estimate the MAC per second for the TMS320C6713 processor
8. Sine wave Generation and playing audio note through Codec.

Course outcomes:
After completing the course, students will demonstrate ability to

- Design and implement energy efficient circuits.
- Develop a system using the concepts of RISC architecture, ARM and DSP processors.
- Write software programs for ARM and DSP processor to develop a suitable application.
- Select a suitable bus type for design and development of a particular system.

LC CMOS VLSI Design Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. nMOS, pMOS – (90nm, 130nm, 180nm) – DC characteristics.
2. nMOS, pMOS – (90nm, 130nm, 180nm) –AC characteristics.
3. nMOS, pMOS – (90nm, 130nm, 180nm) –Transient characteristics (Static & Dynamic behavior).
4. Threshold voltage extraction methods.
5. CMOS Inverter – Butterfly curve, Noise Margin calculation.
6. CMOS Inverter Layout using MAGIC tool.
7. Ring Oscillator and FSK – Propagation delay
8. Gates and Combinational circuits design
9. Sequential circuits design
10. 6T SRAM design - evaluation of RNM and WNM from butterfly curves
11. Sense Amplifier design
12. Common Source amplifier and common drain amplifier design.
13. Differential amplifier design.
14. Instrumentation amplifier design.

Course Outcomes:
After completing the course, students will demonstrate ability to

- Use various design metrics, design simple and complex digital and analog circuits.
- Use various EDA tools for designing at the circuit level.

LC Multi Rate and Adaptive DSP Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Design of LMS, RLS filters
2. Filter structure realizations
3. Up , down sampling and combination
4. System identification
5. Noise cancellation
6. Application of wavelets for multi-rate signal processing
7. Mean square filters, optimization of error function
8. Application of multi-rate and adaptive filters in image processing and speech processing.

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

- Understand main principles for achieving computationally efficient solutions for sampling rate conversion by integer factors.
- Evaluate filter complexity which depends on the receiver (or transmitter) system design.
- Understand filter optimization techniques, alternative filter structures, and extensive comparisons of different solutions.

LC Speech Processing Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Estimate various parameters of speech such as intensity, pitch, formant frequencies and spectrogram.
2. Estimate the short time energy and zero crossing rate of speech signal.
3. Study of effect of analysis window on frequency resolution of spectrogram.

4. Computing the Linear Predictive Coefficients of speech signal.
5. Computing Mel Frequency Cepstrum Coefficients of speech signal.
6. Using dynamic programming principle compute the minimum edit distance between input and template strings
7. Using Dynamic Time Warping algorithm compute the difference in utterance and speech template.
8. Write a program for isolated word recognition using LPC/MFCC as feature and VQ as classifier.
9. Write a program for speaker identification and verification.
10. Write a program for forward algorithm for recognizing an isolated word using HMM.

Course Outcomes:

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

- Understand the signal processing techniques used in speech analysis, synthesis and perception studies.
- Understand pattern recognition techniques used in automatic speech recognition and simulations of human speech perception.

LC Modeling and Simulation Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Practical: 50 Marks

List of Experiments:

A. Common Experiments for all Students

1. Object oriented programming concepts and familiarity with OOPS software process
2. Random variate generation for specified p.d.f. – code module development
3. Monto Carlo Integration and variance reduction techniques – library development
4. Study of discrete Event Simulation Language GPSS
5. Study of DEVS suite Simulator and CoSMoS Modeler

B. Case study oriented experiments

1. Study of (M/M/1) queue techniques, code implementation and analysis
2. Cobweb model for marketing a product – code development and testing for a system
3. Discrete Simulation and its application like simulation model for missile attack - Study
4. Simulation of queuing systems – code library development
5. Inventory control model – code library development

Note: This laboratory assumes computer programming aptitude and students will develop requisite programming skill set for effective OOPS programming through extra self study, if needed

Course Outcomes:

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

- Understand and evaluate the interactions of parts of a real or theoretical system by designing its representation (model) and executing (running) the model with time and space dimension (simulation).
- Use object oriented programming (C++/Java) styles to develop software library modules.

OEC-II Remote Sensing

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(07)**

Physics Of Remote Sensing: Electro Magnetic Spectrum, Physics of Remote Sensing- Effects of Atmosphere- Scattering – Different types –Absorption-Atmospheric window- Energy interaction with surface features – Spectral reflectance of vegetation, soil ,and water atmospheric influence on spectral response patterns- multi concept in Remote sensing.

Unit 2 **(08)**

Data Acquisition: Types of Platforms – different types of aircrafts-Manned and Unmanned spacecrafts –sun synchronous and geo synchronous satellites – Types and characteristics of different platforms – LANDSAT,SPOT,IRS,INSAT,IKONOS,QUICKBIRD etc – Photographic products, B/W, colour, colour IR film and their characteristics – resolving power of lens and film - Opto mechanical electro optical sensors – across track and along track scanners multispectral scanners and thermal scanners – geometric characteristics of scanner imagery - calibration of thermal scanners.

Unit 3 **(08)**

Scattering System: Microwave scatterometry – types of RADAR – SLAR – resolution - range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave imagestopographic effect - different types of Remote Sensing platforms –airborne and space borne sensors – ERS, JERS, RADARSAT, RISAT - Scatterometer, Altimeter- LiDAR remote sensing, principles, applications.

Unit 4 **(08)**

Thermal And Hyper Spectral Remote Sensing: Sensors characteristics - principle of spectroscopy - imaging spectroscopy – field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications.

Unit 5 **(09)**

Data Analysis: Resolution – Spatial, Spectral, Radiometric and temporal resolution- signal to noise ratio- data products and their characteristics - visual and digital interpretation –Basic principles of data processing –Radiometric correction –Image enhancement – Image classification – Principles of LiDAR, Aerial Laser Terrain Mapping.

Text and Reference Books:

1. Lillesand T.M., and Kiefer, R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6th Edition.
2. John R. Jensen , Introductory Digital Image Processing: A Remote Sensing Perspective , 2nd Edition, 1995.
3. John A.Richards, Springer –Verlag, Remote Sensing Digital Image Analysis 1999.
4. Paul Curran P.J. Principles of Remote Sensing, ELBS; 1995.
5. Charles Elachi and Jakob J. van Zyl , Introduction To The Physics and Techniques of Remote Sensing , Wiley Series in Remote Sensing and Image Processing, 2006.
6. Sabins, F.F.Jr, Remote Sensing Principles and Image interpretation, W.H. Freeman & Co, 1978.

Course Outcomes:

After completing the course, students will demonstrate ability to

- Provide knowledge and understanding of the basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles;
- Provide examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

PCC Audio Video Engineering

Teaching Scheme
Lectures : hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(08)**
Introduction to basic principles of television
Perception of signal by human eyes, Color TV systems, Television basics, color fundamental, mixing of Colors, color perception, chromaticity diagram, color TV camera and picture tubes. Display devices FL, LCD, TFT.

Unit 2 **(08)**
Analog Television
NTSC, PAL, SECAM system, Color TV transmitter, high level, low level transmitters,color TV receivers remote control, antenna transmission, TV alignment and fault finding with wobbuloscope and TV pattern generator, field strength meter.

Unit 3 **(08)**
Digital Television
Introduction to Digital TV, Principle of Digital TV, Digital TV signals and parameter, MAC signals, advanced MAC signal transmission, Digital TV receivers, NTSC, DTV, MPEG 2, JPEG 4 MAC production tools, Digital compression techniques, H. and G. standards, digital TV recording techniques/ broadcasting.

Unit 4 **(08)**
Advances in Digital TV:-
HDTV standards and systems HDTV transmitter and receiver/ encoder, satellite TV,video on demand, CCTV, CATV, direct to home TV, set top box, conditional access system (CAS) introduction to 3D stereoscopic systems, digital broadcasting AV setup case study (Cricket match, Marathon, Foot ball match)

Unit 5 **(04)**
Audio processing
Methods of sound recording and reproduction, optical magnetic recording, CD recording, CD DVD player, MP3 player, MPEG audio standards.

Unit 6 **(04)**
Audio processing
Studio Acoustics chamber, reverberation, PA system for auditorium, Acoustics chamber cordless microphone systems, special type of speakers/ cell phones. Introduction to satellite radio reception (world space).

Text books:

1. A.M. Dhake, "Television and Video Engg'", TMH publication.
2. Vasudev Bhaskran," Image and Video Compression Standards", Kluwer Academic Publication, Second Edition
3. R. G. Gupta, "Audio Video systems", Technical Education

Reference books:

1. S. P. Bali, " Colour TV theory and practice"
2. Benard Globb, Charles E. Herndon, "Basic TV and Video systems"
3. Gulati, "Monochrome and Colour TV", PHI

Course Outcome:

After completing the course, students will demonstrate ability to

- Compare different video standards analog and digital TV
- Understand audio recording and compression techniques

PCC Mobile Communication

Teaching Scheme
Lectures : hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Cellular Communication Fundamentals: Cellular system design, Co channel interference ratio, Co channel interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment, Frequency reuse channels, concepts of cell splitting, handover in cellular system.

Unit 2 **(06)**

Multiple access technologies: Frequency Division Multiple access (FDMA), Time Division Multiple access (TDMA), Code Division Multiple access (CDMA), spectral efficiency calculations, comparison of T/F/CDMA technologies based on their signal separation techniques, advantages, disadvantages and application areas.

Unit 3 **(08)**

GSM Architecture and Interfaces: Introduction to GSM subsystems, GSM Interfaces, GSM architecture, details of following blocks in GSM (Mobile station, Base station systems, Switching subsystems, Home location registers, Visiting location registers, Equipment identity register, Echo canceller), Mapping of GSM layers onto OSI layers, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.

Unit 4 **(08)**

Mobile Radio Propagation: Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration

into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread, Doppler Spread; Rayleigh and Ricean Distributions.

Unit 5 **(06)**

Higher Generation Cellular Standards: 2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE, 3 G Standards: evolved EDGE.

Unit 6 **(08)**

Code Division Multiple Access: Introduction to code division multiple access technology, Diversity, Combining and antennas, IS 95 system Architecture, Air Interface, Forward Link, Reverse link, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (cdmaOne)to cdma 2000.

Text books

1. V.K.Garg, J.E.Wilkes, "Principle and Application of GSM", Pearson Education.
2. V.K.Garg, "IS-95 CDMA & CDMA 2000", Pearson Education.
3. T.S.Rappaport, "Wireless Communications Principles and Practice", II Ed. PHI

Reference books

1. William C.Y.Lee, "Mobile Cellular Telecommunications Analog and Digital Systems", II Ed. TMH.
2. Asha Mrhrotra, "A GSM system Engineering" Artech House Publishers Bosten, London.

Course Outcomes:

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

- Use principles and technique to design appropriate mobile communication systems.
- Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques
- Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages.
- Analyze and design GSM system knowing system architecture, mapping of functional layers, different Call flows.
- Analyze path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
- Analyze and design CDMA system functioning with knowledge of forward and reverse channel details.

EC Joint Time Frequency Analysis

Teaching Scheme
Lectures : hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Introduction: Review of Fourier Transform, Parseval Theorem and need for joint time-frequency Analysis. Concepts of non-stationary signals, Short-time Fourier transform (STFT), Uncertainty Principle, Localization/Isolation in time and frequency, Hilbert Spaces, Banach Spaces, Fundamentals of Hilbert Transform.

Unit 2 **(06)**

Bases for Time-Frequency Analysis: Wavelet Bases and filter Banks, Tilings of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.

Unit 3 **(08)**

Multiresolution Analysis: Haar Multiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of upsamplers and downsamplers, Conditions for alias cancellation and perfect reconstruction, Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal framework of Haar 2-band filter bank.

Unit 4 **(08)**

Wavelets: Daubechies Wavelet Bases, Daubechies compactly supported family of wavelets, Daubechies filter coefficient calculations, Case study of Daub-4 filter design, Connection between Haar and Daub-4, Concept of Regularity, Vanishing moments. Other classes of wavelets like Shannon, Meyer, Battle-Lamarie.

Unit 5 **(08)**

Bi-orthogonal wavelets and Applications: Construction and design. Case study of bi-orthogonal 5/3 tap design and its use in JPEG 2000. Wavelet Packet Trees, Time-frequency localization, compactly supported wavelet packets, case study of Walsh wavelet packet bases generated using Haar conjugate mirror filters till depth level, Lifting schemes for generating orthogonal bases of second-generation wavelets.

Unit 6 **(06)**

JTFA Applications: Riesz Bases, Scalograms, Time-Frequency distributions: fundamental ideas, Applications: Speech,audio, image and video compression; signal denoising, feature extraction, inverse problem.

Text Books

1. S. Mallat, "A Wavelet Tour of Signal Processing," Academic Press, Second Edition, 1999.
2. L. Cohen, "Time-frequency analysis", Prentice Hall, 1995.

Reference Books

1. G. Strang and T. Q. Nguyen, "Wavelets and Filter Banks", Wellesley-Cambridge Press, Revised Edition, 1998.
2. Daubechies, "Ten Lectures on Wavelets", SIAM, 1992.
3. P. P. Vaidyanathan, "Multirate Systems and Filter Banks", Prentice Hall, 1993.
4. M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding", Prentice Hall, 1995 24

Course outcomes:

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

- Understand shortcomings of Fourier transforms for completeness of signal analysis.
- Understand short time Fourier transform and its limitations.
- Show introductory yet detailed knowledge of wavelets.
- Use wavelets and operators to various systems for analysis purpose.

EC Embedded Software and RTOS

Teaching Scheme
Lectures : hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(08)**

RTOS Concepts: Foreground and background systems, Critical section, Shared Resources, Tasks, Multitasking, Context Switching, Kernels, Pre-emptive and non pre-emptive Schedulers, Static and Dynamic Priorities, Priority Inversion, Mutual exclusion, Synchronization , Inter task communication mechanisms, Interrupts: Latency, Response and recovery, Clock Tick, Memory Requirements.

Unit 2 **(08)**

Structure of μCOS-II: Kernel Structure: Tasks, Task States, TCB, Ready List, Task Scheduling, Task Level Context Switching, Locking and unlocking of scheduler, Idle Task, Statistics Task, Interrupts, Clock Tick, Initialization, Starting the OS. Task Management: Creating/ Deleting and Suspending/ Resuming Tasks, Task Stacks and checking, Changing Task's Priority. Time Management: Delaying/Resuming Task, System Time. Event Control Blocks: Initialization of ECB, Placing/Removing Task from ECB waitlist, Finding Highest Priority Task, List of Free ECB, Task State Management.

Unit 3 **(06)**

Synchronization in μCOS-II: Semaphore Management: Creation/Deletion, Pending /Posting / Acceptance / Query. Mutual Exclusion Semaphores: Creation/Deletion, Pending /Posting /

Acceptance / Query Event Flag Management: Internals, Creation/Deletion of Event Flag groups, Waiting / Setting / Clearing / Looking for / Querying an Event Flag Group.

Unit 4 **(06)**

Communication in μCOS-II: Message Mailbox Management: Creating / Deleting a MailBox, Waiting / Sending / Getting without waiting a Message from MailBox, Status of MailBox, Alternate uses of MailBox, Message Queue Management: Creating / Deleting / Flushing a Message Queue, Waiting / Sending / Getting without waiting a Message from Queue, Status and Alternate use of Message Queue.

Unit 5 **(06)**

Memory management and Porting of μCOS-II: Memory Management: MCB, Creating a partition, Obtaining / Returning / Waiting for a memory Block, Partition Status. Porting of μCOS-II: Development Tools, Directories and Files, Configuration and testing of Port.

Unit 6 **(06)**

Real Time Application using μCOS-II: Automatic Chocolate Vending Machine, Temperature Controller.

Text Books:

1. Jean Labrosse: MicroC/OS-II The Real Time Kernel: CMP Books, 2nd Edition
2. Raj Kamal: Embedded Systems – Architecture: Programming and Design: TMH

Course outcomes:

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

- Distinguish a real-time system from other systems.
- Evaluate the need for real-time operating systems.
- Implement the real-time operating system principles.
- Appreciate the use of multitasking techniques in real-time systems.

EC RF circuit Design

Teaching Scheme
Lectures : hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(08)**

Transmission Line Analysis: Examples of transmission lines , Equivalent circuit representation, Theoretical foundation, Circuit parameter for a parallel plate transmission line, General transmission line equation, Microstrip lines, Terminated lossless transmission line, Special termination conditions, Sourced and loaded transmission line. RF behavior of passive components, chip components and circuit board considerations.

Unit 2 **(04)**

The Smith Chart: From reflection coefficient to load impedance, Impedance transformation, Admittance transformation, Parallel and series connections. Single and Multiport Networks: Definitions, Interconnecting networks, Network properties and application, Scattering parameters.

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Unit 3 **(06)**

RF Filter Design: Basic resonator and filter configuration, Special filter realizations, Filter implementation, Coupled filter. Active RF Components: Semiconductor basics, RF diodes, Bipolar-junction transistor, RF field effect transistors, High electron mobility transistors.

Unit 4 **(06)**

Active RF Component Modeling: Diode models, Transistor models, measurement of active devices, Scattering parameter device characterization. Matching and Biasing Networks: Impedance matching using discrete components, Microstrip line matching networks, Amplifier classes of operation and biasing and networks.

Unit 5 **(06)**

RF Amplifier Design: Characteristics of amplifiers, Amplifier power relations, Stability considerations, Constant gain, Noise figure circles, Constant VSWR circles, Broadband amplifiers, High power amplifiers, Multistage amplifiers.

Unit 6 **(06)**

Oscillator and Mixers: Basic oscillator model, High frequency oscillator configurations- fixed frequency, dielectric resonator, YIG-tuned, voltage control Gunn element, Basic characteristics of mixers-concepts, frequency domain consideration, single ended mixer design, single and balanced mixer.

Text Books:

1. Reinhold Ludwig: "RF circuit Design Theory and Applications". Pearson Education
2. Radmanesh:"RF and Microwave Electronics Illustrated", Pearson Education

Course Outcomes:

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

- Select the passive and active components for a particular RF circuit design
- Design and develop a prototype for RF filters, amplifiers, oscillators and mixer.

EC Antenna Radiating Systems

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(03)**

Introduction: Types of Antenna, Radiation Mechanism, Current distribution on thin wire antenna.

Unit 2 **(08)**

Antenna fundamentals: 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, Friis Transmission equation, Antenna Temperature.

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 3 **(07)**

Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current.

Unit 4 **(07)**

Linear 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, non uniform amplitude, array factor, binomial and dolph chebyshev array.

Unit 5 **(08)**

LF to HF Antennas: Structural details, dimensions, radiation pattern, specifications, features and applications of following antennas: Hertz & Marconi antennas. Effects of ground & antenna height. Electrically short antennas. Beverage antenna. Medium frequency antennas: Tower radiation, construction, feed, ground system. HF antennas: Resonant & non-resonant antennas. Harmonic antenna. V- Antenna. Rhombic antenna. TW antennas. Loop antenna. Ferrite rod antenna. Whip antenna.

Unit 6 **(07)**

VHF to SHF Antennas: Structural details, dimensions, radiation pattern, specifications, features and applications of following antennas: Folded dipole, Yagi-Uda, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors, Cassegrain reflectors.

Text Books:

1. C.A. Balanis, "Antenna Theory - Analysis and Design", John Wiley.
2. E.C. Jordon and E.G. Balman, Electro-magnetic Waves and Radiation Systems, Prentice Hall India.

Reference Books:

1. K. D. Prasad, "Antenna & Wave Propagation", Satya Prakashan, New Delhi.
2. J. D. Kraus, "Antennas", Mc Graw Hill.

Course Outcomes:

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

- Compute the far field distance, radiation pattern and gain of an antenna for given current distribution.

- Estimate the input impedance, efficiency and ease of match for antennas.
- Compute the array factor for an array of identical antennas.
- Design antennas and antenna arrays for various desired radiation pattern characteristics.

EC System Programming and Operating Systems

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Test-1: 20 marks, Test-2: 20 marks
End-Sem Exam- 60 marks.

Unit 1 **(06)**

Basics of system programming: Language processors: Language processing activities, Fundamentals of language processing, Fundamentals of language specification, Language processor development tools. Data structures for language processing: Search data structure, Allocation data structures. Scanning and parsing, Assembler: Assembly language programming, simple assembly scheme, pass structure of assembler, design of two pass assembler.

Unit 2 **(06)**

Macro processor, Compliers and Interpreters: Macro definition and call, macro expansion, Machine Independent macro processor features, Nested macro calls, advanced macro facilities, Design of macro preprocessor. Basic compliers function, Phases of compilation, memory allocation, compilation of expression, compilation of expressions, compilation of control structures, code of optimization, interpreter.

Unit 3 **(06)**

Linkers and Loaders and Software tools: Basic loaders functions, central loaders scheme Absolute loaders, Subroutine linkers, relocation. Loader, Direct linking loader, Dynamic linking loader, Design of absolute loaders direct linking loader, Implantation of MS DOS linker, Software tools for program development, editors, debug monitor, programming environment, user interfaces.

Unit 4 **(06)**

Introduction to Operating System, Process and threads and Deadlocks: Evolution of O. S. Function, various OS, OS concepts, OS structure Processes, threads, inter process communication, IPC problems, scheduling Resources, introduction to deadlock, ostrich algorithm, deadlock detection and recovery, avoidance, prevention, other aspects.

Unit 5 **(06)**

Memory management: Basics of memory management, Swapping, Virtual memory, Page replacement algorithm, FIFO, second chance PR, clock PR, least recently used, working set PR, WS clock PR, Design issues for Paging systems, OS involvement with paging, page fault handling, Segmentation.

Unit 6 **(06)**

Input and Output, File system: Review of computer hardware, principles of I/O hardware, principles of I/O software, I/O software layers, disks, clocks, graphical user interface, network terminal, power management Files, directories, file system and implementation, file system

layout, implementing files, implementing directories, shared files, disc space management, examples of file system: CDROM, MSDOS, Win98, Unix.

Text Books:

1. D. M. Dhamdhere, "Systems Programming and Operating System", TMH.
2. Andrew S. Tanenbaum, "Modern Operating Systems", Second Edition, PHI.

Reference Books:

1. J. J. Donovan, "Systems Programming", McGraw Hill.
2. Siberschatz A; Galvin P.B; Gagne G, "Operating System Concepts", John Wiley.
3. Leland L. Beck, "System Software," Pearson Editions.

Course Outcomes:

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

- Design simple editor, pseudo assembler etc.
- Select and configure OS, file system towards optimizing performance

EC Satellite Communication

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	Test-1: 20 marks, Test-2: 20 marks End-Sem Exam- 60 marks.

Unit 1: Introduction to Satellite Communication (06)

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

Unit 2: Orbital Mechanics (06)

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

Unit 3: Satellite sub-systems (08)

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

Unit 4: Typical Phenomena in Satellite Communication (06)

Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.

Unit 5: Satellite link budget **(08)**

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

Unit 6: Modulation and Multiple Access Schemes **(06)**

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

Text Books:

1. Timothy Pratt and Others : Satellite Communications : Wiley India.
2. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill.
3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill

Course Outcomes:

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

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

EC Error Control Coding Techniques

Teaching Scheme	Examination Scheme
Lectures : 3 hrs/week	TE-I-- 20, TE-II --20
	End Sem Exam – 60

Unit 1 **(04)**

Coding for Reliable Digital Transmission and Storage

Introduction. Types of Codes, Modulation and Demodulation. Maximum Likelihood Decoding, Types of Errors and Error Control Strategies, Turbo Codes

Unit 2 **(08)**

Introduction to Number Theory

Euclidean Algorithm, Fundamental Theorem of Arithmetic and Applications, Dirichlet Progressions, Irrational Numbers, Fermat Factorization, Linear Diophantine Equations, Perfect Numbers, Mersenne Numbers, Congruence, Linear Congruence, Chinese Remainder Theorem, Wilson's and Fermat's Little Theorem, Primality Testing and Carmichael Numbers, Euler's Theorem, Properties of the Euler Phi Function.

Unit 3 **(04)**

Introduction to Algebra

Definitions. Groups. Fields, Introduction to finite fields and finite rings; factorization of $(X^n - 1)$ over a finite field, Galois Field GF(2^m), Construction and Properties, Vector Spaces, Matrices

Unit 4 **(04)**

Linear Block Codes

Introduction, Syndrome and Error Detection, Minimum Distance. Error Correction Capability, Standard Array and Syndrome Decoding, Error Probability over BSC, Hamming Codes

Unit 5 **(04)**

Cyclic Codes

Description. Generator and Parity-Check Matrices, Encoding, Syndrome and Error Detection. Decoding, Cyclic Hamming Codes

Unit 6 **(06)**

BCH Codes

Description. Encoding/Decoding, Nonbinary BCH Codes and Reed Solomon Codes, Weight Distribution and Error Detection Capability

Unit 7 **(06)**

Convolutional Codes

Encoding, Structural Properties Of Convolutional Codes, Distance Properties of Convolutional Codes , convolutional codes, and modern graph-based codes (Turbo-Codes and LDPC codes).

Unit 8

Maximum Likelihood Decoding of Convolutional codes **(06)**

The Viterbi Algorithm, Performance Bounds for Convolutional Codes, Construction. Implementation of Viterbi Algorithm, Sequential Decoding of Convolutional Codes, Introduction to Trellis Coded Modulation

Text Books:

1. S. Lin and D. Costello, Error Control Coding, Prentice-Hall, 200, 2nd edition
2. Richard E. Blahut, Theory and Practice of Error Control Codes Addison Wesley Publishing Company, 1983.

Reference Books:

1. Rosen K.H, "Elementary Number Theory", 6th Ed, Addison-Wesley, 2010.
2. T. Richardson and R. Urbanke, Modern Coding Theory. Cambridge University Press, 2008

3. F. MacWilliams and N. Sloane, The Theory of Error-Correcting Codes. North-Holland, 1988.

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

- Learn the principles of error-control coding and their application to communications systems with noise.
- Design both encoders and decoders for linear block codes, convolutional codes and understand the principles of ML decoding, Viterbi decoding and MAP decoding for iteratively-decoded codes.
- Understand basic error-correcting code properties such as minimum distance, error-correcting and detecting ability, and code rate.

LC Audio-Video Engineering Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. To generate different video patterns and study their utilities
2. To observe the response of tuners in RF stage ,IF stage and sound section in analog television system
3. To study the Digital TV and HDTV.
4. To observe and analyze signal at different sections of color television
5. To study the set-top box
6. To write c/c++ code for basic blocks in MPEG algorithm to acvive compression of data
7. To observe and analyze the signal at different sections of DVD player
8. To implement reading image file on FPGA platform
9. To implement reading video file on FPGA platform

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

- Understand the working principle of audio and video systems from perception to implementation.
- To analyze the signal of audio and video

LC Mobile Communication Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Study of GSM handset for various signaling and fault insertion techniques.
2. To study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK signal.
3. To study and observe system blocks/ sections in GSM handset like: clock, SIM card, charging, LCD module, Keyboard, UI (User interface circuit) by observation of different signals at test points and observe the effect of fault insertion.
4. To study various GSM AT Commands
5. Study of direct sequence spread spectrum (DSSS) technique for CDMA.
6. Study of DSSS technique, types of PN codes, chip rate, spreading factor, processing gain.
7. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section
8. To study and analyze different modulation techniques in time and frequency domain.
9. To study and analyze convolution encoder, Interleaver and De- Interleaver
10. Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system by AT Commands in 3G network
11. Understanding Cellular Fundamentals like Frequency Reuse, Architecture, Interference, Path Environment, Coverage and Capacity using wireless communication software.
12. Knowing GSM and CDMA Network concepts like Call Management, Call Setup, call release, Handover, GSM Security and Power Control, Handoff Process, Rake Receiver, Capacity of CDMA using wireless communication software.

Note: Three to four assignments based on theory topics with aim of extending the knowledge in that area or latest updates will be declared in the class per batch.

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

- Use GSM handset effectively and analyze problem if any
- Acquire knowledge of GSM AT commands for different applications
- Understand DSSS technique by knowing different types of PN codes, chip rate, spreading factor, processing gain
- Utilize Software Radio design for different modulation techniques
- Understand 3G system for various features using AT comman

LC Embedded Systems and RTOS Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Controlling of peripherals without using µC/OS -II services.
2. Study of Task creation using OSTaskCreate()
3. Study of Task creation using OSTaskCreateExt()
4. Exploring multitasking features of µC/OS -II.
5. Study of Semaphore Service of µC/OS -II.
6. Study of Mutex Service of µC/OS -II.
7. Exploring Mailbox management Services of µC/OS -II.
8. Exploring Message Queue Services of µC/OS -II.
9. Study of ISR
10. Real Time Application Development using µC/OS –II services.

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

- Understand the features and structures of practical implementations and how application areas impact on real-time operating system facilities.

LC RF Circuit Design Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. Estimate reflection coefficient and VSWR of sourced and loaded transmission line.
2. Impedance transformation using Smith chart.
3. Estimate the scattering matrix parameters of a two port network.
4. Design of low pass and high pass filters at RF using micro strip line
5. Design of band pass and band stop filters at RF using micro strip line.
6. Design of RF amplifier.
7. Design of RF oscillator.
8. Design of RF mixer.

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

- Analyze parameters of two port network.
- Design various types of filters, amplifiers, oscillators, mixer at RF using micro strip line.

LC Antenna Radiating Systems Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

A. To Measure Radiation pattern, Return Loss, Impedance, Gain, Beam width for the following antennas (Any Five)
    1. Dipole antenna
    2. Folded Dipole
    3. Yagi-Uda
    4. Horn
    5. Parabolic Reflector
    6. Micro strip Antennas

B. MATLAB Simulation of following antenna arrays (Plotting radiation pattern)
    1. Broad side linear array with uniform spacing and amplitude
    2. End fire linear array with uniform spacing and amplitude
    3. Binomial array
    4. Dolph-Tchebyshev

    Any three of above experiments are to be carried out by using any student trial version EM simulation software such as CAD-FEKO, NEC, IE3D etc.

Course Outcomes:

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

- Determine specifications, design, construct and test antenna.
- Explore and use tools for designing, analyzing and testing antennas. These tools include Antenna design and analysis software, network analyzers, spectrum analyzers, and antenna pattern measurement techniques.

LC System Programming And Operating Systems Lab

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

Write C Program to implement Lexical Analyzer for simple arithmetic operation involving equal to (=) and arithmetic operators (+, -); Expected O/P to create: i) Identifier Table ii) Literal Table iii) Symbol Table and iv) Uniform Symbol Table

1. To implement simple arithmetic operation using Lexical analyzer and compiler using LEX and YACC
2. Design of PASS I of two pass assembler for a subset of 8086
3. Design of a MACRO PASS-I
4. Design of a MACRO PASS-II
5. Implement Job scheduling algorithms: i) FIFO ii) Shortest Path First iii). Round Robin
6. Bankers Algorithm for deadlock detection and avoidance
7. Implementation page replacement algorithm: i) FIFO ii) LRO
8. Write an interactive shell program on UNIX / LINUX
9. Case Studies: i) UNIX/LINUX/WIN 2000 ii) Device drivers

Course Outcomes:

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

- Develop C/CPP programming capability by implementing assignments based in lexical analysis, assemblers, macro-processors etc.
- Understand and simulate the fundamental concepts of OS in scheduling processes, deadlocks, memory management etc.

LC Satellite Communication Laboratory

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

List of Experiments:

1. To establish a direct communication link between Uplink transmitter and Downlink receiver using tone signal.
2. To setup an Active satellite link and demonstrate link fail operation.
3. To establish an AUDIO-VIDEO satellite link between Transmitter and Receiver.
4. To communicate VOICE-signal through satellite link.
5. To change different combinations of uplink and downlink frequencies and to check the communication link.

6. To transmit and receive three separate signals (Audio, Video, Tone) simultaneously through satellite link.
7. To transmit and receive PC data through satellite link.
8. To draft satellite link budget (uplink and downlink) for the given parameters under clear air and rainy conditions. (design examples for C-band and Ku band satellites)
9. To write a program for the preparation of satellite link power budget and evaluation of C/N ratio with a provision to enter all parameters related to earth station, propagation path and satellite transponder.
10. A case-study of the features, parameters and applications of one of the recently launched satellites by India. (Separate satellite selection by separate groups).
    (Report and presentation on this case-study)

Course Outcomes:

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

- Understand multimedia information (text, audio, video, images etc.) transfer mechanism using satellite communication.
- Design satellite link budget under different scenarios for demanding application needs.

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