Structure & syllabus
of
Final year
Semester VII

Sr. No	Course type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	ILOE	Institute level Open Elective [To be offered to other Depts. and also to parent dept for 1st option]	3	0	0	3
2	LLC	Liberal Learning Course	1	0	0	1
3	DEC	Department Elective -II	3	0	0	3
4	SBC	Project Stage-I	0	0	4	2
5	PCC1	Microwave and Optical Communication	3	0	0	3
6	PCC2	Audio Video Engineering	3	0	0	3
7	PCC3	Computer networks	3	0	0	3
8	LC1	Microwave and Optical Communication Lab	0	0	2	1
9	LC2	Audio Video Engineering Lab	0	0	2	1
10	LC3	Computer networks lab	0	0	2	1
11	LC4	Departmental Elective-II Lab	0	0	2	1
		Total Academic Engagement and Credits	16		12	22

ILOE- 1. Machine learning 2. Broadband communication 3. DSP and Applications

Semester VIII

Sr.No	Course type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	MLC	Intellectual Property Rights	1	0	0	0
2	LLC	Liberal Learning Course	1	0	0	1
3	PCC/HSMC	Mobile Communication	3	0	0	3
4	DEC1	Department Elective-III	3	0	0	3
5	DEC2	Simulation tools	1	0	4	2
6	PEC	Project Stage-II	0	0	12	6
7	LC1	Mobile Communication lab	0	0	2	1
8	LC2	Department Elective-III lab	0	0	2	1
			9		20	
		Total Academic Engagement and Credits				17

Departmental Elective II

1. RISC Microcontrollers and DSP Processors

2. Speech Processing

3. Satellite communication

4. Joint Time Frequency Analysis

5. Digital CMOS design

Departmental Elective III

1. Multirate and adaptive signal processing

2. Embedded Software and RTOS

3. RF circuit design

4. IoT based systems

5. Analog CMOS design

Microwave and Optical Communication

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks.
End-Sem Exam – 60.

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:
- Gerd Keiser,Optical Fiber Communication,5/e, TMH, 2013.
- M.Kulkarni, Microwave and Radar Engineering,Umesh Publications.

Reference Books:
- John M Senior,Optical Fiber Communications", 3/e, Person, 2010
- David M Pozar, Microwave Engineering" Wiely 3/e, 2005

Course Outcomes:

At the end of this course students will demonstrate the ability

1. To understand and visualize the different modes of microwave and light wave propagation. PO[a,b]
2. To compare merits and demerits of various microwave and optical sources and detectors. PO [a,b]
3. To contribute in the areas of microwave and optical communication link design. PO [c,d]
4. To implement simple microwave and optical communication system and will be in a position to understand the developments in the technology of advanced communication. PO [c,d]

Audio Video Engineering

Unit 1*:*

Introduction to principles of Audio and Visual systems: (06)

Perception of signal by human eyes, Color TV systems, Television basics, color fundamental, mixing of Colors, color perception, chromaticity diagram, color TV camera, picture tubes and Display. Generation and Perception of audio signal by human, microphone and loudspeaker basics

Unit 2:

Analog Television (06)

NTSC, PAL, SECAM system, Different color models, 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:

Digital Television (08)

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, 3D video, Internet Television like Netflix, serial interfaced cameras.

Unit 4:

AudiRecording (06)

Methods of sound recording and reproduction, optical magnetic recording, CD recording, CD DVD player, MP3 player, multi dimension sound

Unit5:

Audio processing (06)

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)

Unit 6:

Audio and Video codecs **(08)**

HDTV standards and systems HDTV transmitter and receiver/ encoder, studying the open source codecs of video compression like AVC, MPEG audio standards and Dolby, studying the open source audio codec like AAC.

Text books:

- Madisetti V., " Video, Speech, and Audio Signal Processing and Associated Standards", CRC Press, Year of publication 2009
- Vasudev Bhaskran, "Image and Video Compression Standards", Kluwer Academic Publication, Second Edition.
- A.M. Dhake, "Television and Video Engineering" , TMH publication
- R.G. Gupta, "Audio Video systems", Technical Education

Reference books:

- Benard Globb, Charles E. Herndon, "Basic TV and Video systems" CRC
- L.R. Rabiner and R.W. Schafer, "Digital Processing of Speech Signal" , Prentice Hall , Second Edition
- Working Drafts of AVC and AAC from ISO standards and ITU-T standards

Course Outcome:

After completing the course, students will demonstrate ability to

1. Compare different video standards of analog and digital TV
2. Understand audio recording and compression techniques
3. Analyze different methods in audio and video codecs of ISO and ITU-T standards

Computer Networks

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

Unit 1 (8)

Introduction to computer networks and the Internet: 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, Internet of Things.

Unit 2 (8)

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 (6)

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

Unit 4 (6)

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

Unit 5 (6)

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

Unit 6 (6)

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:

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

Course Outcomes:

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

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

Department Elective-II

RISC Microcontrollers and DSP Processors

Teaching Scheme
Lectures : 3 hrs/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.

(08)
Unit 4
STM32F4xx microcontroller- Internal memory, GPIOs, Timers, ADC, UART and other serial interfaces, PWM, RTC, WDT .

Unit 5 **(04)**
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 **(08)**
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.

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.

Reference books:

1. STM32F4xx 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. Ahmad M Ibrahim,” Fuzzy Logic for Embedded Systems Applications”, Elsevier.
5. Frank Vahid and Tony Givargis, “Embedded System Design”, Wiley.
6. Lapsley P., Bier J., Shoham A., Lee E.A. “DSP Processor Fundamentals-Architecture and Features” (IEEE Press).
7. Dag Stranneby and William Walker, “Digital Signal Processing and Applications”, second edition, Elsevier.
8. Technical references and user manuals on www.arm.com and ST Microelectronics www.st.com

Course Outcomes:

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

1. Know architecture and programmer’s model of ARM cortex-M3 processor core.
2. Utilize GNU software tool chain for programming the STM32F4xx microcontroller.
3. Become proficient in programming of embedded platforms based on ST Microelectronics STM32F4xx microcontroller processor and the peripheral support available on the chip.
4. Identify and formalize architectural level characterization of Programmable DSP Processors.
5. Design, program, and testing (assembly and C) code using Code Composer Studio environment for TMS320C6000 DSP Processor.

Speech Processing

Teaching Scheme
Lectures : 3 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 **(07)**

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.

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 **(07)**

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 **(08)**

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), Study of Speech Interpretation and Recognition Interface (SIRI).

Unit 6 **(06)**

Speech Processing Applications: Text dependen t and Text Independent speaker recognition systems, Text to Speech Synthesis, Speech Enhancement, Sound-Source Localization. Broad overview of Natural Language Processing (NLP), Examples: Text Classification task, News flow classification, sentiment analysis, spam filtering

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 the course, students will be able to

1. Evaluate different parameters of speech signal.
2. Identify and analyze different speech analysis systems.
3. Develop algorithms for Recognition, Enhancement and Coding of speech.

Satellite Communication

Teaching Scheme
Lectures : 3 hrs/week

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

Unit 1: Introduction to Satellite Communication (03)
Principles and architecture of satellite Communication, Brief history of satellite systems, Classification of satellite orbits. Advantages, disadvantages, applications and frequency bands used for satellite communication

Unit 2: Orbital Mechanics (08)
Introduction, Kepler laws, definitions, orbital element, apogee and perigee heights, Orbital equations - evaluation of velocity, orbital period, angular velocity etc of a satellite. Look angles, limits of visibility. Orbit perturbations - Effects of non-Spherical Earth, gravitational force from other bodies, solar radiation pressure and atmospheric Drag, Inclined orbits-calendars, universal time, sidereal time, Julian date.

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, satellite antennas, power sub-systems etc. Equipment reliability and space quantification.

Unit 4: Typical Phenomena in Satellite Communication (06)
Solar eclipse on satellite, its effects and 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 (07)
Basic transmission theory – Flux density, EIPR 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.

Reference Books:

1. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill.
2. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill.

Course Outcomes:

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

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

Joint Time Frequency Analysis

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	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

Course outcomes:

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

1. Understand shortcomings of Fourier transforms for completeness of signal analysis.
2. Understand short time Fourier transform and its limitations.
3. Show introductory yet detailed knowledge of wavelets.

Use wavelets and operators to various systems for analysis purpose.

Digital CMOS Design

Teaching Scheme
Lectures : 3 hrs/week

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

Unit-1 **(07)**

Introduction to VLSI, Manufacturing process of CMOS integrated circuits, CMOS n-well process design rules, packaging integrated circuits, trends in process technology. MOS transistor, Energy band diagram of MOS system, MOS under external bias, derivation of threshold voltage equation, secondary effects in MOSFETS.

Unit – 2 **(07)**

MOSFET scaling and small geometry effects, MOS capacitances, Modeling of MOS transistors using SPICE, level I II and equations, capacitance models. The Wire: Interconnect parameters: capacitance, resistance and inductance. Electrical wire models: The ideal wire, the lumped model, the lumped RC model, the distributed RC model, The transmission line model, SPICE wire models.

Unit-3 **(07)**

MOS inverters: Resistive load inverter, inverter with n type MOSFET load, CMOS inverter: Switching Threshold, Noise Margin, Dynamic behavior of CMOS inverter, computing capacitances, propagation delay, Dynamic power consumption, static power consumption, energy, and energy delay product calculations, stick diagram, I C layout design and tools.

Unit-4 **(07)**

Designing Combinational Logic Gates in MOS and CMOS: MOS logic circuits with depletion MOS load. Static CMOS Design: Complementary CMOS, Ratioed logic, Pass transistor logic, BI CMOS logic, pseudo nMOS logic, Dynamic CMOS logic, clocked CMOS logic CMOS domino logic, NP domino logic, speed and power dissipation of Dynamic logic, cascading dynamic gates.

Unit-5 **(07)**

Designing sequential logic circuits: Timing metrics for sequential circuits, classification of memory elements, static latches and registers, the bistability principle, multiplexer based latches, Master slave Edge triggered register , static SR flip flops, dynamic latches and registers, dynamic transmission gate edge triggered register, the C2MOS register,

Unit-6 **(07)**

Pulse registers, sense amplifier based registers, Pipelining, Latch verses Register based pipelines, NORA-CMOS. Two phase logic structure; VLSI designing methodology – Introduction, VLSI designs flow, Computer aided design technology: Design capture and verification tools, Design Hierarchy Concept of regularity, Modularity & Locality, VLSI design style, Design quality.

Text Books

- Jan M Rabaey, Anantha Chadrakasan, Borivoje Nikolic, " Digital integrated circuits a design perspective" , Pearson education.
- Sung MO Kang Yusuf Leblebici, "CMOS digital integrated circuits", Tata McGraw Hill Publication.

Reference Book

- Neil E Weste and Kamran Eshraghian, " Principle of CMOS VLSI Design", Pearson education

Course Outcomes:

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

a) Analyze, design, optimize and simulate simple and complex digital circuits using CMOS according to the design metrics.

b) Connect the individual gates to form the building blocks of a system.

c) Use EDA tools like Cadence, Mentor Graphics and other open source software tools like NGSPICE.

Microwave and Optical Communication Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs/week	Continuous evaluation : 50 marks
	Exam: 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)

Laboratory Course Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

1. Use Microwave Bench set up for X-band applications.
2. Characterize microwave components using S-matrix.
3. Compute the important parameters of optical fiber.
4. Evaluate power and rise-time limited distance for typical point to point optical links.

Audio Video Engineering Lab

Teaching Scheme — **Examination Scheme**

Practical: 2 hrs/week — Continuous evaluation : 50 marks

Exam: 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 achieve 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

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

Computer Networks Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Continuous evaluation : 50 marks
Exam: 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 implement congestion control algorithms.
5. To capture packets using Wireshark and analyze them at all the layers of network
6. Dijkstra’s shortest path algorithm for routing table updation
7. To write C/C++ code for socket programming to implement file transfer
8. To implement 1-bit sliding window protocol in C/C++
9. Case study of existing networks and components, ways to connect to internet

Departmental Elective-II lab

RISC Microcontrollers and DSP Processor 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. Evaluate the various sleep modes by putting core in sleep and deep sleep modes.

17. System reset using watchdog timer in case something goes wrong.
18. Generate a Real time clock using the 32-bit timers and output time over UART.

Any Eight experiments will be conducted on RISC Microcontrollers.

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 DSK67xx kit.

Phase I: Preliminaries of Code Composer Studio and DSK67xx Kit

The experiments in this phase are oriented to familiarize students with the basics of C67xx processor interface through Code Composer Studio, Simulation and DSK67xx 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 67xx kit
5. On-Line diagnostic for the DSP 67xx kit
6. Practice C programming in Simulator mode

Phase II: TMS320C67xx Architecture, Instruction Set Studies

The experiments in this phase are oriented to familiarize students with the basics of C67xx 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 C67xx Processor, Assembly Language Programming, Application Programming using C Language, Use of Pseudo Instructions: Impact of NOP instructions and IDLE instructions, Timing Analysis for C67xx processor using on chip timer registers and DSK Board /Kit. At least one experiment on each of these modules.

(A) DSKC67xx 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) 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. Explore the assembly code for NOP / IDLE effectiveness.
6. Estimate the MAC per second for the TMS320C67xx processor
7. Sine wave Generation and playing audio note through Codec.

Course outcomes:

After completing the course, students will demonstrate ability to

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

Speech Processing Laboratory

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs/week	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 the course, students will demonstrate the ability to

1. Analyze the speech signal and estimate the frame level features.
2. Develop MATLAB functions for speech analysis and coding.
3. Design a speech recognition system with a limited vocabulary.

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 the course, students will demonstrate the ability to

1. Establish audio, video and data links through satellite communication.
2. Evaluate the performance parameters of the satellite link.
3. Design satellite link budget under different scenarios of clear sky, rainy conditions etc.

Joint Time Frequency Analysis Lab

Teaching Scheme
Practical: 2 hrs./week

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

Course Objectives:

- The objectives of the lab course is transforms and its limitations

List of Experiments:

1. Generate 1-D Gaussian pulse and find its Fourier transform
2. Write a MATLAB code for Short Time Fourier Transform (STFT)
3. MATLAB code in time domain for Gabor filter
4. Study of different wavelets like Haar, Morlet, Daubechies (daub-4, daub-8, daub-16)
5. Decomposition of signals using wavelet functions

Digital CMOS Design Lab

Teaching Scheme
Practical : 2 hrs/week

Examination Scheme
Continuous evaluation : 50 marks
Exam- 50 marks.

List of Experiments:

1. DC and Transient analysis of NMOS and PMOS Transistor using NGSPICE.
2. DC, Transient analysis of CMOS Inverter using NGSPICE.
3. Design of 5 stage ring oscillator using NGSPICE.
4. DC, Transient analysis of CMOS Inverter using Cadence EDA Tool.
5. Schematic to Symbol generation using Cadence EDA Tool.
6. Schematic to Layout of CMOS Inverter using Cadence EDA Tool.
7. Post Layout simulation of CMOS Inverter and Parasitic Extraction.
8. Design of all basic gates and /or Combinatorial circuits using Cadence EDA Tool.
9. Design of a 6 Transistor SRAM cell using Cadence EDA Tool.
10. Design of Sequential circuits using Cadence EDA Tool.

Laboratory Outcomes:
At the end of the laboratory work, students will demonstrate the ability to:
1. Understanding of Digital Circuit design using CMOS.
2. Build blocks of a system to solve engineering problems.
3. Use EDA tools like Cadence, Mentor Graphics and other open source software tools like NGSPICE through lab exercises.

Minor in IoT
Wireless sensor networks

Teaching Scheme
Lectures : 3 Hrs/week

Examination Scheme
Test1, Test2: 20 Marks each
End-Sem. Exam: 60 Marks

Course Outcomes:

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

- Design wireless sensor network system for different applications under consideration.
- Understand the hardware details with different types of sensors and select right type of sensor for various applications.
- Understand radio standards and communication protocols to be used for wireless sensor network based systems and applications.
- Use operating systems and programming languages for wireless sensor nodes,
- Handle special issues related to sensors like energy conservation and security challenges

[06 Hrs]

Unit 1

Introduction and overview of wireless sensor network (WSN)

Introduction and overview of sensor network architecture, challenges and its applications, wireless sensor network comparison with Ad Hoc Networks, network architecture details

[06 Hrs]

Unit 2

Sensor node hardware and Operating System requirements

Study of Sensor nodes, Hardware details of sensor nodes, study based on transceivers, controllers, storage, examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and Sun SPOT,

Operating Systems features for WSN, operating systems examples: tinyOS, MANTIS, Contiki, and RetOS. Programming tools: C, nesC.

[06 Hrs]

Unit 3

Protocols requirement for WSN

Overview of sensor network protocols, features of protocols for different types of layers including Physical, MAC and routing/ Network layer protocols, higher layer protocols.

[06 Hrs]

Unit 4

Localization and positioning related to WSN

Localization related sensor node connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid technology.

[06 Hrs]

Unit 5

Data dissemination and processing in WSN

Differences between sensor network database compared with other database management systems, data storage techniques; query processing techniques in WSN.

[06 Hrs]

Unit 6

Specialized features for wireless sensor network

Study of Energy saving and network efficiency for WSN; security challenges and security features requirement for WSN

Text books:

- H. Karl and A. Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, India, 2012.

Reference Books:

- C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, "Wireless Sensor Networks", Springer Verlag, 1st Indian reprint, 2010.
- F. Zhao and L. Guibas, "Wireless Sensor Networks: An Information Processing Approach", Morgan Kaufmann, 1st Indian reprint, 2013.
- Yingshu Li, MyT. Thai, Weili Wu, "Wireless sensor Network and Applications", Springer series on signals and communication technology, 2008.

Semester VIII

Mobile Communication

Teaching Scheme
Lectures: 3 hrs/week

Examination Scheme
Quiz/test (I), Quiz/test (II) – 20 marks.
End Sem exam – 60 marks.

Unit 1 **(5)**
Cellular Concept: System Design Fundamentals:

Cellular system design, , Frequency reuse, Co channel and adjacent channel interference, Interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment techniques, Improving the capacity of cellular system and related design problems, concepts of cell splitting, handover concepts in cellular system.

Unit 2 (8)

GSM Architecture and Interfaces: Introduction to GSM subsystems, 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), GSM Interfaces, Mapping of GSM layers onto OSI layers, GSM Logical Channels importance, Data Encryption in GSM, Mobility Management, Call Flows in GSM, Spectral efficiency calculations with multiple access technologies like TDMA, FDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas**.**

Unit 3 **(6)**
Code Division Multiple Access:

CDMA technology, RAKE receiver, 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, Comparison of GSM and CDMA technology, Spectral efficiency calculations for CDMA, Evolution of IS 95 (CDMA One) to CDMA 2000, IMT 2000 vision, CDMA 2000 layering structure and channels, 3 G mobile system: WCDMA

Unit 4 **(9)**
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; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

Unit 5 **(10)**
Higher Generation Cellular Standards:

GPRS Architecture and node functionalities, Changes in N/W architecture from 2G to 2.5G, GPRS Interfaces, Identifiers, Logical and Physical channels, GPRS Call setup procedures – Attach/Detach/PDP context/LA-RA Update, GPRS services

2.75 G Standards: EDGE, 3G Network Architecture, Changes in N/W architecture, 3G Services.

Limitation of 3G and motivation for 4G, 3G to 4G Evolution path, Changes in N/W arch from 3G to 4G, 4G Introduction and vision, LTE enabler Technologies: OFDMA, SC-FDMA, MIMO etc.

Adaptive multiple antenna techniques, radio resource management, QOS requirements for 4G.

LTE Network architecture, interfaces and node functionalities, LTE identifiers, LTE Services, LTE Protocol stack, LTE Frame Sub-frame structure, Modulation and MAC, Coding, Security.
Logical, Physical and Transport Channels: Mapping of data on to logical sub-channels physical layer procedures, establishing a connection, retransmission and reliability, power control

LTE Call Procedures – LTE Synchronization, Attach/Detach, Mobility and Session Management, LTE Voice and Data calls, Handover

Unit 6 **(2)**
Introduction to 5G:

Drivers for 5G, 5G Roadmap and Vision, 5GEnabler technologies / Key building Blocks (High Level View), 5G current state, Recent Trends in Telecommunication Industries, Case Studies by BSNL.

Text books

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

Reference books

- J. E. Flood , “Telecommunications Switching, Traffic and Networks”, Pearson Education
- Krzysztof Wesolowski, “Mobile Communication Systems”, Wiley Student Edition.
- Mischa Schwartz, “Mobile Wireless Communications”, Cambridge University Press
- John C. Bellamy, “Digital Telephony”, Third Edition; Wiley Publications
- Fundamentals of 5G Mobile Networks - By: Jonathan Rodriguez, Publisher: John Wiley & Sons

Course Objectives:

1. To study the concept of cellular system design with frequency-reuse, cell sectoring and handoff techniques
2. To understand GSM, CDMA mobile technologies their design issues and comparison
3. To study Mobile Radio Propagation by analyzing large scale path loss, small scale fading and their influences on a mobile-communication system’s performance.
4. To understand important features of advance technologies (higher generations) starting form 2.5 G to 5G (GPRS, EDGE, HSCSD, WCDMA, CDMA 2000, LTE, UMTS etc.)
5. To learn and understand the basic principles of Telecommunication switching, traffic and Networks.

Course Outcomes:

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

- Analyze radio channel and cellular capacity.
- Design and apply concepts of mobile cellular systems like GSM, CDMA.
- Synthesize and analyze wireless systems over stochastic fading channel with understanding of different indoor and outdoor propagation models related to different types of fading and path loss.
- Study of evolution of mobile communication generations 2G, 2.5G, 3G with their characteristics and limitations.
- Understand emerging technologies for fourth generation mobile systems such as LTE and 5G
- Explain and apply the concepts telecommunication switching, traffic and networks

Department Elective-III

Multi Rate and Adaptive signal processing

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

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

Embedded software and RTOS

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	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:. Case study examples for demonstrating task management functionalities (ex: Task switching, task deleting, task suspending and resuming, managing priority and etc.,) using RTOS

Course Outcomes

At the completion of the subject, students should be able to

1. Analyze the structure and working of real-time operating systems.
2. Design applications by exploring different services of real time operating systems.
3. Apply formal methods of scheduling policies of RTOS for the analysis and design of real-time systems.

Text Books:

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

RF Circuit Design

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
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.

Unit 3 **(06)**
RF Filter Design and: Basic resonator and filter configuration, Special filter realizations, Filter implementation, Coupled filter.

Unit 4 **(06)**
Active RF Component and Modeling: RF diodes, Bipolar-junction transistor, RF field effect transistors, High electron mobility transistors, Diode models, Transistor models, parameter measurement of active devices, Scattering parameter device characterization.

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 the course, students will demonstrate the ability to

1. Select the passive and active components for a particular RF circuit design
2. Model the active components for design of RF circuits.
3. Design and develop a prototype for RF filters, amplifiers, oscillators and mixer.

CMOS Analog IC Design

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 marks

Unit-1 (06)

Large Signal Models of MOS Transistors: I-V Characteristics, Early Effect, Channel Length Modulation, Back Gate Effect and other Second-Order Effects. Passive Components: Properties of Resistors and Capacitors and Matching Considerations.

Unit – 2 (07)

Analog Sub-circuits: Basic MOS Amplifiers - CS, CD, CG, Differential Pairs, Current Sources, MOS Switches, and Basic Sample/Hold Circuit.

Unit-3 (08)

Basic Two-Stage Op-Amp Design: NMOS and CMOS architectures, DC Design, Frequency Compensation, Slew Rate, Power Supply Rejection, Offset Voltage calculation and Noise considerations Advanced CMOS OP Amp Configurations: Folded-Cascode Op-amp, Class AB Op-amps, and Fully Differential op-amp

Unit-4 (06)

Voltage References: Basic Design and Evaluation of Band Gap Reference, and CMOS Band Gap References MOS Voltage Comparators: Various Configurations and Offset Cancellation Techniques

Unit -5 (07)

Digital-to-Analog and analog to digital converters Current scaling DAC, Voltage scaling DAC charge scaling DAC, Extending resolution of parallel DAC, similar scaled DACs High speed ADCS, parallel or flash ADCS, interpolating ADCS, folding ADCS, Multi-bit pipeline ADCS delta sigma modular, Decimators filters.

Unit-6 (06)

Switched Capacitor Filters: Basic Switched Capacitor Integrators, Z-transforms, and

Switched Capacitor Filter Design, MOSFET-C Filters, and techniques of non linearity cancellation in MOS circuit.

Text Books:
1) “ Design of Analog CMOS Integrated Circuits” by Behzad Razavi; Tata Mc Graw-Hill
2) “CMOS analog Circuit Design” by Allen Holberg; Oxford University Press

Reference Books:
1) “ Analog VLSI Signal and Information Processing” by Mohammed I smail Terri Fiez; Mc Graw Hill International Editions.
2) “ Analog MOS Integrated Circuits for Signal Processing” by Roubik Gregorian and Gabor
C. Temes; Wiley series on filters
3) “ Analysis and Design of Analog Integrated Circuits”, Fourth Edition by Gray Hurst Lewis

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

1. Analyze, design, optimize and simulate simple and complex analog circuits using CMOS according to the design metrics.
2. Connect the individual amplifiers to form the analog building blocks of a system.
3. Use EDA tools like Cadence, Mentor Graphics

IoT based system

Teaching Scheme:	**Examination Scheme:**
Lectures: 3 hrs/week	T1 and T2: 20 Marks each
	End-Sem Exam: 60 marks

Unit 1 **(6 hrs)**
Sensing and actuator devices: Integrated IoT sensors, Technology analysis: wireless sensor structure, energy storage module, power management module, RF module, sensing module Wireless sensors

Unit II **(8 hrs)**

Networking and communication aspects: IPv6, 6LoWPAN, COAP, MQTT

Unit III **(8 hrs)**

Modern networking:

Cloud computing: Introduction to the Cloud Computing, History of cloud computing, Cloud service options, Cloud Deployment models, Business concerns in the cloud, Hypervisors, ,Comparison of Cloud providers

Unit IV **(8 hrs)**

SDN :Network Requirements - The SDN Approach SDN Data Plane - Open Flow Logical Network Device -Open Flow Protocol - SDN Control Plane Architecture - REST API - SDN

Unit 5: Cryptography for IoT Security **(6 hrs)**

Cloud and Fog Ecosystem for IoT Review of architecture & cryptographic algorithms, Analysis of Light weight Cryptographic solutions IoT security, DES,AES, Key exchange using Elliptical Curve Cryptography, Comparative analysis of Cryptographic Library for IoT,

Unit 6: IoT Databases **(6 hrs)**

OLAP and OLTP , NoSQL databases, Row and column Oriented databses, Introduction to Columnar DBMS CStore , Run :Length and Bit vector Encoding, Integrating Compression and Query Execution in Columnar databases, IoT Data Analytics, Visualization & dashboarding

Books:

1. Internet of Things with Python By Gaston C. Hillar
2. Internet Security: Cryptographic Principles, Algorithms and Protocols- Man Young Rhee
3. Big-Data Analytics for Cloud, IoT and Cognitive Computing- Kai Hwang, Min Chen

Reference books:

1. Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud" William Stallings Publisher: Addison-Wesley 2015 ISBN: 9780134175393
2. Analytics for the Internet of Things (IoT)- Andrew Minteer
3. Internet of Things, a hands on approach by Arshdeep Bahga and Vijay Madisetti

Reference Study Material:

1. Analysis of security for IoT- Christer Eriksen Hole
2. Cryptography Crash Course- KU Leuven

Course Outcomes

1. knowledge and understanding of fundamental IOT paradigms, architectures, possibilities and challenges, both with respect to software and hardware
2. Open platforms databases to store your sensor data in the Cloud including data analytics.

Mobile Communication Lab

Teaching Scheme	Examination Scheme
Practical: 2 Hrs / Week	Term Work: 50 Marks
	Oral : 50 Marks

List of Practical's:

1. Understanding Cellular Fundamentals like Frequency Reuse, Architecture, Interference, Path Environment, Coverage and Capacity using wireless communication software.
2. 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.
3. Study of GSM handset for various signaling conditions, to study transmitters and receiver section in mobile handset and measure frequency band signal and GMSK signal by observing signals at different test points.
4. To study and observe system blocks/ sections in GSM handset like: clock, SIM card, charging, LCD module, Keyboard, UI (User interface circuit) and observe the effect of fault insertion techniques.
5. To study various GSM AT Commands and understand its usages, different UI features, Understating of 3G Communication System with features like; transmission of voice and video calls, SMS, MMS, TCP/IP, HTTP, GPS and File system in 3G network.
6. Develop any one Android App on AT commands kit.
7. Study of direct sequence spread spectrum (DSSS) technique for CDMA, observe effect of variation of types of PN codes, chip rate, spreading factor, processing gain on performance of CDMA.
8. To learn and develop concepts of Software Radio in real time environment by studying the building blocks like Base band and RF section, to study and analyze different modulation techniques in time and frequency domain.
9. To study and analyze convolution encoder, Interleaver and De- Interleaver

Assignments: *4-5 assignments based on theory topics with aim of extending the knowledge in that area or latest updates in Mobile Communication.*

1. Numbering plan, charging plan for mobile phones
2. Handset comparison based on at least 8 important features
3. Health hazards due to mobile radiation (MS and BS)
4. Mobile signal measurement at 10 places and analyze the effect with justification
5. Base station site selection and design criteria
6. Test and Measurements for Mobile networks (Mobile Network Simulators, Protocol Analyzers)

Course Outcomes:

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

1. Use GSM handset effectively by detail section study (keyboard, display, battery, SIM, UI) and analyze problem if any using fault analysis
2. Acquire knowledge of GSM AT commands for different applications and understand 3G system features
3. Understand effect on CDMA performance by varying different types of PN codes, chip rate, spreading factor, processing gain
4. Utilize Software Defined Radio platform for different modulation schemes and interleaving techniques
5. Develop awareness among users towards mobile applications

Department Elective-III lab

Multi Rate and Adaptive DSP Lab

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	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

Application of multi-rate and adaptive filters in image processing and speech processing

Embedded Software and RTOS Lab

Teaching Scheme
Practical: 2 hrs./week

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

Outcomes:

- To understand and implement real-time operating system principles in real-time system design.

List of Practical:

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. Real Time Application Development using µC/OS –II services.

RF Circuit Design Laboratory

Teaching Scheme:
Practical: 2 hrs. /week

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

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List of Experiments/Assignments:

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 the lab course, the students will be able to

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

CMOS Analog IC Design Lab

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	Continuous evaluation : 50 marks Exam- 50 marks.

List of Experiments:

1. AC analysis of NMOS and PMOS Transistor using Cadence EDA Tool.
2. AC analysis of Common Source Amplifier using Cadence EDA Tool.
3. AC analysis of Common Gate and Common Drain Amplifier using Cadence EDA Tool.
4. AC analysis of Current Source using Cadence EDA Tool.
5. DC and AC analysis of two stage Differential Amplifier using Cadence EDA Tool..
6. Noise and Frequency analysis of Amplifiers using Cadence EDA Tool.
7. Design of Band Gap reference circuits using Cadence EDA Tool..
8. Design of D to A converters using Cadence EDA Tool.
9. Design of A to D converters using Cadence EDA Tool.
10. Design of basic switched capacitor filters using Cadence EDA Tool.

Laboratory Outcomes:

At the end of the laboratory work, students will demonstrate the ability to:

a) Understanding of analog Circuit design using CMOS.
b) Build blocks of a system to solve engineering problems.
c) Use EDA tools like Cadence, Mentor Graphics

IoT based system Lab

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	Continuous evaluation : 50 marks Exam- 50 marks.

Eight experiments will be performed in consultation with Industry.

1. Hardware: Focus will be on Raspberry Pi platform and Intel Galileo platform
2. Software: Python programming

Simulation tools

Course outcomes:

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

- Understand the Python programming as a tool for electronic engineering
- Use Python for Interfacing with Hardware platforms like Raspberry Pi

Syllabus

Unit 1: **(4)**

Introduction to Python, Python Data types, Strings, Lists and Dictionaries, Functions and Branching, File operations,

Unit 2: **(6)**

Computing with formulas, Complex number and symbolic Computing, Object oriented Programming Concepts, Class hierarchy for numerical Integration, introduction to Python Libraries

Unit 3: **(4)**

Array Computing and curve Plotting, Plotting of Scalar and Vector Fields, High performance computing with Arrays, Graphical user Interfaces

Unit 4: **(4)**

Hardware related module for Using Python of Raspberry Pi, Digital Output, and analog Inputs

Text Books

1. A Primer on Scientific Programming with Python- Hans Petter Langtangen
2. Python Programming and GUIs for Electronic Engineers, Andrew Pratt, Elektor International Media BV, 2010
3. Introduction to Programming in Python: An Interdisciplinary Approach - Robert Sedgewick, Kevin Wayne, Robert Dondero
4. Learn Python the Hardway- Z.A. Shaw

Python Programming Laboratory

Lab Objectives:

- Understand Python for Electronics and Telecommunication engineering applications

Lab Activities outcomes:

- At the end of this Lab Students will demonstrate the skills to use Python for Interfacing with Hardware platforms like Raspberry Pi

Lab Experiments:

List of Experiments will be based on the Students requirement for Mini-Project under Skill Based Course (SBC) philosophy. The following Core Experiments with Python Coding will be compulsory (any four)

1. Electromagnetic Interference / Electromagnetic Compatibility (EMI/EMC) Port spectra computations
2. Reliability Evaluation for Electronic subsystems and Computations of MTTR/MTBF
3. Frequency Management and Channel Assignment
4. CommPy based coding
5. Image processing using OpenCV

References

1. Programming the Raspberry Pi: Getting Started with Python-Simon Monk
2. Python Programming and GUIs for Electronic Engineers, Andrew Pratt, Elektor International Media BV, 2010
3. http://tbc-python.fossee.in/book-details/566/
4. https://www.baldengineer.com/raspberry-pi-gui-tutorial.html
5. http://tbc-python.fossee.in/convert-notebook/Wireless_Communications_by_T._L._Singal/CHAPTER7.ipynb
6. http://tbc-python.fossee.in/convert-notebook/Wireless_Communications_by_T._L._Singal/CHAPTER6.ipynb

ILOE

Machine Learning

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
End-Sem Exam: 60 marks

Unit 1: (6)
Introduction to Machine Learning: Basic definitions, types of learning, designing a learning system, perspectives and issues, hypothesis space and inductive bias, evaluation, cross-validation

Unit 2: (6)
Linear regression, Decision trees, Splitting Criteria, Issues in decision tree learning, overfitting and evaluation, nearest neighbor methods

Unit 3: (8)
Neural network: Perceptron, multilayer network, backpropagation, introduction to deep neural network

Unit 4: (6)
Dimensionality Reduction: Feature reduction, Principal Component Analysis, Fischer's Discriminant Analysis

Unit 5: (6)
Probability and Bayes learning, Naive Bayes Model, Logistic Regression, Reinforcement learning

Unit 6: (8)
Support Vector Machine, Kernel function and Kernel SVM, Clustering: partitioning, k-means clustering, hierarchical clustering, and Case studies

Text Books:

- Ethem Alpaydin, Introduction to Machine Learning, Second Edition, The MIT Press, 2010.
- Tom Mitchell, Machine Learning, McGraw-Hill, 1997.

Reference Books:

- Stephen Marsland, Machine Learning: An Algorithmic Perspective, CRC Press, 2009.
- Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

Course Outcomes:

1. Understanding of the fundamental issues and challenges of machine learning algorithms
2. Understanding of a wide variety of learning algorithms.
3. Designing and Applying the machine learning algorithms to real world problems

Broadband Communication

Teaching Scheme:
Lectures: 3 hrs/week

Examination Scheme:
T1 and T2: 20 Marks each
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.

Minor in IoT

IOT architecture

Teaching Scheme | **Examination Scheme**

Lectures : 3 Hrs/week

T1, T2/Assignments: 20 Marks each

End-Sem. Exam: 60 Marks

Course outcomes:

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

- Identify need of IoT technologies for today's need, and system requirement in certain scenarios.
- Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
- Apply these technologies to tackle scenarios in terms of using an experimental platform for implementing prototypes and testing them as running applications.

Unit 1 **[06 Hrs]**

Introduction to Internet of Things

Building blocks of IOT enabling technologies, characteristics of IOT systems, Physical and Logical design of IoT, Data acquisition using sensors, camera, GPS, Smart phone

Unit 2 **[06 Hrs]**

IoT and Machine to Machne (M2M)

Differences and similarities between IoT and M2M, Software Defined Networking (SDN) and applications, Big data, Data Analytics: Hadoop

Unit 3 **[06 Hrs]**

IoT platform design Methodology

Purpose and Requirements specification for IoT, operational view specification, application development

Unit 4 **[06 Hrs]**

Introduction to cloud storage for IoT

Introduction to the use of cloud platforms and frameworks for developing different IoT applications

Unit 5 **[06 Hrs]**

Internet of Things Privacy, Security and Governance

Introduction, Overview of Governance, Privacy and Security Issues, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities

Unit 6 **[06 Hrs]**

Case Studies illustrating IoT design

i. Home Automation – Smart Lighting
ii. Smart City: Smart Parking
iii. Environment: Weather monitoring system
iv. Agriculture: Smart Irrigation
v. Health care
vi. Robotics

Text books:

- A Bahaga, V. Madisetti, "Internet of Things- Hands on approach", VPT publisher, 2014.

Reference books:

- McEwen, H. Cassimally, "Designing the Internet of Things", Wiley, 2013.
- Samuel Greenguard, "Internet of things", MIT Press.

Web resources:

- http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
- https://developer.mbed.org/handbook/AnalogIn
- http://www.libelium.com/50_sensor_applications/
- M2MLabs Mainspring http://www.m2mlabs.com/framework