## SEMESTER VI

| Code | Course of Study | | L | T | P | C |
|---|---|---|---|---|---|---|
| EC302 | Digital Communication | | 3 | 0 | 0 | 3 |
| EC304 | Mobile Communication | | 3 | 0 | 0 | 3 |
| EC306 | Microwave Component and Circuits | | 3 | 0 | 0 | 3 |
| EC308 | VLSI Design | | 3 | 0 | 0 | 3 |
| EC310 | Embedded System Design | | 3 | 0 | 0 | 3 |
| | Elective-1 | | 3 | 0 | 0 | 3 |
| EC312 | Communication Engineering Laboratory | | 0 | 0 | 3 | 2 |
| EC314 | VLSI Design Laboratory | 0 | 0 | 3 | 2 | |
| | **TOTAL** | | **18** | **0** | **6** | **22** |

**List of Electives**

## ELECTIVES SEMESTER-VI

| Code | Course of Study | | L | T | P | C |
|---|---|---|---|---|---|---|
| EC352 | Speech Processing | | 3 | 0 | 0 | 3 |
| EC354 | Display Systems | 3 | 0 | 0 | 3 | |
| EC356 | Operating System | | 3 | 0 | 0 | 3 |
| | Adaptive Signal processing | | 3 | 0 | 0 | 3 |

## SEMESTER VI

### EC302DIGITAL COMMUNICATION (3-0-0)3

**Pre-Requisite:**EC301

**Objectives:**

1. To understand the key modules of digital communication systems with emphasis on digital modulation techniques.
2. To get introduced to the concept and basics of information theory and the basics of source and channel coding/decoding.

**Topics Covered :**

Unit -1: Pulse Modulation

Base band transmission.Pulse Modulation techniques – PAM, PPM, PDM. Pulse code modulation (PCM), DM, Destination SNR in PCM systems with noise.

Unit -2: Baseband Pulse Transmission

Matched filter, Nyquist criterion for zero ISI, Baseband M-ary PAM Transmission, Optimum transmit and receive filters, Correlative Coding, Equalization; zero-forcing and adaptive linear equalizers.

Unit -3: Passband Digital Transmission

Digital modulation techniques – binary ASK, FSK, and PSK. Signal space diagram. Error probabilities.M-ary PSK, FSK, QAM, MSK and GMSK. Optimum detector. Signal constellation, error probability.

Unit -4: Error Control Coding

Linear block codes, Encoding and decoding. Cyclic codes.Convolutionalcodes.Viterbidecoding.TCM.

Unit -5: Spread-Spectrum Modulation

Spread spectrum (SS) techniques; direct S.S and frequency hop S.S. Processing gain and jamming margin. CDMA

**Course Outcomes :**

Students are able to

1. Apply the knowledge of statistical theory of communication and explain the conventional digital communication system.

2. Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.
3. Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.
4. Describe and analyze the digital communication system with spread spectrum modulation.
5. Design as well as conduct experiments, analyze and interpret the results to provide valid conclusions for digital modulators and demodulator using hardware components and communication systems using CAD tool.

**Text Books:**


1. J.G. Proakis, "Digital Communications" (5/e), McGraw – Hill,2007.
2. S. Haykin, "Communication Systems" (4/e), Wiley,2001.


**Reference Books:**


1. B. Sklar, "Digital Communications: Fundamentals & Applications", (2/e),Pearson Education, 2001.
2. A.B. Carlson :"Communication Systems", (5/e), McGraw Hill, 2009.
3. R.E. Zimer& R.L. Peterson: "Introduction to Digital Communication", (2/e), Prentice Hall, 2001.


**EC304 MOBILE COMMUNICATION (3 – 0 - 0) 3**

**Pre-Requisite :EC301 and EC305**

**Objective:**

To understand the basics of wireless digital communication used for mobile telephony. To study the basic methodologies of cellular system designing. To study various modulation mechanisms.To understand the wireless channel characterization.To understand the various multiplexing mechanisms.To understand the interference measurement and reduction techniques.

**Topics Covered:**

Unit-1:Cellular concept

Frequency reuse – co-channel interference - adjacent channel interference - power control for reducing interference - improving capacity in cellular systems - cell splitting - sectoring - hand off strategies - channel assignment strategies - call blocking in cellular networks

Unit-2:Mobile Radio Propagation

Reflection, Diffraction, Fading. Multipath propagation.Statistical characterization of multipath fading.Diversity techniques for mobile wireless radio systems concept of diversity branch and signal paths - combining methods - selective diversity combining - maximal ratio combining- equal gain combining

Unit-3:Propagation models

Path loss prediction over hilly terrain.Practical link budget design using Path loss models. Indoor and outdoor Propagation models

Unit-4:Multiple access techniques

FDMA, TDMA, SDMA and CDMA. Spread spectrum. Power control.WCDMA. Capacity of multiple access schemes

Unit-5: Mobile communication Standards

Overview of second generation cellular wireless systems: GSM and IS-95 standards, 3G systems: UMTS & CDMA 2000 standards and specifications OFDM and MC-CDMA. WLAN technology.Ad hoc networks.Bluetooth.

**Course Outcome:**

Describe the cellular concept and analyze capacity improvement Techniques. Mathematically analyze mobile radio propagation mechanisms. Summarize diversity reception techniques. Analyze and examine the multiple access techniques and its application.

**Text Books:**

1. KamiloFeher, 'Wireless Digital Communications', PHI
2. Rapport T.S., 'Wireless Communications, Principles and Practice', Prentice Hall

**Reference Books:**

1. Lee W.C.Y., 'Mobile Cellular Telecommunication', MGH
2. Proakis J.G., 'Digital Communications', MGH

**EC306 MICROWAVE COMPONENTS AND CIRCUITS (3-0-0)3**

**Pre-Requisite:** EC204

**Objective:**

To impart knowledge on the essential Microwave Circuit Theory and the design aspects of Microwave Integrated Circuit components.

**Topics Covered:**

Unit-1: Microwave Network Basics & Devices
Microwave network parameters - The Scattering matrix – Properties – formulation - Signal flow graph - Passive microwave devices – terminations – bends – corners – attenuators - phase changers - directional couplers - hybrid junctions - Ferrite devices.

Unit-2 Basic circuit elements & Theorems
Transmission line sections and stubs - Richard transformation - Kuroda identities.

Unit-3: MIC filter design
Low pass to high pass - band pass and band stop transformations - Realization using microstrip lines and strip lines.

Unit-4: MIC Couple design
Design and realization of MIC components - 3 dB hybrid design - Directional coupler – circulator - power divider – Wilkinson power divider - realization using microstrip lines and strip lines.

Unit-5 Applications and Hazards of Microwaves
Applications of microwaves – RADAR - Communication Systems – Industrial – Medical -Radio Modem - Microwave Radiation Hazards – HERP – HERO – HERF - Standards.

**Course Outcomes:**

Students are able to

1. Know the basics of S parameters and use them in describing the components
2. Realize the importance of the theory of Microwave circuit theory.
3. Work out the complete design aspects of various M.I.C. filters
4. Confidently design all M.I.C. components to meet the industry standard
5. Know the applications and realize the hazards of microwaves

**Text Books:**


1. D.M.Pozar, "Microwave Engineering", 4th edition, Wiley,2011.
2. AnnapurnaDas,SisirK.Das,"MicrowaveEngineering", 2nd edition, TMHCo.,Ltd.,2010.


**References:**


1. I.J.Bhal&P.Bhartia, "Microwave Solid state Circuit Design", 2nd edition, Wiley Publishers, 2003
2. R.E.Collin, "Foundations for Microwave Engineering", 2nd edition, Mc Graw–Hill, 2009.


**EC308 VLSIDESIGN (3-0-0)3**

**Pre-Requisite:EC309**

**Objectives:**

1. To introduce various aspects of Digital VLSI circuits
2. To teach the layout issues for CMOS Digital circuits.
3. To make them understand the testing issues.

**Topics Covered:**

Unit -1: Introduction
VLSI design methodology, VLSI technology- NMOS, CMOS and BICMOS circuit fabrication. Layout design rules. Stick diagram. Latch up, Non-idealities of MOSFET.

Unit -2: Combinational circuits
Characteristics of MOS and CMOS switches. Implementation of logic circuits using MOS and CMOS technology, multiplexers and memory, MOS transistors, threshold voltage, MOS device design equations. CMOS inverters, propagation delay of inverters, Pseudo NMOS, Dynamic CMOS logic circuits, power dissipation.

Unit -3: Memory System
Memory cell: Layout of SRAM, DRAM.ROM Implementation, Timing constraints, Min-Max Delay, Computation of interconnect delay, Techniques for driving large off-chip capacitors, long lines, Implementation of PLD, EPROM, EEPROM,

Unit -4: FPGAs and ASICs
An overview of the features of advanced FPGAs, LUTs, Comparison of ASICs, FPGAs , PDSPs and CBICs . Fault tolerant VLSI architectures

Unit -5: Testing
VLSI testing -need for testing, Fault Modelling, Single and Multiple stuck at fault, manufacturing test principles, design strategies for test, chip level and system level test techniques.

**Course Outcomes:**

1. Able to design CMOS Digital Circuits.
2.Able to Layout CMOS Circuits.
3.Understand the timing issues related to combinational and sequential circuits.

**Text Books:**

1. *N.H.E. Weste et al, CMOS VLSI design, (3/e), Pearson , 2005.*
2. *J. Smith, Application Specific Integrated Circuits, Pearson, 1997.*

***Reference Books:***

1. *Pucknell&Eshraghian, Basic VLSI Design, PHI, (3/e).*
2. *Uyemura, Introduction to VLSI Circuits and Systems, Wiley, 2002.*

**EC310 EMBEDDED SYSTEM DESIGN (3-0-0)3**

**Pre-Requisite:EC208, EC311**

**Objectives:**

To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform .

**Topics Covered:**

Unit-1: Introduction
Overview of various types of microcontrollers -.Processor selection for embedded system- Selection of memory for embedded system- Devices and buses for device networks.

Unit-2: 8 and 16 bit microcontroller

Motorola 68HC11/ 68HC12 family of microcontrollers-Internal architecture- Addressing modes and instruction set- Interrupts.

Unit-3: Software development
Introduction- Integrated Development Environment-High speed I/O interfacing-Memory interfacing- Modem communication.

Unit-4: Real time operating systems
Introduction- OS services-I/O subsystems-Network operating system- Real time embedded system OS- Interrupt routine in RTOS- OS security.

Unit-5: 32 bit microcontroller
Intel 16 and 32 bit microcontroller- 8096/80196 family-Architecture- Addressing modes-Instruction set- Introduction to ARM processor.

**Course Outcomes:**
Students are able to

1. Describe the differences between the general computing system and the embedded system, also recognize the classification of embedded systems..
2. Become aware of interrupts, hyper threading and software optimization.
3. Design real time embedded systems using the concepts of RTOS.
4. Analyze various examples of embedded systems.

***Text Books:***


1. *Raj Kamal, Embedded Systems Architecture, Programming, and Design. (2/e), Tata McGraw Hill, 2008.*
2. *K.V. Shibu, Introduction To Embedded Systems, Tata McGraw, 2009.*
3. *Peter Barry and Patric Crowley, Intel architecture for Embedded system .*


**Reference Books:**


1. Jonathan.W.Valvano, Embedded Microcomputer Systems, Real Time Interfacing, Published by ThomsonBrooks/Col, 2002.
2. G.H. Miller, Microcomputer Engineering, 3d edition, Pearson Education.

**EC312COMMUNICATION ENGINEERING LABORATORY (0-0-3-2)**

**List of Experiments:**

1. Generation and Demodulation of AM signal
2. Generation and Demodulation of DSB-SC signal
3. Generation and Demodulation PAM signal
4. Generation and Demodulation PWM signal using sawtooth generator.
5. Generation of PWM signal using PLL.
6. Generation of PPM signal using IC565.
7. Generation and Demodulation ASK signal.
8. Generation and Demodulation of FSK.
9. Design and analysis of frequency multiplier circuit.
10. Analog Modulated signal generators using COMM-SIM .
11. Pulse Modulated signal generators using COMM-SIM .
12. Digital Modulated signal generators using COMM-SIM .
13. Study of performance of network with CDMA and Wi-Max.
14. Study of performance of MANET, TCP/IP, ALOHA, CSMA/CD and OFDMA
15. Study and analysis of RTP, Queues, schedulers and routing protocols

**EC314 VLSI and embedded system design lab (0 - 0 - 3 – 2)**

**List of Experiments:**

## Using HDLs (using FPGA):

**Using Spice:**

1. MOSFET characteristics
2. Oscillator design using Inverters
3. Combinational circuit implementation using CMOS Logic.
4. Sequential Circuit implementation using CMOS Logic

**USING XILINX**

6. Timing and Power dissipation Adders and subtractors
7. Timing and Power dissipation Mux &Demux
8. Timing and Power dissipation Encoders & Decoders
9. Implementation of Counters.
10. Implementation of FSM

**EC354 SPEECH PROCESSING (3-0-0-3)**

**Objective:**

1. The course covers the main aspects of speech processing by computer. Topics include: models of the vocal tract; identification and extraction of speech features; speech compression; the recognition of speech and speakers by computer; and control of speech synthesizers.
2. To understand the process of speech production and perception
3. Processing the speech for finding the speech and speaker information
4. Understand about the automatic recognition of speech

**Topics Covered:**

Unit-1: Digital models for the speech signal

Process of speech production - Acoustic theory of speech production - Lossless tube models - and Digital models for speech signals

Unit-2: Time domain models for speech processing

Time dependent processing of speech - Short time energy and average magnitude - Short time average zero crossing rate - Speech vs silence discrimination using energy & zero crossings - Pitch period estimation - Short time Autocorrelation function - Short time average magnitude difference function - Pitch period Estimation using autocorrelation function

Unit-3: Short time Fourier analysis

Linear Filtering interpretation - Filter bank summation method - Overlap addition method - Design of digital filter banks - Implementation using FFT - Spectrographic displays - Pitch detection - Analysis by synthesis -Analysis synthesis systems.

Homomorphic speech processing: Homomorphic systems for convolution - Complex cepstrum - Pitch detection - Formant estimation – Homomorphic vocoder

Unit-4: Linear predictive coding of speech

Basic principles of linear predictive analysis - Solution of LPC equations - Prediction error signal - Frequency domain interpretation - Relation between the various speech parameters - Synthesis of speech from linear predictive parameters - Applications

Unit-5: Speech Enhancement

Spectral subtraction & filtering -Adaptive noise cancellation - Speech Synthesis: Principles of speech synthesis - Synthesizer methods - Synthesis of intonation - Speech synthesis for different speakers - Speech synthesis in other languages – Evaluation - Practical speech synthesis - Automatic Speech Recognition -Audio Processing: Auditory perception and psychoacoustics – Masking - frequency and loudness perception - spatial perception - Digital Audio, Audio Coding - High quality -lowbit- rate audio coding standards – MPEG - AC-3 - Multichannel audio - Stereo, 3D binaural and Multichannel surround sound

**Course Outcome:**

Students know about the necessity of speech processing for finding speech information or speaker information

**Text Books:**

1. L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals," Pearson Education (Asia) Pte. Ltd., 2004.
2. L. R. Rabiner and B. Juang, “Fundamentals of Speech Recognition,” Pearson Education (Asia) Pte. Ltd., 2004.

**Reference Book:**

1. C Becchetti& L P Ricotti, “Speech Recognition Theory & C++ Implementation” John Wiley & Sons
2. D. O’Shaughnessy, “Speech Communication Human & Machine”, Universities Press.
3. B. Gold & N. Morgan “Speech & Audio Signal Processing”, John Wiley & Sons
4. D. O’Shaughnessy, “Speech Communications: Human and Machine,” Universities Press, 2001.
3. Z. Li and M.S. Drew, “Fundamentals of Multimedia,” Pearson Education (Asia) Pvt. Ltd., 2004.

**EC454 DISPLAY SYSTEMS(3-0-0)3**

**Pre-Requisite: None**

**Objective:**

To expose the students to the basics of the display systems and to illustrate the current design practices of the display systems.

**Topics Covered:**

Unit-1:Introduction to displays

Requirements of displays. Display technologies, CRT, Flat panel and advanced display technologies. Technical issues in displays.

Unit-2:Head mounted displays

Displays less than and greater than 0.5 m diagonal.Low power and light emitting displays.

Unit-3: TFTs and MIMS

Operation of TFTs and MIMS.LCDs, Brightness.Types of LCD displays.

Unit-4:Emissive displays

ACTFEL, Plasma display and Field emission displays, operating principle and performance.

Unit-5:Types of Displays

3D, HDTV, LED, Touch screen.

**Course Outcomes:**

On the successful completion of this course Student are able

1. To understand the basics of various display technologies and technical issues related to them.
2. To apply the acquired knowledge in practical design of a display system.

**Text Books:**

1. L.W. Mackonald& A.C. Lowe, Display Systems, Design and Applications, Wiley, 2003.
2. E.H. Stupp& M. S. Brennesholtz, Projection Displays, Wiley, 1999.

**Reference Book:**

1. Peter A. Keller, Electronic Display Measurement: Concepts, Techniques, and Instrumentation, Wiley-Interscience, 1997.

**EC457 OPERATING SYSTEMS (3-0-0)3**

**Pre-Requisite:** None

**Objective:**

To expose the principles and practice of operating system design and to illustrate the current design practices using DOS and UNIX operating systems.

**Topics Covered:**

Unit-1: Types of operating systems, Different views of the operating system, Principles of Design and Implementation. The process and threads. System programmer's view of processes, Operating system's views of processes, Operating system services for process management. Process scheduling, Schedulers, Scheduling algorithms. Overview of Linux operating system.

Unit-2: Interprocess synchronization, Mutual exclusion algorithms, Hardware support, Semaphores, Concurrent programming using semaphores.

Unit-3: Conditional critical regions, Monitors, Interprocess communication: Messages, Pipes. Deadlocks: Characterization. Prevention.Avoidance.Detection and recovery.Combined approach to deadlock handling.

Unit-4: Contiguous allocation. Static and dynamic partitioned memory allocation. Segmentation.Non-contiguous allocation. Paging, Hardware support, Virtual Memory

Unit-5: Need for files. File abstraction. File naming. File system organization. File system optimization. Reliability.Security and protection.I/O management and disk scheduling.Recent trends and developments.

**Course Outomes:**

1. Students will understand the principle of operating system design and their memory allocation strategies.
2. Students will have the knowledge of various concurrent processes of the operating systems.

***Text Books:***

1. *Gary: Operating Systems- A modern Perspective, (2/e), Addison Wesley, 2000.*
2. *M. Milenkovic: Operating systems, Concepts and Design, McGraw Hill, 1992.*

***Reference Books:***

1. *C. Crowley: Operating Systems, Irwin, 1997.*
2. *J.l. Peterson & A.S. Chatz: Operating System Concepts, Addison Wesley, 1985.*
3. *W. Stallings: Operating Systems, (2/e), Prentice Hall, 1995.*
4. *Mattuck, A., Introduction to Analysis, Prentice-Hall,1998.*

**ADAPTIVE SIGNAL PROCESSING (3-0-0-3)**

**Objective:**

The course Adaptive Signal Processing presents its algorithms and architectures and explains their use in real world applications. As prerequisites it is assumed that students have studied discrete and continuous signals and systems, and introductory linear algebra.

**Topics Covered:**

Unit-1: General Introduction

Adaptive systems: Definition and characteristics, areas of applications - general properties - Open and closed loop adaptation - applications of closed loop adaptation

The adaptive liner combiner: General description -input signal and weight vectors - desired Response and error - the performance function - gradient and minimum mean square error - Example of performance surface - alternative expression of the gradient - de-correlation of Error and input components

Unit-2: Theory of adaptation with stationary signals

Properties of the quadratic performance surface: Normal form of the input correlation Matrix - eigen values and eigen vectors of the input correlation matrix - an example with two weights - geometrical significance ofeigen vectors and eigen values

Searching the performance surface: Methods of searching the performance surface - basic ideas of gradient search methods - a simple gradient search algorithm and its solution - stability and rate of convergence

Unit-3: Gradient estimation and its effects on adaptation

Gradient component estimation by derivative measurement - the performance penalty - derivative measurement and performance penalties with multiple weights - variance of the gradient estimate

Unit-4: Partial Characterization of a Discrete-Time Stochastic

Process - Mean Ergodic Theorem - Correlation Matrix - Correlation Matrix of Sine Wave Plus Noise - Stochastic Models - Asymptotic Stationary of an Autoregressive Process - Yule-Walker Equations -Complex Gaussian Process - Power Spectral Density - Properties of Power Spectral Density - Transmission of a Stationary Process Through a Liner Filter - Cramer Spectral Representation for a Stationary Process - Power Spectrum Estimation - Other Statistical Characteristics of a Stochastic Process - Wiener filters:Linear Optimum Filtering - Statement of the problem - Principle of Orthogonally

Unit-5: Minimum Mean-Square Error Adaptive algorithms and structures

The LMS algorithms - RLS adaptive filters: Some Preliminaries - The Matrix Inversion Lemma - The Exponentially Weighted Recursive Least-Squares Algorithm - Selection of The Regularizing Parameter - Update Recursion for the sum of weighted Error Squares convergence analysis of the RLS Algorithm - Computer Experiment on Adaptive Equalization - Robustness of RLS filter

**Course Outcomes:**

Students will learn about the real world applications of signal Processing

**Text Books:**


1. Adaptive Filter Theory- S. Haykin,4th Edition, Pearson Education, 2008
2. Adaptive Filters, A. H. Sayed, John Wiely and Sons, 2008


**Reference Books:**


1. Adaptive filtering primer with MATLAB, Alexander D. Poularikas, Zayed M. Ramadan, CRC Press, 2006

2 Adaptive Signal Processing, B. Widrow and S.D. Stearns,Prentice Hall, Englewood Cliffs, NJ, 1985.