DAV UNIVERSITY JALANDHAR

Course Scheme & Syllabus
Master of Technology

In

Electronics and Communication Engineering

Program Code: 43

Session 2019–2020
Onwards

DAV UNIVERSITY, JALANDHAR

Scheme of Courses
M Tech (Electronics and Communication Engineering)

Semester-1

Sr no	Course Code	Course Title	L	T	P	Cr	Course Type
1	ECE501	ADVANCE COMMUNICATION SYSTEM	4	0	0	4	PCC
2	ECE502	ADVANCE OPTICAL COMMUNICATION	4	0	0	4	PCC
3	ECE506	ADVANCE DIGITAL SIGNAL PROCESSING	4	0	0	4	PCC
4	VLS502	LOGIC SYNTHESIS USING HDL	4	0	0	4	PCC
5	ECEXXX	PROGRAM SPECIALIZATION ELECTIVE-I	4	0	0	4	PEC
6	ECE504	ADVANCED COMMUNICATION ENGINEERING LABORATORY	0	0	3	2	LC
7	ECE509	SIGNAL PROCESSING LABORATORY	0	0	3	2	LC

Semester-2

Sr no	Course Code	Course Title	L	T	P	Cr	Course Type
1	ECE551	DIGITAL IMAGE AND VIDEO PROCESSING	4	0	0	4	PCC
2	ECE508	INFORMATION AND COMMUNICATION THEORY	4	0	0	4	PCC
3	ECEXXX	PROGRAM SPECIALIZATION ELECTIVE -II	4	0	0	4	PEC
4	ECEXXX	PROGRAM SPECIALIZATION ELECTIVE -III	4	0	0	4	PEC
5		GENERIC ELECTIVE-I	4	0	0	4	OEC
6	ECE555	DIGITAL IMAGE AND VIDEO PROCESSING LAB	0	0	3	2	LC
7	ECE550	MINI PROJECT	0	0	3	2	PROJ

Semester-3

Sr no	Course Code	Course Title	L	T	P	Cr	Course Type
1	ECEXXX	PROGRAM SPECIALIZATION ELECTIVE -IV	4	0	0	4	PEC
2		GENERIC ELECTIVE -II	4	0	0	4	OEC
3	ECE604A	DISSERTATION PART - I	0	0	16	8	PROJ

Semester-4

Sr no	Course Code	Course Title	L	T	P	Cr	Course Type
1	ECE605A	DISSERTATION PART - II	0	0	24	12	PROJ

Abbreviation	Definition
L	LECTURE
T	TUTORIAL
P	PRACTICAL
Cr	CREDITS
PCC	PROFESSIONAL CORE COURSES
PEC	PROFESSIONAL ELECTIVE COURSES
OEC	OPEN ELECTIVE COURSES
LC	LABORATORY COURSES
PROJ	PROJECT, DISSERTATION

Program Specialization Elective-I*

Sr no	Course Code	Course Title	L	T	P	Cr	Specialization
1	ECE503	MICROELECTRONICS	4	0	0	4	VLSI and Embedded Design
2	ECE553	DETECTION AND ESTIMATION THEORY	4	0	0	4	Signal Processing
3	ECE507	MOBILE AD-HOC NETWORKS	4	0	0	4	Wireless Communication
4	ECE552	OPTO-ELECTRONIC DEVICES	4	0	0	4	Optical Communication

Program Specialization Elective-II*

Sr no	Course Code	Course Title	L	T	P	Cr	Specialization
1	VLS506	VLSI SUBSYSTEM DESIGN	4	0	0	4	VLSI and Embedded Design
2	ECE561	BIOMEDICAL SIGNAL PROCESSING	4	0	0	4	Signal Processing
3	ECE562	WIRELESS SENSOR NETWORKS	4	0	0	4	Wireless Communication
4	ECE563	OPTICAL NETWORKS	4	0	0	4	Optical Communication

Program Specialization Elective-III*

Sr no	Course Code	Course Title	L	T	P	Cr	Specialization
1	VLS507A	VLSI ARCHITECTURES	4	0	0	4	VLSI and Embedded Design
2	ECE571	AUDIO AND SPEECH PROCESSING	4	0	0	4	Signal Processing
3	ECE572	WIRELESS AND MOBILE COMMUNICATION	4	0	0	4	Wireless Communication
4	ECE573	OPTICAL SWITCHING AND WAVELENGTH ROUTING	4	0	0	4	Optical Communication

Program Specialization Elective-IV*

Sr no	Course Code	Course Title	L	T	P	Cr	Specialization
1	VLS523	EMBEDDED SYSTEMS	4	0	0	4	VLSI and Embedded Design
2	ECE651	ADAPTIVE SIGNAL PROCESSING	4	0	0	4	Signal Processing
3	ECE652	MODERN RADAR SYSTEMS	4	0	0	4	Wireless Communication
4	ECE653	PHOTONICS	4	0	0	4	Optical Communication

Open Elective Courses*

S. No	Course Code	Course Title	L	T	P	Cr.
1	ELE901	RENEWABLE ENERGY SOURCES	4	0	0	4
2	ELE902	ENERGY AUDIT AND MANAGEMENT	4	0	0	4
3	CHL901	ANALYTICAL TECHNIQUES	4	0	0	4
4	CHL902	POLLUTION ABATRMENT AND CONTROL EQUIPMENT’S	4	0	0	4
5	MEC901	METHODS ENGINEERING AND ERGONOMICS	4	0	0	4
6	MEC902	POWER PLANT ENGINEERING	4	0	0	4
7	CSE901	SOFT COMPUTING	4	0	0	4
8	CSE902	MOBILE COMMUNICATIONS	4	0	0	4
9	ECE901	SMART SENSORS	4	0	0	4
10	ECE902	SILICON CHIP TECHNOLOGY	4	0	0	4
11	CIV901	TRANSPORTATION ENGINEERING	4	0	0	4
12	CIV902	WATER RESOURCE ENGINEERING	4	0	0	4
13	MGT051	BUSINESS STRATEGY	4	0	0	4
14	MGT052	PRINCIPLES OF MARKETING	4	0	0	4

*Not limited to

DAV UNIVERSITY, JALANDHAR

M. TECH (ECE) PROGRAM STRUCTURE

Year 2019	PROGRAM STRUCTURE ECE	PCC	LC	PEC	OEC	PROJ	Total
		24	6	16	8	22	76

Course Title: Advanced Communication System

Course Code: ECE501

L	T	P	Credits
4	0	0	4

Course Objective: The course considers advanced communication systems and techniques. In this course we will introduce some of the basic mathematical concepts that will allow us to think in the two "domains" of communications, the time domain and the frequency domain. We will cover the types of analog to analog modulation, analog to digital modulation, digital to analog modulation, digital to digital modulation from both a mathematical description and from a block-diagram system approach.

Learning Outcomes: The scope of this course is to provide the complete analysis of Analog, pulse & digital communication over analog as well as digital channels. This knowledge helps them to acquire better application of these principles in higher end communication systems. The overall objective is to introduce the student to the basics of communication. This course emphasizes:

- Analog to analog modulation and demodulation techniques.
- Acquiring mathematical understanding of Communication Systems.
- Understanding the trade-offs (in terms of bandwidth, power, and complexity requirements)
- Performance evaluation of communication systems in the presence of noise.
- Design of practical communication system at the block diagram level under certain constraints and requirements.

Section A

Generalized Communication Systems **(10 Hrs)**

Introduction, generalized block diagram of communication system, Superhetrodyne & Tuned Radio Frequency Receiver, review of analog communication system: Amplitude modulation, DSB-SC, SSB-SC, SSB-PC/RC, VSB, ISB, Frequency modulation, amplitude, frequency spectrum, power calculations, band width calculations etc. electromagnetic frequency spectrum, bandwidth, information capacity and noise.

Digital Transmission Part 1 **(10 Hrs)**

Introduction, Pulse modulation, Sampling, PAM: Natural and Flat top, PAM Transmitter & Receiver, PWM: Transmitter and Receiver, PPM: Transmitter and Receiver, Difference in PAM, PWM, and PPM.

Section B

Digital Transmission Part 2 **(10 Hrs)**

PCM, PCM Sampling, Signal to Quantization noise ratio, Linear & non-linear, PCM codes, coding methods, Companding: A-Law, μ- law, Digital companding, Delta modulation, Adaptive delta modulation, differential PCM, inter symbol interference, eye patterns.

Digital Modulation **(10 Hrs)**

Introduction, information capacity bits, bit rate, baud & M-ary encoding, ASK, FSK, PSK, BPSK, QPSK, 8PSK, 16 PSK, QAM, 8 QAM, 16 QAM, Bandwidth efficiency, DPSK, Trellis code modulation, Probability of error, error performance

Section C

Digital Baseband Transmission **(10 Hrs)**

Introduction, introduction to discrete PAM signals, Line coding and its properties. Various PAM formats for line codes, RZ, NRZ and Manchester coding. HDB, B8ZS (unipolar and Bipolar)

Section D

Data Communications **(10 Hrs)**

Introduction, data communication codes, error control, error detection, error correction, character synchronization, ISDN, ATM

References:

1. Tomasi, Wayne. *Electronic Communication Systems*. Pearson, 2013
2. Proakis. *Digital Communication.* PHI, 2012.
3. Lathi, BP. *Modern Digital and Analog Communications systems*. Oxford, 2013
4. Haykin, Simon. *Communication Systems*. John wiley & Sons, 2011
5. Related IEEE/IEE publications.

Course Title: Advanced Optical Communication

Course Code: ECE502

L	T	P	Credits
4	0	0	4

Course Objective: To expose basics of Optical devices and components. To expose various optical fibre modes configurations and various signal degradation factors associated with optical fiber and to the design simple optical communication system.

Learning Outcomes: This course will help the students

- To understand all Optical devices and components.
- To understand the principles of fiber-optic communications and the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
- To design the optical communication system.

Section A

Introduction (8 Hrs)

Evolution of optical communication systems, elements of optical fiber transmission link, Comparison of optical communication systems with other contemporary communication systems.

Optical Fibers & Signal Degradation (8 Hrs)

Basics of optical fibers, Attenuation and dispersion effects in single mode and multimode optical fibers.

Section B

Optical Fibers & Signal Degradation (8 Hrs)

Control of dispersion in single mode & multimode fibers

Transmitter Receivers & Modulators (7 Hrs)

Light emitting diodes, laser diodes, their structures, efficiency of laser diodes, functional block diagram & typical circuits of transmitter. PIN & APD photodiodes noise sources in photo detectors, SNR and noise equivalent power, sensitivity & quantum limit of receivers

Section C

Transmitter Receivers & Modulators **(7 Hrs)**

Functional block diagram and typical circuits of a receiver, decision circuit design, Electro-optic, electro-absorption & acousto-optic external modulators.

Digital Transmission Systems **(8 Hrs)**

Point to Point link, system considerations, link power, budget & rise time budget analysis, Line coding techniques, NRZ, RZ, Manchester etc., eye pattern analysis.

Section D

WDM Base Optical Communication System **(7 Hrs)**

Introduction to wavelength division multiple access, Receiver & transmitter requirements in WDM networks, Repeaters & amplifiers, Erbium doped fiber amplifier (EDFA).

Passive Components for WDM Based Systems **(7 Hrs)**

Couplers & splitters, FBT couplers, WDM multiplexer & de-multiplexers fixed & tunable filters, isolators, circulators & attenuators, Optical switches & wavelength converters

References:

1. Keiser, G. *Optical Fiber Communications*. McGraw Hill, 2009.
2. Myanbaev, D.K. & Lowell L. Scheiner. *Fiber Optic Communication Technolog.* Pearson Education Asia, 2008.
3. Agrawal, G.P. *Nonlinear Fiber Optics.* Academic Press, 2009.
4. Senior, J.M. *Optical Fiber Communications*. Prentice Hall India, 2008.

Course Title: Advanced Digital Signal Processing
Course Code: ECE506

L	T	P	Credits
4	0	0	4

Course Objective:
To introduce the student to advanced digital signal processing techniques.

Learning Outcomes:
- To study the parametric methods for power spectrum estimation.
- To study adaptive filtering techniques using LMS algorithm and to study the applications of adaptive filtering.
- To study multi-rate signal processing fundamentals.
- To study the spectral estimation of various signals.
- To introduce the student to applications of Signal Processing

Section A

Review of Signal Processing
Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, and Parallel all pass realization of IIR.

Section B

Multi Rate Signal Processing
Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.

Autoregressive modelling
Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Section C

Adaptive Signal Processing
Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm

Spectral Estimation

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.

Applications of DSP

Section D

Applications of Signal Processing

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

References:

1. John Proakis, G. & Dimitris G. Manobakis, *Digital Signal Processing Principles, Algorithms and Applications*, PHI. 4th edition 2007.
2. N. J. Fliege, "*Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets*", 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, "*Multirate and Wavelet Signal Processing*", 1st Edition, Academic Press, 1997.
4. M. H. Hayes, "*Statistical Digital Signal Processing and Modeling*", John Wiley & Sons Inc., 2002.
5. S.Haykin, "*Adaptive Filter Theory*", 4th Edition, Prentice Hall, 2001.
6. D.G.Manolakis, V.K. Ingle and S.M.Kogon, "*Statistical and Adaptive Signal Processing*", McGraw Hill, 2000.

Course Title: Logic Synthesis Using HDL

Course Code: VLS502

L	T	P	Credits
4	0	0	4

Course Objective:

HDL programming is fundamental for VLSI design and hence this course is given.

Learning Outcome:

- Acquired know ledge about combinational & sequential circuits.
- Foster ability to identify and code the module using different modeling styles.
- Foster ability to code using subprograms.
- Foster ability to w rite test benches in Verilog.
- Acquired know ledge about FSM and how to code a FSM.
- Ability to synthesize the Verilog code.

Section A

Review of digital design (6 Hrs)

MUX based digital design, Design using ROM, Programmable Logic Arrays (PLA) and Programmable Array Logic (PAL), Sequential circuit design - design of Moore and Mealy circuits, Design of a pattern sequence detector using MUX, ROM and PAL.

Introduction to Verilog (6 Hrs)

Verilog as HDL, Levels of Design Description, Concurrency, Simulation and Synthesis, Functional Verification, System Tasks, Programming Language Interface (PLI), Module, Simulation and Synthesis Tools, Test Benches.

Language Constructs and Conventions (6 Hrs)

Introduction, Keywords, Identifiers, White Space Characters, Comments, Numbers, Strings, Logic Values, Strengths, Data Types, Scalars and Vectors, Parameters, Memory, Operators, System Tasks.

Section B

Gate Level Modeling (6 Hrs)

Introduction, AND Gate Primitive, Module Structure, Other Gate Primitives, Illustrative Examples, Tri-State Gates, Array of Instances of Primitives, Additional Examples, Design of Flip-flops with Gate Primitives, Delays, Design of Basic Circuits.

Behavioral Modeling (6 Hrs)

Introduction, Operations and Assignments, Functional Bifurcation, Initial Construct, Always Construct, Examples, Assignments with Delays, Wait construct, Multiple Always Blocks, Designs at Behavioral Level, Blocking and Non-blocking Assignments, The case statement, Simulation Flow.

if and if-else constructs, assign-deassign construct, repeat construct, for loop, the disable construct, while loop, forever loop, parallel blocks, force-release construct, Event.

Modeling at Dataflow Level (6 Hrs)

Introduction, Continuous Assignment Structures, Delays and Continuous Assignments, Assignment to Vectors, Operators.

Section C

Design using Algorithmic State Machine Charts (6 Hrs)

Derivation of ASM charts, Design examples such as dice game, etc. using ASM charts, Implementation of ASM charts using microprogramming, and Verilog design of bus arbitrator.

Test Benches (6 Hrs)

Test benches, verifying responses, clocks and resets, printing response values, reading data files, reading standard types, error handling.

Section D

Simulation, Synthesis, Place and Route, and Back Annotation (6 Hrs)

Design flow, Simulation using Modelsim, Synthesis using Synplify, Place and Route, and Back Annotation using Xilinx.

Design of memories (5 Hrs)

Verilog realization of Read Only Memory (ROM), Verilog realization of Random Access Memory (RAM), and Verilog coding of controller for accessing external memory.

Introduction to Hardware Implementation (1 Hrs)

References:

1. Verilog HDL: A Guide to Digital Design and Synthesis; S.Palnitkar; PH/Pearson, 1996.
2. Verilog HDL Synthesis; J.Bhaskar; BS publications, 2001.
3. Digital Principles and Applications; Donald P Leach, A P Malvino; Tata McGraw-Hill Edition 2006.

Course Title: Advanced Communication System Laboratory

Course Code: ECE504

L	T	P	Credits
0	0	3	2

Course Objectives: This lab helps the students to understand the basic principles of digital communication systems by practical module systems. The experiments are designed in such a way that the theoretical concepts introduced in lectures are re-discussed and implemented practically.

Learning Outcomes:

To demonstrate digital communication concepts using hands-on experience and using simulation environments such as PSPICE / Multisim, or Matlab/Simulink, or LabVIEW.

List of Experiments

1. **Analog Modulation based Communication:** To generate various Analog modulation techniques like Amplitude Modulation, Frequency Modulation and Phase Modulation used in RF Communication using MATLAB.
2. **Digital Modulation based Communication:** To implement various Digital Modulation techniques like ASK, FSK, BPSK, QPSK, 8PSK, QAM using MATLAB.
3. **Waveform Coding:** Implementation of PCM, DPCM and its analysis, Implementation of A-Law, µ-Law and its analysis.
4. **Channel Modeling:** Implementation of AWGN, BSC, DMS, Rayleigh and Rician fading Channels.
5. **Channel coding techniques:** Implementation of various channel coding techniques and their analysis using MATLAB.
6. **Bit error Rate:** To design a complete digital communication system and study the Bit error rate on various levels of signal to noise ratio.
7. **Free Space Communication:** To build a free space communication model and to analyze the free space loss and power received using MATLAB.
8. **RF link Budget:** To calculate the RF link budget for satellite communication using MATLAB Program.

9. **CDMA transmitter and Receiver:** To simulate the basic CDMA transmitter and receiver using MATLAB.
10. **OFDM:** To simulate the basic OFDM communication model using MATLAB.
11. **Antenna:** In this the experiments will demonstrate the following
    i. Antenna radiation patterns
    ii. Antenna beam-width
    iii. Effective radiative powers
    iv. Antenna array
    v. Antenna gain
    vi. Effective aperture
    vii. Antenna directivity,
    viii. Main to side lobe ratio.

The above experiments will be performed on various antennas such as Dipole antenna, Parabolic antenna, Micro-strip antenna, Horn antenna, Yagi-uda antenna etc.

Course Title: Signal Processing Laboratory

Course Code: ECE509

L	T	P	Credits
0	0	3	2

Course Objective:

To introduce the student to advanced digital signal processing techniques with help of MATLAB

Learning Outcomes: This will help the students to

- Study of the parametric methods for power spectrum estimation.
- Study of adaptive filtering techniques using LMS algorithm and to study the applications of adaptive filtering.
- Study of multi-rate signal processing fundamentals.
- Study of the analysis of signals.

List of Experiments

1. Experiment to demonstrate the sample rate reduction, interpolation and decimation using MATLAB.
2. Experiment to demonstrate the Line enhancer using MATLAB
3. Experiment to demonstrate the adaptive filtering using MATLAB
4. Experiment to demonstrate Hilbert transform using MATLAB
5. Experiment to demonstrate DCT using MATLAB
6. Experiment to demonstrate STFT using MATLAB
7. Experiment to demonstrate DWT using MATLAB
8. Experiment to demonstrate IDWT using MATLAB
9. Experiment to compare the various transform using MATLAB

Course Title: Digital Image and Video Processing

Course Code: ECE551

L	T	P	Credits
4	0	0	4

Course Objective:

The objective of this course is to introduce the students to the fundamental techniques and algorithms used for acquiring, processing and extracting useful information from digital images. Particular emphasis will be placed on covering methods used for image sampling and quantization, image transforms, image enhancement and restoration, image encoding, image analysis and pattern recognition. In addition, the students will learn how to apply the methods to solve real-world problems in several areas including medical, remote sensing and surveillance and develop the insight necessary to use the tools of digital image processing (DIP) to solve any new problem. The study is extended to the video processing as well.

Learning Outcomes:

- To study fundamentals of digital imaging.
- To study various image and video enhancement techniques.
- To study image segmentation techniques
- To study image processing of color images.
- To introduce the student to feature extraction of images

Section A

Digital Image and Video Fundamentals

Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform

Section B

Image, Video Enhancement and Restoration

Image, Video Enhancement and Restoration Histogram, Point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, de-interlacing, video resolution enhancement, Image and Video restoration (recovery).

Image and Video Segmentation

Image and Video Segmentation Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.

Section C

Colour image Processing

Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing

Image and Video Compression

Lossless image compression including entropy coding, lossy image compression, video compression techniques, and international standards for image and video compression (JPEG, JPEG 2000, MPEG-2/4, H.264, SVC), Video Quality Assessment

Section D

Feature Extraction

Object recognition Image Feature representation and description-boundary representation, boundary descriptors, regional descriptors, feature selection techniques, introduction to classification, supervised and unsupervised learning, Template matching, Bayes classifier

References:

1. Ed. Al Bovik ,"*Handbook of Image and Video Processing*", 2nd Edition, Academic Press, 2000.

2. J. W. Woods, "*Multidimensional Signal, Image and Video Processing and Coding*", 2nd Edition, Academic Press, 2011.
3. Rafael C. Gonzalez and Richard E. Woods," *Digital Image Processing*", 3rd Edition, Prentice Hall, 2008.
   1.3.1. M. Tekalp, "*Digital Video Processing*", 2nd Edition, Prentice Hall, 2015.
4. S. Shridhar, "*Digital Image Processing*", 2nd Edition, Oxford University Press, 2016.

Course Title: Information and Communication Theory
Course Code: ECE508

L	T	P	Credits
4	0	0	4

Course Objective:

This course is intended to make students understand the concepts of information theory. This will also help them to learn the physical significance of various source and channel coding algorithms

Learning Outcomes:

At the end of the course students should be able to

- Calculate the information content of a random variable from its probability distribution
- Relate the joint, conditional, and marginal entropies of variables in terms of their coupled probabilities
- Define channel capacities and properties using Shannon's Theorems
- Construct efficient codes for data on imperfect communication channels
- Generalize the discrete concepts to continuous signals on continuous channels

Section A

Foundations of Information theory (10 Hrs)

Probability, uncertainty, information, concepts of randomness, redundancy, compressibility, noise, bandwidth, ensembles, random variables, marginal and conditional probabilities.

Section B

Entropy (8 Hrs)

Marginal entropy, joint entropy, conditional entropy

Source Coding (8 Hrs)

Source coding theorem, Huffman coding, Channel coding theorem, channel capacity theorem, Channels, Shenonfano theorem

Sampling Process (8 Hrs)

Base band and band pass sampling theorems reconstruction from samples, Practical aspects of sampling and signal recovery TDM.

Section C

Channel Coding Part 1 **(10 Hrs)**

Waveform Coding and Structured Sequences, Types of Error Control, Structured Sequences, Linear Block Codes, Error-Detecting and Correcting Capability, Cyclic Codes.

Channel Coding Part 2 **(8 Hrs)**

Convolutional Encoding, Convolutional Encoder Representation, Convolutional Decoding & Problems, Properties of Convolutional Code.

Section D

Channel Coding Part 3 **(8 Hrs)**

Reed-Solomon Codes, Interleaving and Concatenated Codes, Coding and Interleaving Applied to the Compact Disc.

References:

1. Cover, T.M. & J.A. Thomas. *Elements of information theory*. New York. Wiley.
2. Sklar, Bernard. *Digital Communications, Fundamentals and Applications.* Prentice Hall. Second Edition
3. Gallanger, Robert G. *Information Theory and Reliable Communication*. Mc Graw Hill.
4. Related IEEE/IEE publications.

Course Title: Digital Image and Video Processing lab

Course Code: ECE555

L	T	P	Credits
0	0	3	2

Course Objective:

To introduce the student to Digital Image and Video processing techniques with help of MATLAB

Learning Outcomes: This will help the students to

- Implementation of basic operations on digital imaging
- Study of image compression and enhancement techniques.
- Study of image restoration techniques
- Extraction of important features from the image.

List of Experiments

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a color model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

Course Title: Mini Project
Course Code: ECE550

L	T	P	Credits
0	0	4	2

Course Objective: To train the students in preparing and presenting technical topics

Learning Outcomes: This will help the student to identify their topics of interest related to the program of study and prepare and make presentation before an enlightened audience

The students are expected to give at least two presentations on their topics of interest which will be assessed by a committee constituted for this purpose. This course is mandatory and a student has to pass the course to become eligible for the award of degree. Marks will be awarded out of 100 and appropriate grades assigned as per the regulations

Course Title: Dissertation Part-1 and Part-2

Course Code: ECE604A & ECE605A

Course Code	L	T	P	Credits
ECE604A	0	0	-	8
ECE605A	0	0	-	12

Course Objective: To undertake research in an area related to the program of study. This will help the students to be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society.

Learning Outcome: This will help the students to identify their potential areas of research and to contribute their skills towards the field of Electronics and Communication engineering.

M.Tech Dissertation should be socially relevant and research oriented ones. Each student is expected to do an individual research. The research work is carried out in two phases – Phase I in III semester and Phase II in IV semester. Phase II of the thesis work shall be in continuation of Phase I only. At the completion of dissertation, the student will submit a research report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the Research report and a viva voce examination on the same. The detailed assessment and evaluation procedure of dissertation will be implemented according to the guidelines & policies notified by the University.

Course Title: Microelectronics

L	T	P	Credits
4	0	0	4

Course Code: ECE503

Course Objective:

The course considers helps the students to understand Microelectronics

Learning Outcomes:

Students will learn the practical aspects of Microelectronics and their uses

Section A

A Review of microelectronics and introduction to MOS technology

(8Hrs)

Introduction to IC technology, metal oxide semiconductor and related VLSI technology , Basic MOS transistors, enhancement and depletion model transistors, N-MOS and CMOS fabrication process, thermal aspects of processing, and production of E beam masks.

Electrical properties of MOS circuit

(8Hrs)

Parameters of MOS transistors, drain to source current, threshold voltage, trans-conductance output conductance and figure of merit, pass transistor, N-MOS inverter, pull-up to pull down ratio for an N-MOS inverter, alternative forms of pull up

Section B

CMOS and BiCMOS Circuits

(7Hrs)

C-MOS inverters, MOS transistor circuit model, comparative aspects of key parameters of CMOS and bipolar transistor BiCMOS inverters, latch up in CMOS circuits, BiCMOS latch up susceptibility

Design processes (7Hrs)

MOS layers, stick diagram, design rules and layout, double metal single poly silicon C-MOS process.

Section C

Basic circuit concepts (8Hrs)

Sheets resistance, area capacitance, delay unit, inverter delay, super buffers, and propagation delays.

Scaling of MOS circuits (7Hrs)

Scaling factor, limitations, scaling of wires and inter connections

Section D

Subsystem design & layout (7Hrs)

Architectural issues, switch logic, gate logic, clocked sequential circuits, and other system consideration.

Ultra-fast VLSI circuits and systems (8Hrs)

Ultra-fast systems, GaAs crystal structure, GaAs devices, fabrication, device modeling and performance estimation.

References:

1. DA. & K, Eshrachian *Basic VLSI design systems & circuits*. Prentice Hall India, 1988.
2. Geigar B.R., Strader M.E. & P.E. Allen. *VLSI design techniques for analog & digital circuit*y. McGraw Hill, 1990.
3. Related IEEE/IEE publications

Course Title: Detection and Estimation Theory

Course Code: ECE553

L	T	P	Credits
4	0	0	4

Course Objective:

The course considers helps the students to understand principles of detection and estimation theory

Learning Outcomes:

Students will learn the details of

1. Vector Spaces
2. Stochastic Processes
3. Detections and estimation theory

Section A

Vector and Matrices spaces

Review of Vector Spaces, Vectors and matrices: notation and properties, orthogonality and linear independence, bases, distance properties, matrix operations, Eigen values and eigenvectors.

Symmetric Matrices

Properties of Symmetric Matrices, Diagonalisation of symmetric matrices, symmetric positive definite and semi definite matrices, principal component analysis (PCA), singular value decomposition.

Section B

Stochastic Processes:

Time average and moments, ergodicity, power spectral density, covariance matrices, response of LTI system to random process, cyclo-stationary process, and spectral factorization.

Detection Theory

Detection in white Gaussian noise, correlator and matched filter interpretation, Bayes' criterion of signal detection, MAP, LMS, entropy detectors, detection in colored Gaussian noise, Karhunen-Loeve expansions and whitening filters.

Section C

Estimation Theory

Minimum variance estimators, Cramer-Rao lower bound, examples of linear models, system identification, Markov classification, clustering algorithms.

Section D

Kalman and Weiner Filtering

Discrete time Wiener-Hopf equation, error variance computation, causal discrete time Wiener filter, discrete Kalman filter, extended Kalman filter, examples. Specialized Topics in Estimation: Spectral estimation methods like MUSIC, ESPIRIT, DOA Estimation.

References:

1. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory",
2. Prentice Hall, 1993
3. Steven M. Kay, "Fundamentals of Statistical Signal Processing, Volume II: Detection Theory", 1st Edition, Prentice Hall, 1998
4. Thomas Kailath, Babak Hassibi, Ali H. Sayed, "Linear Estimation", Prentice Hall, 2000.
5. H. Vincent Poor, "An Introduction to Signal Detection and Estimation", 2nd Edition, Springer, 1998.

Course Title: Mobile Ad Hoc Networks

L	T	P	Credits
4	0	0	4

Course Code: ECE507

Course Objectives: To understand the fundamentals and architectures of wireless communication standards and Mobile Adhoc networks.

Learning Outcomes:

- To study the introduction of wireless communication systems.
- To study the specifications and functionalities of wireless protocols / standards.
- To study the fundamentals of mobile Adhoc networks.

Section A

Introduction to Wireless Network (8 Hrs)

Evolution of Mobile Cellular Network, Global System for Mobile Communications (GSM), General Packet Radio Service (GPRS), Personal Communications Services (PCSs), Wireless LANs (WLANS), Universal Mobile Telecommunications System (UMTS, IMT2000, IS-95, cdma-One and cdma2000 Evolution.

Origins of Ad Hoc (8 Hrs)

Packet Radio Networks: Introduction, Technical Challenges, Architecture of PRNETs, Components of Packet Radios, Routing in PRNETs, Route Calculation, Pacing Techniques, Media Access in PRNETs, Flow Acknowledgments in PRNETs

Section B

Ad Hoc Wireless Networks (10 Hrs)

Ad Hoc Network, Heterogeneity in Mobile Devices, Wireless Sensor Networks, Traffic Profiles, Types of Ad Hoc Mobile Communications, Types of Mobile Host Movements, Challenges Facing Ad Hoc Mobile Networks .

Ad Hoc Wireless Media Access Protocols **(8 Hrs)**

Introduction, Problems in Ad Hoc Channel Access, Receiver-Initiated MAC Protocols, Sender-Initiated MAC Protocols, Existing Ad Hoc MAC Protocols, MARCH: Media Access with Reduced Handshake

Section C

Overview of Ad Hoc Routing Protocols **(10 Hrs)**

Table-Driven Approaches, Destination Sequenced Distance Vector (DSDV), Wireless Routing Protocol (WRP), Cluster Switch Gateway Routing (CSGR), Source-Initiated On-Demand Approaches, Ad Hoc On-Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR), Temporally Ordered Routing Algorithm (TORA), Signal Stability Routing (SSR), Location-Aided Routing (LAR), Power-Aware Routing (PAR), Zone Routing Protocol (ZRP), Source Tree Adaptive Routing (STAR), Relative Distance, Micro-diversity Routing (RDMAR).

Section D

Communication Performance of Ad Hoc Networks **(8 Hrs)**

Introduction, Performance Parameters of Interest, Route Discovery (RD) Time, End-to-End Delay (EED) Performance, Communication Throughput Performance, Packet Loss Performance, Route Reconfiguration/Repair Time, TCP/IP-Based Applications

Ad Hoc Nomadic Mobile Applications **(8 Hrs)**

In the Office, While Traveling, Arriving Home, In the Car, Shopping Malls, The Modern Battlefield, Car-to-Car Mobile Communications, Mobile Collaborative Applications

References:

1. Toh, C.K. *Ad Hoc Mobile Wireless Networks: Protocols and Systems*. PHI
2. Basagni, Stefano. *Mobile Ad Hoc Networking.* Wiley Publications

Course Title: Opto-electronic Devices

Course Code: ECE552

L	T	P	Credits
4	0	0	4

Course Objectives:

This course provides a complete overview of the wide variety of different semiconductor. Optoelectronic devices employed in light wave systems and networks. Topics include variety of different subjects including a detailed discussion of the design and operation of optical LEDs, the basic physics and operation of lasers and photo detectors, details of the basic physics and operation of solar cells, the operation of quantum well electro-absorption modulators and electro-optic modulators, and the design and operation of optoelectronic integrated circuits. Emphasis is on the underlying device physics behind the operation and design of optoelectronic devices.

Learning Outcomes:

- Explain key concepts in quantum and statistical mechanics relevant to physical, electrical and optoelectronic properties of materials and their applications to optoelectronic devices and photonic integrated circuits that emit, modulate, switch, and detect photon
- Describe fundamental and applied aspects of optoelectronic device physics and its applications to the design and operation of laser diodes, light-emitting diodes, and photo detector
- Analyze optoelectronic device characteristics in detail using concepts from quantum mechanics and solid state physics

Section A

Basics of Optics: **(10 Hrs)**

Wave nature of light, Light sources-blackbody radiation, review of some quantum mechanical concepts, Energy bands in solids, Electrical conductivity, semiconductors, carrier concentration, Work function, Excess carriers in semiconductors, junctions, and quantum well, Elliptical polarization, Birefringence, optical activity, Electro-optic effect, Kerr modulators, Scanning and switching, Magneto optic devices, Acousto-optic effect, Quantum well modulators, nonlinear optics.

Section B

Optical Sources 1: (10 Hrs)

Difference between optical display devices and electrical display devices such as Photoluminescence, Cathodoluminescence, Cathode ray tube, Electro luminescence, Injection luminescence and light emitting diodes, Plasma displays, Display brightness, LCD, Numeric displays

Section C

Optical Sources 2: (10 Hrs)

Lasers: Emission and absorption of radiation, Einstein relations, Absorption of radiation, Population inversion, Optical feedback, Threshold conditions-laser losses, Line shape function, population inversion and pumping threshold conditions, Laser modes, Classes of Laser, Single mode operation, Frequency stabilization, Mode locking, Q switching, Laser applications, Measurement of distance, Holography, High energy applications of lasers.

Section D

Photo diodes: (10 Hrs)

PN, PIN and Avalanche photodiode, Detector performance parameters, Thermal detectors, Photon devices.

Optical Waveguides: (10 Hrs)

Total internal reflection, planar dielectric waveguide, Optical fiber waveguide, Losses in fibers, Optical fiber connectors, Measurement of fiber characteristics, Fiber material and manufacture, Fiber cables.

Optical Communication Systems: **(8 Hrs)**

Modulation schemes, free space communication, Fiber optical communication systems, integrated optics.

Non-Communications Applications of fibers: (2 Hrs)

Optical fiber sensors, Light guiding fibers.

References

1. Wilson, John and Hawkes, John, Optoelectronics: An Introduction, Prentice Hall (2003) 2nd ed.
2. Kasap, S.O., Optoelectronics and Photonics: Principles and Practices, Prentice Hall (2001).
3. Keiser, G, Optical Fiber Communication, Tata McGraw Hill (2007).
4. Senior, John M., Optical Fiber Communication, Dorling Kindersley (2008) 2nd ed.

Course Title: Biomedical Signal Processing

Course Code: ECE561

L	T	P	Credits
4	0	0	4

Course Objectives:

To introduce the fundamentals of Biomedical Signal Processing.

Learning Outcomes:

When passed, the student should be able to:

- Describe the origin, properties and suitable models of important biological signals such as ECG, EEG and EMG.
- Determine and successfully apply suitable algorithms for analysis of biomedical signals. Specifically, the student should be able to implement and apply algorithms for parametric and non-parametric estimation of a signal's power spectrum density

Section A

Introduction **(15 Hrs)**

Genesis and significance of bioelectric potentials, ECG, EOG, EMG and their monitoring and measurement, Spectral analysis, digital and analog filtering, correlation and estimation techniques, AR / ARMA models, Adaptive Filters.

Section B

ECG **(15 Hrs)**

Pre-processing, Measurements of amplitude and time intervals, Classification, QRS detection, ST segment analysis, Baseline wander removal, wave form recognition, morphological studies and rhythm analysis, automated diagnosis based on decision theory ECT compression, Evoked potential estimation.

Section C

EEG **(15 Hrs)**

evoked responses, Epilepsy detection, Spike detection, Hjorth parameters, averaging techniques, removal of Artifacts by averaging and adaptive algorithms, pattern recognition of alpha, beta, theta and delta waves in EEG waves, sleep stages,

Section D

EMG **(15 Hrs)**

Wave pattern studies, biofeedback, Zero crossings, Integrated EMG. Time frequency methods and Wavelets in Biomedical Signal Processing

References:

1. Willis J Tompkins, ED, "Biomedical Digital Signal Processing", Prentice-Hall of India, 1996.
2. R E Chellis and R I Kitney, "Biomedical Signal Processing", in IV parts, Medical and Biological Engg. And current computing, 1990-91.
3. Special issue on "Biological Signal Processing", Proc. IEEE 1972
4. Arnon Kohen, "Biomedical Signal Processing", Volumes I & II, CRC Press.
5. Metin Aray, "Time frequency and Wavelets in Biomedical Signal Processing", IEEE Press, 1999.Current Published literature

Course Title: ECE562

Course Code: Wireless Sensor Networks

L	T	P	CR
4	0	0	4

Course Objective:

This course is intended to make students understand the concepts of wireless sensor networks. This will also help them to learn the various protocols and management of wireless sensor networks.

Learning Outcome:

At the end of the course students should be able to:

- Understand the sensor technology and data transmission over sensor networks
- Various medium access and routing protocols used in sensor network
- Management of wireless sensor networks

Section A

Introduction and Applications of Wireless sensor networks (7 Hrs)

Overview of Wireless Sensor Networks, Applications of wireless sensor networks; Category 2 WSN applications, Category 1 WSN applications.

Basic Wireless Sensor Technology (7 Hrs)

Sensor Node Technology, Sensor Taxonomy, WN Operating Environment, WN Trends.

Wireless Transmission Technology and Systems (7 Hrs)

Radio Technology Primer, Available Wireless Technologies.

Section B

Medium Access Control Protocols for Wireless Sensor Networks (7 Hrs)

Fundamentals of MAC Protocols, MAC Protocols for WSNs, Sensor-MAC Case Study, IEEE 802.15.4 LR-WPANs Standard Case Study.

Routing Protocols for Wireless Sensor Networks (6 Hrs)

Routing Challenges and Design Issues in Wireless Sensor Networks, Routing Strategies in Wireless Sensor Networks.

Section C

Transport Control Protocols for Wireless Sensor Networks (6 Hrs)

Traditional Transport Control Protocols, Transport Protocol Design Issues, Performance of Transport Control Protocols, CODA, ESRT, RMST, PSFQ, GARUDA.

Middleware for Wireless Sensor Networks (7 Hrs)

WSN Middleware Principles, Middleware Architecture, MiLAN, IrisNet, AMF, DSWare, CLMF and MSM.

Section D

Network Management for Wireless Sensor Networks (7 Hrs)

Requirements, Traditional Network Management Models, Network Management Design Issues, MANNA Architecture.

Operating Systems for Wireless Sensor Networks (6 Hrs)

Operating System Design Issues, Examples; TinyOS, mate, MagnetOS, MANTIS, OSPM and EYES OS.

References:

1. K Sohraby, D Minoli, T Znati**,** Wireless Sensor Networks; Technology, Protocols and Applications, Wiley Interscience.
2. Related IEEE publications

Course Title: Optical Networks

Course Code: ECE563

L	T	P	Credits
4	0	0	4

Course Objectives:

The course will give the student in-depth understanding of the functionality of optical networks and how they may be implemented. How an optical network can work together with an IP-based network infrastructure for ensuring both high reliability and performance in access, metro and transport networks, is paid special attention.

Learning Outcomes:

- To be able to design optical networks, taking both physical transmission properties and optical networking constraints into account
- To be able to evaluate performance of optical packet switched nodes using discrete event simulation methods

Section A

Optical Networks **(8 Hrs)**

Principles and Challenges: Wavelength-Division Multiplexing (WDM): Networking Evolution, WDM Network Constructions, WDM Economics.

Next Generation Networks **(9 Hrs)**

Multiplexing Level, WDM – Passive Optical Network, Wavelength Allocation Strategies, Dynamic Network Reconfiguration Using Flexible WDM, Static WDM PONs, Wavelength Routed PON, Reconfigurable WDM PONs, Wavelength Broadcast-and-Select Access Network, Wavelength Routing Access Network, Geographical, Optical and Virtual Topologies: Star, Tree, Bus, Ring and Combined, Compatibility with Radio Applications UWB, UMTS, Wi-Fi, Radio-Over-Fibre, Next Generation G/E-PON Standards Development Process.

Section B

Network Protection **(9 Hrs)**

Protection Schemes, Reliability Performance Evaluation.

Traffic Studies **(9 Hrs)**

Dynamic Bandwidth Allocation, QoS and Priorization in TDMA PONs, WDMA/TDMA Medium Access Control, Access Protocols for WDM Rings with QoS Support, Efficient Support for Multicast and Peer-to-Peer Traffic, Single-Hop Networks, Multihop Networks, Channel-Sharing and Multicasting

Section C

Virtual Topology Design **(9 Hrs)**

Introduction, System Architecture, Formulation of the Optimization Problem, Algorithms, Experimental Results -Physical Topology as Virtual Topology (No WDM), Multiple Point-to-Point Links (No WRS), Arbitrary Virtual Topology (Full WDM), Comparisons, Effect of Nodal Degree and Wavelength, Network Design: Resource Budgeting and Cost Model, Virtual Topology Reconfiguration.

Section D

Ring Networks **(8 Hrs)**

Introduction, System Architecture and Assumptions (Model), Illustrative Examples, Optimization Criteria, Flow-Based Algorithms, delay-Based Algorithms, Illustrative Examples-Network Description, Delay vs. N Characteristics, Delay vs. Throughput Characteristics, Two or Greater Partitions.

All-Optical Cycle Elimination **(9 Hrs)**

Introduction, Wavelength Cross-connect Switches, Network Assumptions, Overview of Solution and Algorithms, Details of Algorithms, Illustrative Examples-Dynamic Analysis, Static Analysis.

References

1. Murthy, C. Siva Ram, Mohan Gurusamy, WDM Optical Networks: Concepts, Design, and Algorithms, Prentice Hall of India (2001).
2. Maier, Marti, Optical Switching Networks, Cambridge University Press (2008).
3. Sivalingam, Krishna M., Subramaniam, Suresh, Emerging Optical Networks Technologies: Architectures, Protocols, and Performance, Springer (2004).
4. Mukherjee, Biswanath, Optical WDM Networks, Springer (2006).

Course Title: VLSI Architectures

Course Code: VLS507A

L	T	P	Credits
3	0	0	3

Course Objectives:

The course aims to convey the knowledge of advanced concepts of microcomputer architectures and memory hierarchy design.

Learning Outcomes:

- Acquire the knowledge of CISC processors, their architecture and examples
- Acquire the knowledge of RISC processors, their organization, RISC concepts, difference between RISC and CISC.
- Ability to understand and implement the concept of Pipelining in processor architecture and issues
- To reinforce the need of memory hierarchy design and multi-core architectures
- Ability to learn and design arithmetic system design and issues

Section – A

Complex Instruction Set Computers (CISC) (13 Hrs)

Instruction Set, Characteristics and Functions, Addressing Modes, Instruction Formats, Architectural Overview, Processor Organization, Register Organization, Instruction Cycle, Instruction Pipelining, Pentium Processor, PowerPC Processor.

Section – B

Reduced Instruction Set Computers (RISC) (14 Hrs)

Instruction execution Characteristics, Register Organization, Reduced Instruction Set, Addressing Modes, Instruction Formats, Architectural Overview, RISC Pipelining, Motorola 88510, MIPS R4650, RISC Vs. CISC.

Pipeline Processing (14 Hrs)

Basic Concepts, Classification of Pipeline Processors, Instruction and Arithmetic Pipelining: Design of Pipelined Instruction Units, Pipelining Hazards and Scheduling, Principles of Designing Pipelined Processors.

Section – C

Memory Architectures (14 Hrs)

Memory hierarchy design, Multiprocessors, thread level parallelism and multi-core architectures, I/O buses. Arithmetic: Fixed point, Floating point and residue arithmetic, Multiply and Divide Algorithms.

Issues in arithmetic system design, Issues in the applications (optimizing the hardware – software interface), ASIP, reconfigurable computing, Future microprocessor architectures.

Section – D

Superscaler Processors (5 Hrs)

Overview, Design Issues, PowerPC, Pentium.

References

1. Patterson, D.A. and Hennessy, J., Computer Architecture: A Quantitative Approach, Morgan Kaufmann (2003)3rd ed.
2. Stallings, W., Computer Organization and Architecture: Designing for Performance, Prentice Hall (2003) 7th ed.
3. Patterson, D.A. and Hennessy, J., Computer Organization and Design, Elsevier(2004) 3rd ed.

Course Title: Audio and Speech Processing

Course Code: ECE571

L	T	P	Credits
4	0	0	4

Course Objective:

The aim of this module is to describe techniques used in, and architectures for, the design of state-of-the-art speech technology systems. These methods are starting to appear in many types of information processing and computer systems. The course focusses on three main areas: speech recognition; spoken dialogue systems and text-to-speech speech synthesis.

Learning Outcomes:

- The students will get familiar with basic characteristics of speech signal in relation to production and hearing of speech by humans.
- They will understand basic algorithms of speech analysis common to many applications.
- They will be given an overview of applications (recognition, synthesis, coding) and be informed about practical aspects of speech algorithms implementation.

Section A

Digital Models for the Speech Signal (7 Hrs)

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

Time Domain Models For Speech Processing (8 Hrs)

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, Median smoothing.

Section B

Digital Representations of the Speech Waveform (7 Hrs)

Sampling speech signals, Instantaneous quantization, Adaptive quantization, Differential quantization, Delta Modulation, Differential PCM, Comparison of systems, direct digital code conversion.

Short Time Fourier Analysis (8 Hrs)

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.

Section C

Homomorphic Speech Processing (7 Hrs)

Homomorphic systems for convolution, Complex cepstrum, Pitch detection, Formant estimation, Homomorphic vocoder.

Linear Predictive Coding of Speech (8 Hrs)

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.

Section D

Speech Enhancement (7 Hrs)

Spectral subtraction & filtering, Harmonic filtering, parametric re-synthesis, Adaptive noise cancellation.

Speech Synthesis (8 Hrs)

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: Introduction, Speech recognition vs. Speaker recognition, Signal processing and analysis methods, Pattern comparison techniques, Hidden Markov Models, Artificial Neural Networks.

References:

1. L. R. Rabiner and R. W. Schafer, “Digital Processing of Speech Signals”, Pearson Education (Asia) Pte. Ltd., 2004.
2. D. O’Shaughnessy, “Speech Communications: Human and Machine”, Universities Press, 2001.
3. L. R. Rabiner and B. Juang, “Fundamentals of Speech Recognition”, Pearson Education (Asia) Pte. Ltd., 2004.
4. Z. Li and M.S. Drew, “Fundamentals of Multimedia”, Pearson Education (Asia) Pte. Ltd., 2004

Course Title: Wireless and Mobile Communication

Course Code: ECE572

L	T	P	Credits
4	0	0	4

Course Objective:

To introduce the students to the concepts of wireless systems, mobile systems

Learning Outcomes:

After **completion** of this course students will be able to understand

- Basic wireless, cellular concepts.
- 2G, 3G and 4G networks
- Various performance analysis of mobile communication system

Section A

Cellular Concepts (8 Hrs)

System Design Fundamentals: Cellular concept-channel reuse- handoff strategies-dynamic resource allocation-interference and system capacity-improving capacity and coverage of cellular systems.

Second and third generation network standards (8 Hrs)

GSM standardization-architecture and function partitioning-GSM radio aspects-security aspects-protocol model-call flow sequences evolution to2.5G mobile radio networks. IS-95 service and radio aspects, key features of IS-95 CDMA systems- ECWDMA-UMTS physical layer-UMTS network architecture-CDMA 2000 physical layer

Section B

Wireless Local Area Networks (WLAN) (10 Hrs)

Components and working of WLAN, transmission media for WLAN, Modulation techniques for WLAN (DSSS, FHSS), IEEE802.11 standards and protocols for WLAN (MACA, MACAW). Mobile Network and Transport layer: Mobile IP, Mobile TCP, traffic routing in wireless networks, wireless ATM. Wireless Local Loop (WLL), WLL Architecture, WLL Technologies and frequency spectrum. 4G mobile techniques, Wi-Fi Technology.

Section C

Capacity of Wireless Channels (9 Hrs)

Capacity of Flat Fading Channel- Channel Distribution Information known – Channel Side Information at Receiver – Channel Side Information at Transmitter and Receiver – Capacity with Receiver diversity – Capacity comparisons – Capacity of Frequency Selective Fading channels.

Diversity

Realization of Independent Fading Paths – Receiver Diversity – Selection Combining – Threshold Combining – Maximal-Ratio Combining – Equal - Gain Combining – Transmitter Diversity – Channel known at Transmitter – Channel unknown at Transmitter – The Alamouti Scheme-basic concepts of RAKE receivers

Section D

Multiple Access Techniques (8 Hrs)

Frequency division multiple access-time division multiple access-spread spectrum multiples access space division multiple access- packet radio.

MIMO and multicarrier modulation (9 Hrs)

Narrowband MIMO model-parallel decomposition of MIMO channel-MIMO channel capacity-MIMO diversity gain –data transmission using multiple carriers multicarrier modulation with overlapping sub-channels-mitigation of subcarrier fading-basic concepts of OFDM

References:

1. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005
2. T.S. Rappaport, "Wireless Communications," Pearson Education, 2003
3. Pandya, Raj. Mobile and Personal Communication systems and services. Prentice Hall of India

Course Title: Optical Switching and Wavelength Routing

Course Code: ECE573

L	T	P	Credits
4	0	0	4

Course Objectives:

This is a research-oriented course dealing with the principles and issues arising in the design of optical networks with WDM technology. We will study the architecture of WDM networks and related protocols, as they are today and as they are likely to evolve in the future. Emphasis will be placed on performance, internetworking, and transition strategies from today's technology to a future all-optical infrastructure..

Learning Outcomes:

- This will help the student to understand the details of several particular protocols, as example implementations of fundamental principles, and digest descriptions of specific protocols, extracting the salient concepts; implement or simulate complex protocols for optical networks; identify and employ appropriate tools for evaluating optical network performance

Section A

Routing and Wavelength Assignment (12 Hrs)

Introduction, Problem Formulation, Illustrative Examples - Static Lightpath Establishment (SLE), Dynamic Lightpath Establishment (DLE), Introduction, Basics of Wavelength Conversion, Network Design, Control, and Management Issues, Benefit Analysis, Benefits of Sparse Conversion, Circuit-Switched Approaches, Packet-Switched Approaches, Reconfiguration in WDM Networks, WDM Network Control and Management, Amplification-Related Issues, Systems Design Considerations.

Section B

Electro-optic and Wavelength Conversion (9 Hrs)

Enabling Technologies, Wavelength-Converter Design, Wavelength-Convertible Switch Design, Network Design, Control, and Management Issues, Network Design, Network Control, Network Management.

Terabit Switching and Routing Network Elements (9 Hrs)

Transparent Terabit Switching and Routing, Opaque Terabit Switching and Routing, Modular Structure and Greater Granularity, Scalability, Multiple Protocol Interfaces, Architectures and Functionalities, Buffering Scheme, Switching Fabric, IP-Based IPI and OPI, IP-Based Electronic Controller, Multiprotocol Label Switching.

Section C

Protocol Design Concepts (12 Hrs)

Capacity, Interface Speeds, and Protocols, TCP/IP, and the Network Layer, Protocols and Layering , Internet Protocol Design: The End-to-End Principle, Transport Layer and TCP, Service Models at the Transport Layer, UDP and Connectionless Transport, TCP and Connection-Oriented Transport, Network Layer, Network Service Models, Internet Protocol and Fragmentation/Reassembly, Routing in the Internet, Asynchronous Transfer Mode, IP over ATM , IP Switching, QoS, Integrated Services, and Differentiated Services, Integrated Services and RSVP, Differentiated Services, Multiprotocol Label Switching, Labels, Route Selection.

Section D

Optical Network Engineering (9 Hrs)

Optical Network Architecture, Optical Network and Traffic Engineering, Routing and Wavelength Assignment, Optical Network Design and Capacity Planning, Physical Topology Design, Virtual Topology Design, Design of Survivable Optical Networks, Dynamic Light path Provisioning and Restoration, Route Computation, Wavelength Assignment, Performance of Dynamic RWA Algorithms, Control Plane Issues and Standardization Activities, Traffic Management for IP-over-WDM Networks, IP- and Wavelength-Routing Networks.

Internetworking Optical Internet and Optical Burst Switching (9 Hrs)

Overview of Optical Burst Switching, QoS Provisioning with OBS, Survivability Issue in OBS Network, IP-over-WDM Control and Signaling, Network Control, Engineering Control Plane, MPlS/GMPLS Control Plane for Optical Networks, Signaling Protocol.

References

1. Liu, Kelvin H., IP Over WDM, Wiley (2002).
2. Dixit, Sudhir, IP over WDM: Building the Next Generation Optical Internet, Wiley Interscience (2003).
3. Serrat, Joan and Galis, Alex, Deploying and Managing IP over WDM networks, Artech House (2003).

Course Title: Embedded Systems

Course Code: VLS523

L	T	P	Credits
4	0	0	4

Course Objective:

Course introduces system hardware and firmware design for embedded applications. It also teaches all aspects of design and development of an embedded system.

Learning Outcome:

- Acquire the knowledge of the basic ARM Microcontroller, and based embedded designs.
- Acquire the knowledge about embedded system design, firmware including programming languages.
- Ability to learn and understand the RTOS concepts, including RTOS timers, interrupts, system clock.
- Ability to learn and design 32-Bit ARM programming and hardware implementation

Section – A

Introduction To Embedded System And Arm Architect (12 Hrs)

Challenges of Embedded Systems – Embedded system design process. Embedded processors – ARM processor – Architecture, ARM and Thumb Instruction sets.

Section – B

Embedded C Programming (12 Hrs)

C-looping structures – Register allocation – Function calls – Pointer aliasing – structure arrangement – bit fields – unaligned data and endianness – inline functions and inline assembly – portability issues.

Optimizing Assembly Code (12 Hrs)

Profiling and cycle counting – instruction scheduling – Register allocation – conditional execution – looping constructs – bit manipulation – efficient switches– optimized primitives.

Section – C

RTOS Principle **(12 Hrs)**

Operating systems and its internals - Multitasking and Real time Operating Systems – Task Swapping Methods – Scheduler Algorithms – Priority Inversion – Task , Thread and Process – Choosing Operating System – Commercial Operating Systems – Linux.

Section – D

Embedded Software Development Process **(12 Hrs)**

Meeting real time constraints – Multi-state systems and function sequences. Embedded software development tools – Emulators and debuggers. Design methodologies – Case studies – Complete design of example embedded systems.

References

1. Mckenzie, Scott, The 8051 Microcontroller, PHIs, (1995) 5th ed.
2. Simon, David E., An Embedded System Primer, Pearson Education, (2005) 4th ed.
3. K.V.K.K.Prasad, Embedded/Real-time Systems: Concepts, Design and Programming – Dreamtech press.
4. Proramming for Embedded Systems – Dreamtech Software team, Willey – Dreamtech
5. Andrew N Sloss, D. Symes and C. Wright, "*ARM system developers guide",* Morgan Kauffman/ Elsevier, 2006.

DAV UNIVERSITY, JALANDHAR

Course Title: Adaptive Signal Processing

Course Code: ECE651

L	T	P	Credits
4	0	0	4

Course Objective:

The study of adaptive signal processing involves development of various adaptation algorithms and assessing them in terms of convergence rate, computational complexity, robustness against noisy data, hardware complexity, numerical stability etc.

Learning Outcomes:

- This course will develop main classes of adaptive filter algorithms, namely the LMS. Towards this, it will develop all necessary mathematical tools, in particular, random variables, stochastic processes and correlation structure. The filtering problem is developed in the form of computing orthogonal projection on a signal subspace

Section A

Adaptive systems **(12 Hrs)**

definitions and characteristics, Open and Closed loop adaptation, Adaptive linear combiner, Performance function, Gradient and minimum mean square error, performance function, Gradient and minimum mean square error, Alternate expressions of gradient

Section B

Theory of adaptation with stationary signals **(12 Hrs)**

Input correlation matrix, Eigen values and Eigen vectors of the i/p correlation matrix

Searching the performance surface **(12 Hrs)**

Basic ideas of gradient search, Stability and rate of convergence, Learning curve, Newton's method, steepest descent method, Comparison

Section C

Important adaptive algorithms (12 Hrs)

LMS Algorithm, Derivation, Convergence of the weight vector, learning curve, noise vector in weight vector solution, mis adjustment, performance, Z Transforms in Adaptive signal processing, other adaptive algorithms- LMS Newton , Sequential regression, Recursive least squares, adaptive recursive filters, random search algorithms, Adaptive Lattice predictor, Adaptive filters with orthogonal signals.

Section D

Applications of Adaptive signal processing (12 Hrs)

Adaptive modeling of a multi-path communication channel, adaptive model in geophysical exploration, Inverse modeling, Adaptive interference canceling: applications in Bio-signal processing

References:

1. Adaptive signal processing: Widrow and Stearns, Pearson 2.Statistical and Adaptive signal processing- Manalokis, Ingle and Kogon, Artech House INC., 2005.
2. Adaptive filter theory- 4 th edition, Simon Haykin, Prentice Hall 2.Adaptive filters- A H Sayed, John Wiley
3. Adaptive filtering primer with MATLAB – A Poularikas, Z M Ramadan, Taylor and Francis Publications
4. Digital Signal and Image processing- Tamal Bose, John Wiley publications.

Course Title: Modern Radar Systems

Course Code: ECE652

L	T	P	Credits
4	0	0	4

Course Objective: This course aims at providing the necessary basic concepts in Surveillance Radar. Knowledge of fundamentals and applications of Tracking RADAR. Understanding of concepts of RADAR waveform design and RADAR applications such as stealth technology etc.

Learning Outcomes: At the end of the course, the students would

- Have a fundamental knowledge of the basic RADAR concepts.
- Have a well-founded knowledge of Tracking RADAR & steps involve in RADAR waveform design.
- Be able to understand the basic concept behind various applications such as stealth technology & ECC measures etc. the

Section A

Fundamentals of Surveillance Radar and Design (15 Hrs)

Bandwidth considerations, prf, Unambiguous range and velocity, Pulse length and Sampling, Radar Cross-section and Clutter.

Section B

Tracking Radar (15 Hrs)

Tracking and Search Radars, Antenna beam shapes required, Radar guidance, Frequency agility, Importance of Monopulse Radar.

Section C

Radar waveform design (15 Hrs)

Bandwidth and pulse duration requirements, Range and Doppler accuracy uncertainty relation, pulse compression and phase coding.

Section D

Principles of Secondary Surveillance Radar **(15 Hrs)**

Radar studies of the atmosphere, OHR and Radar jamming, EC, ECC measures and stealth applications.

References:

1. "Microwave and Radar Engineering" by Gottapu Sasi Bhushana Rao, ISBN – 978813179944 Pearson Education 2013.
2. "Understanding of Radar Systems", Simon Kingsley and Shaun Quegan,McGraw Hill
3. Radar Handbook by Skolnik.

Course Title: Photonics

Course Code: ECE653

L	T	P	Credits
4	0	0	4

Course Objectives:

The aim of this course is to train students in methods of analysis, design, and dimensioning performance evaluation of optical fibre based communications systems. First, we consider the parameters of interest for systems planning using different photonic technologies as well as advanced optical signal processing models. Then, using this knowledge, we will study the design and evaluation of modern optical fibre based communication systems.

Learning Outcomes:

- Ability to dimension and design WDM high bit-rate fibre optic communication systems.
- Ability to analyze, model and implement advanced optical communication systems.
- Ability to use optical communications simulation tools to assess the results obtained from theoretical studies

Section A

High-Speed Low-Chirp Semiconductor Lasers (9 Hrs)

Introduction, Fundamental Dc Properties of Long-Wavelength QW Lasers, High-Speed Direct Modulation Of Strained Qw Lasers, Quantum Dot Lasers, Long-Wavelength Vcsels, Wavelength Integration And Control, Plasmonic Vcsels, Optical Signal Processing Based On Vcsel Technologies, And Vcsel-Based Slow Light Devices.

Telecom Optical Amplifiers (8 Hrs)

Power Photonics, single-mode fiber 980-NM pumps, Materials for 980-nm Pump Diodes, Optical Beam Narrow Stripe Technology, Output Power Scaling, Spectral Stability, Packaging, Failure Rate.

Section B

High-Speed Optical Modulators (9 Hrs)

Introduction, principles and mechanisms of external optical modulation, modulators based on phase changes and interference, intensity modulators based on absorption changes, traveling wave electroabsorption modulators (EAMS), high-efficiency modulators.

Advances in Photodetectors **(7 Hrs)**

Waveguide Photodiodes, Balanced Receivers, High-Power Photodetectors, Avalanche Photodiodes.

Section C

Planar Light wave Circuits **(9 Hrs)**

Introduction, Basic Waveguide Theory And Materials, Passive Optical Filtering, Demodulating, And De-multiplexing Devices, Inter-Signal Control Devices, Intra-Signal Control Devices.

Silicon Photonics **(9 Hrs)**

Introduction, Soi Wafer Technology, High-Index-Contrast Waveguide Types And Performance On Soi, Input–Output Coupling, Passive Waveguide Devices And Resonators, Active Modulation Silicon Photonics, Germanium Photodetectors And Photoreceivers For Integrated Silicon Photonics, Cmos Integration and Integated Silicon Photonics, Nonlinear Effects, Applications.

Section D

Microelectromechanical Systems **(9 Hrs)**

For Light wave Communication: Introduction, Optical Switches and Cross-connects, Wavelength-Selective MEMS Components, Transform Spectrometers, Diffractive Spectrometers and Spectral Synthesis, Tunable Lasers, Other Optical MEMS Devices, Emerging MEMS Technologies and Applications.

References

1. Kaminow, Ivan P., Li, Tingye, Willner, Alan E., Optical Fiber Telecommunications V.A., Components and Subsystems, Elsevier (2008).
2. Kaminow, Ivan P., Li, Tingye and Willner, Alan E., Optical Fiber Telecommunications V.B., Systems and Networks, Academic Press (2008) 5th ed.
3. Goleniewski, Lillian, Jarrett Kitty Wilson, Telecommunications Essentials: The Complete Global Source, 2nd Edition, Addison Wesley Professional (2006).
4. Lee, Chi H., Thompson and Brian J., Optical Science and Engineering, CRC (2007).