WITH EFFECT FROM THE ACADEMIC YEAR 2011-2012

DEPARTMENT OF
ELECTRONICS & COMMUNICATION ENGINEERING

Scheme of Instruction
And
Syllabi of

M.E. (ECE)

COMMUNICATION ENGINEERING AND SIGNAL PROCESSING
(With effect from 2011-2012)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
OSMANIA UNIVERSITY
Hyderabad-500 007
Andhra Pradesh
WITH EFFECT FROM THE ACADEMIC YEAR 2011-2012

SCHEME OF INSTRUCTION & EXAMINATION
ME (ECE) COURSE - 4 Semester (Regular) with Specialization in
COMMUNICATION ENGINEERING AND SIGNAL PROCESSING

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<tr>
<th>S. No</th>
<th>Subject</th>
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Note: Six core subjects and six elective subjects should be completed by the end of Semester – II.

* One project seminar presentation.

** 50 marks to be awarded by guide and 50 marks to be awarded by Viva Committee with guide and two internal faculty members.

*** Excellent/Very Good/Good/Satisfactory/Unsatisfactory
List of subjects for M.E. (ECE) course (Regular) with specialization in COMMUNICATION ENGINEERING AND SIGNAL PROCESSING

<table>
<thead>
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<td>EC 661</td>
<td>Signal Compression Theory and Methods</td>
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<td>2.</td>
<td>EC 662</td>
<td>Multirate Processing</td>
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<td>3.</td>
<td>EC 663</td>
<td>Video and Speech Processing</td>
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<td>Digital Modulation Techniques</td>
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<td>Wireless Communications and Networking</td>
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<td>7.</td>
<td>EC 667-1</td>
<td>Advanced Signal Processing Lab</td>
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<td>8.</td>
<td>EC 667-2</td>
<td>Communication Systems Simulation Lab</td>
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<td>EC 668-3</td>
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<td>13.</td>
<td>EC 670</td>
<td>Array Signal Processing</td>
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<td>14.</td>
<td>EC 671</td>
<td>Spread Spectrum and CDMA Systems</td>
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<td>EC 672</td>
<td>Wireless Channel Coding</td>
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<td>Data and Computer Communication Networks</td>
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<td>Multimedia Information Systems</td>
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<td>EC 562</td>
<td>Adaptive Signal Processing</td>
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<td>Optimization Techniques</td>
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<td>EC 577</td>
<td>Image and Video Processing</td>
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<td>Neural Networks &amp; Fuzzy Logic</td>
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<td>EC 580</td>
<td>Numerical Methods in Engineering</td>
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<td>EC 591</td>
<td>Modern Digital Communication Systems</td>
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<td>EC 593</td>
<td>Probability and Random Processes</td>
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<td>EC 594</td>
<td>Coding Theory and Techniques</td>
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<td>EC 600</td>
<td>Satellite and Microwave Communication</td>
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<td>EC 603</td>
<td>Smart Antennas for Mobile Communications</td>
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<td>34.</td>
<td>EC 605</td>
<td>Detection and Estimation Theory</td>
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<td>35.</td>
<td>EC 641</td>
<td>DSP Processors – Architecture</td>
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<td>36.</td>
<td>EC 643</td>
<td>Graph Theory and its Applications to VLSI</td>
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EC 661       SIGNAL COMPRESSION THEORY AND METHODS

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**Unit-I**

**Unit-II**
Rate distortion theory: Rate distortion function R(D),Properties of R(D); Calculation of R(D) for the binary source and the Gaussian source, Rate distortion theorem, Converse of the Rate distortion theorem, Quantization - Uniform & Non-uniform - optimal and adaptive quantization, vector quantization and structures for VQ, Optimality conditions for VQ, Predictive Coding - Differential Encoding Schemes.

**Unit- III**
Mathematical Preliminaries for Transforms, Subbands and Wavelets, Karhunen Loeve Transform, Discrete Cosine and Sine Transforms, Discrete Walsh Hadamard Transform, Lapped transforms.

**Unit- IV**

**Unit-V**

**Suggested Reading:**
EC 662  MULTIRATE PROCESSING

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**Unit-I**

Fundamentals of Multirate Theory: The sampling theorem - sampling at sub-Nyquist rate - Basic Formulations and schemes. Basic Multirate operations- Decimation and Interpolation - Digital Filter Banks- DFT Filter Bank- Identities- Poly-phase representation

(c) Maximally decimated filter banks: Poly-phase representation, Errors in the QMF bank, Perfect reconstruction (PR) QMF Bank, Design of an alias free QMF Bank.

**Unit-II**

M-channel perfect reconstruction filter banks: Uniform band and non uniform filter bank - tree structured filter bank- Errors created by filter bank system- Poly-phase representation- perfect reconstruction systems -

**Unit-III**


**Unit-IV**

Cosine Modulated filter banks: Cosine Modulated pseudo QMF Bank- Alas cancellation-phaseline distortion- Closed form expression- Poly-phase structure- PR System

**Unit-V**

Introduction to Wavelet Transforms: Short time Fourier Transform, Cabor Transform, Wavelet Transform, Recursive multi resolution decomposition, Haar wavelet, Digital Filter implementation of the Haar wavelet.

**Suggested Reading:**

WITH EFFECT FROM THE ACADEMIC YEAR 2011-2012

**EC 663**

**VOICE AND SPEECH PROCESSING**

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**Unit-I**

**Unit -II**
Speech coding: sub-band coding of speech - transform coding - channel vocoder - formant vocoder - cepstral vocoder - vector quantizer coder - Linear predictive Coder. Speech synthesis - pitch extraction algorithms - gold rabiner pitch trackers - autocorrelation pitch trackers - voice/unvoiced detection

**Unit-III**
Homo-morphic speech processing – homo-morphic systems for convolution - complex cepstrums - pitch extraction using homo-morphic speech processing. Sound Mixtures and Separation - CASA, ICA & Model based separation.

**Unit - IV**

**Unit - V**

**Suggested Reading:**
EC 664  
DIGITAL MODULATION TECHNIQUES

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**Unit-I**  

**Unit-II**  
Performance of carrier modulation schemes: Performance of BPSK and QPSK in AWGN Channel, Performance of Binary FSIC in M- ary PSK in AWGN Channel, Minimum Shift keying (MSK) Modulation, GMSK continuous phase modulation (CPM) schemes.

**Unit-III**  
Channel characterization and modeling: Optimum receivers for AWGN Channels, Equalization techniques, Orthogonal Frequency Division Multiplexing (OFDM). Carrier Synchronization, Timing synchronization.

**Unit-IV**  
Introduction to spread spectrum modulation, Direct Sequence modulation, spreading codes, Advantage of CDMA for wireless, Code Synchronization, Code Acquisition and tracking. Channel estimation, Power control, the near-far problem, FEC coding and CDMA, Frequency Hopping spread spectrum, Complex baseband representation of FHSS, slow and fast frequency hopping, Processing gain.

**Unit -V**  
Spread spectrum as a Multiple access technique: Multi channel and Multi carrier systems; Digital Communication through fading multipath channels; Multi user communications. ‘Space diversity on Receiver´ technique, MIMO antenna systems, Space time codes for MIMO wireless Communication, Differential space time block codes, SDMA, Smart antennas.

**Suggested Reading:**
EC 665                  WIRELESS COMMUNICATIONS AND NETWORKING

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Unit - I
Radio Propagation Characteristics: Models for path loss, shadowing and multipath fading (delay spread, coherence band width, coherence time, Doppler spread), Jakes channel model, Digital modulation for mobile radio, analysis under fading channels:

Unit – II
Wireless Communication Techniques: Diversity techniques and RAKE demodulator, channel coding techniques, multiple access techniques used in wireless mobile communications. Space time propagation, wireless channel, channel as a space time random field, space time channel and signal models, capacity of space time channels, spatial diversity, space time receivers, space time coding with channel knowledge, space time OFDM.

Unit – III

Unit – IV
Signaling and call control: Mobility management, location tracking. Wireless data networking, packet error modeling on fading channels, performance analysis of link and transport layer protocols over wireless channels.

Unit – V

Suggested Reading:
EC 666 PRINCIPLES OF COMMUNICATION SYSTEMS SIMULATION WITH WIRELESS APPLICATIONS

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UNIT – I

UNIT – II

UNIT – III

UNIT – IV

UNIT – V

Suggested Reading:
EC 667-1 ADVANCED SIGNAL PROCESSING LAB

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**Section - 1:**

1. Generating basic waveforms (impulse, step, ramp, exponential, sin, ...)
2. Digital FIR Filter implementation and realizations: with and without windows.
3. Design of IIR filters (Butterworth, Chebychev, IIR, ...).
5. Using the Simulink generate the basic waveforms (impulse, step, ramp, exponential, sin, ...) observe the waveforms on the CRO.
6. Using Simulink generate the modulated waveforms.
7. Study and implementation of sigma - delta modulator/ Transmultiplexer.

**Section – 2:**

1. Declaring and initializing the variables and moving the data to and from Memory (register to memory, memory to register).
2. Setting up Circular buffering, hardwared loops:
   a. Adding the 10 consecutive numbers
   b. Splitting he numbers
   c. Bit level operations.
3. Underatsatding the DSP MAC capabilities.
   a. Windowing, Convolution, FIR filtering
4. Underatsatding the DSP parallel instruction optimisation.
   a. FFT without parallel instructions
   b. FFT with parallel instructions
5. Creation of periodic waveforms and noise sequences using the DSP kit.
6. Interfacing the DSP processor in real time.
7. Initialization of Audio codec.

Note: The experiments will be decided and modified if necessary and conducted by the lecturer concerned.
EC 667-2  COMMUNICATION SYSTEMS SIMULATION LAB

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**Section - 1:**

1. Simulation study of wavelength division multiplexing and de-multiplexing.
2. Study of digital modulation schemes using Spectrum analyzer.
3. Study and implementation of different simulation techniques.
4. Error detection codes in data communications.
5. Analysis of error coding, parity check and hamming check.
6. Simulation of a communication channel using convolutional encoding and Viterbi decoding using MATLAB.
7. Simulation of Channel coding / decoding using MATLAB and SIMULINK.

**Section – 2:**

1. Study of wireless LAN
2. Using Wireless digital communication trainer, study of:
   a) Baseband digital communication link
   b) Quadrature modulation schemes
   c) Adaptive equalization techniques
   d) GSM and Basics of DS-CDMA
   f) Basics of OFDM.
3. Implementation of DPSK modulators and demodulators using MATLAB.
4. Simulation of software radio system using MATLAB.
5. Simulation study of collaborative transmission schemes for Multiuser wireless systems using MATLAB.

Note: The experiments will be decided and modified if necessary and conducted by the lecturer concerned.
Oral presentation and technical report writing are two important aspect of engineering education. The objective of the seminar is to prepare the student for a systematic and independent study of the state of the art topics in the advanced fields of Communication Engineering and related topics.

Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
- Presentation of OHP slides / LCD presentation
- Technical writing

Each student required to:

1. Submit a one page synopsis before the seminar talk for display on the notice board.
2. Give a 20 minutes time for presentation following by a 10 minutes discussion.
3. Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.
EC 668-2    SEMINAR - II

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Seminar topics may be chosen by the students with advice from the faculty members. Students are to be exposed to the following aspects for a seminar presentation.

- Literature survey
- Organization of the material
- Presentation of OHP slides / LCD presentation
- Technical writing

Each student required to:

4. Submit a one page synopsis before the seminar talk for display on the notice board.

5. Give a 20 minutes time for presentation following by a 10 minutes discussion.

6. Submit a detailed technical report on the seminar topic with list of references and slides used.

Seminars are to be scheduled from the 3rd week to the last week of the semester and any change in schedule shall not be entertained.

For award of sessional marks, students are to be judged by at least two faculty members on the basis of an oral and technical report preparation as well as their involvement in the discussions.
EC 668-3  

**PROJECT SEMINAR**

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The main objective of the Project Seminar is to prepare the students for the dissertation to be executed in 4th semester. Solving a real life problem should be focus of Post Graduate dissertation. Faculty members should prepare the project briefs (giving scope and reference) at the beginning of the 3rd semester, which should be made available to the students at the departmental library. The project may be classified as hardware / software / modeling / simulation. It may comprise any elements such as analysis, synthesis and design.

The department will appoint a project coordinator who will coordinate the following:
- Allotment of projects and project guides.
- Conduct project - seminars.

Each student must be directed to decide on the following aspects
- Title of the dissertation work.
- Organization.
- Internal / External guide.
- Collection of literature related to the dissertation work.

Each student must present a seminar based on the above aspects as per the following guidelines:

1. Submit a one page synopsis before the seminar talk for display on the notice board.
2. Give a 20 minutes presentation through OHP, PC followed by a 10 minutes discussion.
3. Submit a report on the seminar presented giving the list of references.

Project Seminars are to be scheduled from the 3rd week to the last week of the semester.
The internal marks will be awarded based on preparation, presentation and participation.
The students must be given clear guidelines to execute and complete the project on which they have delivered a seminar in the 3rd semester of the course.

All projects will be monitored at least twice in a semester through student’s presentation. Sessional marks should be based on the grades/marks, awarded by a monitoring committee of faculty members as also marks given by the supervisor.

Efforts be made that some of the projects are carries out in industries with the help of industry coordinates.

Common norms will be established for documentation of the project report by the respective department.

The final project reports must be submitted two weeks before the last working day of the semester.

The project works must be evaluated by an external examiner and based on his comments a viva voice will be conducted by the departmental committee containing of HOD, two senior faculty and supervisor.

+ Excellent /Very Good / Good/Satisfactory / Unsatisfactory
EC 670  ARRAY SIGNAL PROCESSING

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**Unit-I**
Spatial Signals: Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and Near field signals.

**Unit-II**

**Unit-III**

**Unit-IV**
Direction of Arrival Estimation : Non parametric methods - Beam forming and Capon methods. Resolution of Beam forming method

**Unit-V**
Subspace methods: Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques. Spatial Smoothing.

**Suggested Reading:**
EC 671 SPREAD SPECTRUM AND CDMA SYSTEMS

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**Unit-I**
Fundamentals of Spread Spectrum: Introduction to spread spectrum communication, pulse noise jamming, low probability of detection, direct sequence spread spectrum, frequency-hopping and time-hopping spread spectrum systems, correlation functions, spreading sequences - maximal-length sequences, gold codes, Walsh orthogonal codes - properties and generation of sequences. Synchronization and Tracking: delay lock and tau-dither loops, coarse synchronization - principles of serial search and match filter techniques.

**Unit-II**
Performance Analysis of SS system: Performance of spread spectrum system under AWGN, multi-user Interference, jamming and narrow band interferences. Low probability of intercept methods, optimum intercept receiver for direct sequence spread spectrum. Error probability of DS-CDMA system under AWGN and fading channels, RAKE receiver.

**Unit-III**
Capacity & Coverage of Spread Spectrum Multiple Access Networks: Basics of spread spectrum multiple access in cellular environments, reverse Link power control, multiple cell pilot tracking, soft and hard handoffs, cell coverage issues with hard and soft handoff, spread spectrum.

**Unit-IV**

**Unit-V**

**Suggested Reading:**
**EC 672**  
**WIRELESS CHANNEL CODING**

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**Unit-I**  

**Unit-II**  
Multiple Antenna and Space-Time Communications: Narrowband MIMO Model, Parallel Decomposition of MIMO Channel, MIMO diversity Gain: Beam forming, Space-Time modulation and coding. Frequency-Selective MIMO communications, Smart Antennas, MIMO Channel Capacity.

**Unit-III**  
Coding for Wireless Channels: Channel Coding and its potential. Coding in a signal space. Coded modulation and coding with interleaving. Basic error control coding & concerned mathematics. Linear block codes, Cyclic codes, BCH and Reed-Solomon codes.

**Unit-IV**  
Trellis representation of codes, Coding on a trellis, Convolutional Codes, Trellis coded modulation. Codes on graphs and Concatenated codes. Turbo Codes and LDPC codes.

**Unit-V**  
Adaptive modulation and coding: Adaptive techniques, Variable-Rate Variable-Power MQAM: adaptive rate and power techniques, Adaptive coded modulation, adaptive techniques in combined fast and slow fading.

**Suggested Reading:**

EC 673  ADVANCED OPTICAL COMMUNICATION

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Unit-I
Solution to Maxwell’s equation in a circularly symmetric step index optical fiber, linearly polarized modes, single mode and multimode fibers, concept of V number, graded index fibers, total number of guided modes (no derivation), attenuation mechanisms in fibers, dispersion in single mode and multimode fibers, dispersion shifted and dispersion flattened fibers, attenuation and dispersion limits in fibers, Kerr nonlinearity, self phase modulation, combined effect of dispersion and self phase modulation.

Unit-II
Optical sources - LED and laser diode - Principles of operation, concepts of line width, phase noise, switching and modulation characteristics. Optical detectors - PN detector, pin detector, avalanche photodiode - Principles of operation, concepts of responsivity, sensitivity and quantum efficiency, noise in detection, typical receiver configurations (high impedance and trans-impedance receivers).

Unit-III
Coherent systems - Homodyne and heterodyne systems, coherent systems using PSK, FSK, ASK and DPSK modulations.

Unit -IV
Noise Effects in coherent systems: Related noise effects, performance degradation induced by laser phase and intensity noise, degradation due to fiber dispersion, degradation induced by nonlinear effects in fiber propagation.

Unit -V
Optical amplifiers - semiconductor amplifier, rare earth doped fiber amplifier (with special reference to erbium doped fibers), Raman amplifier, Brillouin amplifier - principles of operation, amplifier noise, signal to noise ratio, gain, gain bandwidth, gain and noise dependencies, inter modulation effects, saturation induced crosstalk, wavelength range of operation.

Suggested Reading:

EC 674  MIMO COMMUNICATION SYSTEMS

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**Unit-I**
Information theoretic aspects of MIMO: Review of SISO communication - MIMO channel models - Classical i.i.d. and extended channels – Frequency selective and correlated channel models - Capacity of MIMO channels - Ergodic and Outage Capacity - Capacity bounds - Influence of channel properties on capacity.

**Unit-II**

**Unit-III**
Space Time Block Codes: Alamouti’s code for two transmit antennas - Comparison with dual-branch receive diversity STBC based on real/complex orthogonal designs - Code Design Criteria for quasi-static Channels (Rank, Determinant and Euclidean Distance).

**Unit-IV**

**Unit-V**
Space Time Trellis Codes: Diagram - Code construction. Delay diversity as a special case of STTC- Performance Analysis.

**Suggested Reading:**

EC 675

ACTIVE RF DEVICES AND CIRCUITS

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**Unit – I**
Transistor and MESFETS: Transistor Amplifiers - Types of amplifiers. S-parameter characterization of transistors; MESFETs – Equivalent circuit model. Single stage amplifier design- unilateral and bilateral cases, Amplifier stability, Constant gain and noise circles, DC bias circuits for amplifiers; Detectors and Mixers.

**Unit – II**
Diodes:Point contact and Schottky barrier diodes- Characteristics and equivalent circuit, Theory of microwave detection, Detector circuit design.

**Unit – III**

**Unit – IV**
Oscillators:
Oscillator versus amplifier design, Oscillation conditions; Gunn diode – Modes of operation, Equivalent circuit. Design of Gunn diode oscillator in microstrip. FET oscillators. Frequency tuning techniques.

**Unit – V**
Switches and Phase Shifters: PIN diode– Equivalent, circuit and Characteristics, Basic series and shunt switches in microstrip; SPST and SPDT switches, Switched line, branch line coupled and loaded line phase shifters in microstrip. Applications in phased arrays.

**Suggested Reading:**

EC 504 DATA AND COMPUTER COMMUNICATION NETWORKS

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UNIT - I

UNIT - II

UNIT - III

UNIT - IV
LAN Architecture: Topologies, Choice of Topology, Ring and Star Usage, MAC and LLC, Generic MAC Frame Format, Bridge, Bridge Operation, Bridges and LANs with Alternative Routes, Spanning Tree, Loop resolution in bridges, Hubs, Two Level Star Topology, Layer 2 Switches, Wireless LAN, Multi cell Wireless LANs, IEEE 802.11 Architecture, IEEE 802.11 Medium Access Control logic.

UNIT - V

Suggested Reading:
EC 513  MULTIMEDIA INFORMATION SYSTEMS

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UNIT I

UNIT II

UNIT III
Motion estimation techniques: Brute force, algorithm three step, search algorithm. 2-D algorithm and conjugate direction search algorithm.

UNIT IV
Audio coding: Introduction to multi rate signals. MPEG1 and MPEG2 audio encoder and decoder.

UNIT V
Multimedia information indexing and Retrieval: General information Retrieval (IR) model. Differences between IR and DBMS Basic IR models. File structure, audio indexing and Retrieval methods. Image Retrieval based on shape and moments and watermarking Techniques.

Suggested Reading:

**EC 535**  
**GLOBAL NAVIGATION SATELLITE SYSTEMS**

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**UNIT-I**  
GPS fundamentals: INS, Trilateralion, Hyperbolic navigation, Transit, GPS principle of operation, architecture, operating frequencies, orbits, Keplerian elements. Solar and Siderial days, GPS and UTC Time.

**UNIT-II**  
GPS Signals: Signal structure, C/A and P-Code, ECEF and ECI coordinate systems and WGS 84 and Indian datums. Important components of receiver and specifications, link budget.

**UNIT-III**  

**UNIT-IV**  
GPS data processing, DGPS and Applications: RINEX Navigation and Observation formats, Code and carrier phase observables, linear combination and derived observables, Ambiguity resolution, cycle slips, Position estimation. principle of operation of DGPS, architecture and errors.

**UNIT-V**  
Other Constellations and Augmentation systems Other satellite navigation constellations GLONASS and Galileo IRNS System. Relative advantages of SBAS and GBAS, Wide area augmentation system (WAAS) architecture, GAGAN, EGNOS and MSAS. Local area augmentation system (LAAS) concept.

**Suggested Reading:**

EC 545  RADAR SIGNAL PROCESSING

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UNIT-I

UNIT-II

UNIT-III
Range and Doppler Resolution: Ambiguity function and its properties. Local and Global Accuracy. Signal Design. LFM. Polyphase coded signals Detection of a Doppler shifted slowly fluctuating point target return in a discrete scatterer environment.

UNIT-IV
Dobly dispersive Fading Target and Clutter models-Scattering function description. Land clutter-pulse length limited and Beam width limited clutter. Sea clutter.

UNIT-V

Suggested Reading:
EC 562      ADAPTIVE SIGNAL PROCESSING

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UNIT-I
Approaches to the development of adaptive filter theory. Introduction to filtering, smoothing and prediction. Wiener filter theory, introduction; Error performance surface; Normal equation; Principle of orthogonality; Minimum mean squared error; example.

UNIT-II
Gradient algorithms; Learning curves; LMS gradient algorithm; LMS stochastic gradient algorithms; convergence of LMS algorithms.

UNIT-III
Applications of adaptive filter to adaptive noise canceling, Echo cancellation in telephone circuits and adaptive beam forming.

UNIT-IV
Kalman Filter theory; Introduction; recursive minimum mean square estimation for scalar random variables; statement of the kalman filtering problem: the innovations process; Estimation of state using the innovations process; Filtering examples.

UNIT-V

Suggested Reading:

EC 572  
**OPTIMIZATION TECHNIQUES**

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UNIT-I
Use of optimization methods. Introduction to classical optimization techniques, motivation to the simplex method, simplex algorithm, sensitivity analysis.

UNIT-II

UNIT-III
Descent methods, Gradient of function, steepest decent method, conjugate gradient method.

UNIT-IV
Review of a global optimization techniques such as Monte Carlo method, Simulated annealing and Tunneling algorithm.

UNIT-V
Generic algorithm - Selection process, Crossover, Mutation, Schema theorem, comparison between binary and floating point implementation.

Suggested Reading:
EC 577  IMAGE AND VIDEO PROCESSING

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**UNIT-I**

**UNIT-II**

**UNIT-III**
Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporal redundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZW coding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding, JPEG Standards.

**UNIT- IV**

**UNIT-V**
2-D Motion Estimation: Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region based Motion Estimation, Multi resolution motion estimation, Waveform based coding, Block based transform coding, Predictive coding, Application of motion estimation in Video coding.

**Suggested Reading:**
2. Yao Wang, Joem Ostermann and Ya–quin Zhang ,Video processing and communication, 1st Ed., PH Int.
UNIT-I
Introduction: Introduction to ANS (Artificial Neural systems) Technology, ANS simulation, Types of Neural Networks: Hopfield, perceptron and related models, Adaline and Madaline: Adaline and the Adaptive Linear Combiner, the Madaline and simulating the Adaline. Essential vector operations, Lateral Inhibition and Sensory Processing.

UNIT-II:
Probabilistic Models, Fuzzy ARTMAP and Recurrent Networks:- Probabilistic Neural Networks, General Regression Neural Networks, Fuzzy ARTMAP, Recurrent Back propagation Neural Networks, Hybrid Learning Neural Networks:- Counter propagation Network, Radial basis Function Networks.

UNIT-III

UNIT – IV

UNIT-V

Suggested Reading:
**EC 580**  
**NUMERICAL METHODS IN ENGINEERING**

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**UNIT-I**

**UNIT-II**
Interpolation for functions of a single variable – Newton’s divided differences interpolation, Lagrange’s interpolation, Newton’s forward and backward interpolation, Stirling’s Central differences interpolation. Bivariate interpolation – Lagrange’s and Newton’s formulas.

**UNIT-III**

**UNIT-IV**

**UNIT-V**

**Suggested Reading:**

EC 592  MODERN DIGITAL COMMUNICATION SYSTEMS

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**UNIT-I**

**UNIT-II**
Baseband Data Transmission: Correlative coding: Duobinary signaling, Duobinary decoding, Precoding, Duobinary equivalent transfer function, Comparison of Binary with Duobinary signaling Polybinary signaling, Inter symbol interference, Equalization.

**UNIT-III**
Bandpass Data Transmission: Coherent and non coherent modulation and detection of digital (binary and M-ary) signals, Optimum Receiver, MSK, Mary signaling and performances.

**UNIT-IV**
Encryption and Decryption: A model of the encryption and decryption process, cipher systems, stream encryption and public key encrypt systems.

**UNIT-V**
Fading channel characteristics: channel characteristics, channel classification, channel correlation function and power spectra, the effect signal characteristics on the choice of channel model, Mitigation techniques for multipath fading channel: space diversity, frequency diversity, time diversity, multipath diversity and RAKE Receiver, frequency selective and non selective fading, Example of Radio channels.

**Suggested Reading:**
EC 592  WIRELESS MOBILE COMMUNICATION SYSTEMS

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UNIT-I

UNIT-II
Interference and system capacity, near end and far end interference, effect of near end mobile units. Grade of service, improving coverage and capacity in cellular systems.

UNIT-III

UNIT-IV

UNIT-V
Modulation techniques for mobile radio, constant enevelop modulation AMPS, and ETACS, GSM. Intelligent network for wireless communication advanced intelligent network (AIN), SS7 network for ISDN & AIN. Wireless ATM networks.

Suggested Reading:
EC 593                      PROBABILITY AND RANDOM PROCESSES

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UNIT-I
Probability and distribution: Joint and conditional probability, independent events, Combined sample space, events in the combined space, probabilities in combined experiments, concept of random variables, distribution and density functions: Gaussian, Binomial, Poison, Uniform, Exponential, Rayleigh, Rice and Chi-Square distributions, conditional distribution and density functions.

UNIT-II
Operations in Random Variables: Expectation, moments, Chebychev’s inequality and Markov’s inequality. Functions that give moments, characteristic functions, moment generating function, transformation of a random variable, computer generation of one random variable problems, vector random variables, joint distribution and joint density properties, condition distribution and density, statistical independent, sum of several variables, central limit theorem: unequal distribution, equal distribution.

UNIT-III
Multiple Random Variables and Processes: Expected value of a function of Random variables, Joint moments about the origin, joint central moments, joint characteristic functions, jointly Gaussian random variables and properties, Linear transformation of Gaussian Random Variables. Sampling and Limit theorems: estimation of Mean, Power and Variance, Weak law of Large numbers and Strong law of Large numbers. Complex random variables.

UNIT-IV

UNIT- V

Suggested Reading:
EC 594 CODING THEORY AND TECHNIQUES

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UNIT – I
Introduction: Digital communication system, Wireless channel statistical models, BER performance in AWGN and fading channels for different modulation schemes, BER performance of CDMA, FH – CDMA in AWGN and fading channels, capacity of fading channels with CSI, Diversity reception, channel coding Theorem, Channel coding gain.

UNIT – II
Block Coding: Galois fields, polynomials over Galois fields, RS codes, Decoding Techniques for RS codes, LDPC encoder and decoder, Performance analysis of RS and LDPC codes. BCH codes.

UNIT – III
Convolution codes: Linear convolution encoders, Structural properties of Convolution codes, Viterbi decoding technique for convolution codes – Soft / Hard decision, concatenation of block codes and convolutional codes, performance analysis, concept of Trellis coded modulation.

UNIT – IV
Turbo Codes: Parallel concatenation, Turbo encoder, Iterative decoding using BCJR algorithm, Performance analysis.

UNIT – V
Space – Time Coding: MIMO systems, MIMO fading channels, rate gain & diversity gain, transmit diversity, Alamouti scheme, OSTBC codes, Linear space – time codes, trellis space – time codes, Space – time codes with no CSI

Suggested Reading:
1. S.B. Wicker, Error control systems for Digital communication and storage,
EC 600  SATELLITE AND MICROWAVE COMMUNICATION

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UNIT-I
Introductory concepts: Transmission problem, simplified transmission system, the decibel and basic derived decibel unit, Neper, practical transmission, speech, SNR, Noise figure and noise temperature, EIRP and conversion factors, CCITT modulation plan, loading of FDM system, pilot tones, noise calculation, through super group techniques, compandors, characteristics of carrier equipment.

UNIT- II
Line-of-sight communication systems: Link engineering, propagation characteristics in free space, path calculations, feeding, diversity reception, noise power ratio and its measurements, frequency planning. Path and link reliability, rainfall and other precipitation attenuation, radio link repeaters, antenna towers and masts, plain reflectors as passive repeaters, noise planning on radio links.

UNIT – III
Tropospheric scatter communication system: Introduction, phenomenon of tropospheric scatter, tropospheric fading, path loss calculations, aperture to medium coupling loss take of angle, equipment configuration, isolation, inter modulation, typical tropospheric scatter parameters. Frequency assignment. Earth station technology: The satellite earth space window, path loss considerations of the up link and down path calculations.

UNIT- IV
Earth station, G/T, C/N, link calculation, C/N for the complete link, and design of communication systems via satellites, Modulation, Multiplexing and multiple access techniques: TDMA, FDMA, CDMA, SSMA, SPADE.

UNIT – V
Reliability, Redundancy, Quality assurance, Echo control and Echo suppression, introductory concepts of VSATS, GIS, GPS and Future trends, Pay load engineering – Definition, constraints, specification and configurations.

Suggested Reading:
EC 603  SMART ANTENNAS FOR MOBILE COMMUNICATIONS

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**UNIT- I**

**UNIT- II**

**UNIT- III**
Smart Antennas Techniques for CDMA: Non Coherent CDMA – Coherent CDMA – Multi user spatial processing – Re sectoring using Smart Antennas – Down link beam forming for CDMA.

**UNIT- IV**

**UNIT- V**

**Suggested Reading:**
EC 605  DETECTION AND ESTIMATION THEORY

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UNIT-I
Classical Detection Theory: Binary hypothesis testing; Baye’s, Minimax and Neyman – Pearson tests. Composite hypothesis testing.

UNIT- II

UNIT-III

UNIT-IV

UNIT- V
Signal Detection in Continuous Time : Detection of deterministic signals in Gaussian noise; Coherent detection. Detection of signals with unknown parameters.

Suggested Reading:
# EC 641 DSP PROCESSORS – ARCHITECTURE

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## UNIT I
Introduction to DSP Processors: Differences between DSP and other µp architectures, their comparison and need for special ASPs, RISC & CISC CPUs.

## UNIT II
Overview of DSP processor design: fixed point DSPs – Architecture of TMS 320C 5X, C54X Processors, addressing modes, Assembly instructions, Pipelining and on-chip peripherals. Floating point DSPs: Architecture of TMS 320 – IX.

## UNIT III
Data formats, F.P. operations, addressing modes, instructions, pipelining and peripherals.

## UNIT IV
DSP interfacing & software development tools: I/O interfacing with A/D converters, PCs, Dual port RAMs, EPGA, DSP tools – Assembler, debugger, c-compiler, linker, editor, code composer studio.

## UNIT V
Applications using DSPs adaptive filtering, spectrum analysis, Echo cancellation modems, voice synthesis and recognition. Brief ideas of AD, Motorola DSP CPUs and their comparison with TI CPUs.

## Suggested Reading:
EC 643  GRAPH THEORY AND ITS APPLICATIONS TO VLSI

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UNIT-I
Introduction: Basic definitions, results and examples relating to Graph theory, self-complementing graphs and properties of graphs, Trees, Spanning tree & directed graphs.

UNIT-II
Definitions of strongly, weakly, unilaterally connected graphs and deadlocks. Metric representation of graphs. Classes of graphs: standard results relating to characterization of Hamiltonian graphs, standard theorems

UNIT-III
Self-centered graphs and related theorems. Chromatic number vertex and edge – application to coloring, linear graphs, Euler’s formula.

UNIT-IV
Graph algorithms: DFS – BFS algorithms, min. spanning tree and max. spanning tree algorithm. Directed graphs algorithms for matching, properties flow in graph and algorithms for max flow. PERT-CPM, complexity of algorithms, P-NP – NPC – NP hard problems and examples.

UNIT-V

Suggested Reading: