MAHATMA GANDHI UNIVERSITY

SCHEME AND SYLLABI

FOR

M. Tech. DEGREE PROGRAMME

IN

COMMUNICATION ENGINEERING

(2011 ADMISSION ONWARDS)
SCHEME AND SYLLABI FOR M. Tech. DEGREE
PROGRAMME IN COMMUNICATION ENGINEERING

SEMESTER – I

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Subject</th>
<th>Hrs / Week</th>
<th>Evaluation Scheme (Marks)</th>
<th>Credits (C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td>L  T  P</td>
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<td>ESE  Total</td>
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<tr>
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<td>MECCE 101</td>
<td>Applied Mathematics for Communication Engineering</td>
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<td>4</td>
<td>MECCE 104</td>
<td>High Performance Communication Network</td>
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<td>5</td>
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Elective - I (MECCE 105)

<table>
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<tbody>
<tr>
<td>MECCE 105-1</td>
<td>Soft Computing</td>
</tr>
<tr>
<td>MECCE 105-2</td>
<td>Antenna Theory and Design</td>
</tr>
<tr>
<td>MECCE 105-3</td>
<td>Global Tracking and Positioning Systems</td>
</tr>
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<td>MECCE 105-4</td>
<td>Satellite Communication</td>
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Elective - II (MECCE 106)

<table>
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<tr>
<th>Course No.</th>
<th>Subject</th>
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<tbody>
<tr>
<td>MECCE 105-1</td>
<td>Soft Computing</td>
</tr>
<tr>
<td>MECCE 105-2</td>
<td>Antenna Theory and Design</td>
</tr>
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<td>MECCE 105-3</td>
<td>Global Tracking and Positioning Systems</td>
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<tr>
<td>MECCE 105-4</td>
<td>Satellite Communication</td>
</tr>
</tbody>
</table>

L – Lecture, T – Tutorial, P – Practical

TA – Teacher’s Assessment (Assignments, attendance, group discussion, Quiz, tutorials, seminars, etc.)

CT – Class Test (Minimum of two tests to be conducted by the Institute)

ESE – End Semester Examination to be conducted by the University

Electives: New Electives may be added by the department according to the needs of emerging fields of technology. The name of the elective and its syllabus should be submitted to the University before the course is offered.
# SEMESTER - II

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Subject</th>
<th>Hrs / Week</th>
<th>Evaluation Scheme (Marks)</th>
<th>Credits</th>
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<td>T</td>
<td>P</td>
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<td>MECCE 204</td>
<td>Radio Frequency Integrated Circuits</td>
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<td>6</td>
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<td>Elective IV</td>
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<td>DSP Lab</td>
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**Elective - III (MECCE 205)**

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<th>Course No.</th>
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<tr>
<td>MECCE205-1</td>
<td>Communication Network Security</td>
</tr>
<tr>
<td>MECCE 205-2</td>
<td>Speech and Audio Processing</td>
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<tr>
<td>MECCE 205-3</td>
<td>Wireless Sensor Networks</td>
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<td>MECCE 205-4</td>
<td>Optical Signal Processing</td>
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**Elective IV- (MECCE 206)**

<table>
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<th>Course No.</th>
<th>Subject</th>
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<tbody>
<tr>
<td>MECCE205-1</td>
<td>Communication Network Security</td>
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<tr>
<td>MECCE 205-2</td>
<td>Speech and Audio Processing</td>
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<tr>
<td>MECCE 205-3</td>
<td>Wireless Sensor Networks</td>
</tr>
<tr>
<td>MECCE 205-4</td>
<td>Optical Signal Processing</td>
</tr>
</tbody>
</table>

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## SEMESTER - III

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
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<th>Hrs / Week</th>
<th>Evaluation Scheme (Marks)</th>
<th>Credits (C)</th>
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<td>Master’s Thesis Phase - I</td>
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<td>0 0 30</td>
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<td>CT 0</td>
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* TA based on a Technical Report submitted together with presentation at the end of the Industrial Training and Mini Project

** Evaluation of the Industrial Training and Mini Project will be conducted at the end of the third semester by a panel of examiners, with at least one external examiner, constituted by the University.

*** The marks will be awarded by a panel of examiners constituted by the concerned institute

## SEMESTER - IV

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Course No.</th>
<th>Subject</th>
<th>Hrs / Week</th>
<th>Evaluation Scheme (Marks)</th>
<th>Credits (C)</th>
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<td>Master’s Thesis</td>
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<td>TA* 300</td>
<td>CT 0</td>
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</table>

* Grand Total of all Semesters 2750 80

* 50% of the marks to be awarded by the Project Guide and the remaining 50% to be awarded by a panel of examiners, including the Project Guide, constituted by the Department

** Thesis evaluation and Viva-voce will be conducted at the end of the fourth semester by a panel of examiners, with at least one external examiner, constituted by the University.
Module 1: Random Processes -I: -

Module 2: Random Processes -II: -

Module 3: Vector Space and Linear Transformation

Module 4: Inner Product Spaces:
Inner Product spaces, norm, orthogonality, Hilbert spaces, orthogonal complements, projection theorem, orthogonal projections, orthonormal basis.

References:
5. S.D. Sharma, Operation Research

6. Manmohan Gupta, Optimization techniques


Module 1: Detection and Estimation

Module 2: Multiplexing and multiple access
Multiple access techniques-system and architecture-Access algorithms-multiple access techniques for INTELSAT-multiple access techniques for LAN

Module 3: Spread spectrum Techniques
Spread spectrum overview-PN sequences-DS spread spectrum-Frequency hopping-synchronization-jamming considerations- commercial applications-cellular systems

Module 4: Digital Communications through Fading Channels
Fading-signal time spreading-time varience caused by motion-mitigating the degradation effects of Fading-Rake Receiver-viterbi equaliser.

References:

Module 1: Review of Basic Transmission Line Theory
Review of basic transmission line theory, transmission lines analysis, transmission lines, circuit representations, parameters, transmission line equations, microstrip transmission line terminated lossless transmission line, special termination condition, sourced and loaded transmission lines, smith chart.

Module 2: RF Filter Design
Basic resonator and filter configurations, special filter realization, filter implementation, scattering parameters.

Module 3: Active RF Components
RF Diodes, BJT, FET, impedance matching using discreet components, microstrip line matching networks, Amplifier classes of operation and biasing networks.

Module 4: RF Transistor Amplifier and Oscillators Design
Amplifier power relation, stability considerations, constant gain, noise figure circles, constant VSWR circles, Basic oscillator modal, High frequency oscillator configuration, basic characteristics of mixers

References:

Module 1: Review of Networking Concepts

Services, layered architectures, packet switching, OSI and IP models, IEEE 802.x, ethernet, token ring, Fiber Distributed Data Interface (FDDI), Distributed-Queue Dual-Bus(DQDB), Frame Relay and Switched Multimegabit Data Service(SMDS). Internet and TCP/IP networks, TCP and UDP.

Module 2: TCP/IP Network

Performance of TCP/IP Networks, Circuit switched networks, performance of Synchronous Optical Networking(SONET), Dense Wavelength Division Multiplexing(DWDM), Fiber To The Home(FTTH), DSL, Intelligent networks, CATV.

Module 3: ATM Network

ATM network, features, addressing, signalling, routing, ATM adaptation layer (AAL), management and control, BISDN, internetworking with ATM. Optical networks, WDM systems, cross connects, optical LANs and Networks.

Module 4: Switching

Switching, performance measures, time and space division switching, modular switch designs, packet switching, distributed buffer, shared buffer, output buffer and input buffer switches, attributes of a global multimedia network, challenges in its realization.

References:
Module 1: Introduction
Soft computing constituents, conventional artificial intelligence, computational intelligence, characteristics, fuzzy sets, set theoretic operations, membership functions, one and two dimensional, fuzzy union, intersection and compliment.

Module 2: Rules and Reasoning
Extension principle, fuzzy relations, if-then rules, reasoning, inference systems-mamdani model, considerations, input space partitioning, fuzzy modeling.

Module 3: Least-Square Methods
Basics of matrix manipulation and calculus, least square estimator, geometric interpretation of LSE, recursive LSE, neuro networks, architecture, back propagation for feedback.

Module 4: Adaptive Neuro-Fuzzy Inference System
Architecture, hybrid learning algorithm, data clustering algorithms- clustering, k-means, fuzzy c-means (FCM), rule base structure - input selection, space partitioning, rule base organization.

References:

Module 1: Basic Concepts of Radiation
Fundamentals of electromagnetism, radiation, antenna transmission, antenna parameters, review of basic antenna systems- impedance matching, review of basic antenna family-array antennas, dipole antennas, reflector antennas.

Module 2: Receiving Antenna
Reciprocity theorem, antenna effective receiving area, antenna behaviour in presence of noise, aperture antennas, wire antennas.

Module 3: Printed Antennas
Different types, field analysis of printed antennas, parameters of printed antenna, lens antennas, types of lens antennas, large antennas, microwave antennas, array antenna, linear array theory, effect of phase quantization, frequency scanned array.

Module 4: Antennas and Signal Theory
Equivalence of an aperture and a spatial frequency filter, synthesis of an aperture for a given radiation pattern, antennas as a filter of angular signals. Case Study Smart antennas and their design techniques for mobile communication, antenna measurements.

References:

Module 1: Introduction
Satellites, introduction to tracking and GPS System, applications of satellite and GPS for 3D position, velocity determination as function of time, interdisciplinary applications (e.g. crystal dynamics, gravity field mapping, reference frame), basic concepts of GPS - space segment, control segment, user segment, history of GPS constellation, GPS measurement characteristics, selective availability (AS), anti-spoofing (AS)

Module 2: Orbits and Reference Systems
Basics of satellite orbits and reference systems, two-body problem, orbit elements, timer system and timer transfer using GPS, coordinate systems, GPS orbit design, orbit determination problem, tracking networks, GPS force and measurement models for orbit determination, orbit broadcast ephemeris, precise GPS ephemeris, Tracking problems.

Module 3: GPS Measurements
GPS observable-measurement types- C/A code, P code, L1 and L2 frequencies for navigation, pseudo ranges, atmospheric delays (tropospheric and ionospheric), data format (RINEX), data combination (narrow/wide lane combinations, ionosphere, free combinations, single, double, triple differences), undifferenced models, carrier phase vs integrated doppler, integer biases, cycle slips, clock error.

Module 4: Processing Techniques & GPS Applications
Pseudo range and carrier phase processing, ambiguity removal, least square methods for state parameter determination, relation positioning, dilution of precision

GPS Applications:- Surveying, Geophysics, Geodesy, Airborne GPS, ground-transportation, space-borne GPS orbit determination, attitude control, meteorological and climate research using GPS

References:


Module 1: Introduction to Satellite Communication
Orbital mechanics look angle determination, orbital perturbation, launchers and launch vehicles, orbital effect in communication system performance, satellite subsystem, altitude and orbit control system, telemetry tracking command and monitoring, power system, communication subsystem, satellite antennas

Module 2: Satellite Link Design and Error Control for digital satellite links
Basic transmission, system noise temperature, G/T ratio, design of down links, satellite system using small earth station, uplink design, design of specified C/N, system design examples.

Error detection and correction for digital satellite links, channel capacity, error control coding, performance of block error correction codes, convolutional codes, implementation of error detection on satellite links concatenated coding and interleaving, turbo codes

Module 3: Multiple Access
Introduction, FDMA, TDMA, onboard processing, DAMA, random access, packet radio systems and protocols, CDMA.

Module 4: VSAT & GPS System
Overview of VSAT systems, network architecture, access control protocols, basic techniques, VSAT earth station Engineering, GPS Introduction, position location principles, Receivers and codes, satellite signal acquisition, GPS Signal Message, signal levels, timing accuracy, GPS receiver operation, GPS C/A code accuracy, differential GPS

References:
Module 1: MEMS Introduction & their applications

Aeronautics, aerospace, automobiles, biomedical engineering, smart materials introduction, piezoelectric, magnetic, shape memory alloys, ferroelectric and rheological materials. Introduction to MEMS, surface, bulk and LIGA process. Sensors, actuators and working principles, transducer classifications, electrostatic, resistive, capacitive etc..

Module 2: Elements of RF Circuit Design

Recent developments in MEMS. RF circuit design, physical aspects of RF circuit design, skin effect, transmission lines on thin substrates, self-resonance frequency, quality factor packaging, practical aspects of RF circuit design, DC biasing, impedance mismatch effects in RF MEMS.

Module 3: RF MEMS

RF MEMS, enabled circuit elements and models, RF/microwave substrate properties, micro machined, enhanced elements, capacitors, inductors, varactors, MEM switch, shunt MEM switch, push-pull series switch, resonators, transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustics wave resonators, MEMS modeling- mechanical modeling, electromagnetic modeling.

Module 4: Novel RF MEMS

Novel RF MEMS enabled reconfigurable circuits, the resonant MEMS switch, capacitors, inductors, tunable CPW resonator, MEMS micro-switch arrays, reconfigurable circuits, double stud tuner, Nth-stub tuner, filters, resonator tuning system, reconfigurable antennas, tunable dipole antennas, tunable microstrip patch-array antenna.

References:

1. Tai- Ran Hus, “MEMS & Microsystems design and manufacture”, McH 2002

Module 1: Basics of Pattern Recognition
Pattern recognition systems, design of pattern recognition systems, learning and adaptation, bayesian decision theory- classifiers, discriminant functions, decision surfaces, normal density and discriminant functions, discrete features.

Module 2: Parameter Estimation Methods
Maximum-likelihood estimation, bayesian estimation, gaussian mixture models, expectation, maximization.

Module 3: Density Estimation
Non-parametric techniques for density estimation- parzen-window method, k-nearest neighbour method.

Module 4: Linear Discriminant Functions
Linear discriminant functions and decision surfaces, Non-metric methods for pattern classification- Non-numeric data or nominal data, Decision trees.

Unsupervised Learning and Clustering
Criterion functions for clustering, algorithms for clustering- K-means, cluster validation.

References:

Module 1: Concepts of Information Theory
Entropy, relative entropy and mutual information, asymptotic equipartition property, entropy rate of a stochastic process, data compression, channel capacity, differential entropy, gaussian channel.

Module 2: Error Detection Codes
Groups, rings, vector spaces, galois fields, polynomial rings, channel models, linear block codes, cyclic codes, BCH codes, reed solomon codes, berlekamp-massey and euclid decoding algorithm, decoding beyond the minimum distance parameter, applications of reed solomon codes.

Module 3: Convolutional Codes
Convolutional codes, decoding algorithms for convolutional codes, viterbi, stack and fano algorithms, application of convolutional codes.

Module 4: Decoding Algorithms
Soft decision decoding algorithms, Iterative decoding algorithms, Turbo-decoding, Two-way algorithm, LDPC codes, Use of LDPC codes in digital video broadcasting, belief propagation (BP) algorithms, Space Time codes.

References:

Module 1: Basics of Scientific Computing and Overview of Computational Electromagnetics
Numerical error, convergence, interpolation, extrapolation, numerical integration, numerical differentiation, direct and iterative matrix equation solvers. CEM techniques, CEM modelling, CEM, the future.

Module 2: Finite Difference Method
Overview of finite differences, one dimensional FDTD, Obtaining wideband data using the FDTD, Numerical dispersion in FDTD simulations.

Module 3: Finite Difference Time Domain Method in Two and Three Dimensions
2D FDTD algorithm, PML absorbing boundary condition, 3D FDTD algorithm, Commercial implementations.

Module 4: Finite Element Method
Variational and galerkin weighted residual formulations- Laplace equation, Simplex coordinates, high, frequency variational functional, Spurious modes, vector (edge) elements, application to waveguide eigenvalue analysis, three-dimensional Whitney element.

References:


1) Measurement of High frequency circuit parameters using spectrum analyzer.
2) Experiments using communication toolbox in MATLAB.
3) Antenna pattern measurements.
4) Experiments of fibre optic communication systems.

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the first semester of the M. Tech. programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.
SEMESTER II

MECCE 201  ADVANCED DIGITAL SIGNAL PROCESSING

Module 1: Discrete-time Signals and Systems
Discrete-time Signals and Sequences, Linear Shift-Invariant systems, Stability and Causality, Linear constant coefficient difference equations, Frequency domain representation of discrete-time signals and systems, Sampling of continuous time signals, Two dimensional sequences and systems

Module 2: Transforms and Filters
Z-transform, Region of convergence, Stability and ROC, Inverse z-transform, Discrete Fourier transform, Time domain aliasing, Properties of DFT, Fast Fourier transform, Decimation in time algorithm, IDFT using FFT algorithm, Design of IIR low pass and High pass Digital filters

Module 3: Adaptive Signal Processing
Adaptive systems, Definition and characteristics, General properties, open and closed loop adaptation, Performance function and performance surface, Gradient and minimum MSE, Methods of searching the performance surface, Simple gradient search algorithm, Gradient search by method of steepest descent, The LMS adaptive algorithm.

Module 4: Digital Signal Processors
Multiplier and Multiplier Accumulator, Modified bus structure and Memory access scheme in P-DSPs, Multiple access memory, Multiported memory, VLIW architecture, Instruction pipelining, Architecture and Assembly language instructions of TMS320C5X processor.

References:


Module 1: Radio Propagation Characteristics
Radio Propagation Characteristics- Models for path loss, shadowing and multipath fading (delay spread, coherence bandwidth, coherence time, Doppler spread), Jakes channel model.

Module 2: Digital Modulation
Digital modulation for mobile radio, analysis under fading channels- diversity techniques and RAKE demodulator, channel coding techniques, multiple access techniques used in wireless mobile communications.

Module 3: Wireless Networks
Wireless networks, WLAN, bluetooth, cellular concept- frequency reuse, basic theory of hexagonal cell layout, Spectrum efficiency, FDM / TDM cellular systems- Channel allocation schemes, handover analysis, erlang capacity comparison of FDM / TDM systems and cellular CDMA.

Module 4: Cellular Standards
Discussion of GSM and CDMA cellular standards, Signalling and call control, Mobility management, location tracking, wireless data networking, packet error modelling on fading channels, performance analysis of link and transport layer protocols over wireless channels- mobile data networking (Mobile IP), wireless data in GSM, IS, 95 and GPRS, space time wireless Communications.

References:

Module 1: Introduction to Opto-electronics
Nature of light, guided optical communication, transmission parameters, transmission windows, optical properties of semiconductor, PN junction, carrier recombination and diffusion hetrojunction, double hetrojunction.

Module 2: Opto Electronic Sources and Detectors
LED- types, power, efficiency, structure, characteristics, Laser Diodes- types, power, efficiency, structure, characteristics. Optical detectors-photo diodes, types, power, efficiency, structure, characteristics.

Module 3: Optical Devices
Optical Component Technologies, Optical amplifiers, Splitters and Couplers, polarisation control, lens and prisms, diffraction gratings, filters, modulators and switches, repeaters.

Module 4: Optical Communication systems
Point to point transmission system, modulation, transmission line limits and characteristics, Optical System engineering, control of dispersion in single mode and multi mode fiber links, WDM, DWDM, components of WDM

References:
Module 1: Microstrip Lines
Introduction, types of MICs and their technology, Microstrip field configuration, analysis of microstrip line by conformal transformation, Introduction to microstrip discontinuities, equivalent circuits (open ends, gap in microstrip, steps in width, bends & T junction) and compensation techniques. losses in microstrip, introduction to slot line and coplanar wave guide.

Module 2: Coupled Microstrip Circuit, Couplers and Lumped Elements for MICs
Introduction to coupled microstrip, even and odd mode analysis, directional couplers, branch line couplers, design and fabrication of lumped elements for MICs, comparison with distributed circuits, MICs in satellite and radar

Module 3: Non-Reciprocal Components and Active Devices for MICs
Ferromagnetic substrates and inserts, microstrip circulators, phase shifters, microwave transistors, parametric diodes and amplifiers, PIN diodes, transferred electron devices, IMPATT, BARITT, avalanche diodes, microwave transistors circuits.

Module 4: MMIC Technology
Fabrication process of MMIC, hybrid MICs, configuration, dielectric substances, thick and thin film technology, testing methods, encapsulation and mounting of devices.

Text Books:

Module 1: Conventional Encryption
Introduction to Elementary number theory, finite series, arithmetic and algebraic algorithms.

Conventional encryption model, steganography, data encryption standard, block cipher, encryption algorithms, confidentiality, key distribution, secrete key and public key cryptography.

Module 2: Public Key Encryption
Principles of public key cryptosystems, pseudo random bit generators, block and stream ciphers, RSA algorithm, diffie-hellman key exchange.

Module 3: Hashing
Hash functions and message digests, public key encryption, authentication, digital signatures, zero knowledge interactive protocols, elliptic curve cryptosystems, formal verification, crypt analysis, hard problems.

Module 4: Security
IP Security- overview, IP security architecture, authentication, header, security payload, security associations, key management, web security requirement, secure sockets layer, transport layer security, secure electronic transaction, dual signature, intruders, viruses, worms, firewall design, trusted systems, antivirus techniques, digital immune systems.

References:
Module 1: Speech Production and Acoustic Phonetics
Human speech production mechanism, acoustic theory of speech production, nature of speech signal, articulatory phonetics, acoustic phonetics, coarticulation, prosody. **Speech Analysis and Synthesis**: Time and frequency domain analysis of speech, speech parameter estimation, linear prediction analysis, cepstral analysis, vector quantization(VQ) methods, principles of speech synthesis.

Module 2: Speech Recognition
Speech recognition, baye’s rule, segmental feature extraction, mel frequency cepstral coefficient(MFCC), dynamic time -wrapping(DTW), hidden markov model(HMM) approaches for speech, speaker and language recognition.

Module 3: Speech Coding and Enhancement
Speech coding, quality measures, speech redundancies, time-domain waveform coding, Linear predictive coding, speech enhancement techniques.

Module 4: Audio Processing
Audio processing, characteristics of audio signals, sampling, audio compression techniques, standards for audio compression in multimedia applications, MPEG audio encoding and decoding, audio databases and applications.

References:
Module 1: Introduction to Wireless Sensor System
Basic terminology, unique constraints and challenges, advantages, applications, collaborative processing, tracking scenario, problem formulation, distributed representation and inference of states, tracking multiple objects, sensor models, performance comparison and metrics.

Module 2: Networking Sensors
Medium access control, sensor medium access control (SMAC) protocol, IEEE 802.15.4 standards and ZigBee, geographic, energy, aware routing, attributed based routing.

Module 3: Infrastructure Establishment and Sensor Network Databases
Topology control, clustering, time, synchronization, localization and localization services, sensor tracking and control- task driven sensing, role of sensor nodes and utilities, information based sensor tasking, joint routing and information aggregation.

Sensor Network Databases:- Challenges, querying the physical environments, query interfaces, high level database organization, in-network aggregation, data centric storage, data indices and range queries, distributed hierarchical aggregation, temporal data.

Module 4: Sensor Network Platforms and Tools
Sensor node hardware, programming challenges, node level software platforms, node level simulators, programming beyond individual nodes.

References:
Module 1: Analysis of Two Dimensional Signals and Systems.
Review of one-dimensional fourier analysis, analysis of two-dimensional signals and systems, fourier analysis in two dimensions, localization, linear systems and fourier analysis, two-dimensional sampling theory.

Module 2: Foundations of Scalar Diffraction Theory
Kirchoff and rayleigh-sommerfield formulations, comparison of kirchoff and rayleigh-sommerfield theories, huygens-fresnel principle, non-monochromatic waves, diffraction at boundaries, angular spectrum of plane waves fresnel and fraunhofer diffraction fresnel approximation, fraunhofer approximation, examples of fraunhofer diffraction patterns, examples of fresnel diffraction calculations.

Module 3: Wave Optics Analysis of Coherent Optical Systems
Thin lens as phase transformation, fourier transforming properties of lenses, image formation- monochromatic illumination. Transfer Functions and Frequency Analysis of Optical Imaging Systems: Generalized treatment of imaging systems, amplitude transfer function, frequency response for coherent and incoherent imaging, aberrations and their effect on frequency response, comparison of coherent and incoherent imaging, resolution beyond classical diffraction limit.

Module 4: Wavefront Modulation
Photographic film, liquid crystals and other modulators, diffractive optical elements, analog optical information processing, incoherent image processing systems, coherent optical image processing systems. Holography- wavefront reconstruction problem, gabor and leith, upatnieks holograms, image locations and magnification, different types of holograms- thick holograms, recording materials, computer-generated holograms, degradation of holographic images, holography with spatially incoherent light, applications.
References:


Module 1: Digital Image Fundamentals
Digital image fundamentals, image acquisition, representation, visual perception, quality measures, sampling and quantization, basic relationship between pixels, imaging geometry, color spaces.

Module 2: Two Dimensional Systems
Two dimensional systems, properties, analysis in spatial, frequency and transform domains, image transforms, DFT, DCT, Sine, Hadamard, Haar, Slant, KL transform, Wavelet transform.

Module 3: Image Enhancement
Image enhancement, point processing, spatial filtering, Image restoration, inverse filtering, deblurring, image segmentation, feature extraction, region oriented segmentation, descriptors, morphology, image recognition.

Module 4: Video Processing
Video processing, display enhancement, video mixing, video scaling, scan rate conversion, Video compression, motion estimation, intraframe and interframe prediction, perceptual coding, standards, MPEG, H.264

References:
Module 1: Light Wave Basics
Introduction to light propagation in optical fiber, two approaches, dispersion, loss, bandwidth, non linear effects in optical fiber-scattering, self phase modulation, cross phase modulation, four wave mixing, introduction to optical networks, transmission basics, optical layer, network evolution.

Module 2: Optical Network Components
Transmitters and detectors, laser diode, photo detectors, optical amplifiers, erbium-doped fiber amplifier (EDFA), Raman amplifiers, semiconductor optical amplifier(SOA), multiplexer and filters. TDM, WDM, optical time division multiplexing(OTDM), Fabry-perot filter, thin film filter, acoustooptic tunable filter, optical switches, wavelength converters, cross connects, couplers, circulators and isolators.

Module 3: Transmission System Engineering
Optical modulation, demodulation techniques, optical amplifier analysis, cross talk, role of chromatic dispersion management, overall design considerations, design of soliton based systems, WDM network elements and its design.

Module 4: Optical Networks
Optical packet switching, client layers of the optical layer, Synchronous Optical Network /Synchronous Digital Hierarchy(SONET/SDH), ATM, functions, quality, control, layers, structure and elements. internet protocol-multiprotocol label switching(IP-MPLS), Storage area networks, enterprise systems connection(ESCON), fiber channel, high performance parallel interface(HIPPI), optical transport network(OTN), automatically switched optical network(ASON) models.

Reference:
Module 1: Introduction
Introduction- basic radar equation, range delay, velocity delay, Doppler effect, accuracy, resolution and ambiguity, Tradeoffs and penalties in waveform design, significance of matched filter in radar signal analysis- complex representation of band-pass signal, matched filter response to Doppler shifted signal.

Module 2: Basic Radar Signals
Basic radar signals- constant frequency pulse, linear frequency modulated pulse, costas frequency modulated pulse, nonlinear frequency modulation, phase coded pulse- barker code, chirp-like phase code, asymptotically perfect codes, Huffman code, bandwidth considerations in phase-coded signals, multi carrier phase coded signal in radar signals.

Module 3: Pulse Repetition Interval
Diverse pulse repetition interval (PRI) pulse trains- introduction to moving target indication (MTI) radar, blind speed. Synthetic Aperture Radar: Synthetic aperture radar (SAR) - SAR principle, k-space understanding of SAR, different compensation techniques, sparse SAR.

Module 4: Detection and Recognition
Detection and recognition using radar- detection and recognition using 1-D range profile, detection and recognition using SAR image, space time adaptive processing (STAP)- understanding STAP, uses of STAP, civilian uses of radar- space based SAR, segmentation of SAR images from satellite.

References:

Module 1: Hypothesis Testing
Criteria in Hypothesis Testing, neyman pearson criterion, bayes criterion and minimum probability of error criterion, likelihood ratio test, application examples- signal constellations and the matched filter, binary symmetric channel.

Module 2: Detection
Detection with unknown signal parameters (UMP tests, GLRT, Bayes factor), MAP rule, multiple decision problem, detection of deterministic and random signals in noise.

Module 3: Parameter Estimation

Module 4: Linear Estimators

References:
MECCE 207  DSP LAB

Experiments in DSP, Image and Speech processing using MATLAB/similar softwares such as

1. Two-dimensional Fourier transform
2. Linear filtering using convolution
4. Filter bank design.
5. Highly selective filters.
7. Morphological operations.
8. Histogram equalization.

Experiments using Code composer studio

1. Convolution.
2. Filter design.

MECCE 208  SEMINARS- II

Each student shall present a seminar on any topic of interest related to the core / elective courses offered in the second semester of the M. Tech. programme. He / she shall select the topic based on the references from international journals of repute, preferably IEEE journals. They should get the paper approved by the Programme Co-ordinator / Faculty member in charge of the seminar and shall present it in the class. Every student shall participate in the seminar. The students should undertake a detailed study on the topic and submit a report at the end of the semester. Marks will be awarded based on the topic, presentation, participation in the seminar and the report submitted.
SEMESTER III

MECCE 301	INDUSTRIAL TRAINING AND MINIPROJECT

The student shall undergo

i) An Industrial Training of 12 weeks duration in an industry / company approved by the institution / institute and under the guidance of a staff member in the concerned field. At the end of the training he / she have to submit a report on the work being carried out.

OR

ii) An Industrial Training of 1 month duration and Mini Project of 2 months in an industry / company approved by the institution / institute and under the guidance of a staff member in the concerned field. At the end of the training he / she have to submit a report on the work being carried out.

MECCE 302	MASTER’S THESIS PHASE – I

The thesis (Phase - I) shall consist of research work done by the candidate or a comprehensive and critical review of any recent development in the subject or a detailed report of project work consisting of experimentation / numerical work, design and or development work that the candidate has executed.

In Phase - I of the thesis, it is expected that the student should decide a topic of thesis, which is useful in the field or practical life. It is expected that students should refer national & international journals and proceedings of national & international seminars. Emphasis should be given to the introduction to the topic, literature survey, and scope of the proposed work along with some preliminary work / experimentation carried out on the thesis topic. Student should submit two copies of the Phase - I thesis report covering the content discussed above and highlighting the features of work to be carried out in Phase – II of the thesis. Student should follow standard practice of thesis writing. The candidate will deliver a talk on the topic and the assessment will be made on the basis of the work and talks there on by a panel of internal examiners one of which will be the internal guide. These examiners should give suggestions in writing to the student to be incorporated in the Phase – II of the thesis.
SEMESTER IV

MECCE 401  MASTER’S THESIS

In the fourth semester, the student has to continue the thesis work and after successfully finishing the work, he / she have to submit a detailed thesis report. The work carried out should lead to a publication in a National / International Conference. They should have submitted the paper before M. Tech. evaluation and specific weightage should be given to accepted papers in reputed conferences.

MECCE 402  MASTER’S COMPREHENSIVE VIVA

A comprehensive viva-voce examination will be conducted at the end of the fourth semester by an internal examiner and external examiners appointed by the university to assess the candidate’s overall knowledge in the respective field of specialization.