SYLLABUS

For

Master of Engineering Programmes
(M.Tech. Wireless Communication)

(For admission in 2022-23 and onwards)
Courses Structure and Scheme of Examination for  
M. Tech.- 2 Year Programme  
Wireless Communication

### Semester I

<table>
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Advanced Mathematics (AHT-301)

L:T:P:: 3:1:0  

Course objectives:

- To learn principles of advanced engineering mathematics through linear algebra and calculus of variations.

Learning outcomes:

1. Ability to analyze and solve both linear & non-linear engineering problems whose solutions are not found in the closed form
2. Ability to analyze and solve stochastic engineering & industrial problems
3. Ability to analyze the solution & examine its stability in operator theory
4. Ability to optimize & solve real life problems
5. Ability to solve image processing & signal processing problems

Course content:

Unit I: Numerical Analysis: (8 hours)

Use of Interpolation formulae of Stirling, Bessel’s, Spline. Solutions of system of linear simultaneous equations using SOR algorithm, Newton’s method [up to two variables]

Unit II: Stochastic Process: (10 hours)

[Prerequisite: Basic Under graduate course in probability]
Random processes, Random walk, Markov process with special emphasis on Markov chain.

Unit III: Linear algebra: (8 hours)
Vector spaces, Linear transformations, Eigenvalues, Eigenvectors, some applications of Eigen value & Eigen vector problems.

Unit IV: Optimization Technique: (8 hours)

Calculus of several variables, Implicit function theorem, Nature of singular points, Necessary and sufficient conditions for optimization, Constrained Optimization, Lagrange multipliers, Gradient method – steepest descent method.

Unit V: Fourier series and Transform: (8 hours)

Fourier series, integrals and transforms and their properties. One dimensional Fourier transform, Convolution theorem, Parseval’s formula, Introduction to 2-dimensional Fourier transform.

Text Books / References:
Course Objectives:
- To learn principles of advanced engineering mathematics through linear algebra and calculus of variations.
- To understand probability theory and random process that serve as an essential tool for applications of electronics and communication engineering sciences.

Course Outcomes:
CO1: Ability to analyze and solve both linear & non-linear engineering problems whose solutions are not found in the closed form

CO2: Ability to analyze and solve stochastic engineering & industrial problems

CO3: Ability to analyze the solution & examine its stability in operator theory

CO4: Ability to optimize & solve real life problems

CO5: Ability to solve image processing & signal processing problems

Course Contents:
UNIT-I (8 hours)

UNIT-II (8 hours)
Random Processes: Definition and classification, stochastic integrals, Fourier transforms of random processes, stationary and non-stationary processes, correlation functions. Ergodicity, power spectral density, transformations of random processes by linear systems.

UNIT-III (8 hours)

UNIT-IV (8 hours)
Optimum Filtering: Matched filters for deterministic signals in white and colored Gaussian
noise. Wiener filters for random signals in white and colored Gaussian noise.

Text Books:
- Principles of Linear Systems and Signals, 2e (Intl. Version), Lathi, 2nd, Oxford
- Signal & Systems 3e, Chen 3rd, Oxford
- Fundamentals of Signals and Systems, M.J. Roberts, Wiley
- Signals and Systems, P Rao, TMH
- Signals and Systems: A Simplified Approach, Ganesh Rao, Pearson
- Signals and Systems: Continuous and Discrete, Roger E Ziemer, Phi
- Signals and Systems, Ravi Kumar, Phi
Course Objectives:

- Understand and appreciate the need of various modulation and spread spectrum techniques.
- Analyze the properties of basic Modulation techniques and apply them to Digital Communication.
- Apply different types of coding techniques to design the optimum receiver for channels with ISI and AWGN.

Course Outcomes:

Upon successful completion of the course, the students will be able to:

**CO1:** Explain merits and demerits of different modulation techniques & coding techniques, spread spectrum signals and channel behaviors.

**CO2:** Analyze various modulation, equalization, diversity and coding techniques for communication systems.

**CO3:** Compare performance of different types of modulation on different wireless application fading channels.

**CO4:** Design and demonstrate various modulation/coding equalization techniques and measure their performance.

Course Contents:

**Unit-I** (8 hours)

**Digital Modulation Techniques:** Digital modulation formats, Coherent binary modulation techniques, Coherent quadrature – modulation techniques, Non-coherent binary modulation techniques, Comparison of binary and quaternary modulation techniques, M-ray modulation techniques, Power spectra, Bandwidth efficiency, M-array modulation formats viewed in the light of the channel capacity theorem, Effect of inter symbol interference, Bit verses symbol error probabilities, Synchronization, Applications.

**Unit-II** (8 hours)

**Coding Techniques:** Convolutional encoding, Convolutional encoder representation, Formulation of the convolutional decoding problem, Properties of convolutional codes: Distance property of convolutional codes, Systematic and nonsystematic convolutional codes, Performance Bounds for Convolutional codes, Coding gain, Other convolutional decoding algorithms, Sequential decoding, Feedback decoding, Turbo codes.
Unit-IV


Unit-V

Digital Communication through Fading Multipath Channels: Characterization of fading multipath channels, the effect of signal characteristics on the choice of a channel model, Frequency nonselective, slowly fading channel, Diversity techniques for fading multipath channels, Digital signals over a frequency selective, slowly fading channel.

Books and References:

Text Books:


References books:

SIGNAL THEORY LAB (WEP-301)

L:T:P::0:0:3 Credits-1

Course Objective:

- The objective of the course is to make familiar with practical implementation of the digital signal processing. Students can able to develop DSP algorithms for convolution, correlation, DFT, filtering of signals etc.

Course Outcomes:

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

CO 1: To use computational tools to do basic operations for signal processing.

CO 2: To develop algorithms for designing and implementation of FIR and IIR filters with standard techniques.

EXPERIMENTS USING TMS320C6XXX DSP KITS

1. FIR Digital Filter Design
2. IIR Digital Filter Design
3. FFT of a given signal
4. Plot PSD/Power Spectrum of a signal
5. Discrete Cosine Transform
6. Adaptive Filter Design using Standard LMS Algorithm
7. Speech analysis using L.P.C.
DIGITAL COMMUNICATION SYSTEM LAB (WEP-302)

L:T:P::0:0:3

Course Objectives:

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

Course Outcomes:

Students are able to

CO1: Apply the knowledge of statistical theory of communication and explain the conventional digital communication system.

CO2: Apply the knowledge of signals and system and evaluate the performance of digital communication system in the presence of noise.

CO3: Apply the knowledge of digital electronics and describe the error control codes like block code, cyclic code.

CO4: Describe and analyze the digital communication system with spread spectrum modulation.

CO5: Design as well as conduct experiments, analyze and interpret the results to provide valid conclusions for digital modulators and demodulator using hardware components and communication systems using CAD tool.

PART I: PCM AND LINK ANALYSIS

Link establishment, Noise on PCM link, Error detection, BER calculation, Error correction, TDM.

PART II: DIGITAL MODULATION & KEYING

ASK, FSK, PSK, QPSK Modulation and Demodulation.

PART III: CDMA - DSSS

Modulation, Demodulation & BER measurement.
PART IV: SIMULATION IN MATLAB ENVIRONMENT

BPSK, QPSK, FSK Modulation & Demodulation. BER calculation.
Research Methodology and IPR (AHT-302)

Course Objectives:

1. To understand the fundamentals of research in today’s world controlled by technology, ideas, concept, and creativity.
2. To understand different methods of research designing and data collections.
3. To understand the methods of report writing and its different methods of interpretations.
4. To understand research ethics and methods of research publications.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

Course Outcomes:

1. To understand research problem formulation.
2. To study research design and method of data collections.
3. To study methods of report writing.
4. To follow research ethics.
5. To enhance student’s competence to discover new inventions.

Syllabus Contents:

UNIT 1: FUNDAMENTAL OF RESEARCH

Meaning of research; objectives of research; basic steps of research; criteria of good research; Research methods vs. Methodology. Types of research –criteria of good research; Meaning of research problem; selection of research problem; Approaches of investigation of solutions for research problem, Errors in selecting a research problem, Scope and objectives of research problem, Review of related literature- Meaning, necessity and sources.

Unit 2: RESEARCH DESIGN AND DATA COLLECTION

Research design: Types of research design- exploratory, descriptive, diagnostic and experimental;Variables- Meaning and types; Hypothesis- Meaning, function and types of hypothesis; Null/Alternative hypothesis; Sampling- Meaning and types of sampling; Probability and Non-Probability; Tools and techniques of data collection- questionnaire, schedule, interview, observation, case study, survey etc.

Unit 3: REPORT WRITING AND ITS INTERPRETATION
Unit 4: RESEARCH ETHICS AND SCHOLARY PUBLISHING

Ethics-ethical issues, ethical committees (human & animal); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism and its concept and importance for scholar.

Unit 5: INTELLECTUAL PROPERTY RIGHT (IPR)


Reference Books:

2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
MOBILE COMMUNICATION( WET-303)

L:T:P::3:1:0

Credits-4

Course Objectives:

- Educate students to understand the bandwidth of operation of cellular technology and plan spectrum deployment for cellular systems to provide better customer services as well as earn revenue of service provider
- Utilize the subject knowledge in specifying the technological problems for evolving cellular technology.
- Understand the needs of technological solution for designing and developing next generation cellular technology to fulfill the ever growing service demands of customer
- Apply the mobile and wireless principles for creating solutions for data and voice communication in various Industries like Banking, Marketing and Automobile.

Course Outcomes:

Upon successful completion of the course, the students will be able to

CO1: Developments in the current and next generation mobile technologies
CO2: Knowledge on mobility support in network layers.
CO3: Details of advanced mobile communication standards and their evolution.
CO4: Recognize the various frequency and bandwidth allocations, design concepts of emerging communication systems.
CO5: Design a cellular system in a specific radio and geographic environment with specific frequency range

Course Contents:

Unit-I (8 hours)


Unit-II (8 hours)


Unit-III (8 hours)

UNIT 4 BEYOND 3G (8 hours)


UNIT 5 MOBILE NETWORK, TRANSPORT & APPLICATION LAYERS (8 hours)


Text Books:


References books:

ADVANCED WIRELESS COMMUNICATION (WET-304)

L:T:P::3:1:0 Credits-4

Course Objectives
- Developments in the current and next generation mobile technologies.
- Details of advanced mobile communication standards and their evolution.
- Knowledge on mobility support in network layers

Course Outcomes
Upon successful completion of the course, the students will be able to

CO1: Students will be able to design appropriate mobile communication system by applying frequency reuse concept and also analyze the effect of interference and handoff techniques.

CO2: Students will be able to distinguish various multiple access techniques for mobile communication and their advantages and disadvantages.

CO3: Students will be able to analyze path loss and interference for wireless telephony and their influences on mobile communication system performance.

CO4: Students will be able understand the importance of different diversity techniques as well equalizer in wireless communication system.

CO5: Students will be able to analyze and design CDMA system functioning with knowledge of forward and reverse channel.

Course Contents

Unit-I
CELLULAR COMMUNICATION FUNDAMENTALS: Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment. GSM architecture and interfaces.

Unit-II
MULTIPLE ACCESS TECHNIQUES: Spectral efficiency analysis based on calculations for Multiple access technologies: TDMA, FDMA and CDMA, Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.

Unit-III
Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading.

**Unit-IV**
**EQUALIZATION, DIVERSITY:** Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.

**Unit-V**
**IS 95 SYSTEMS:** Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA.

**Text Books:**

**Reference Books:**
MOBILE COMMUNICATION LAB (WEP-303)

L:T:P::0:0:3 Credits-1

Course Objectives This course enables the students to:
- Understand the basic commands to interface GSM module
- Implement all applications of mobile communication.

Course Outcomes At the end of the course, a student should be able to:
CO1: To understand the basic command and applications of AT commands in mobile communication.
CO2: To understand different spread spectrum modulation/demodulation schemes.
CO3: To be able to measure different test point voltages of mobile phones and identify the switch faults.

List of Experiments:
1. Study & use of AT commands.
2. Study of voice call using AT command.
3. Sending message using AT command.
4. Study theory of direct sequence spread spectrum modulation & demodulation.
5. Generation of DSSS modulated signal.
6. Demodulation of DSSS modulated signal.
7. Introduction to parts of mobile phone
8. Measurement of test point voltages of mobile
9. Observe waveforms at different test points of mobile
10. Study of switch faults
11. Video calling
ADVANCED WIRELESS COMMUNICATION LAB
(WEP-304)

L:T:P::0:0:3 Credits-1

Course Type: Core / Elective

Course Objectives This course enables the students to:
- To understand the emerging technologies of wireless and mobile communication.
- To simulate the problems using specific wireless and mobile communication tools.

Course Outcomes At the end of the course, a student should be able to:
CO1: Understand the basic concept of wireless communication i.e. hoc network, Bluetooth & Wi-Fi.
CO2: To develop the Android application.
CO3: To create a program for various problems using Android application.

List of Experiments:
1. Prepare a wireless ad hoc network and show its working.
2. Prepare a Case Study on Wi-Fi tools
3. Study on Bluetooth protocol stack
4. Write installation steps for Android studio
5. Install Genymotion in Android studio.
6. Develop an android app which displays “Hello, welcome to Android Lab” message
7. Implement an Android application that converts Fahrenheit to Celsius and Celsius to Fahrenheit.
8. Write a program for finding factorial of a number.
9. Develop calculator Android Application
10. Write a program to find hamming distance. For example, Hamming distance d (v1, v2) =3 if v1=110011, v2=100111.
Course Objectives

- To introduce various aspects in the design of systems for satellite communication and its application.

Course Outcome:

CO1: Analyze the satellite orbits

CO2: Analyze the earth segment and space segment

CO3: Able to understand how analog and digital technologies are used for satellite communication networks

CO4: Able to explain various applications of satellite with the focus on national satellite system

SYLLABUS:

Unit-I (8 hours)

Elements of orbital mechanics: Kepler’s Laws, Newton’s law, orbital parameters, orbital perturbations, station keeping, geo stationary and non Geo-stationary orbits, Look Angle Determination, Limits of visibility, Eclipse, Sub satellite point, Sun transit outage, Launching Procedures, launch vehicles and propulsion

Unit – II (8 hours)

Spacecraft Technology: Structure, Elements of communication satellite design. Spacecraft subsystems, Reliability considerations, Spacecraft integration, Attitude and Orbit control, Thermal control and Propulsion, communication Payload and supporting subsystems

Unit – III (8 hours)

The space link: Introduction, Equivalent isotropic radiated power (EIPR), transmission losses, the link power budget equation, system noise, carrier-to-noise ratio (C/N), the uplink, the downlink, effects of rain, combined uplink and downlink C/N ratio, inter modulation noise, inter satellite links. Interference between satellite circuits.
Unit – IV  
(8 hours)
**Satellite station:** Ground station and satellite antenna, radio wave propagation in atmosphere, multiple access techniques. FDMA, TDMA, CDMA. Random Access Techniques. Satellite onboard processing.

Unit - V  
(8 hours)
**Remote Sensing Satellites:** Classification of remote sensing systems, orbits, Payloads, Types of images: Image Classification, Interpretation, Applications

**Weather Forecasting Satellites:** Fundamentals, Images, Orbits, Payloads, Applications.

**Navigation Satellites:** Development of Satellite Navigation Systems, GPS system, Applications.

**TEXTBOOKS:**

**REFERENCEBOOKS:**
Course Objectives:
- Understand the techniques for design and realization of digital Filters for various electronic communication applications.
- Understand how to choose the sampling rate conversion and apply to Multirate signal processing techniques.
- Design of Adaptive filters, linear prediction and optimum linear filters.

Course Outcomes:
After the successful completion of course, the students will be able to:
CO1 Evaluate various Digital filters, linear filters and adaptive filters for multirate signal processing and power spectrum estimation.
CO2: Apply different design techniques for FIR and IIR filters
CO3: Design and demonstrate various Digital Signal Processing systems using modern software and hardware

Course Contents:
Unit-I Design of Digital Filters: General Considerations, Design of FIR filters, Design of IIR filters from analog Filters, Frequency Transformation.

Unit-II Multirate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a Rational Factor I/D. Implementation of sampling Rate Conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion by an Arbitrary Factor, Applications of Multirate Signal Processing, Digital Filter Banks, Two-Channel Quadrature Mirror Filter Bank, M-channel QMF Bank.

Unit-III Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, and Power spectra, innovations representation of a stationary random process, Forward and backward Linear Prediction, Levinson – Durdin algorithm, properties of the Linear Prediction-Error Filters, Wiener Filters for filters for filtering and prediction.

Unit-IV Adaptive Filters: Applications of Adaptive filers, Adaptive Direct-Form FIR Filters- The LMS algorithm, Adaptive Direct Form Filters- RLS algorithm.
Unit-V

Power Spectrum Estimation: (10 hours)

References:

Information Theory & Coding (WET-307)

L: T: P: 3: 1: 0

Course Objectives:
- 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

Course Outcome:
CO 1: Understand the information content of a random variable
CO 2: Understand the variables in terms of their coupled probabilities
CO 3: Understand the basic concepts of cryptography
CO 4: Explore the properties using Shannon’s Theorems

SYLLABUS:

Unit – I

Elements of information theory: Measurement of information and the Entropy Function, Entropies defined, and why they are measures of information, marginal entropy, joint entropy, Conditional entropy and the Chain Rule for Entropy. Sources with and without Memory: Sources coding theorem, Prefix, Variable and Fixed- length Codes. Error Correcting Codes

Unit – II

Channel Types, Properties, Noise and Channel Capacity: Perfect communication through a noisy channel. The binary symmetric channel, their classification and capacity of a noiseless discrete channel. The Hartley and Shannon laws for channel capacity.

Unit – III:

Continuous Information; Density; Noisy Channel Coding Theorem: Extensions of the discrete entropies and measures to the continuous case. Signal-to-noise ratio; power spectral density,
Gaussian channels, Relative significance of bandwidth and noise limitations. The Shannon rate limit and efficiency for noisy continuous channels.

Unit – IV  

**Error Control Coding:** Linear blocks codes and their properties, hard-decision decoding, cyclic codes, Convolution codes, Soft decision decoding, Viterbi decoding algorithm.

Unit – V  

**Advanced Coding Techniques and Cryptography:** BCH codes, Trellis coded modulation, introduction to cryptography, overview of encryption techniques, symmetric cryptography, DES, IDEA, asymmetric algorithms, RSA algorithm.

**TEXT BOOKS**

2. Richard B. Wells, Applied Coding and Information Theory for Engineers, Pearson
4. R.G.Gallager, Information Theory and Reliable Communication, Wiley

**REFERENCES**

3. Taub & Schilling, Principles of communication, McGraw Hill
4. Thomas Cover & Joy Thomas, Elements of Information Theory, John Wiley &Sons
HIGH FREQUENCY ELECTRONICS (WET-308)

L: T: P: 3: 0: 0                                                                                                 Credits-3

Course Objectives:

- Analyze high-frequency propagation, standing wave ratios, distributed impedance and reflections by applying transmission line theory and Smith charts.
- Analyze electrical structures where active components require high-frequency modelling, and propagation delays are not insignificant.
- Design high frequency multiport circuits using S and Z parameters, as well as signal flow graphs.
- Design high-frequency multistage amplifiers, including the case where the amplifiers require impedance matching networks.

Course Outcome:

CO1: Understand and identify the fundamental concepts and various components of analog communication systems.

CO2: Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.

CO3: Describe analog pulse modulation techniques and digital modulation technique.

CO4: Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

Syllabus:

UNIT-I (2 hours)
Introduction: Overview of wireless communication system, Signal, spectrum and modulation, Features of this course.

UNIT-II (10 hours)

Multirate Digital Signal Processing: Decimation by a factor D, Interpolation by a factor I, Sampling rate conversion by a Rational Factor I/D. Implementation of sampling Rate Conversion, Multistage implementation of sampling rate conversion, Sampling rate conversion by an Arbitrary Factor, Applications of Multirate Signal Processing, Digital Filter Banks, Two-Channel Quadrature Mirror Filter Bank, M-channel QMF Bank.

UNIT-III (10 hours)

Linear Prediction and Optimum Linear Filters: Random Signals, Correlation Functions, and Power spectra, innovations representation of a stationary random process, Forward and backward Linear Prediction, Levinson – Durdin algorithm, properties of the Linear Prediction-Error Filters, Wiener Filters for filters for filtering and prediction.

UNIT-IV (10 hours)

Adaptive Filters: Applications of Adaptive filters, Adaptive Direct-Form FIR Filters- The LMS algorithm, Adaptive Direct Form Filters- RLS algorithm

UNIT-V (10 hours)


Text Books:

References books:


BIOMEDICAL ELECTRONICS(WET-309)

L: T: P: 3: 0: 0

Credits-3

Course Objectives:

- To study the working of different medical equipment’s.
- To understand the applications and able to measure different physiological parameters of human body.

Course Outcome:

CO1: To understand the electronic devices and theory of operation in the medical area.

CO2: To apply the knowledge of engineering and science to understand biomedical electronic circuits.

CO3: To understand the advanced technologies of healthcare treatment.

CO4: To study various ECG compression techniques.

Syllabus:

Unit I (8 hours)

Unit II (8 hours)
Biomedical equipments & measurements: Bioelectrodes and biopotential amplifiers for ECG, EMG, EEG, etc. Measurement of blood temperature, pressure and flow. Impedance plethysmography. Ultrasonic and nuclear imaging. Prostheses and aids: pacemakers, defibrillators, heart-lung machine, artificial kidney, aids for the handicapped. Safety aspects.

Unit III          (8 hours)
Telemetry: Transmission of the original through wire & wireless. Imaging techniques – Ultrasound, CAT, X-Rays, PET, NMR, Nuclear. Physiological effect of electric current, safety.

Unit IV          (8 hours)
Cardiological Signal Processing: Basic Electrocardiography, ECG data acquisition, ECG lead system, ECG parameters & their estimation, the use of multi scale analysis for parameters estimation of ECG waveforms, Arrhythmia analysis, monitoring, long form continuous ECG recording.

Unit V           (8 hours)
ECG data compression: reduction technique, Direct data compression techniques, Direct ECG data compression techniques. Transformation compression techniques. Other data compression techniques. Data compression techniques, comparison.

BOOKS

- Medical Instrumentation: Application and Design, 3ed-, Webster, Wiley
- Biomedical Signal Processing, D Reddy, TMH
- Electronics in Medicine and Biomedical Instrumentation, Phi
- Biomedical Signal Processing, D.Reddy,TMH
- Medical Instrumentation Application And Design,John G.Webster,Oxford
- Advanced Methods Of Biomedical Signal Processing,SergioCerutti,Oxford
ANTENNA THEORY AND TECHNIQUES (WET-310)

L: T: P: 3: 0: 0 Credits-3

Course Objectives:

- To provide comprehensive knowledge of different design and performance parameters of antenna.

- To provide the overall idea about various existing antennas and different advance antennas presently in practice.

- To provide principle of operation, analysis and application of different antennas such as micro-strip antenna, smart antenna, etc.

Course Outcomes:

CO1: It provides career path to get into different antenna manufacturing industry such as Linx technology, Wavelin Inc. etc.

CO2: It provides an active participation in the electronics industry where antennas are essential equipment such as Samsung, Apple etc.
CO3: It provides an opportunity to serve as a faculty in RF & Microwave Engineering.

Unit I

**Fundamental Concepts:** Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

Radiation from Wires and Loops: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

Unit II

Biconical antenna, discone& conical skirt monopole, equiangular spiral antenna, fractal antenna concept & technology, corrugated horn antenna, multimode horn antenna, smart antenna- benefit, drawbacks & design, adaptive beamforming, MANET, array theory, Electrically small & big antenna

Unit III

Artificial dielectric lens antenna, Luneburg & Einstein lenses, electrically & physically small antenna, ground plane antenna, sleeve antenna, turnstile antenna, submerged antenna, surface wave & leaky wave antenna, weather-vane antenna, flagpote antenna, chimney antenna, ILS antenna, sugar-scoop antenna, asteroid detection antenna, embedded antenna, plasma antenna

Unit IV

Microstrip and other planar antennas, Various types of feeding methods for microstrip antenna (Co-axial, Inset, Aperture/Slot Coupled, Proximity coupled and Corporate feeding for Arrays); Analysis of rectangular Patch Antenna, Cavity/ Modal Expansion Technique, microstrip antenna array

Unit V

Conventional Scanning Techniques, Feed Networks for phased Arrays, Frequency Scanned Array Design, Search Patterns
Text Books:


Course Objectives:

- Learn the elements of current media formats
- Learn the building blocks of compression systems and select processing modules to enable efficient compression.

Course Outcomes:

CO1: Students will be able to understand various transforms used in digital image processing.
CO2: Students will be able to understand image enhancement techniques and its applications.
CO3: Students will have knowledge of image restoration and its applications.
CO4: Students will be able to understand image segmentation and compression and their practical uses.
CO5: Students will be capable of solving engineering problems related to digital image processing.

Syllabus:

UNIT 1: 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.

UNIT 2: 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).

UNIT 3: 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.

UNIT 4: Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, full colour processing. 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.
UNIT 5: 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.

Text Books:

Reference Books:
Course Objectives:

- To provide knowledge of semiconductors and solid mechanics to fabricate MEMS devices.
- To educate on the rudiments of Micro fabrication techniques.
- To introduce various sensors and actuators
- To introduce different materials used for MEMS
- To educate on the applications of MEMS to disciplines beyond Electrical and Mechanical engineering.

Course Outcomes:

CO1: Ability to understand the operation of micro devices, micro systems and their applications.

CO2: Ability to design the micro devices, micro systems using the MEMS fabrication process.

Syllabus:

UNIT 1 INTRODUCTION (8 hours)


UNIT 2 SENSORS AND ACTUATORS-I (8 hours)


UNIT 3 SENSORS AND ACTUATORS-II (8 hours)


UNIT 4MICROMACHINING (8 hours)

UNIT 5 POLYMER AND OPTICAL MEMS (8 hours)

Polymers in MEMS– Polimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene – Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.

Text Books:


References books:

DETECTION AND ESTIMATION THEORY (WET-321)

Course Objectives:

- To provide knowledge about various estimation techniques like parametric and non-parametric estimation techniques.
- To provide knowledge for finding good estimators.
- To provide enough knowledge for detection of signal in noise and estimate the signals in the presence of noise.

Course Outcomes:

CO1: The students will be able to apply various methods of signal estimation knowing the significance of each method.
CO2: The students will be able to decide which is a good estimator for the given specifications.
CO3: By applying suitable criterion, the students will be able to detect the signals with minimum errors in the presence of noise.

Syllabus:

Unit 1 (8 hours)
Binary hypothesis testing; Bayes, minimax and Neyman-Pearson tests. Composite hypothesis testing.

Unit 2 (8 hours)

Unit 3 (8 hours)

Unit 4 (8 hours)

**Unit 5**  
*(8 hours)*

Signal detection in continuous time: Detection of deterministic signals in Gaussian noise. Coherent detection in White Gaussian noise

**Text Books:**


**References books:**

OPTIMIZATION TECHNIQUES (WET-322)

Course Objectives:

- Analyze the advantages and disadvantages associated with the large-scale optimization techniques when applied to problems from Electrical and Computer Engineering (ECE) applications.
- Implement selected optimization algorithms commonly used in machine learning and other areas of ECE.
- Design and implement appropriate optimization approaches for specific ECE applications.

Course Outcome:

CO1: Formulate and solve linear programming problems.

CO2: Solve the problems on networks models such as Transportation, Assignment, Shortest path, minimal spanning tree, and Maximal flow.

CO3: Solve the problems of Project Management using CPM and PERT.

CO4: Solve Non-linear Programming problems of some kinds.

CO5: Implement the Linear programming techniques using C or any other optimization software.

Syllabus:

UNIT 1 Introduction:
Historical development, application to engineering problems, statement of optimization, classification of optimization, examples of optimization problems.

UNIT 2 Linear Programming:
Graphical method, simplex method, revised simplex method, Big-M method, 2-phase method, alternate optimal solutions, unbounded LPs, degeneracy and convergence, duality in linear programming, sensitivity analysis, dual simplex method, Transportation, assignment and other applications.

UNIT 3 Non-Linear Programming:
Unconstrained optimization techniques, direct search methods (Fibonacci method, golden section, quadrature and cubic interpolation) descent methods, constrained optimization, direct and indirect methods, optimization with calculus, kuhn-tucker conditions.

UNIT 4 Dynamic Programming:
Forward recursions, General problem, Reliability problem, Capital budgeting problem, Cargo-
loading problem, Multistage decision process, principles of optimality, computational procedures in dynamic programming.

UNIT 5 CPM and PERT:
Drawing of networks, Removal of redundancy, Network computations, Free slack, Total slack, Crashing, Resource allocation.
Software: Introduction to software for optimization techniques (TORA).

Text Books:


Reference Books:

Course Objectives:

- This subject aims at introducing to the students the knowledge about the telecommunication industry.
- Its services and market, the theoretical basis about performance (queuing theory) and operation (multiplexing, switching, routing, and signaling) in telecom networks.

Course Outcome:

CO1: Describe and apply fundamentals of telecommunication systems and associated technologies.

CO2: Apply the principles of queuing theory in evaluating the performance of congested telecommunication networks.

CO3: Solve problems and design simple systems related to tele-traffic and trunking efficiency.

CO4: Understand and explain the reasons for switching, and the relative merits of the possible switching modes, e.g. packet and circuit switching.

CO5: Understand the principles of the internal design and operation of telecommunication switches, and the essence of the key signaling systems that are used in telecommunication networks.

Syllabus:

Unit I: (8 Hours)

Introduction
Introduction to telephone communication, manual switching system, Automatic strowger switching system, crossbar switching system, Signaling in Automatic Strowger Switching System, Elements of a Switching System, Design parameters of Switching System.

Unit II: (8 Hours)

Elements of Tele-Traffic
Network traffic Load and parameters, grade of service, Trunking Efficiency and blocking probability, modeling switching systems, incoming traffic and service time characterization, blocking models and loss estimates, delay systems.

Unit III: (8 Hours)
Switching: Electronic space division switching: Stored program control; centralized and distributed, software architecture, application software, enhanced services, single and multistage networks.
Time division switching: Basic time division space switching, basic time division time switching, time multiplexed space switching, time multiplexed space switching, combination switching, multistage combination switching

Unit IV: (8 Hours)

Telephone Networks: Analog termination requirements, BORSCHT configuration, digital termination requirements, signaling tones, touch tone dial generation, design consideration, touch tone detection, switching hierarchy and routing, transmission plan, numbering plan- CCITT No. 7 Signaling systems.

Unit V: (8 Hours)

Data Networks: Data transmission in PSTN’s switching, techniques for data transmission, data communication architecture, link to link layers, end to end layers, PABX, data network standards, Metropolitan Area Network (MAN), Satellite based data networks, fibre optic networks.
Network Hierarchy: Network hierarchy in the telephone network, Network hierarchy in other networks;
Network Intelligence.

BOOKS

1. ThiagarajanVishwanathan/ Telecommunication Switching Systems and Networks/PHI
6. Anders Hellman & Gudrun Bager/ Understanding Telecommunication 1/Printed in Sweden, Student literature, Lund Ericsson Telecom AB, Competence Development centre
Course Objectives:
- To introduce some practical aspects of signal processing, and in particular adaptive systems
- To introduce current applications for adaptive systems are in the fields of communications, radar, sonar, seismology, navigation systems and biomedical engineering
- This course will present the basic principles of adaptation, will cover various adaptive signal processing algorithms (e.g., the LMS algorithm) and many applications, such as adaptive noise cancellation, interference canceling, system identification, etc.

Course Outcomes:

CO1: The student will be able to explain the importance of signal processing in non-stationary environment.

CO2: List and apply the various mathematical models to adaptive signal processing

CO3: Understand the problem of finding the minimum error criteria.

CO4: A good understanding of techniques like Kalman Filtering and Recursive Least-Squares techniques will be useful to extend them to machine learning paradigms

Syllabus:

UNIT 1 (8 hours)

UNIT 2 (8 hours)

UNIT 3 (8 hours)
Least-Mean-Square (LMS) adaptive filters – LMS algorithm, LMS adaptation algorithm – applications. Method of Least Squares – Data windowing, Normal equations and linear least square filters, Recursive least squares algorithm. (8 hours)

UNIT 4 (8 hours)

UNIT 5 (8 hours)
Applications of adaptive signal processing - adaptive modeling and system identification inverse adaptive modeling, deconvolution and equalization adaptive control systems adaptive interference canceling canceling noise, canceling periodic interference, canceling interference in ECG signals

Text Books:


References books:

CLOUD COMPUTING (DET 323)

L: T: P: 3: 0: 0

Course Objectives:

• To understand the concept of cloud computing.
• To appreciate the evolution of cloud from the existing technologies.
• To have knowledge on the various issues in cloud computing.
• To be familiar with the lead players in cloud.
• To appreciate the emergence of cloud as the next generation computing paradigm.

Course Outcomes:

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.

CO2: Learn the key and enabling technologies that help in the development of cloud.

CO3: Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

CO4: Be able to install and use current cloud technologies.

CO5: Evaluate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

Syllabus:

UNIT 1 (8 hours)


UNIT 2 (8 hours)

UNIT 3 (8 hours)


UNIT 4 (8 hours)


UNIT 5 (8 hours)


Text Books:


References books:


ARTIFICIAL INTELLIGENCE (DET-326)

L: T: P: 3: 0: 0 Credits-3

Course Objectives:

• To learn the difference between optimal reasoning Vs human like reasoning
• To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
• To learn different knowledge representation techniques
• To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing

Course Outcomes:

CO1: Articulate the main concepts, key technologies, strengths and limitations of Artificial Intelligence

CO2: Learn the key and enabling technologies that help in the development of Artificial Intelligence.

CO3: Develop the ability to understand the forms of learning.

CO4: Be able to implement NLP.

CO5: Analyze and apply the AI tools.

Syllabus:

UNIT 1 (8 hours)


UNIT 2 (8 hours)
Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining

UNIT 3 (8 hours)
Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, why learning works, Learning in Neural and Belief networks

UNIT 4 (8 hours) Practical Natural Language Processing: Practical applications, Efficient parsing, Scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis


Text Books:

References books:
1. Artificial Neural Networks B. Yagna Narayana, PHI
3. Artificial Intelligence and Expert Systems – Patterson PHI.
6. Neural Networks Simon Haykin PHI
Technical Writing and Presentation Skills (AHT-303)

L:T:P::2:0:0 Non-credits

Course Objectives:
- To develop effective writing and presentation skills in students.
- To develop textual, linguistic and presentation competencies instudents appropriate for their professional careers.

Course Outcomes:
After the successful completion of course, the students will be able to:
CO1: Write clearly and fluently to produce effective technical documents.
CO2: Demonstrate an appropriate communication style to different types of audiences both orally and written as per demand of their professional careers.
CO3: Communicate in an ethically responsible manner.

Course Contents:

WRITING SKILLS

Unit-I (4 hours)
Technical Writing-Basic Principles: Words-Phrases-Sentences, Construction of Cohesive Paragraphs, Elements of Style.

Unit-II (4 hours)
Principles of Summarizing: Abstract, Summary, Synopsis

Unit-III (6 hours)
Technical Reports: Salient Features, Types of Reports, Structure of Reports, Data Collection, Use of Graphic Aids, Drafting and Writing

PRESENTATION SKILLS

Unit-IV (6 hours)

Unit-V (8 hours)

References: