(IV YEAR B.E.) SEMESTER 'A'
EC 45009 : WIRELESS AND MOBILE NETWORKS

COURSE OUTCOMES:

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

1. Understand basic technologies implied in 3G and 4G mobile networks.
2. Learn device to device and millimeter wave communication in 5G networks.
3. Develop the basic concepts of wireless sensor network and its protocols
4. Describe the routing mechanism inside wireless sensor networks.
5. Classify the technology and standards of Mobile IP, Bluetooth, ZigBee and RFID.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit 1: 3G & 4G Mobile Networks

Third Generation mobile Technology 3G –UMTS, UTRAN- Architecture, WCDMA, HSDPA, Spreading and De-Spreading, Scrambling, User Equipment (UE), CS and PS Domain Protocol Architectures, SGSN and GGSN in UMTS, 4G- LTE and LTE-Advance.

Unit 2: Emerging Mobile Networks

Millimeter-wave Communications (5G) – Introduction to MIMO, Beam-forming, physical layer techniques, Interference and mobility management, Massive MIMO - propagation channel models, Channel Estimation, Imperfect CSI. Pilot Contamination, Spatial Modulation (SM), Device to Device (D2D) Communication.

Unit 3: Wireless Sensor Networks: Basic and MAC Protocols

Wireless sensor Network- Architecture, Applications, Technology for sensor nodes & networks, operating environment, Medium Access Control Protocols - Low duty cycle protocols and wakeup concepts -Contention-based and contention-free protocols, Schedule-based hybrid protocols.

Unit 4 Wireless Sensor Networks: Routing Protocols

Routing And Data Gathering Protocols. Routing Challenges and Design Issues in Wireless Sensor Networks. Data centric Routing, Energy aware routing, Gradient-based routing, Rumor Routing, Hierarchical Routing, Location Based Routing.

Unit 5: Short Range wireless networks

Mobile IP, Bluetooth- Protocol stack, RFID and ZigBee technologies and their practical usage. IEEE 802.11 standards and its variants. 6LoWPAN, LoRa.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam

TEXT BOOKS RECOMMENDED:

1. Sumith Kaseara, Nishit Narang, "3G Networks Architecture, Protocols", Tata McGraw Hill
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, "Fundamentals of 5G Mobile Networks" , Cambridge University Press
3. Feng Zhao and Leonidas Guibas – *Wireless Sensor Networks, An information processing approach* - Morgan Kaufmann publication
4. Kaveh Pahlavan, Prashant Krishnamoorthy – *Principle of wireless networks- A united approach*- Pearson Education, 2002.

REFERENCE BOOKS RECOMMENDED:

1. Kazem Sohraby, Daniel Minoli and Taieb Znati- *Wireless Sensor Networks: Technology, Protocols and Applications* -Wiley publication
2. Martin Sauter "From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband", Wiley-Blackwell.
3. Vijay K. Garg – *Wireless communication and networking* – Morgan-Kaufmann series in networking- Elsevier publication

PEC-3

EC 45207 : MICROWAVE DEVICES & CIRCUITS

COURSE OUTCOME:-

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

1. Understanding the scattering parameters and corresponding instruments.
2. Identify various types of Microwave electronic components and systems.
3. Study of different modes of operation of various RF and Microwave devices and circuits.
4. Design and analysis of dielectric resonator circuits and systems.
5. Solving complex RF amplifiers parameters; Microwave communication network design problems.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Features and applications of microwaves, Wave propagation in striplines and microstrip lines, and Slot lines, Limitations of conventional vacuum tubes, Microwave tubes like Two cavity klystron and Reflex klystron, Magnetron, TWT, Backward wave oscillator etc.

Unit 2. Solid state microwave sources, transferred electron devices, Tunnel diode Gunn diode and oscillators, IMPATT diode, TRAPATT diode, Pin diode, Varactor diode, Schottky diode, Parametric amplifiers, Crystal diode, Frequency multipliers, Microwave BJT & FET.

Unit 3. Scattering matrix, S-parameters & its applications in Network analysis, Matching Network, Detector diodes, detector mounts, detector output indicator, slotted line, measurement of power, impedance & S-parameter, measurement of frequency & VSWR.

Unit 4. Impedance transformer, Microwave filters, Power dividers and Diodirectional couplers, E-plane Tee, H-plane tee, Matched hybrid Tee.Tensor permeability, Wave propagation in ferrite medium, Isolators, Circulators, YIG resonators, Simulation Techniques for design of Microwave Components and devices.

Unit 5. Analysis and design of Dielectric resonators; Design of RF and microwave low noise and power amplifiers & oscillators using S- parameter techniques, Mixer and converter design, diode phase shifters, attenuators, Design of hybrid and monolithic, microwave and millimeter wave integrated circuits.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

.LIST OF EXPERIMENTS

1. To determine the characteristics and electronic tuning range of Klystron tube amplifier.
2. To determine the frequency & wavelength in a rectangular waveguide working on TE10 mode E.M. propagation .
3. To determine the Standing Wave Ratio and Reflection Coefficient in a Rectangular waveguide system with different loads .
4. To determine an unknown Impedance in a slotted line section using Smith chart.
5. To measure V-I characteristics of Gunn Diode at microwave frequencies .

6. To measure the following parameters in a multi-hole directional coupler
7. Main-line and auxiliary-line VSWR.
8. The coupling factor and directivity.
9. To determine the S-Matrix of Magic Tee.
10. To determine the characteristics of Isolator and Circulators at different microwave frequencies.
11. Design study of microwave amplifier using microwave office (Virtual experiment)
12. To design microwave filter sing electromagnetic software (Virtual experiment)

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:

1. Liao S., Microwave Devices & Circuits''., 2nd ed. 2001,PHI.
2. Gupta K.C., Microwave Engg., 3rd ed.2004,Wiley Easter Pub.
3. Watson, Solid State Microwave Devices, 5th ed.2008,Wiley.
4. David M. Pozar, Microwave Engineering, 3rd edition, 2011 Willey India.

REFERENCE BOOKS RECOMMENDED:

1. Gandhi, Microwave Engineering & Application, 2nd ed.2005,McMillan Int. Ed.
2. Reich, Microwave Principles, 5th ed.2009,CBS Publ.
3. Collin, Foundations for microwave engineering, 4th ed. 2001,Wiley Publ.

PEC 3

EC …….: ADVANCED ANTENNA DESIGN

Prerequisite: - Physics, Electromagnetic fields and Waves, Transmission lines, Antenna and wave propagation

Course Outcome:-

Students should be able to:

1. **Learn approach for mathematical modeling of electromagnetic antenna problems**
2. **Basic concepts of design of antennas**
3. **Concepts of antenna Design and fabrication**
4. **Application of High frequency and numerical techniques in Antenna Design**
5. **Learn Practical design of various antennas and measurement**

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

Theory:

Unit 1: **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

Unit 2: **Radiation from Wires and Loops**: Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop. **Aperture Antennas**: Huygens' Principle, radiation from rectangular and circular apertures, design considerations, Babinet's principle, Radiation from sectoral and pyramidal horns, lens and reflector antennas, design concepts, dielectric resonator antenna (DRA)

Unit 3: **Broadband Antennas**: Broadband concept, Log-periodic antennas, frequency independent antennas. Helical and Spiral antennas**. Microstrip Antennas**: Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

Unit 4: **Antenna Arrays**: Analysis of uniformly spaced arrays with uniform and non-uniform excitation amplitudes, extension to planar arrays. **Smart Antennas**: Concept and benefits of smart antennas, Fixed weight beam forming basics, Adaptive beamforming, beam steering, nulling and direction finding. Frequency selective surfaces (FSS), Metamaterial antennas, Defected ground structure (DGS) antenna

Unit 5: **High Frequency techniques** for scattering i.e. GTD, UTD, UAT, PTD etc. **Computational Numerical techniques** i.e. Method of moment (MOM), Finite difference time domain (FDTD), Finite element method (FEM).

Text Books Recommended:

1. C.A.Balanis,"Antenna Theory and Design", 3 rd Ed., John Wiley & Sons., 2005.
2. Antenna Theory and Design : Warren L. Stutsman Gary A. Thiele , Wiley Publication.
3. Mathew N.O. Sadiku, Numerical Techniques in Electromagnetic, II edition, CRC press.
4. Ramesh Garg, Computational methods in Electromagnetic, CRC press.
5. Roger F. Harrington, Field computation by Moment Methods, Oxford university press.

Reference Books Recommended:

1. Collin R.E., Antennas & Wave Propagation, 3rd ed., 2001, McGraw Hill.
2. Roger F. Harrington, Introduction to Electromagnetic Engineering. Dover Publication.
3. R.S.Elliot,"Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

List of Experiments

S.N.	Experiments
1	Study and Design of High gain Horn Antenna through simulator
2	Design and check the various performance parameters of 2 by 2 patch antenna Array
3	Estimate the radiation pattern of E plane and H plane Horn antenna through antenna trainer kit
4	Develop the MATLAB programme for estimate various parameters of antenna like directivity, radiation pattern etc.
5	Estimate the radiation pattern of Helical antenna through antenna trainer kit
6	Estimate the performance parameter of High gain antennas through VNA
7	Estimate the various performance parameter like gain, polarization, efficiency etc. of High gain antennas i.e. horn, helical etc. through Anechoic chamber
Project	
8	To design, develop, fabricate, test & measure the suitable high gain antennas in RF and Microwave laboratory for parameters like polarization, efficiency, gain, directivity , and E, H plane 2-d and 3-d radiation pattern.

EC45208: OPTICAL COMMUNICATIONS

COURSE OUTCOMES:

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

1. Understand Optical Fiber Communication System and its parameters.
2. Analyze transmission characteristics of optical fiber and their effects.
3. Understand the construction and operation of various optical sources and detectors.
4. Design and study performance analysis of optical receivers.
5. Brief introduction of optical fiber networks and amplifiers.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	2	70	30	40	60	200	3	1	4

THEORY:

Unit 1. Overview of optical fiber communications system: elements of an optical fibre transmission link, Wave propagation in optical fiber, analysis of optical waveguide using ray theory, wave model, Optical fibers : Structure & wave guiding fundamentals, basic optical laws, optical fibre modes & configuration mode, different types of optical fibers, Physical and electrical characteristics of fiber.

Unit 2. Signal degradation in Optical Fiber due to dispersion and attenuation: signal distortion in optical wave guides, pulse broadening in graded index and step index wave guides, mode coupling, Fabrication of fibers, overview of fibre materials and measurement techniques like OTDR.

Unit 3. Optical sources and detectors: LEDs, LASER diodes, basic principle, various structures-semiconductor lasers, distributed feedback lasers Photo-detectors - pin-diodes, APDs, Physical principles of photo diodes, photo detector noise-NEP, detector response time, Avalanche multiplication noise, photo diode materials.

Unit 4. Optical receivers Direct detection and coherent receivers, noise in detection process, System design, power budgeting, rise time budgeting; fibre to fibre joints, and splicing techniques, Optical fibre connectors, Introduction to optical amplifiers (EDFA, SOA), optical switches

Unit 5. Optical networks: Basic networks- SONET/ SDH, WDM network : Broadcast – and –select Networks, wavelength routed networks, DWDM, Passive Optical Access Networks, Introduction to elastic optical network and LiFi.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

PRACTICALS:

List of Experiments

1. To familiarize with the optical communication kit and its specifications and interfaces.
2. To establish data link communication employing intensity modulation and demodulation.

3. To generate frequency and pulse width modulation and demodulation in optical communication.
4. To measure various losses in optical communication
5. To measure the effect of bending on attenuation in optical fiber.
6. To measure the optical parameters.
7. To characterize LED as optical source.
8. To characterize Laser Diode.
9. To establish PC to PC communication using RS232 interface via optical fiber link.
10. Preparation of fiber optic cable termination.

ASSESMENT:

Internal viva, Continuous evaluation of experiments, Journal write-up, and Additional experiments conducted, Quiz, End semester exam.

TEXT BOOKS RECOMMENDED:-

1. Senior J.M., Optical Fibre Communications: Principles & Practice, 2nd ed. 2001, PHI.
2. Agrawal Govind P., Fibre Optic Communication Systems, 5th ed. 2001, John Wiley & Sons, students ed.
3. Black Uyless, Optical Networks and 3rd Genration Transport Systems, 3rd ed. 1998, Pearson.

REFERENCE BOOKS RECOMMENDED:-

1. Keiser G, Optical Fibre Communication, 5th ed. 2006, McGraw Hill.
2. Mynbanv and Scheiner, Fibre Optic Communication Technology, 2n^{d} ed 2010, Pearson Edu.
3. Djfar K Mynbaev & Scheiner, Fibre Optic Communication Technology, 5th ed. 2005, Pearson

CO 45251: DATA SCIENCE

PRE-REQUISITE: NIL

COURSE OUTCOMES: After Completing the course student should be able to:

1. Comprehend the IT-interestingness of data and understand the attributes of data. 2. Preprocess the given data and visualize it for a given application or data exploration/ mining task.

3. Apply techniques of supervised and unsupervised machine learning for various data applications.

4. Implement web search methods by page ranking and can implement models of information retrieval by applying different techniques of text mining.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

COURSE CONTENTS: THEORY:

UNIT 1. Understanding Data: Data Wrangling and Exploratory Analysis, Data Transformation & Cleaning, Feature Extraction, Data Visualization. Introduction to contemporary tools and programming languages like R, Python etc. for data analysis.

UNIT 2. Statistical & Probabilistic analysis of Data: Multiple hypothesis testing, Parameter Estimation methods, Confidence intervals, Bayesian statistics and Data Distributions.

UNIT 3. Introduction to machine learning: Supervised & unsupervised learning: Classification & Clustering Algorithms like Decision Tree based classification and KMeans clustering, Dimensionality reduction: PCA & SVD, Correlation & Regression analysis, Training & Testing data: Overfitting & Under fitting.

UNIT 4. Introduction to Information Retrieval: Boolean Model, Vector model, Probabilistic Model , Text based search: Tokenization , Tf-IDF, stop words and ngrams , synonyms and parts of speech tagging

UNIT 5. Introduction to Web Search & Big Data: Crawling and Indexes, Search Engine architectures, Link Analysis and ranking algorithms such as HITS and Page Rank Hadoop File system & Map Reduce Paradigm.

TEXT BOOKS RECOMMENDED:

1. Field Cady, “The Data Science Handbook” , 1/e , 2018, Publisher: Wiley

2. Sinan Ozdemir, “Principles of Data Science “, 1/e, 2016, Packt Publishing Limited

REFERENCE BOOKS:

1. Peter Bruce, “Practical Statistics for Data Scientists: 50 Essential Concepts”, Shroff/O'Reilly; First edition (2017)

2. Pang-Ning Tan, “Introduction to Data Mining”, Pearson Edu., 2007

3. Ricardo Baeza-Yates and Berthier Ribeiro-Neto, “Modern Information Retrieval”, Pearson Education, 2004

THEORY ASSESSMENT:

1. Internal Assessment for continuous evaluation, mid-term tests, Tutorials, Quizzes, Class Performance, etc. (30%)

2. End semester Theory Exam (70%)

EC 45301: INTERNET OF THINGS (IoT)

COURSE OUTCOMES:

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

1. Understand IoT architecture and IoT decision framework.
2. Configure Raspberry Pi, understand sensors, actuators & get started with Python on Raspberry Pi.
3. Understand various IoT networking protocols used to develop communication solutions.
4. Able to design architecture for an end-to-end solution and perform data analytics.
5. Understand IoT challenges, business solutions, research scope and current development.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1:

Introduction: Definition, Characteristics of IoT, IoT Conceptual framework, IoT Architectural view, Physical design of IoT, Logical design of IoT, Application of IoT.

(Power constraints for IOT implementation.)

UNIT 2:

Machine-to-machine (M2M), SDN (software defined networking) and NFV (network function virtualization) for IoT, data storage in IoT, IoT Cloud Based Services.

(Fog ecosystem for IOT)

UNIT 3:

Design Principles for Web Connectivity: Web Communication Protocols for connected devices, Message Communication Protocols for connected devices, SOAP, REST, HTTP Restful and Web Sockets. Internet Connectivity Principles: Internet Connectivity, Internet based communication, IP addressing in IoT, Media Access control.

UNIT 4:

Sensor Technology, Participatory Sensing, Industrial IoT and Automotive IoT, Actuator, Sensor data Communication Protocols, Radio Frequency Identification Technology, Wireless Sensor Network Technology.

UNIT 5:

IoT Design methodology: Specification -Requirement, process, model, service, functional & Operational view.IoT Privacy and security solutions, Raspberry Pi & arduino devices. IoT Case studies: smart city streetlights control & monitoring.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. V. Madisetti and A. Bahga, "Internet of things (A-Hand-on-Approach)", Universal Press.
2. Rajkamal, "Internet of Things", Tata McGraw Hill publication.
3. A. Pajankar and A. Kakkar, "Raspberry Pi by Example", Packet Publishing Ltd, Birmingham, UK.

REFERENCE BOOKS RECOMMENDED:

1. F. Dacosta "Rethinking the Internet of things: A Scalable Approach to Connecting Everything", Apress publications.
2. D. Norris, "The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black", McGraw-Hill Education, New Delhi.
3. P. Raj and A.C. Raman, "The Internet of Things", CRC Press (T&F Group), New York

EI 45252: VLSI TECHNOLOGY

COURSE OUTCOMES:

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

1: To describe crystal growth and wafer preparation methods.

2: To discuss layering in terms of chip fabrication.

3: Illustration of various patterning methods.

4: Gain knowledge about layout design rules, stick diagrams etc.

5: Illustration of subsystem design and memories.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

THEORY:

Unit 1. Crystal Growth and wafer preparation: Wafer terminology, different crystalline orientations, CZ method, CMOS IC Design flow, Crystal Defects, Fabrication process of FETs, MOSFETs, and BIMOS etc.

Unit 2. Layering: Epitaxial growth methods, oxidation, Kinetics of oxidation, thin film fabrication, Metallization, Physical Vapor Deposition and Sputtering.

Unit 3. Patterning: Lithography, Optical Lithography, Electron Lithography, X- Ray Lithography, Ion Lithography. Photo masking steps, Resists. Doping: Diffusion; Diffusion models, Ion Implantation; Implantation Equipment, Channeling.

Unit 4. VLSI process techniques and Integration: Floor planning, layout, Design rules, stick diagrams, Test generation, Logic Simulation, Introduction to EDA tools. Contamination control: Clean rooms, HEPA, ULPA Filters and Class numbers.

Unit 5. Subsystem Design: Data-paths; adder, Shift resisters, ALU, Memory; NVRWM, Flash memories, 6-Transistor RAMs. Latch up in CMOS circuits.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. S.K. Gandhi, VLSI Fabrication Principles, Wiley.
2. S.M. Sze, VLSI Technology, II edition, McGraw Hill.
3. P. Van Zandt, Microchip Fabrication, A practical Guide to Semiconductor Processing, Third edition, McGraw Hill.

REFERENCE BOOKS RECOMMENDED:

1. James D Plummer, Silicon VLSI Technology Fundamentals Practice & Modeling Pearson Education Limited
2. Singh R.K., VLSI Technology Design & Basics of Microelectronics, S. Kataria & Sons

2. D. Norris, “The Internet of Things: Do-It-Yourself Projects with Arduino, Raspberry Pi, and BeagleBone Black”, McGraw-Hill Education, New Delhi.
3. P. Raj and A.C. Raman, “The Internet of Things”, CRC Press (T&F Group), New York.

EC 45302: ADVANCED DIGITAL SIGNAL PROCESSING

COURSE OUTCOMES:

At the end of the course, the student should be able to:

1. Analyze and apply the concepts of random processes in practical applications
2. Analyze and apply linear estimation and prediction techniques for a given random process
3. Analyze, mathematically model, modify and enhance speech and music signals.
4. Analyze and apply appropriate adaptive algorithm for processing non-stationary signals
5. Analyze and apply wavelet transforms for signal and image processing based applications

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

UNIT 1 : Discrete-Time Random Signals
Discrete random process – Ensemble averages, Stationary and ergodic processes, Autocorrelation and Autocovariance properties and matrices, Response of LTI systems to random processes Power Spectral Density, Some useful random process models.

UNIT 2: Linear Estimation and Prediction
Estimation of mean, variance and covariance, Estimation theory, Spectrum estimation, Optimum Linear filters, Optimal FIR (Wiener) filter, Extraction of signal from noise, Forward and Backward Linear prediction and all-pole signal modeling.

UNIT 3: Speech and Audio Processing
Audio Signal Characteristics, Production model, Hearing and Auditory model, Acoustic characteristic of speech, Speech production models, Linear Separable equivalent circuit model, Vocal Tract and Vocal Cord Model. Audio signal acquisition, Representation and Modeling, Enhancement of audio signals: Spectral Subtraction, Weiner based filtering, Neural nets.

UNIT 4: Adaptive Filtering:
Concept of adaptive filtering, Method of Steepest descent, LMS adaptive filters: Structure and operation of LMS algorithm, Statistical LMS theory, Other LMS based algorithms, RLS algorithm.

UNIT 5: Introduction to Wavelets:
Piecewise constant approximation - the Haar wavelet, Building up the concept of dyadic Multiresolution Analysis (MRA), Relating dyadic MRA to filter banks, review of discrete signal processing, Elements of multirate systems and two-band filter bank design for dyadic wavelets, The Uncertainty Principle and its implications: the problem and the challenge that Nature imposes, The importance of the Gaussian function.
ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. Simon Haykin, Adaptive Filter Theory, Fourth Edition, Pearson Education India, 2002.
2. Vikram Gadre and Aditya Abhyankar, Multiresolution and Multirate Signal Processing: Introduction, Principles and Applications, McGraw Hill Education; First edition, July 2017.
3. Sen, Soumya, Dutta, Anjan, Dey, Nilanjan, Audio Processing and Speech Recognition,1st edition, 2019, Springer.
4. D.G.Manolakis and V.K.Ingle Applied Digital Signal Processing: Theory and Practice,

Cambridge University Press, 2011.

REFERENCES BOOKS RECOMMENDED:

1. C.Widrow and S.D. Stearns, Adaptive signal processing, Prentice Hall, 1984.
2. S.K.Mitra, Digital Signal Processing: A computer based approach.TMH
3. Y.T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.
4. Gold, B.; Morgan, N.; Ellis, D. Speech and audio signal processing: processing and perception of speech and music. 2nd rev. ed. Wiley-Blackwell, 2011.

BM 45… : DIGITAL IMAGE PROCESSING

COURSE OUTCOMES:

1: Study of fundamentals of image processing and image perception.
2: Introduction to image enhancement spatial domain techniques.
3: Introduction to image restoration: noise degradation model.
4: Introduction to different image transforms.
5: Concepts of image analysis, feature extraction etc.

Hours / Week			Maximum Marks				Total Marks	Credits		
			Theory		Practical					
L	T	P	End Sem	CW	SW	End Sem		Th	Pr	Total
3	-	-	70	30	-	-	100	3	-	3

Unit. 1 Fundamentals of Image Processing and Image Perception

Two-dimensional systems - linear systems and shift invariance. Fourier transform - Z - transform - Block matrices, Toeplitz and Kronecker product. Luminance, brightness and contrast. Color representation, color matching and reproduction, color vision model. Image sampling and quantization. Two dimensional sampling theory, reconstructions of images from its samples. Image acquisition.

Unit. 2 Image Enhancement Spatial Domain Techniques

Image negative, contrast stretching, gray level and bit plane slicing, power law transformation, histogram equalization and histogram specification, local enhancement techniques, image subtraction, averaging and logical operations. Spatial filtering: low pass, high pass and derivative filters, median filtering. Frequency domain filters: low pass, high pass and butterworth filters.

Unit. 3 Image Restoration

Noise degradation model, estimation of degradation model. Restoration in presence of noise- spatial filtering, frequency domain filtering, inverse filter and least mean square error(wiener) filtering.

Unit. 4 Image Transforms

2-D FFT and its properties. Walsh transform, Hadamard Transform, Discrete cosine Transform, Haar transform, Slant transform, K L transform

Unit. 5 Image Analysis Feature extraction, spatial features, amplitude and histogram features, transform features, edge detection: gradient, Compass Laplace, Sobel, Prewitt operators, stochastic gradients. Line and spot detection. Boundary extraction: connectivity and contour following.

ASSESMENT: Mid-term test, Assignment, Tutorial, Quiz and End semester exam.

TEXT BOOKS RECOMMENDED:

1. Gonzalez Rafel C, Wintz Paul , *Digital Image Processing*, Addison Wesley, 1987.
2. Jain Anil K,*Fundamentals of Digital Image Processing* , Prentice Hall, 1996.
3. B. Chanda, D. Majumder,*Digital Image Processing and Analysis*, PHI, 2011.

REFERENCE BOOKS RECOMMENDED:

1. Pratt William K *, Digital Image Processing*, John Wiley and Sons, 2006