Bansilal Ramnath Agarwal Charitable Trust's

Vishwakarma Institute of Information Technology, Pune-48

(An Autonomous Institute affiliated to Savitribai Phule Pune University)

Syllabus for

F.Y. M.Tech. (E&TC)

(Pattern 2020)

w.e.f: A.Y. 2020-21

Department of Electronics & Telecommunication Engineering

VISION:

- Excellence in Electronics & Telecommunication Engineering Education

MISSION:

- Provide excellent blend of theory and practical knowledge. sustainable development of society
- Establish centre of excellence in post graduate studies and research.
- Prepare engineering professionals with highest ethical values and a sense of responsible citizenship.

First Year M. Tech. (FYMT)
(Electronics and Telecommunication Engineering) Semester I
(Pattern 2020)

Course Code	Course		Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW /OR		
ETPA11201	Image and Video Processing	TH	3	-	20	30	20	30	-	100	3
ETPA11202	Advanced Embedded Processors and Programming	TH	3	-	20	30	20	30	-	100	3
ETPA11203	Machine Learning	TH	3	-	20	30	20	30	-	100	3
ETPA11204	Program Elective I	TH	3	-	20	30	20	30	-	100	3
ETPA11205	Program Elective II	TH	3	-	20	30	20	30	-	100	3
IOEP11206	Open Elective I	CE	2	-	-	-	-	-	50	50	2
ETPA11207	Research Methodology	CE	2	-	-	-	-	-	50	50	2
ETPA11208	Laboratory I	CE-OR	-	4	-	-		-	50	50	2
AP1	Audit Course I	-	-	-	-	-		-	-	-	-
	Total		19	4	100	150	100	150	150	650	21

Course code	**Program Elective I**
ETPA11204A	Artificial Intelligence
ETPA11204B	Advanced Digital Signal Processing
ETPA11204C	Biomedical Signal Processing

Course code	**Program Elective II**
ETPA11205A	IOT and applications
ETPA11205B	Data Networks and Security
ETPA11205C	Joint Time Frequency Analysis

Course code	**Open Elective I**
IOEP11206A	Soft Computing Techniques
IOEP11206B	Ethical Hacking
IOEP11206C	Product Design Engineering

Audit Course I and II

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

BoS Chairman Dean Academics Director

First Year M. Tech. (FYMT)
(Electronics and Telecommunication Engineering) Semester II
(Pattern 2020)

Course Code	Course		Teaching Scheme		Examination Scheme					Total	Credits
			L	P	CIE	ISE	SCE	ESE	TW /OR		
ETPA12201	Digital Design and Verification	TH	3	-	20	30	20	30	-	100	3
ETPA12202	Wireless Sensor Networks	TH	3	-	20	30	20	30	-	100	3
ETPA12203	Deep Learning	TH	3	-	20	30	20	30	-	100	3
ETPA12204	Program Elective III	TH	3	-	20	30	20	30	-	100	3
ETPA12205	Program Elective IV	TH	3	-	20	30	20	30	-	100	3
IOEP12206	Open Elective II	CE	2	-	-	-	-	-	50	50	2
ETPA12207	Intellectual Property Rights	CE	2	-	-	-	-	-	50	50	2
ETPA12208	Laboratory II	CE-OR	-	4	-	-	-	-	50	50	2
AP2	Audit Course II	-	-	-	-	-					
	Total		19	4	100	150	100	150	150	650	21

Course code	**Program Elective III**
ETPA12204A	Image and Video Compression
ETPA12204B	Low Power CMOS Design
ETPA12204C	Estimation and Detection Theory

Course code	**Program Elective IV**
ETPA12205A	Computer Vision
ETPA12205B	Statistical Information Processing
ETPA12205C	Remote Sensing

Course code	**Open Elective II**
IOEP12206A	Project Planning and Management
IOEP12206B	Blockchain Technologies
IOEP12206C	Data Science for Engineers

Audit Course I and II

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

BoS Chairman Dean Academics Director

Semester – I

Image and Video Processing (ETPA11201)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite: Students are expected to know the concepts of Digital Signal Processing.

Course Objectives:

- To introduce students to digital images and its acquisition fundamentals
- To learn basic techniques / algorithms used in enhancement, compression and restoration in spatial and frequency domain transformations
- To expose students to the techniques used for image analysis.
- Introduce students to the applications of DIP
- To introduce video processing and compression fundamentals.
- To learn and use MATLAB/OpenCV with Python toolbox

Course Outcomes:

After studying this course students will be able to

1. Understand human visual perception and image and video formation.
2. know how to process two dimensional image data
3. use Image transform for image enhancement and compression
4. apply segmentation algorithms for object recognition in images and video.
5. apply deblurring algorithms for image and video restoration.
6. Use knowledge acquired in preprocessing of images in machine vision applications.

Unit I : Digital Image and Video Fundamentals

Digital image, its type, format, scale. Elements of human visual perception, Simple image formation model, Image sampling and quantization –Gray and Spatial resolution, basic relationships between pixels, Image statistics. Elements of human visual perception, Image statistics. Digital video, Sampled Video, Video Transmission.

Unit II : Image Enhancement in Spatial and Frequency domain

Spatial domain methods: point processing - intensity transformations, histogram processing, image subtraction, image averaging; Spatial filtering - smoothing filter, sharpening filter. 2D-DFT, FFT, Motion-compensated filtering, frame rate conversion, de interlacing, video resolution enhancement.

Unit III : Image and Video Compression

Image Compression: Fundamentals,. 2D-DCT, KL, Hadamard Image compression using DCT, zig-zag scanning, still image compression standard - baseline JPEG. Vector Quantization. Video compression fundamentals. Video formats, Motion estimation and detection, MPEG 2/4 Video Compression Standard. Image and Video quality assessment.

Unit IV : Image and Video Segmentation

Image Segmentation: Fundamentals, line and edge detection, Thresholding and labeling, Edge linking Hough transform, Region oriented segmentation region splitting and merging, Segmentation using watersheds. Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation.

Unit V : Image and Video Restoration

Image Degradation model - Inverse filtering, Wiener filter, Multi frame Image Restoration, Intensity

Flicker Correction. Color Images, Color fundamentals, Color model, Conversion of color model, Pseudo coloring.

Unit VI : Object recognition

Basic Morphological operations, Image Feature representation and description-boundary representation, chain code s, boundary descriptors, regional descriptors, Texture analysis. Feature selection and classification.

Text Books :

1. Gonzalez and Woods, "Digital Image Processing," Pearson Education.
2. Alan Bovik, "Handbook of Image and Video Processing," Academic Press.

Reference Books :

1. Pratt William K. "Digital Image Processing," John Wiley & sons
2. Joshi, Madhuri A., Mehul S. Raval, Yogesh H. Dandawate, Kalyani R. Joshi, and Shilpa P. Metkar, "Image and Video Compression: Fundamentals, Techniques, and Applications," CRC Press, 2014.
3. S. Jayaraman, S. Esakkiraian "Digital Image Processing," Tata McGraw-Hill Education.

Advanced Embedded Processors and Programming (ETPA11202)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Microcontroller architecture
2. C programming
3. Basics of Linux

Course Objectives:
- To understand and able to design an application specific systems.
- To understand advanced embedded architecture for applications.
- To understand design and implementation of OS based embedded systems.
- To understand open source platform for embedded system

Course Outcomes:
Upon learning the course the student will be able to
1. understand design of embedded system.
2. use OS in embedded application.
3. use modern architecture for embedded system.
4. use Linux for embedded system development.
5. use open platform for embedded system development.

Unit I : Advanced Processor Architecture
Philosophy of RISC design, Advantages of RISC architecture for embedded applications, Development tool chain insights (GNU), guidelines for Selection of hardware and memory architecture, embedded C programming, embedded system design challenges.

Unit II : Parallel Processing and Pipelining Processing
Parallel Processing - Architectural Classification, Applications of parallel processing, Instruction level Parallelism and Thread Level Parallelism, Explicitly Parallel Instruction Computing (EPIC) Architecture
Pipeline Architecture - Principles and implementation of Pipelining, Classification of pipelining processors, Design aspect of Arithmetic and Instruction pipelining, Pipelining hazards and resolving techniques, Data buffering techniques, Advanced pipelining techniques, VLIW (Very Long Instruction Word) processor.

Unit III : Cortex architecture
Introduction to ARM CORTEX series, Design Philosophy, processors series, versions, features and applications. CMSIS standard for ARM Cortex. Survey of CORTEX based controllers A-R-M. ARM-CM3 Based Microcontroller LPC1768: Features, Architecture (Block Diagram & Its Description), Interrupt structure, modes of operations. On chip facility for control, compute and communication applications, Architectural features for digital signal processing.

Unit IV: Embedded/Real time OS and concurrent programming
Types and basic philosophy of Embedded/Real time OS, porting onto embedded architecture, application programming interfaces (API),concurrent programming techniques, Latency hiding techniques, Principles of multithreading, Issues and solutions.

Parallel Programming Techniques: Message passing program development. Message passing libraries for parallel programming interface, Message Passing Interfaces (MPI). Introduction to CUDA kernel and programming basics

Unit V : Embedded Linux

Linux for embedded systems, embedded Linux development system, kernel architecture and configuration, file systems, porting Linux on ARM architecture, bootloaders, tool utilities such as Minicomp, Busybox, Redboot, Libc, Device drivers- concept, architecture, types, sample character device driver

Unit VI : Open hardware /development systems and Case study

Arduino open platform (IDE), development using ATMega328p based Uno board, structure of Arduino programs, introduction to Arduino library, sample GPIO program. Case study of implementation with control, compute and communication modules using Arduino platform.

Text Books :

1. Joseph Yiu, "The Definitive Guide to the ARM Cortex-M," Newness, ELSEVIER
2. Andrew Sloss, Dominic Symes, Chris Wright, "ARM System Developer's Guide – Designing and Optimizing System Software," ELSEVIER
3. Kai Hwang, Faye A. Briggs, "Computer Architecture and Parallel Processing," McGraw Hill Education, 2012.
4. Christopher Hallinan, "Embedded Linux Primer -A Practical, Real-World Approach," 2nd edition, Prentice Hall.
5. Parag H. Dave, Himanshu H. Dave, "Embedded systems Concepts, design and programming," Pearson India.

Reference Books :

1. Kai Hwang, "Advanced Computer Architecture," McGraw Hill Education, 1993.
2. Kai Hwang, "Scalable Parallel Computing," McGraw Hill Education, 1998.
3. Harold S. Stone "High-Performance Computer Architecture," Addison-Wesley, 1993.

Machine Learning (ETPA11203)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Course Objectives:

- Explore supervised and unsupervised learning paradigms of machine learning used for regression and classification.
- To design and analyze various machine learning algorithms using neural networks
- To explore Deep learning technique and various feature extraction strategies.

Course Outcomes:

By the end of the course, students will able to

1. Compare and contrast pros and cons of various machine learning techniques.
2. Mathematically analyze various models of classification and regression.
3. Use techniques for dimensionality reduction and clustering.
4. Solve classification problems using back propagation and deep learning convolutional neural networks.

Unit I : Introduction to Machine Learning

Basics of Machine Learning, Types of machine learning, Supervised learning- Classification and regression Linear regression and Logistic regression, Unsupervised learning, Parametric vs non-parametric models, Overfitting. Decision trees, Feature reduction.

Unit II : Classification - I

Classification using KNN, decision trees, conditional probability, Bayesian decision theory- naïve Bayes, logistic regression, Discriminant Functions. Probabilistic Discriminative Models Multivariate Data, Parameter Estimation, Multivariate Classification, Multivariate Regression

Unit III : Classification - II

Kernel Methods: Support Vector machines and Relevance Vector Machines, Classification improvement using ada-boost algorithm. Dimensionality Reduction: Principal Components Analysis, Factor Analysis, Multidimensional Scaling, Linear Discriminant Analysis.

Unit IV : Multilayer Perceptron

Artificial neuron model, concept of bias and threshold, Activation functions, Mc Culloch-Pits Neuron Model, learning paradigms, concept of error energy, gradient descent algorithm and application of linear neuron for linear regression. Multilayer perceptron (MLP) and back propagation algorithm, Application of MLP for classification.

Unit V : Deep Learning

Improvement of the Deep Neural Network: Vanishing Gradient, Overfitting, Computational Load, ReLU Function, Dropout. Architecture of ConvNet, Convolution Layer, Pooling Layer, Applications of CNN's.

Unit VI : Features for Machine learning and Practical Applications

Image features, Time-series features and related applications, Natural language Processing, Use of competitive learning and self-organizing feature maps. The k-means clustering algorithm.

Text Books :

1. Ethem Alpaydın, "Introduction to Machine Learning," Second Edition, MIT Press 2010.
2. Peter Harrington, "Machine learning in Action," Manning, 2017**.**
3. Laurene Fausett , "Fundamentals of Neural Networks: Architectures, Algorithms And Applications," Pearson Education Inc, 2008.

Reference Books :

1. Kevin Murphy, "Machine Learning: A Probabilistic Perspective," MIT Press, 2012
2. Christopher Bishop, "Pattern Recognition and Machine Learning," Springer, 2007
3. Henrik Brink, "Real World Machine Learning," Manning 2016.

Program Elective I: Artificial Intelligence (ETPA11204A)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs /week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence (AI).
- To convey the ideas in AI research and programming language related to emerging technology.
- To understand the concepts of probabilistic reasoning, fuzzy logic and natural language processing.
- To understand the numerous applications and huge possibilities in the field of AI that go beyond the average human imagination.

Course Outcomes:

At the end of this course, students will be able to

1. Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues.
2. Understanding reasoning and fuzzy logic for artificial intelligence.
3. Understanding natural language processing.
4. Apply and integrate various artificial intelligence techniques in intelligent system development as well as understand the importance of maintaining intelligent systems.

Unit I : Introduction to AI

The AI Problems, The Underlying Assumption, AI Techniques, The Level Of The Model, Criteria For Success, Some General References, One Final Word Problems, State Space Search & Heuristic Search Techniques: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics, And Issues In The Design Of Search Programs, Additional Problems. Generate- And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means- Ends Analysis, Intelligent Agents, Problem Solving.

Unit II : Knowledge Representation

Knowledge Representation Issues: Representations and Mappings, Approaches to Knowledge Representation. Using Predicate Logic: Representation Simple Facts In Logic, Representing Instance And Isa Relationships, Computable Functions And Predicates, Resolution. Representing Knowledge Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning.

Unit III : Reasoning

Symbolic Reasoning Under Uncertainty: Introduction To No monotonic Reasoning, Logics For Non-monotonic Reasoning. Statistical Reasoning: Probability And Bays' Theorem, Certainty Factors And Rule-Base Systems, Bayesian Networks, Dempster Shafer theory.

Unit IV : Learning

Learning from observations: forms of learning, Inductive learning, Learning decision trees, Ensemble learning, Knowledge in learning, Logical formulation of learning, Explanation based learning, Learning using relevant information, Inductive logic programming, Statistical learning methods, Learning with complete data, Learning with hidden variable, EM algorithm, Instance based learning, Neural networks -

Reinforcement learning, Passive reinforcement learning, Active reinforcement learning, Generalization in reinforcement learning

Unit V : Perception and Expert System

Visual perception-Waltz's algorithm, Introduction to Expert System, Architecture and functionality, Example Expert system Fuzzy Logic. Weak Slot-and-Filler Structures: Semantic Nets, Frames. Strong Slot-and-Filler Structures: Conceptual Dependency, Scripts, CYC

Unit VI : Natural Language Understanding

Natural Language Processing: Introduction, Syntactic Processing, Semantic Analysis, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking Connectionist Models: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.

Text Books :

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach," Pearson Education / Prentice Hall of India.
2. Elaine Rich and Kevin Knight, "Artificial Intelligence," Tata McGraw-Hill.

Reference Books :

1. Nils J. Nilsson, "Artificial Intelligence: A new Synthesis," Harcourt Asia Pvt. Ltd.
2. George F. Luger, "Artificial Intelligence-Structures and Strategies for Complex Problem Solving," Pearson Education / PHI.

Program Elective I: Advanced Digital Signal Processing (ETPA11204B)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Digital Signal Processing
2. Fundamentals of Matrices

Course Objectives:
- To build an understanding of Multirate DSP.
- To introduce the concept of Adaptive filters.
- To introduce concept of Linear Prediction and efficient computation of LPC.
- To build an understanding of estimation of Power Spectrum of Random Processes

Course Outcomes:
Upon learning the course the student will be able to
1. To understand theory of multirate DSP, solve numerical problems and write algorithms
2. Use Adaptive filtering for real life applications.
3. Compute linear prediction coefficients in efficient manner.
4. To know applications of DSP at block level.

Unit I : DSP Fundamentals
Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR cascaded lattice structure, and IIR Serial and Parallel structures.

Unit II : Multirate DSP
Need of Multi rate DSP, Decimation and Interpolation, Sampling rate conversion by a non-integer factor, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding and CD Hi-fi systems.

Unit III : Linear Prediction
Stationary random process, Linear prediction & optimum linear filters, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.

Unit IV : Adaptive filters
Need of Adaptive filters, main components of adaptive filters, Wiener Hopf equation, LMS algorithm, various configuration and applications of adaptive filters, Recursive Least Square algorithm.

Unit V : Power Spectrum Estimation
Estimation of spectra from finite duration observation of signals; Estimation of autocorrelation and power spectrum of random signals; Non-parametric methods for power spectrum estimation – Periodogram method, modified periodogram method, Bartlett method, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation

Unit VI : Applications of DSP
Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to

image processing, design of phase shifters, DSP in speech processing & other applications
Text Books : 1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications," Fourth edition, Pearson Prentice Hall. 2. E.C. Ifeachor, B.W. Jervis, "Digital Signal Processing: A practical approach," 2nd ed., Pearson Education.
Reference Books : 1. Bruce W. Suter, "Multirate and Wavelet Signal Processing," 1st Edition, Academic Press, 1997. 2. M. H. Hayes, "Statistical Digital Signal Processing and Modeling," John Wiley & Sons Inc., 2002. 3. S. Haykin, "Adaptive Filter Theory," 4th Edition, Prentice Hall, 2001. 4. D. G. Manolakis, V. K. Ingle and S. M. Kogon, "Statistical and Adaptive Signal Processing," McGraw Hill, 2000.

Program Elective I: Biomedical Signal Processing (ETPA11204C)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Digital Signal Processing
2. Fundamentals of signal processing
3. Basics of JTFA

Course Objectives:
- To introduce the students to various bio signals and methods to acquire them.
- To introduce various time and frequency domain techniques for biomedical signal analysis.
- To make students aware of classification techniques for biomedical signal classification.

Course Outcomes:
Upon learning the course the student will be able to
1. Understand different types of biomedical signal.
2. Identify and analyze different biomedical signals.
3. Propose solutions to applications related to biomedical signal processing.

Unit I : Introduction to bio signals
Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, ECG, EEG, Study of diagnostically significant bio-signal parameters, sources of contamination of biomedical signals.

Unit II : Acquisition of bio signals
Electrodes for bio-physiological sensing and conditioning, Electrode-electrolyte interface, polarization, electrode skin interface and motion artefact, biomaterial used for electrode, Types of electrodes (body surface, internal, array of electrodes, microelectrodes), Practical aspects of using electrodes, Acquisition of bio-signals (signal conditioning) and Signal conversion (ADC's and DAC's) Processing, Digital filtering, grounding, shielding.

Unit III : Time frequency analysis of signals
Biomedical signal processing by Fourier analysis, STFT, Wigner Ville distribution, Biomedical signal processing by wavelet (time frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant) (ECG can be taken as a reference bio signal).

Unit IV : Digital filters for signal processing
Classification of signals and noise, Spectral analysis of deterministic, stationary random signals and non-stationary signals, Coherent treatment of various biomedical signal processing methods and applications, Review of FIR, IIR filters, Adaptive filter configurations for noise cancellation (ECG separation of mother and fetal can be taken as application).

Unit V : Statistical analysis techniques and MRA
Principal component analysis, Correlation and regression, Analysis of chaotic signals Application areas of Bio–Signals analysis Multiresolution analysis (MRA) and wavelets, Principal component analysis(PCA), Independent component analysis (ICA).

Unit VI : Soft computing approaches for biomedical signal classification
Pattern classification–supervised and unsupervised classification, Neural networks, Support vector

Machines, Hidden Markov models. Examples of biomedical signal classification examples.

Text books :

1. D C Reddy, "Biomedical Signal Processing," McGraw Hill, 2005.
2. Katarzyn J. Blinowska, Jaroslaw Zygierewicz, "Practical Biomedical Signal Analysis using MATLAB," 1st Edition, CRC Press, 2011
3. John L Semmlow, "Biosignal and Biomedical Image Processing MATLAB-Based Applications," Second Edition, Marcel Dekker, Inc, 2008

Reference Books:

1. W. J. Tompkins, "Biomedical Digital Signal Processing," Prentice Hall, 1993.
2. Eugene N Bruce, "Biomedical Signal Processing and Signal modeling," John Wiley & Son's publication, 2001.
3. Myer Kutz, "Biomedical Engineering and Design Handbook, Volume I," McGraw Hill, 2009.

Program Elective II: IOT and Applications (ETPA11205A)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Microcontrollers
2. Computer Networks

Course Objectives :
- To Understanding concept of IOT.
- To Study different types of IOT platforms and services.
- To study Security and privacy aspects of IOT implementation.
- To study real life examples and Applications of IOT Systems.

Course Outcomes :
Upon learning the course the student will be able to
1. Understand the concept of IOT and M2M.
2. Study IOT architecture and applications in various fields.
3. Study the security and privacy issues in IOT.

Unit I : IoT & Web Technology
The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

Unit II : M2M to IoT
A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

Unit III : IoT Architecture
State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views.

Unit IV : IoT Applications for Value Creations
Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

Unit V : Internet of Things Privacy
Security and Governance Introduction, Overview of Governance, Privacy and Security Issues

Unit VI : IOT Applications
Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities,

First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security.

Text Books :

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)," 1st Edition, VPT, 2014.
2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything," 1st Edition, Apress Publications, 2013.

Reference Books :

1. Cuno Pfister, "Getting Started with the Internet of Things," O'Reilly Media, 2011.

Program Elective II: Data Networks and Security (ETPA11205B)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Course Objectives:

- Build a foundation in computer networks concepts and protocols and interfaces.
- Estimate the key concepts and practices employed in modern computer networking
- Understand the computer security concepts
- Discriminate of security mechanism at various levels of computer networking and to be familiar with security

Course Outcomes:

After completion of the course the student is able to

1. Learn about networking issues and differentiating TCP/IP and 7-Layer OSI models
2. Describe and understand the overview of security principles
3. Understanding of network security related issues and mitigating mechanisms

Unit I : Data and Computer Communication Networks

Data Communication, Transmission Methodologies, Data Link Layer, Multiple Access & Local Area Networks, Connecting Devices and Backbone Networks, Network Layer and Transport Layer, Application Layer.

Unit II : Mobile & Wireless Networks

Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs,, ad-hoc wireless networks & security, wireless sensor networks, Cellular Mobile Wireless Networks, Mobile IP, Managing Mobility in Cellular Networks, Wireless and Mobility: Impact on Higher-Layer Protocols Evolution of Modern Mobile Wireless Communication System.

Unit III : Cryptography and Network Security

Introduction to the Concept of Security, Cryptographic Techniques, Computer-based Symmetric and Asymmetric Key,Cryptographic Algorithms, Public Key Infrastructure (PKI), Internet Security Protocols, Network Security.

Unit IV : Database Security

Data management technologies, Information security, Information Management Technologies, Security policies, Policy enforcement & related issues, Design principles, Multilevel relational data models, Security impact on database function, inference problem,

Unit V : Software Security

Defining a discipline, A Risk Management Framework, Code review with a tools, Architectural risk analysis, Software penetrating testing, Risk Based security Testing, An Enterprise S/W security program, Security knowledge

Unit VI : Security Issues in Mobile Communication:

Mobile Communication History, Security – Wired Vs Wireless, Security Issues in Wireless and Mobile Communications, Security Requirements in Wireless and Mobile Communications, Security for Mobile Applications, Advantages and Disadvantages of Application – level Security

Text Books :

1. James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach Featuring the Internet," Fifth Edition, Pearson Education, 2012.
2. Behrouz A. Forouzan, Firoz Mosharaf, "Computer Networks: A Top-Down Approach," Tata McGraw Hill, 2012.
3. Michael E. Whitman, Herbert J.Mattord, "Principles of Information Security," CENGAGE Learning, 5th Edition.
4. William Stallings, "Cryptography and Network Security," Pearson Education, 4th Edition
5. Pallapa Venkataram, Satish Babu, "Wireless & Mobile Network Security," TMH, 2010.

Reference Books :

1. Larry L. Peterson & Bruce S. Davie, "Computer Networks: A Systems approach," Fifth edition, Elsevier, 2012.
2. Mark Dye, "Network Fundamentals," Pearson Education.
3. Forouzan Mukhopadhyay, "Cryptography and Network Security." Mc-Graw Hill, Second Edition.

Program Elective II: Joint Time Frequency Analysis (ETPA11205C)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Digital Signal Processing
2. Fundamentals of Signals and systems

Course Objectives:
- To provide students the basic foundation of vector spaces
- To make students understand the essence of multi resolution analysis
- To introduce students to different family of wavelets
- T make students understand the different application areas of Joint time frequency analysis

Course Outcomes:
Upon learning the course the student will be able to
1. Introduce Transforms in signal processing.
2. Understand Time -Frequency Analysis & Multiresolution Analysis.
3. Implement wavelets in various problems like image compression, denoising *etc.*

Unit I : Introduction
Review of Fourier Transform, Parseval Theorem and need for joint time-frequency Analysis. Concept of non-stationary signals, Short-time Fourier transform (STFT), Uncertainty Principle, Localization/Isolation in time and frequency, Hilbert Spaces, Fundamentals of Hilbert Transform.

Unit II : Bases for Time-Frequency Analysis
Wavelet Bases and filter Banks, Tilings of Wavelet Packet and Local Cosine Bases, Wavelet Transform, Real Wavelets, Analytic Wavelets, Discrete Wavelets, Instantaneous frequency, Quadratic time-frequency energy, Wavelet Frames, Dyadic wavelet Transform, Construction of Haar and Roof scaling function using dilation equation and graphical method.

Unit III : Multiresolution Analysis
Haar Multiresolution Analysis, MRA Axioms, Spanning Linear Subspaces, nested subspaces, Orthogonal Wavelets Bases, Scaling Functions, Conjugate Mirror Filters, Haar 2-band filter Banks, Study of upsamplers and downsamplers, Conditions for alias cancellation and perfect reconstruction, Discrete wavelet transform and relationship with filter Banks, Frequency analysis of Haar 2-band filter banks, scaling and wavelet dilation equations in time and frequency domains, case study of decomposition and reconstruction of given signal using orthogonal framework of Haar 2-band filter bank

Unit IV : Wavelets
Daubechies Wavelet Bases, Daubechies compactly supported family of wavelets, Daubechies filter coefficient calculations, Case study of Daub-4 filter design, Connection between Haar and Daub-4, Concept of Regularity, Vanishing moments. Other classes of wavelets like Shannon, Meyer

Unit V : Bi-orthogonal wavelets and Applications

Construction and design. Case study of bi-orthogonal 5/3 tap design and its use in JPEG 2000. Wavelet Packet Trees, Time-frequency localization, compactly supported wavelet packets, case study of Walsh wavelet packet bases generated using Haar conjugate mirror filters till depth level 3. Lifting schemes for generating orthogonal bases of second-generation wavelets.

Unit VI : Applications of JTFA

Applications of JTFA: Scalograms, Time-Frequency distributions: fundamental ideas, Applications: Speech, audio, image and video compression

Text Books:

1. S. Mallat, "A Wavelet Tour of Signal Processing," Academic Press, Second Edition, 1999.
2. L. Cohen, "Time-frequency analysis," Prentice Hall, 1995.

Reference Books:

1. G. Strang and T. Q. Nguyen, "Wavelets and Filter Banks," Wellesley-Cambridge Press, Revised Edition, 1998.
2. I. Daubechies, "Ten Lectures on Wavelets," SIAM, 1992.
3. P. P. Vaidyanathan, "Multirate Systems and Filter Banks," Prentice Hall, 1993.
4. M. Vetterli and J. Kovacevic, "Wavelets and Subband Coding," Prentice Hall, 1995

Open Elective I: Soft Computing Techniques (IOEP11206A)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Prerequisite : UG level mathematics

Course Objectives:

- To make students aware about soft computing techniques /AI techniques
- To impart knowledge about working of ANN, applications of ANN
- To impart knowledge about working of Genetic programming, applications of GP
- To impart knowledge about working of Support vector Regression and Model Tree, applications of SVR and MT

Course Outcomes:

Upon learning the course the student will be able to

1. Understand working of ANN and design temporal and cause effect ANN models
2. Understand working of Genetic programming and design temporal and cause effect GP models
3. Understand working of Support Vector Regression and design temporal and cause effect SVR models
4. Understand working of Model Tree and design temporal and cause effect MT models

Unit I : Artificial Neural Networks

Introduction to computing, hard computing-soft computing, AI and Soft computing, ANN as a soft computing technique, Biological neural network, artificial neuron, working of an artificial neural network, network training, validation and testing, standard Back propagation algorithm, introduction of first order, second order and global training algorithms.

Unit II : Neural Network Design and Applications

Important aspects of artificial network design, types of neural networks, Applications of ANN in temporal and cause effect modeling.

Unit III : Genetic Programming

Introduction to Genetic programming, genetic operators, variants in GP, Algorithm of GP, GP parameters Application of GP in temporal and cause effect modeling.

Unit IV : Support Vector Regression and Model Tree

Introduction to Support vector machines, Support Vector Regression, basics of SVR, Application of MT in temporal and cause effect modeling. Introduction to Model Tree, M5 Algorithm, Application of MT in temporal and cause effect modeling

Term work:

Design cause effect model using ANN, GP, SVR and MT for the same problem and compare their results. Students will prepare a single report of these four applications

Text Books:

1. Bose, N. K., Liang, P., "Neural Network Fundamentals with Graphs, Algorithms and Applications," Tata McGraw-Hill Publication.
2. Kosko, B., "Neural Networks and Fuzzy systems," Prentice Hall, Englewood Cliffs, NJ
3. Wasserman, P.D., "Advanced methods in neural computing," Van Nostrand Reinhold, New York

Reference Books:

Publications in ASCE, Science Direct, Springer, Wiley, IEEE journals and/or similar peer reviewed international unpaid journals

Open Elective I: Ethical Hacking (IOEP11206B)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Course Objectives:

- Understand basics of network security and hacking
- Aware of legal perspective of cybercrime including Indian IT ACT 2008
- Learn techniques of gathering network information.
- Identify security tools including, but not limited to intrusion detection and firewall software.

Course Outcomes:

Upon learning the course the student will be able to

1. Use basics knowledge of network security and hacking.
2. Understand and use the IT Laws as and when required.
3. Gather required information to perform an attack.
4. Use various tools and methods for Vulnerability Assessment.

Unit I : Introduction to Network and Security

Basics of Computer Networks: OSI Model, TCP/IP Model, Network topology (Physical & logical), Network Hardware Components: Connectors, Repeaters, hubs, NICs, Bridges and Switches.

Basics of Computer Networks Security: Essential Terminology, Elements of Information Security, Types of Hackers, Steps for Ethical hacking, Types of Attacks.

Unit II : Legal Perspective and Network Protocols

The Indian IT Act, Challenges to Indian law, Cybercrime scenario in India, 2008 amendments to Indian IT Act, Intellectual property in the cyberspace.

Understanding Network Protocols: TCP,UDP,ICMP, Server Protocols: FTP,HTTP,SMTP, Introduction to OWASP.

Unit III : Information Gathering Techniques

Active information gathering, passive information gathering, Trace route, Interacting with DNS Servers, SNMP and SMTP attacks.

Unit IV : Port Scanning and Vulnerability Assessment

Target Enumeration and Port Scanning Techniques: Scanning for Open Ports and Services, Types of Port Scanning, Firewall/IDS Evading Techniques

Vulnerability Assessment: Vulnerability Scanners and How Do They Work, Pros and Cons of a Vulnerability Scanner, Vulnerability Assessment with Nmap, Nessus

Text Books:

1. Rafay baloch, "Ethical hacking and Penetration Testing guide," CRC press, 2015.
2. Nina Godbole, Sunit Belapure, "Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives," WILEY Publications, 2015.

Reference Books:

1. Behrouz Fourzon, "Data Communication and Computer Networks," 5th edition, Pearson Education.
2. Andrew S. Tanenbaum, "Computer Networks," 5th edition, International Economy Edition.

Open Elective I: Product Design Engineering (IOEP11206C)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Prerequisite : UG level mathematics

Course Objectives:

- To understand basic techniques for particular phases of product development
- Make and manage design teams for product development in a company.

Course Outcomes:

Upon learning the course the student will be able to

1. Describe an engineering design and development process.
2. Employ engineering, scientific, and mathematical principles to execute a design from concept to finished product.
3. Create 3D solid models of mechanical components from the perspective of aesthetic, ergonomic and functional requirement using CAD software.
4. Work collaboratively in a team.
5. Create new product based on mechanical design engineering.
6. Investigate contemporary issues and their impact on provided solution.

Unit I : Introduction to Product Design

Characteristics of Successful Product Development, Innovative Thinking, Challenges to Product Development, Product Development Process, Concept Development, Economics – Cost Vs Performance, Design Considerations

Unit II : Product Development Process

Product development process- Identification of customer needs- customer requirements, product development process flows. Product specifications and concept generation, concept selection, concept screening, concept testing, reverse engineering, product architecture

Unit III : Product Design Tools

Creativity and Problem Solving – Creativity methods-Theory of Inventive Problem Solving (TRIZ), Product function tree, Life cycle analysis, Quality Function Deployment, Competing Product Analysis, SWOT analysis, Failure Mode Effect Analysis.

Unit IV : Design for Manufacture and Assembly

Design for assembly, design for disassembly, design for environment, design for graphics and packaging

Text Books:

1. Product Design-Techniques in Reverse Engineering and New Product Development, Kevin Otto, Kristion Wood, Pearson Education, ISBN 978-81-7758-821-7.

2. Karl T.U. And Steven D.E., Product Design and Development, McGraw Hill, Ed 2000.

Reference Books:

1. Dieter G.E., Engineering Design-Material and Processing Approach, McGraw Hill, Ed. 2000.

Research Methodology (ETPA11207)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Prerequisite : Basic statistical tools

Course Objectives:

- To introduce to the concept of research and research problem
- To understand research ethics
- Get introduced to the concept of Intellectual property rights.
- To understand developments in IPR.

Course Outcomes:

Upon learning the course the student will be able to

1. Define research and formulate a research problem.
2. Discuss the importance of Research Design and Literature Review.
3. Discuss classification of data and preliminary data analysis.
4. Write a research proposal to a suitable funding agency.

Unit I : Introduction to Research and Research problem

Meaning of research, types of research, process of research, Objectives of research, Research and Scientific Method, Sources of research problem, Criteria / Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem, defining a research problem (Real life example or case study), formulation of research hypotheses, Qualities of a good Hypothesis, Null Hypothesis & Alternative Hypothesis. Hypothesis Testing - Logic & Importance

Unit II : Research Design and Literature review

Research Design- Concept and Importance in Research, different research designs in research studies, Literature survey- Definition of literature and literature survey, need of literature survey, elements and objectives of literature survey, sources of literature-monographs-patents – web as a source, Critical literature review – Identifying gap areas from literature review and strategies of literature survey, Errors in research.

Unit III : Data and Data Analysis

Classification of data, benefits and drawbacks of data, qualitative methods of data collection, types of data analysis, Sampling, sample size, sample design, Testing of hypothesis and Goodness of Fit: Definition of null and alternative hypothesis, student's 't' distribution, Chi-square distribution, F-test, analysis of variance techniques, introduction to non-parametric tests. Regression Analysis – Simple Linear Regression, Multiple linear Regression

Unit IV : Report, Research proposal and funding agencies

Need of effective documentation, types of reports and their format. Essentials of a research proposal. Different funding agencies for research. Research briefing, presentation styles, elements of effective presentation, writing of research paper, presenting and publishing paper, patent procedure, ethical

issues.

Text Books:

1. Dr. C. R. Kothari, "Research Methodology: Methods and Trends," New Age International Publishers.
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction."
3. Ranjit Kumar, "Research Methodology: A Step-by-Step Guide for Beginners."

Reference Books:

1. Deepak Chawla and Neena Sondhi, "Research Methodology**:** concepts and cases," Vikas Publishing House Pvt. Ltd. (ISBN 978-81-259-5205-3)
2. Louis Cohen, Manion, Morrison, "Research Methods in Education," Routledge (Taylor & Francis Group) /Cambridge University Press India Pvt. Ltd., ISBN-978-0-415-58336-7
3. Sekaran Uma and Roger Bougie, "Research Methods for Business," Wiley, India.

LABORATORY I (ETPA11208)

Teaching Scheme
Credits : 2
Practical : 4 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

List of Experiments :
Students can use MATLAB/ OpenCV with Python for the practical assignments. (4 Hrs/Practical)

1. Implementation of filters: The case study consisting of application of nearly all kind of filters for enhancing of the image.

2. Implementation of Encoding and decoding scheme in JPEG image compression standard. The entropy coding step can be excluded. The performance of the JPEG with different quality factors should be analyzed.

3. A case study for measuring various parameters such as area, perimeter, shape of the objects in an image. This also includes counting the number of different objects in an image. The complete process involves edge detection for segmentation/segmentation using techniques like thresholding, region growing etc, morphological operations.

4. Implementation of Motion estimation and compensation algorithm for generating motion vectors sequence of images.

5. Implementation of MSE, PSNR, SC, IF, MSSIM, NC and edge SSIM quality metrics for evaluation of any compression scheme. (Preferably JPEG with different quality factors).

Semester - II

Digital Design and Verification (ETPA12201)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Digital Electronics
2. OOP concepts

Course Objectives:
- To learn how to design and test gate/RTL level digital circuits using Verilog HDL.
- To learn to build efficient verification testbenches using SystemVeriog.
- To get familiar with Verilog and SystemVerilog design and verification EDA tools.

Course Outcomes:
At the end of this course, students will be able to
1. Get familiar with front end design using Verilog and verification techniques and create reusable test environments using SystemVerilog.
2. Verify increasingly complex designs more efficiently and effectively.
3. Use EDA tools for design and verification efficiently.

Unit I : Fundamentals of Verilog HDL
Introduction, Lexical conventions, Data types, Operators, Modules and ports, Gate-level modeling, Dataflow modeling, Behavioral modeling, Tasks and functions. Timing and Delays, Switch-level modeling, User-defined primitives, Logic synthesis with Verilog HDL.

Unit II : Arithmetic Circuits Design
Unsigned and signed number representation, Addition and subtraction of signed numbers, Arithmetic overflow, Ripple-carry adder, Carry-lookahead adder, BCD adder, Design of adders using Verilog, Multiplication of unsigned and signed numbers, Array multiplier, Fixed-point and floating-point numbers.

Unit III : Combinational and Sequential Building Blocks
Multiplexers, Synthesis of logic functions using multiplexers, Multiplexer synthesis using Shannon's expansion, Design of arithmetic comparator, Verilog constructs for Flip-Flops, Registers, and Counters. Verilog constructs for Moore and Mealy FSM.

Unit IV : SystemVerilog - I
Verification guidelines, Verification process, Verification plan, Data types, Arrays, Linked lists, procedural statements and routines, Tasks and functions, Routine Arguments, Basic OOP concepts, Object Deallocation, Class Routines, Scoping Rules, Dynamic Objects.

Unit V : SystemVerilog - II
Design and testbench interface, Stimulus Timing, SystemVerilog Assertions, The Four-Port ATM Router, Randomization in SystemVerilog, The pre_randomize and post_randomize Functions, Iterative and Array Constraints, Working with Threads, Events, Semaphores, Mailboxes, Building a Testbench with Threads and IPC

Unit VI : SystemVerilog - III

Introduction to Inheritance, Factory Patterns, Composition, Inheritance, and Alternatives, Coverage Types, Functional Coverage Strategies, Anatomy of a Cover Group, Parameterized Cover Groups, Analyzing Coverage Data, Measuring Coverage Statistics During Simulation, Virtual Interfaces with the ATM Router, Connecting to Multiple Design Configurations, Procedural Code in an Interface.

Text Books :

1. Samir Palnitkar, "Verilog HDL: A guide to Digital Design and Synthesis," Prentice Hall, 2nd Edition, 2003.
2. Stephen Brown and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design," TMH.
3. Chris Spear, "SystemVerilog for Verification," Springer.

Reference Books :

1. Douglas Smith, "HDL Chip Design: A Practical Guide for Designing, Synthesizing & Simulating ASICs & FPGAs Using VHDL or Verilog", Doone publications, 1998.
2. Stuart Sutherland, Simon Davidmann, and Peter Flake, "SystemVerilog for Design," Springer.

Wireless Sensor Networks (ETPA12202)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite : Wireless Communication.

Course Objectives:

- To understand the concept of wireless sensor network.
- To grasp the functionalities of specialized protocols used in WSN.
- To understand the parameters related to QoS in WSN.
- To familiarize the security issues related to WSN.

Course Outcomes:

After successfully completing the course the student will be able to

6. Use appropriate model of WSN
7. Comprehend energy efficient MAC protocols.
8. Apply the knowledge of WSN to solve any engineering problem related to WSN
9. Analyze WSN to meet QoS
10. Develop secure solutions for identified WSN.
11. Apply data aggregation techniques suitable for given applications.

Unit I : Introduction to Wireless Sensor Networks

Course Information, Introduction to Wireless Sensor Networks: Motivations, Applications, Performance metrics, History and Design factors, Network Architecture**:** Traditional layered stack, Cross-layer designs, Sensor Network Architecture, Hardware Platforms: Motes, Hardware parameters

Unit II : Medium Access Control Protocols

Contention-Free and Contention-Based Medium Access , Wireless MAC Protocols, CSMA, MACA and MACAW, IEEE 802.11, IEEE 802.15.4 and ZigBee, Characteristics of MAC Protocols in Sensor Networks , Contention-Free MAC Protocols, Traffic-Adaptive Medium Access, Y-MAC, DESYNC-TDMA, Low-Energy Adaptive Clustering Hierarchy, Lightweight Medium Access Control , Contention-Based MAC Protocols , Power Aware Multi-Access with Signaling, Sensor MAC, Timeout MAC, Pattern MAC, Routing-Enhanced MAC, Data-Gathering MAC, Preamble Sampling and Wise MAC, Receiver-Initiated MAC, Hybrid MAC Protocols, Zebra MAC, Mobility Adaptive Hybrid MAC

Unit III : Routing protocols

Introduction, MANET protocols, Routing protocols for WSN: Resource-aware routing, Data-centric, Geographic Routing, Broadcast, Multicast Opportunistic Routing Analysis: Analysis of opportunistic routing (Markov Chain)

Unit IV : QoS, Data Gathering and Management

Quality of service/reliability, Transport protocols, Coverage and deployment - Sensing models, Coverage measures, Uniform random deployments: Poisson point processes, Coverage of random deployments: Boolean sensing model, Coverage of random deployments: general sensing model, Coverage determination, Coverage of grid deployments, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control.

Unit V : Privacy and Security in WSN

Fundamentals of Network Security, Challenges of Security in Wireless Sensor Networks, Security Attacks in Sensor Networks, Denial-of-Service, Attacks on Routing, Attacks on Transport Layer, Attacks on Data Aggregation, Privacy Attacks, Protocols and Mechanisms for Security, Symmetric and Public Key Cryptography, Key Management, Defenses Against DoS Attacks, Defenses Against Aggregation Attacks, Defenses Against Routing Attacks, Security Protocols for Sensor Networks TinySec, Localized Encryption and Authentication Protocol, IEEE 802.15.4 and ZigBee Security

Unit VI : Specialized features

Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

Text Books :

1. Waltenegus Dargie, Christian Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice," Wiley.
2. Holger Karl, Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks," Wiley.

Reference Books :

1. Edgar H. Callaway, Jr. and Edgar H. Callaway, "Wireless Sensor Networks: Architectures and Protocols," CRC Press.
2. Anna Hac, "Wireless Sensor Network Designs," John Wiley & Sons.
3. Robert Faludi, "Building Wireless Sensor Networks: A Practical Guide to the ZigBee Mesh Networking Protocol," Shroff Publishers.

Deep Learning (ETPA12203)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Machine Learning
2. Basics of Statistics and Probability
3. Linear Algebra

Course Objectives:
- To equip students with the basic understanding of the fundamental concept unsupervised learning.
- To understand concept of Autoencoder, its variants and usefulness in dimensionality reduction and data compression.
- To develop understanding of Reinforcement learning and apply in applications like recommender systems and gaming theories.
- To analyze the YOLO algorithms and apply it for object recognition.

Course Outcomes:
After successfully completing the course the student will be able to
1. Develop the Convolutional neural networks and YOLO based object and face recognition applications.
2. Develop LSTM network for classification.
3. Analyze and compare different types of Autoencoders and apply them in dimensionality reduction.
4. Analyze the functioning of Variational Autoencoders and apply to generate latent spaces.
5. Design and evaluate the Generalized Adversarial Networks.
6. Demonstrate the reinforcement learning and apply its principles in recommender systems.

Unit I : CNN and its Applications
CNN visualization, Object classification using CNN,Object localization, Sliding window approach, Intersection of Unions , Anchor boxes, YOLO algorithm, non -maxima suppression, Face recognition, Fun with Neural style transfer

Unit II : Recurrent Neural Networks
Concept of bias, variance and tradeoff, RNN: - One hot word representation, word embedding, LSTM and applications, Time series forecasting with RNNs.

Unit III : Autoencoders
Principle of Autoencoders, Auto encoder Vs PCA, Training Autoencoders , Sparse Autoencoder, Denoising Autoencoder, Contractive Autoencoder ,Convolution Autoencoder

Unit IV : Variational Autoencoders (VAE)
Principles of VAEs, Variational inference, Core equation, Optimization, Conditional VAE (CVAE),Stacked VAE,MNIST variational Autoencoder, Using CNNs for VAEs, Applications of VAE's

Unit V : Generative Adversarial Networks (GAN)

Generative and discriminative models, Principles of GANs, Architecture structure basics, Deep Convolution Generative Adversarial Network (DCGAN), Conditional GAN (CGAN), Types of GAN such as cycle GAN, sim GAN and their applications

Unit VI : Reinforcement Learning

Principles of reinforcement learning (RL), The Q value, Q-Learning example, Nondeterministic environment, Temporal-difference learning, Deep Q-Network (DQN), Double Q-Learning (DDQN), Applications of RL

Text Books :

1. Goodfellow. Ian, Yoshua Bengio, and Aaron Courville, "Deep learning", MIT press, 2016.
2. Atienza, Rowel, "Advanced Deep Learning with Keras: Apply deep learning techniques, autoencoders, GANs, variational autoencoders, deep reinforcement learning, policy gradients, and more," Packt Publishing Ltd, 2018.
3. Michelucci, Umberto. "Advanced applied deep learning: convolutional neural networks and object detection," Apress, 2019.

Reference Books :

1. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
2. Josh Kalin , "Generative Adversarial Networks Cookbook," Packt Publishing Birmingham,2018

Program Elective III: Image and Video Compression (ETPA12204A)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Course Objectives:

- To introduce students to various techniques such as Wavelets, DCT etc used for compressing Still Image and Videos.
- To introduce students to widely used Image and Video standards like JPEG2000, MPEG, H.264.
- To develop ability to select proper algorithm/ modify if required to suit specific application.

Course Outcomes:

By the end of the course, students will able to

1. Understand overview of compression standards like JPEG 2000, MPEG1, MPEG2
2. Gain knowledge of features of various compression standards.
3. Develop ability to choose compression standard for the given application.
4. Cognize techniques used in data compression.
5. Comprehend various video compression standards like MPEG4, H.263 and H.264 etc.
6. Know various audio coding techniques like mp3 and Dolby AC3.

Unit I : Image Compression using Vector Quantization

Introduction, Advantages of Vector Quantization over Scalar Quantization, The Linde-Buzo-Gray Algorithm, Tree-Structured Vector Quantizers, Structured Vector Quantizers, Variations on the Theme, Concept of Fractals and compression using fractals.

Unit II : Wavelet based Image Compression

Introduction, Wavelets, Multiresolution Analysis and the Scaling Function, Implementation Using Filters, Image Compression, Embedded Zerotree Coder, Set Partitioning in Hierarchical Trees, JPEG 2000 compression standard- Preprocessor, Core encoder, Post processing, ROI encoding, scalability

Unit III : Video Compression basics

Analog and digital video, Temporal Redundancy, Motion estimation, Video Signal Representation

Unit IV : Video Compression Standards – I

MPEG1-Video structure, Group of Pictures, Picture slice, Macro- block and block, Motion estimation, Coding of I, P, B and D type pictures, Video Buffer, MPEG2- Difference between MPEG1 and MPEG2, scalability feature, applications.

Unit V : Video Compression Standards – II

MPEG4- Video object plane, shape coding, H.263 and H.264- Video coding for low bit rates, motion vector coding, coefficient coding, protection against error. Overview of MPEG-7 and MPEG -21

Unit VI : Audio Coding

Introduction , Spectral Masking, Temporal Masking, Psychoacoustic Model, MPEG Audio Coding, Layer II Coding, Layer III Coding—mp3, Dolby AC3 (Dolby Digital)

Text Books :

1. Sayood, Khalid. "Introduction to data compression". Newnes, 2012.
2. Joshi, M. A., Raval, M. S., Dandawate, Y. H., Joshi, K. R., & Metkar, S. P., "Image and Video Compression: Fundamentals, Techniques, and Applications," CRC Press.

Reference Books :

1. Mohammed Ghanbari, Standard Codecs: Image Compression to Advanced Video Coding", IEE publication.
2. V. Bhaskaran and K. Konstantinides, "Image video compression standards: algorithms and architecture," Kluwer Academic Publishers
3. Joan Mitchell "MPEG and Video compression standard" Springer
4. Iain E. G. Richardson "H.264 and MPEG-4 Video Compression" Wiley publication

Program Elective III: Low Power CMOS Design (ETPA12204B)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Digital CMOS circuit design
2. MOSFET theory

Course Objectives:
- To know sources of power dissipation in CMOS circuits.
- To understand various power optimization techniques.
- To get familiar with low power clocking techniques.
- To understand low power memory and processor design methods.

Course Outcomes:
At the end of the course, students will be able to:
1. Identify the sources of power dissipation in digital IC systems & understand the impact of power on system performance and reliability.
2. Characterize and model power consumption & understand the basic analysis methods.
3. Understand leakage sources and reduction techniques.

Unit I : Sources of Power Dissipation:
Sources of power dissipation in digital ICs, degree of freedom, recurring themes in low-power, emerging low power approaches, dynamic dissipation in CMOS, effects of Vdd & Vt on speed, constraints on Vt reduction, transistor sizing & optimal gate oxide thickness, impact of technology scaling, technology innovations.

Unit II : Low Power Circuit Techniques:
Power consumption in circuits, flip-flops & latches, high capacitance nodes, energy recovery, reversible pipelines, high performance approaches.

Unit III : Low Power Clock Distribution:
Power dissipation in clock distribution, single driver versus distributed buffers, buffers & device sizing under process variations, zero skew Vs. tolerable skew, chip & package co-design of clock network.

Unit IV : Logic Synthesis for Low Power estimation techniques:
Power minimization techniques, Low power arithmetic components- circuit design styles, adders, multipliers.

Unit V : Low Power Memory Design:
Sources & reduction of power dissipation in memory subsystem, sources of power dissipation in DRAM & SRAM, low power DRAM circuits, low power SRAM circuits.

Unit VI : Low Power Microprocessor Design:
Power management support, architectural tradeoffs for power, choosing the supply voltage, low-power clocking, implementation problem for low power, comparison of microprocessors for power & performance.

Text Books :

1. P. Rashinkar, Paterson and L. Singh, "Low Power Design Methodologies", Kluwer Academic, 2002.
2. Kaushik Roy, Sharat Prasad, "Low power CMOS VLSI circuit design", John Wiley sons Inc. 2000.
3. James B. Kuo, "Low voltage CMOS VLSI Circuits", Wiley, 1999.

Reference Books :

1. A.P. Chandrasekaran and R.W.Broadersen, "Low power digital CMOS design", Kluwer, 1995
2. Gary Yeap, "Practical low power digital VLSI design", Kluwer, 1998.

Program Elective III: Estimation and Detection Theory (ETPA12204C)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite : Fundamentals of probability.

Course Objectives:

- To make students understand linear models and their relationship with probability distributions
- To make students aware of Computation of Cramer Rao Lower Bounds
- To estimate parameters with multiple criteria: minimum variance, maximum likelihood, Bayesian assumptions
- To make students learn to Detect multiple types of signals: deterministic signals, random signals, signals with unknown parameters

Course Outcomes:

At the end of the course, student will be able to

1. Acquire basics of statistical decision theory used for signal detection and estimation.
2. Examine the detection of deterministic signals using statistical models.
3. Examine the detection of random signals using statistical models.
4. Examine the performance of signal parameters using optimal estimators.
5. Analyze signal estimation in discrete-time domain using filters.
6. Cognize various applications of estimation and detection theory.

Unit I : Statistical Decision Theory

Bayesian, minimax, and Neyman-Pearson decision rules, likelihood ratio, receiver operating characteristics, composite hypothesis testing, locally optimum tests, detector comparison techniques, asymptotic relative efficiency.

Unit II : Detection of Deterministic Signals

Matched filter detector and its performance; generalized matched filter; detection of sinusoid with unknown amplitude, phase, frequency and arrival time, linear model.

Unit III : Detection of Random Signals

Estimator-correlator, linear model, general Gaussian detection, detection of Gaussian random signal with unknown parameters, weak signal detection.

Unit IV : Estimation of Signal Parameters

Minimum variance unbiased estimation, Fisher information matrix, Cramer-Rao bound, sufficient statistics, minimum statistics, complete statistics; linear models; best linear unbiased estimation; maximum likelihood estimation, invariance principle; estimation efficiency; Bayesian estimation: philosophy, nuisance parameters, risk functions, minimum mean square error estimation, maximum a posteriori estimation.

Unit V : Signal Estimation in Discrete-Time

Linear Bayesian estimation, Weiner filtering, dynamical signal model, Discrete Kalman filtering.

Unit VI : Applications of Estimation and Detection

Applications in various domains viz. Control systems, Object tracking, non- linear prediction etc.

Text Books :

1. H. L. Van Trees, "Detection, Estimation and Modulation Theory: Part I, II, and III", John Wiley, NY, 1968.
2. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory", Prentice Hall PTR, 1993.

Reference Books :

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory", Prentice Hall PTR, 1998.
2. Signal Detection and Estimation Second Edition by Mourad Barkat, Pearson education

Program Elective IV: Computer Vision (ETPA12205A)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Course Objectives:

- To introduce students to Projections, Camera Models and Camera Calibration used for image formation. Computer Vision fundamentals, applications and challenges and complexities in Computer Vision Systems.
- To introduce students to Stereo Imaging techniques, Multi-View geometry and 3D reconstruction algorithms.
- To study the techniques and algorithms used for Object tracking in Videos.
- To introduce image registration techniques.
- To develop and test basic Computer Vision algorithms in MATLAB/OpenCV.

Course Outcomes:

By the end of the course, students will able to

1. Develop understanding of image formation and working of camera as image sensor.
2. Understand need and procedure of camera calibration.
3. Have knowledge of stereo imaging, its applications and challenges.
4. Conceptualize and understand computer vision algorithms for motion tracking.
5. Develop understanding of infrared/thermal imaging.
6. to select and calibrate camera based on the application requirements.
7. to work with real time 3D problems based on the understanding of stereo vision techniques and algorithms.
8. to apply Object tracking and Recognition techniques in real life applications like Surveillance Security, vehicle and industry.

Unit I : Introduction to Computer Vision and Image Formation

Purpose, state of the art , Applications , Challenges in computer vision, CMOS CCD image sensors, Projective Geometry, Camera parameters, Camera model and Camera calibration • Binocular imaging systems, Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification Digital camera, Bayers pattern. Smart Camera and its applications

Unit II : Feature Detection and Matching

Points and patches, Edges, Lines, Segmentation: Active contours, Level set representations, Fourier and wavelet descriptors, Graph-Cut and energy-based methods, 2D and 3D feature-based alignment, Feature matching.

Unit III : Stereo Imaging

Concept, triangulation, Correspondence, Epipolar geometry, rectification, RANSAC algorithm, dynamic programming. 3D reconstruction. Multi-view stereo: Volumetric and 3D surface reconstruction. Shape from silhouettes

Unit IV : Motion and Object tracking

Basics of motion, corner detector, and optical flow by Lucas Kanade mean shift tracking, Kalman filter,

Object Tracking, condensation. Scale Invariant Feature Transform, Spatio- Temporal Analysis, Dynamic Stereo; Motion parameter estimation, Structure from motion, Motion Tracking in Video

Unit V : Image Registration

Motion Models, Direct (pixel-based) Alignment, Feature-Based Registration, Global Registration, and Compositing. Panorama creation, Introduction to image based rendering. High dynamic range imaging.

Unit VI : Applications of Computer Vision

Thermal and Infrared Imaging. Range Imaging, In Vehicles: Lane Detection., Stereo Obstacle Detection, Laser Obstacle Detection, Vehicle Detection. Biometrics, document processing, Surveillance, Inspection of Cereal Grains. Machine learning in computer vision.

Text Books :

1. Richard Szeliski, Computer vision algorithms and applications, springer
2. Mubarak Shah, Fundamentals of Computer Vision, Online book
3. Emanuele Trucco, Alessandro Verri, "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998

Reference Books :

1. Linda Shapiro and George Stockman: Computer Vision, Prentice Hall
2. E. R. Davies"Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc, 2012.
3. Alexander Hornberg," Handbook of Machine and Computer Vision "Wiley-VCH Verlag 2017

Program Elective IV: Statistical Information Processing (ETPA12205B)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite :
1. Digital Signal Processing
2. Fundamentals of Matrices

Course Objectives:
- To introduce concept of Linear Prediction and efficient computation of LPC.
- To build an understanding of estimation of Power Spectrum of Random Processes
- To understand the theoretical framework upon which error-control codes are built
- To equip students with the basic understanding of the fundamental concept of entropy and information theory.

Course Outcomes:
Upon learning the course the student will be able to
1. Compute linear prediction coefficients in efficient manner.
2. Analyze the discrete time signals by estimating power spectrum using various methods.
3. Formulate, design and implement the appropriate source coding scheme based on given practical constraint.
4. Formulate and implement the appropriate channel coding scheme based on given practical constraint.

Unit I : Review of random variables
Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Central Limit theorem, Discrete & Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions, Spectral representation of random signals, Properties of power spectral density, Gaussian Process and White noise process.

Unit II : Random signal modelling
MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications, Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm.

Unit III : Statistical Decision Theory: Parameter Estimation Theory:
Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing. Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator, Least-Square Estimation Recursive Least-Square Estimator.

Unit IV : Spectral analysis
Estimated autocorrelation function, Periodogram, Averaging the periodogram (Bartlett Method), Welch

modification, Parametric method, AR(p) spectral estimation and detection of Harmonic signals.

Unit V : Information Theory and Coding:
Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, Shanon Fano, Arithmetic, Adaptive coding, RLE, LZW Data compaction, LZ-77, LZ-78. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem, Differential entropy and mutual information for continuous ensembles.

Unit VI : Application of Information Theory:
Group, Ring & Field, Vector, GF addition, multiplication rules. Introduction to BCH codes, Primitive elements ,Minimal polynomials, Generator polynomials in terms of Minimal polynomials, Some examples of BCH codes, & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders

Text Books :

1. Monson Hayes, "Statistical Digital Signal Processing and Modelling", Wiley.
2. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing: Principles, algorithms and applications" Fourth edition, Pearson Prentice Hall.
3. Ranjan Bose, "Information Theory coding and Cryptography", McGraw-Hill Publication, 2nd Edition.
4. J C Moreira, P G Farrell, "Essentials of Error-Control Coding", Wiley Student Edition

Reference Books :

1. Papoulis and S.U. Pillai, "Probability, Random Variables and Stochastic Processes", 4th Edition, McGraw-Hill, 2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, "Statistical and Adaptive Signal Processing", McGraw Hill, 2000.
3. Mourad Barkat , "Signal Detection and Estimation", Artech House, 2nd Edition, 2005.
4. R G. Gallager, "Information theory and reliable communication", Wiley, 1st edition, 1968.
5. F. J. MacWilliams and N. J. A. Sloane, "The Theory of Error-Correcting Codes", New York, North-Holland, 1977.
6. Rosen K.H, "Elementary Number Theory", Addison-Wesley, 6th edition, 2010.
7. Shu lin and Daniel j, Cistellojr., "Error control Coding" Pearson, 2nd Edition.
8. Todd Moon, "Error Correction Coding : Mathematical Methods and Algorithms", Wiley Publication

Program Elective IV: Remote Sensing (ETPA12205C)

Teaching Scheme
Credits : 3
Lectures : 3 Hrs/week

Examination Scheme
CIE: 20 Marks
ISE: 30 Marks
SCE: 20 Marks
ESE: 30 Marks

Prerequisite : Digital Signal Processing

Course Objectives:

- To build an understanding of Remote Sensing.
- To impart knowledge of data acquisition.
- To understand analysis methods of captured information.

Course Outcomes:

Upon learning the course the student will be able to

1. Understand basic concepts, principles and applications of remote sensing, particularly the geometric and radiometric principles.
2. Provide examples of applications of principles to a variety of topics in remote sensing, particularly related to data collection, radiation, resolution, and sampling.

Unit I : Physics of Remote Sensing

Electro Magnetic Spectrum, Physics of Remote Sensing-Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window-Energy interaction with surface features –Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns-multi concept in remote sensing.

Unit II : Data Acquisition

Types of Platforms–different types of aircrafts-Manned and Unmanned space crafts–sun synchronous and geo synchronous satellites –Types and characteristics of different platforms –LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD etc.

Unit III : **Photographic products**

B/W, color, color IR film and their characteristics – resolving power of lens and film - Optomechanical electro optical sensors –across track and along track scanners multispectral scanners and thermal scanners–geometric characteristics of scanner imagery - calibration of thermal scanners

Unit IV: Scattering System

Microwave scatterometry, types of RADAR –SLAR –resolution –range and azimuth –real aperture and synthetic aperture RADAR. Characteristics of Microwave Image topographic effect-different types of Remote Sensing platforms –airborne and space borne sensors -ERS, JERS, RADARSAT, RISAT - Scatterometer, Altimeter-LiDAR remote sensing, principles, applications.

Unit V : Thermal And Hyper Spectral Remote Sensing

Sensors characteristics-principle of spectroscopy imaging spectroscopy–field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing –thermal sensors, principles, thermal data processing, applications.

Unit VI : Data Analysis

Resolution–Spatial, Spectral, Radiometric and temporal resolution-signal to noise ratio-data products and their characteristics-visual and digital interpretation–Basic principles of data processing –

Radiometric correction–Image enhancement–Image classification–Principles of LiDAR, Aerial Laser Terrain Mapping
Text Books : 1. Lillesand. T. M. and Kiefer. R. W., "Remote Sensing and Image interpretation", 6th Edition, John Wiley & Sons, 2000. 2. John R. Jensen, "Introductory Digital Image Processing: A Remote Sensing Perspective", 2nd Edition, Prentice Hall,1995
Reference Books : 1. Richards, John A., Jia, Xiuping, "Remote Sensing Digital Image Analysis", 5th Edition, Springer-Verlag Berlin Heidelberg, 2013. 2. Paul Curran P.J. Principles of Remote Sensing, 1st Edition, Longman Publishing Group, 1984. 3. Charles Elachi, Jakob J. van Zyl, "Introduction to the Physics and Techniques of Remote Sensing", 2nd Edition, Wiley Series, 2006. 4. Sabins, F.F.Jr, "Remote Sensing Principles and Image Interpretation", 3rd Edition, W. H. Freeman & Co, 1978.

Open Elective II: Project Planning and Management (IOEP12206A)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Prerequisite : Basic understanding of Project Management at UG level

Course Objectives:

- To impart knowledge of project life cycle.
- To introduce students to Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies,
- To construct CPM, PERT network for a project.
- To introduce students to Steps in Risk Management, Risk Identification, Risk Analysis and Reducing Risks
- To introduce students to process of project Performance Measurement, Evaluation and closeout.

Course Outcomes:

Upon learning the course the student will be able to

1. Understand principles of Project Management and phases of project life
2. Understand the Project Identification Process, Project Initiation, Pre-Feasibility Study and Project feasibility Studies.
3. Construct CPM, PERT network for a project.
4. Understand the process of project Performance Measurement, Evaluation and closeout.

Unit I : Basics of Project Management

Introduction, Need, Project Management Knowledge Areas and Processes, Concept of Organizational Structure and types, The Project Life Cycle (preferably with case study), Essentials Project Management Principles.

Unit II : Project Identification and Selection

Introduction, Project Identification Process, Project Initiation, Pre-Feasibility Study, Feasibility Studies, Project Break-even point. Case study is preferred

Unit III : Project Planning

Introduction, Need for Project Planning, Work Breakdown Structure (WBS), LOB, CPM and PERT, Network Cost System, Resource Allocation, Scheduling, Project Cost Estimate and Budgets, concept of Project Risk Management

Unit IV : Project Performance Measurement, Evaluation and closeout

Introduction, Performance Measurement, Productivity, Project Performance Evaluation, Benefits and Challenges of Performance Measurement and Evaluation, Controlling the Projects. Project Close-out, Steps for Closing the Project, Project Termination, and project follow-up.case study is preferred

TW: Assignments on each unit.

Text Books:

1. Operations Research by Premkumar Gupta and D.S.Hira, S. Chand Publications (2014)
2. Project Management – K Nagrajan – New age International Ltd.
3. Project Management – Ahuja H.N. – John Wiely, New York.
4. Project Management-Planning and Control---Rory Burkey 4th ed.—Wiley,India.

Reference Books:

1. Project Risk Management - Bruce Barkley- McGraw-Hill, 2004

Open Elective II: Blockchain Technologies (IOEP12206B)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Prerequisite : Knowledge of programming language and script language

Course Objectives:

- To introduce fundamentals of Blockchain
- To explain Bitcoin Blockchain
- To explain Ethereum Architecture & Components.
- To discuss Emerging Trends in Blockchain and Use cases

Course Outcomes:

Upon learning the course the student will be able to

1. Explain fundamental knowledge of Blockchain
2. Illustrate Bitcoin Blockchain
3. Summarise Ethereum Architecture & Components
4. Explore emerging trends in Blockchain and Use cases

Unit I : Overview of Blockchain

Introduction to Blockchain, History of Blockchain, Network and protocols, Smart Contract and Consensus Algorithms, Blockchain users and adoption, Blockchain challenges

Unit II : Bitcoin Blockchain

Blockchain TOC Bitcoin/Blockchain data structures, Keys as Identity, Digital Signatures, Hashes, Hashes as Addresses, Hash Pointers and Data Structures, Blockchain transactions, Blockchain block structure

Unit III : Ethereum Architecture & Components

Evolution of Ethereum, Ethereum Components, Ethereum Virtual Machine, Types of Transactions, Solidity language, Ethereum Smart Contracts, Tokenization, Dapps.

Unit IV : Emerging Trends in Blockchain and Use cases

Introduction of Hyperledger, Corda, Ripple, R3. Blockchain and cloud computing, Blockchain and Artificial Intelligence, Blockchain use cases in Health Care, Banking, Government Sector, Supply Chain Management, Identity Management, etc.

TW:

Case study on various Crypto currencies.
Case study on various Blockchain Platforms
Case study of any Use Case

Text Books:

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa, O'Reilly

3. Mastering Ethereum Building Smart Contracts and DApps, by Andreas M. Antonopoulos, Gavin Wood, O'Reilly
4. Hyperledger Fabric - https://www.hyperledger.org/projects/fabric

Reference Books:

1. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits
2. Etherium Yellow Paper : "Ethereum: A Secure Decentralised Generalised Transaction Ledger Petersburg", Dr. Gavin Wood

Open Elective II: Data Science for Engineers (IOEP12206C)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Prerequisite : Basic Mathematics

Course Objectives:

- Introduce the mathematical foundation.
- Introduce data science algorithms and data analytics.
- Introduce a practical capstone case study.

Course Outcomes:

By the end of the course, students will be able to

1. Describe a flow process for data science problems.
2. Classify data science problems.
3. Correlate results to the solutions.
4. Construct use cases to validate approach.

Unit I: Linear Algebra Basics

Linear algebra for data science, Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse), Geometric view - vectors, distance, projections, eigenvalue decomposition.

Unit II: Statistics and Optimization

Statistics (descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates) and Optimization.

Unit III: Linear regression

Typology of data science problems and a solution framework, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection.

Unit IV: Classification techniques

Classification using logistic regression, Classification using kNN and k-means clustering.

Term work: Assignment on each unit.

Text books:

1. Gilbert Strang, "Introduction to Linear Algebra," 2nd Ed., Wellesley-Cambridge Press.

Reference books:

1. Douglas Montgomery and George Runger "Applied Statistic and Probability for engineers," 6th Ed., Wiley.

Intellectual Property Rights (ETPA12207)

Teaching Scheme
Credits : 2
Lectures : 2 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

Course Objectives:

- Explain the importance of ideas, concept and creativity.
- Transfer the knowledge about the IPR required for Engineers.
- Describe how IPR creates National wealth.
- Teach National and International IP System.

Course Outcomes:

Upon learning the course the student will be able to

1. Explain property and Intellectual property their nature, importance and objectives.
2. Discuss types of IPR: Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting.
3. Understand the process of patenting, development and International scenario: WIPO, TRIPs.
4. Explain administration of patent system.

Unit I : Introduction to the concepts Property and Intellectual Property

Introduction to the concepts Property and Intellectual Property, Nature and Importance of Intellectual Property Rights, Objectives of understanding Intellectual Property Rights, IPR and IITs

Unit II : Intellectual Property Rights

Understanding the types of Intellectual Property Rights: - Patents, Designs, Trademarks (Registered and unregistered trademarks), Copyright, Traditional Knowledge, Geographical Indications, Trade Secrets, Idea Patenting, (Case Studies)

Unit III : New Developments in IPR

New Developments in IPR, Process of Patenting and Development: technological research, innovation, patenting, development, and understanding of IPR issues in cyber world, International Scenario: WIPO, TRIPs, Indian Patent Office.

Unit IV : Administration of Patent System

Administration of Patent System – Patenting under Indian Patent Act, Patenting under PCT, Patent Rights and its Scope, Licensing and transfer of technology, Patent information and database. Provisional and Non-Provisional Patent Application and Specification.

TW: Assignments on each unit.

Text Books:

1. Resisting Intellectual Property by Halbert, Taylor & Francis Ltd, 2007
2. Industrial Design by Mayall, Mc Graw Hill.
3. Intellectual Property in New Technological Age by Robert P. Merges, Peter S. Menell, Mark A. Lemley.

Reference Books:

1. Intellectual Property Rights under WTO by T. Ramappa, S. Chand.
2. Introduction to Design by Asimov, Prentice Hall.

LABORATORY II (ETPA12208)

Teaching Scheme
Credits : 2
Practical : 4 Hrs/week

Examination Scheme
CIE: NA
ISE: NA
SCE: NA
ESE: NA
TW/OR: 50 Marks

List of Experiments :
Students can use Xilinx ISE/EDA Playground/Modelsim or any other compatible EDA tools for the practical assignments.

A. To write Verilog design code and test the design by writing testbench code for

1. N-bit shift register.
2. Random Access Memory (RAM).
3. 4 x 4 Multiplier using structural model.
4. A simple processor to perform load, move, add, and sub operations.

B. To write SystemVerilog code to design and verify

1. FIFO memory
2. RAM
3. UART