With effect from academic year 2021-22

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Scheme of Instruction

and

Syllabus of

M.E. (E.C.E.)

SYSTEMS & SIGNAL PROCESSING

Full Time & PTPG

AICTE Model Curriculum

2021-22

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007

M.E. (ECE-Systems and Signal Processing)

Type of course	Course Code	Course Name	Contact hours per week			Scheme of Examination		Credits
			L	T	P	CIE	SEE	
SEMESTER-I								
Core-I	EC201	Advanced Digital Signal Processing	3	0	0	30	70	3
Core-II	EC202	Digital Image and Video Processing	3	0	0	30	70	3
Programme Elective-I	EC211	Computer Vision	3	0	0	30	70	3
	EC212	DSP Architecture						
	EC213	IOT and Applications						
Programme Elective-II	EC214	Wireless Sensor Networks	3	0	0	30	70	3
	EC215	Biomedical Signal Processing						
	EC216	Remote Sensing						
Audit course -I	AC 031	English for Academic and Research Writing	2	0	0	30	70	0
	AC 032	Disaster Management						
	AC 033	Sanskrit for Technical Knowledge						
	AC 034	Value Education						
Lab-I	EC251	Advanced Digital Signal Processing Lab	0	0	3	50	-	1.5
	EC 261	Seminar-I	0	0	3	50	-	1.5
MC	EC100	Research Methodology in ECE	3	0	0	30	70	3
TOTAL			**17**	**0**	**6**	**280**	**420**	**18**
SEMESTER-II								
Core-III	EC 203	Pattern Recognition and Machine Learning	3	0	0	30	70	3
Core-IV	EC 204	Detection and Estimation Theory	3	0	0	30	70	3
Programme Elective-III	EC 114	Wireless and Mobile Communication	3	0	0	30	70	3
	EC 217	Audio Processing						
	EC 218	Voice and Data Networks						
Programme Elective-IV	EC 219	Adaptive Signal Processing	3	0	0	30	70	3
	EC 220	Artificial Neural Networks						
	EC 221	Optimization Techniques						
Audit course-II	AC 035	Stress Management by Yoga	2	0	0	30	70	0
	AC 036	Personality Development through life enlightenment skills						
	AC 037	Constitution of India						
	AC 038	Pedagogy Studies						
Lab-II	EC 252	Digital Image and Video Processing Lab	-	-	3	50	-	1.5
Lab-IV	EC 262	Seminar-II	0	0	3	50	-	1.5
	EC 070	Mini Project	0	0	6	50	-	3

TOTAL			**14**	**0**	**12**	**300**	**350**	**18**
SEMESTER-III								
Programme Elective-V	EC 222	Coding Theory and Techniques	3	0	0	30	70	3
	EC 111	Advanced Computer Architecture						
	EC 223	Multispectral Signal Analysis						
Open Elective	OE 941	Business Analytics	3	0	0	30	70	3
	OE 942	Industrial Safety						
	OE 943	Operations Research						
	OE 944	Cost Management of Engineering Projects						
	OE 945	Composite Materials						
	OE 946	Waste to Energy						
	OE 947	Internet of Things						
	OE 948	Cyber Security						
Dissertation	EC 281	Major project phase - I	0	0	20	100	-	10
TOTAL			**6**	**0**	**20**	**160**	**140**	**16**
SEMESTER-IV								
Dissertation	EC 282	Major project phase- II	0	0	32	-	200	16
GRAND TOTAL								**68**

SEMESTER - 1

EC 201

ADVANCED DIGITAL SIGNAL PROCESSING

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To make students familiar with the most important methods in DSP, including digital filter design, transform-domain processing and importance of Signal Processors*
- *Create efficient realizations for upsampling and downsampling of signals using the polyphase decomposition*
- *To introduce some practical aspects of signal processing, and in particular adaptive systems*

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

1. *Design, implementation, analysis and comparison of digital filters for processing of discrete time signals*
2. *Acquire the basics of multi rate digital signal processing.*
3. *Comprehend design criteria and modeling adaptive systems and theoretical Performance evaluation*
4. *Analyze the power spectrum estimation*
5. *Apply the algorithms for wide area of recent applications.*

UNIT – I

Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter designand structures: Basic FIR/IIR filter design &structures, design techniques of linear phase FIRfilters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded latticestructures, and Parallel all pass realization of IIR.

UNIT – II

Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator &interpolator, poly phase filters, QMF, digital filter banks, Applications in subband coding.

UNIT – III

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

UNIT – IV

Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods forPower Spectrum Estimation,Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigenanalysis Algorithms for Spectrum Estimation.

UNIT – V

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

References:

1 J.G.Proakis and D.G.Manolakis, *"Digital signal processing: Principles, Algorithm and Applications",* 4th Edition, Prentice Hall, 2007.

2 S.Haykin, *"Adaptive Filter Theory",* 4th Edition, Prentice Hall, 2001.

EC 202

DIGITAL IMAGE AND VIDEO PROCESSING

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Beyond the obvious applications in entertainment and scientific visualization, digital images and video have become a central component of net-centred computing, human/computer interfaces, and databases, as well as data analysis for domains such as biometrics, surveillance and remote sensing.*
- *This course offers fundamentals of digital image and video processing and algorithms for most of the work currently underway in this field.*
- *Through this course, students will get a clear impression of the breadth and practical scope of digital image and video processing and develop conceptual understanding which will enable them to undertake further study, research and/or implementation work in this area.*

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

1. *Describe the fundamentals of image and object recognition video processing and their applications*
2. *Develop familiarity and implement basic image and video processing algorithms.*
3. *Select and apply appropriate technique to real problems in image and video analysis.*
4. *Learn different techniques for image enhancement, video and image recovery*
5. *Understand techniques for image and video segmentation and techniques for image and video compression*

UNIT – I

*Fundamentals of Image Processing and Image Transforms***:**Basic steps of Image Processing System, Monochrome and color vision models**,** Image acquisition and display, Sampling andQuantization of an image – Basic relationship between pixelsImage Transforms: 2 D-Discrete Fourier Transform, Discrete Cosine Transform (DCT), WaveletTransforms: Continuous Wavelet Transform, Discrete Wavelet Transforms.

UNIT – II

*Image Processing Techniques Image Enhancement:*Spatial domain methods: Histogramprocessing, Fundamentals of Spatial filtering, smoothing spatial filters, Sharpening spatial filters.Frequency domain methods: Basics of filtering in frequency domain, image smoothing, imagesharpening, Selective filtering. Laplacian of Gaussian (LOG) filters.

*Image Segmentation:*Segmentation concepts, Point, Line and Edge Detection, Thresholding, RegionBased segmentation. Hough Transform, boundary detection, chain coding.

UNIT – III

Image Compression: Image compression fundamentals - Coding Redundancy, Spatial and Temporalredundancy, Compression models: Lossy & Lossless, Huffman coding, Arithmetic coding, LZWcoding, Run length coding, Bit plane coding, Transform coding, Predictive coding, Wavelet coding,JPEG standards.

UNIT – IV

Basic steps of Video Processing: Analog Video, Digital Video. Principles of color video processing, composite versus component video, Time-Varying Image Formation models Three-DimensionalMotion Models, Geometric Image Formation, Photometric Image Formation, Sampling of Video signals, Filtering operations.

UNIT – V

*2-D Motion Estimation:*Optical flow, General Methodologies, Pixel Based Motion Estimation, Block- Matching Algorithm, Mesh based Motion Estimation, Global Motion Estimation, Region basedMotion Estimation, Multi resolution motion estimation, Waveform based coding, Block basedtransform coding, Predictive coding, Application of motion estimation in Video coding, Contantdependent video coding and Joint shape and texture coding, MPEGs and H.26x standards.

References:

1 Gonzaleze and Woods, "*Digital Image Processing",* 3rd ed., Pearson.
2 Yao Wang, Joem Ostermann and Ya–quin Zhang, *"Video processing and communication"*, 1st Ed., PH Int.
3 M. Tekalp, *"Digital Video Processing",* Prentice Hall International.

EC211

COMPUTER VISION
(PROGRAM SPECIFIC ELECTIVE – I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To introduce students the fundamentals of image formation and the major ideas, methods, and techniques of computer vision and pattern recognition;*
- *To develop an appreciation for various issues in the design of computer vision and object recognition systems;*
- *To provide the student with programming experience from implementing computer vision and object recognition applications.*

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

1. *Identify basic concepts, terminology, theories, models and methods in the field of computer vision.*
2. *Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition.*
3. *Study the image formation models and feature extraction for computer vision*
4. *Identify the segmentation and motion detection and estimation techniques*
5. *Develop small applications and detect the objects in various applications*

UNIT – I

Image Formation Models: Monocular imaging system, Orthographic & Perspective Projection, Camera model and Camera calibration, Binocular imaging systems, Perspective, Binocular Stereopsis: Camera andEpipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Stereovision

UNIT – II

Feature Extraction: Image representations (continuous and discrete), Edge detection, Edge linking, corner detection,texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.

UNIT – III

Shape Representation and Segmentation: Deformable curves and surfaces, Snakes and active contours, Level set representations, Fourier and wavelet descriptors, Medial representations, Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut,Mean-Shift, MRFs, Texture Segmentation

UNIT – IV

Motion Detection and Estimation: Regularization theory, Optical computation, Stereo Vision, Motion estimation, Background Subtraction and Modelling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation, Structure from motion,Motion Tracking in Video

UNIT – V

Object recognition: Hough transforms and other simple object recognition methods, Shapecorrespondence and shape matching, Principal component analysis, Shape priors for recognition

Applications of Computer Vision: Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle VisionSystems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics, stitchingand document processing

References:

1. D. Forsyth and J. Ponce, "*Computer Vision - A modern approach*", Prentice Hall
2. B. K. P. Horn, "*Robot Vision*", McGraw-Hill.
3. Richard Szeliksy *"Computer Vision: Algorithms and Applications"* (http://szeliski.org/Book/)
4. Haralick& Shapiro, "*Computer and Robot Vision*", Vol II
5. G. erardMedioni and Sing Bing Kang "*Emerging topics in computer vision*"
6. Emanuele Trucco and AllessandroVerri, *"Introductory Techniques for 3-D Computer Vision*", Prentice Hall, 1998.
7. Olivier Faugeras, *"Three-Dimensional Computer Vision*", The MIT Press, 1993

EC212

DSP ARCHITECTURE
(PROGRAM SPECIFIC ELECTIVE – I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:
- *To give an exposure to the various fixed point*
- *A floating-point DSP architecture and*
- *To develop applications using these processors.*

Outcomes: *At the end of this course, students will be able to:*
1. *Identify and formalize architectural level characterization of P-DSP hardware*
2. *Design and implement signal processing modules in DSPs*
3. *Ability to design, programming (assembly and C), and testing code using Code ComposerStudio environment*
4. *Deployment of DSP hardware for Control, Audio and Video Signal processingApplications*
5. *Understanding of major areas and challenges in DSP based embedded systems*

UNIT – I
Programmable DSP Hardware: Processing Architectures (von Neumann, Harvard), DSP corealgorithms (FIR, IIR, Convolution, Correlation, FFT), IEEE standard for Fixed- and Floating-Point Computations, Special Architectures Modules used in Digital Signal Processors (like MAC unit, Barrel shifters), On-Chip peripherals, DSP benchmarking.

UNIT – II
Structural and Architectural Considerations: Parallelism in DSP processing, Texas InstrumentsTMS320 Digital Signal Processor Families, Fixed Point TI DSP Processors: TMS320C1X and TMS320C2X Family, TMS320C25 –Internal Architecture, Arithmetic and Logic Unit, Auxiliary Registers, Addressing Modes (Immediate, Direct and Indirect, Bit-reverse Addressing), Basics of TMS320C54x and C55x Families in respect of Architecture improvements and new applications fields, TMS320C5416 DSP Architecture, Memory Map, Interrupt System, Peripheral Devices, Illustrative Examples for assembly coding.

UNIT – III
VLIW Architecture: Current DSP Architectures, GPUs as an alternative to DSP Processors,TMS320C6X Family, Addressing Modes, Replacement of MAC unit by ILP, Detailed study ofISA, Assembly Language Programming, Code Composer Studio, Mixed Cand AssemblyLanguage programming, On-chip peripherals, Simple applications developments as an embeddedenvironment.

UNIT – IV
Multi-core DSPs: Introduction to Multi-core computing and applicability for DSP hardware,Concept of threads, introduction to P-thread, mutex and similar concepts, heterogeneous andhomogenous multi-core systems, Shared Memory parallel programming –

OpenMP approach ofparallel programming, PRAGMA directives, OpenMP Constructs for work sharing like for loop,sections, TI TMS320C6678 (Eight Core subsystem).

UNIT – V

FPGA based DSP Systems: Limitations of P-DSPs, Requirements of Signal processing forCognitive Radio (SDR), FPGA based signal processing design-case study of a complete design of DSP processor.High Performance Computing using P-DSP: Preliminaries of HPC, MPI, OpenMP, multicore DSP as HPC infrastructure.

References:

1. B. Venkataramani & M. Bhaskar, *"Digital Signal Processor, Architecture, Programming and Applications"*,(2/e), McGraw- Hill,2010
2. S. Srinivasan & Avtar Singh, *"Digital Signal Processing, Implementations using DSP Microprocessors with Examples*", TMS320C54X, Brooks/Cole, 2004.
3. Sen M. Kuo & Woon-Seng S. Gan, *"Digital Signal Processors: Architectures, Implementations, and Applications",* Prentice Hall, 2004
4. C. Marven & G. Ewers, *"A Simple approach to digital signal processing*", Wiley Inter science, 1996.
5. R.A. Haddad & T.W. Parson, "*Digital Signal Processing: Theory, Applications and Hardware*", Computer Science Press NY, 1991.

EC 213

IOT AND APPLICATIONS
(PROGRAM SPECIFIC ELECTIVE – I)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Students will be explored to the interconnection*
- *Students will be explored to integration of the physical world and the cyber space.*
- *They are also able to design & develop IOT Devices.*

Outcomes: *At the end of this course, students 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.*
4. *Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks*
5. *Able to understand building blocks of Internet of Things and characteristics.*

UNIT – I

IoT& Web Technology the Internet of Things Today, Time for Convergence, Towards the IoTUniverse, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoTApplications, 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, IoTValue Chains, An emerging industrial structure for IoT, The international driven global valuechain and global information monopolies. M2M to IoT-An Architectural Overview– Building anarchitecture, 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 OperationalView, 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 toMaster IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT ForOil 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, 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

References:

1. Vijay Madisetti, Arshdeep Bahga,*"Internet of Things A Hands-On- Approach*",2014, ISBN:978 0996025515
2. Francis daCosta, *"Rethinking the Internet of Things: A Scalable Approach to ConnectingEverything"*, 1stEdition, Apress Publications, 2013.
3. CunoPfister, *"Getting Started with the Internet of Things"*, O_Reilly Media, 2011.
4. Adrian McEwen, *"Designing the Internet of Things",* Wiley Publishers, 2013, ISBN: 978-1-118-43062-0

EC 214

WIRELESS SENSOR NETWORKS
(PROGRAM SPECIFIC ELECTIVE – II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Wide range of applications such as disaster management, military and security have fueled the interest in sensor networks during the past few years. Sensors are typically capable of wireless communication and are significantly constrained in the amount of available resources such as energy, storage and computation. Such constraints make the design and operation of sensor networks considerably different from contemporary wireless networks, and necessitate the development of resource conscious protocols and management techniques.*
- *This course provides a broad coverage of challenges and latest research results related to the design and management of wireless sensor networks.*
- *Covered topics include network architectures, node discovery and localization, deployment strategies, node coverage, routing protocols, medium access arbitration, fault-tolerance, and network security.*

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

1. *Design wireless sensor network system for different applications under consideration.*
2. *Understand the hardware details of different types of sensors and select right type of sensor for various applications.*
3. *Understand radio standards and communication protocols to be used for wireless sensor network-based systems and application.*
4. *Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms.*
5. *Handle special issues related to sensors like energy conservation and security challenges.*

UNIT – I

Introduction and overview of sensor network architecture and its applications, sensornetwork comparison with Ad Hoc Networks, Sensor node architecture with hardware and software details.

UNIT – II

Hardware: Examples like mica2, micaZ, telosB, cricket, Imote2, tmote, btnode, and SunSPOT, Software (Operating Systems): tinyOS, MANTIS, Contiki, and RetOS.

UNIT – III

Programming tools: C, nesC. Performance comparison of wireless sensor networks simulation and experimental platforms like open source (ns-2) and commercial (QualNet, Opnet).

UNIT – IV

Overview of sensor network protocols (details of atleast 2 important protocol per layer):Physical, MAC and routing/ Network layer protocols, node discovery protocols, multi-hop and cluster based protocols, Fundamentals of 802.15.4, Bluetooth, BLE (Bluetooth low energy),UWB.

UNIT – V

Data dissemination and processing; differences compared with other database management systems, data storage; query processing. 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.

References:

1 H. Karl and A. Willig, *"Protocols and Architectures for Wireless Sensor Networks"*, John Wiley& Sons, India, 2012.

2 C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, *"Wireless Sensor Networks",* Springer Verlag, 1st Indian reprint, 2010.

3 F. Zhao and L. Guibas, *"Wireless Sensor Networks: An Information Processing Approach"*, Morgan Kaufmann, 1st Indian reprint, 2013.

4 YingshuLi, MyT. Thai, Weili Wu, "*Wireless sensor Network and Applications*", Springer series on signals and communication technology, 2008.

EC 215

BIOMEDICAL SIGNAL PROCESSING
(PROGRAM SPECIFIC ELECTIVE – II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To understand the basic signals in the field of biomedical. And study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG. 3.*
- *To understand Sources and characteristics of noise and artifacts in bio signals. 4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation 5.*
- *To explore research domain in biomedical signal processing. 6. To explore application of established engineering methods to complex biomedical signals problems.*

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

1. *Understand different types of biomedical signal.*
2. *Identify and analyze different biomedical signals.*
3. *Find applications related to biomedical signal processing*
4. *Model a biomedical system*
5. *Analyze ECG and EEG signal with characteristic feature points*

UNIT – I

Acquisition, Generation of Bio-signals, Origin of bio-signals, Types of bio-signals, Study of diagnostically significant bio-signal parameters

UNIT – II

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 DAC's) Processing, Digital filtering

UNIT – III

Biomedical signal processing by Fourier analysis, Biomedical signal processing by wavelet (time frequency) analysis, Analysis (Computation of signal parameters that are diagnostically significant).

UNIT – IV

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.

UNIT – V

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)Pattern classification–supervised and unsupervised classification, Neural networks, Support vector Machines, Hidden Markov models. Examples of biomedical signal classification examples.

References:

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.

EC 216

REMOTE SENSING
(PROGRAM SPECIFIC ELECTIVE – II)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *The course is designed to fulfill the following objectives 1. To provide exposure to students in gaining knowledge on concepts and applications leading to modeling of earth resources management using Remote Sensing*
- *To acquire skills in storing, managing digital data for planning and development.*
- *To acquire skills in advance techniques such as hyper spectral, thermal and LiDAR scanning for mapping, modeling and monitoring.*

Outcomes: *At the end of this course, students 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.*
3. *Fully equipped with concepts, methodologies and applications of Remote Sensing Technology.*
4. *Prepare the candidates for National and Global Employability*
5. *Acquire skills in handling instruments, tools, techniques and modeling while using Remote Sensing Technology and It empowers the candidate with confidence and leadership qualities.*

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 spacecraft's–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 -Opto mechanical 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 images 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.

Data Analysis: Resolution–Spatial, Spectral, Radiometric and temporal resolution-signalto 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.

References:

1 Lillesand T.M., and Kiefer,R.W, "*Remote Sensing and Image interpretation*", John Wiley & Sons-2000, 6thEdition

2 John R. Jensen, *"Introductory Digital Image Processing: A Remote Sensing Perspective*", 2nd Edition, 1995.

3 John A.Richards, *"Remote Sensing Digital Image Analysis",* 1999. Springer –Verlag

4 Paul Curran P.J, *"Principles of Remote Sensing",* ELBS; 1995.

5 Frederic k. lutgens, kennth G.pinzke and Edward j. tarbuck, *"Applications and Investigation in Earth science"*, 2008.

6 Glencoe science, "*Physical science with earth science*", 2005. 20

7 Sebins,F., "*Remote Sensing principles and interpretation*", W.H.Freeman and company Newyork 1987

EC 100

RESEARCH METHODOLOGY IN ECE

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To know the motivation on research philosophy and processes in general.*
- *To be able to formulate the problem statement and prepare research plan for the problem under investigation through literature.*
- *To be able to apply various techniques for data analysis and patenting*

Outcomes:

1. *Students able to understand research methodology and problems*
2. *Able to define the techniques involved in defining problem*
3. *Able to Developing a Research plan and research set up*
4. *Able to analyze the collection of data and statistical analysis*
5. *Able to have knowledge on writing the report and patenting*

UNIT – I

Objectives and Types of research: Objectives and Motivation of research- types of research-Research approaches – Significance of Research-Research Methods versus Methodology-Research and Scientific method- Importance of research methodology – Research process-criteria of good research- Problems encountered by Researchers in India-benefits to society in general.

UNIT – II

Research formulation: Defining and formulating the research problem, selecting the problem, importance of literature review in define a problem, literature review, primary and secondary sources, reviews, monograms, patents, research data bases web as a source, identifying gap areas from literature review and research data bases, devilment of working hypothesis

UNIT – III

Research Design and methods: Meaning of research design - need of research design-features of a gooddesign- important concepts relating to research design- different research designs- BasicPrinciples of experimental designs- Developing a Research plan-Exploration, descriptions diagnosis and experiment

UNIT – IV

Execution of the research and data collection: Aspect of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis, strategies and tool, data analysis with statistical packages (sigma STAT, SPSS for student test t-test, ANOVA, etc.) hypothesis testing, generalization and interpretation.

UNIT – V

Reporting and thesis writing: Structure and components of scientific reports, types of report, technical report and thesis. Thesis writing-different steps and software tools (word processing) in the design and preparation of thesis, layout, structure (chapter plan) and language of typical reports, illustrations and tables, bibliography, referencing and footnotes. Use of visual aids.

Patenting: The Basics of the Patent System, Patent Law, How to Read a Patent, Protecting Invention and Planning Patent Filing, Preparing Patent Application

References:

1 C.R.Kothari, "*Research methodology, Methods & technique*", New age international publishers, 2004.

2 R.Ganesan, "*Research Methodology for Engineers*", MJP Publishers: Chennai, 2011.

3 P.Ramdass and A.Wilson Aruni, *"Research and Writing across the disciplines",* MJP Publishers, Chennai 2009

4 Matthew Y Ma,"Fundamentals of Patenting and Licensing for Scientists and Engineers" 2nd Edition 2015

AC 031

ENGLISH FOR ACADEMIC AND RESEARCH WRITING
(AUDIT COURSE-I)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives: *To expose the students to...*

- *Features of Academic writing; different kinds of Academic writing*
- *Some academic writing skills; the research process; the structure of a research document*

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

1. *Academic writing features; Academic writing kinds; Important academic writing skills*
2. *The process of research; general research document structure*

UNIT – I
Features of Academic Writing
Language: Clear, Correct, Concise, Inclusive; **Tone**: Formal, Objective, Cautious; **Style**: Appropriate, Accurate, Organized; **Ethics**: Honesty, Integrity, Responsibility, Accountability.

UNIT – II
Kinds of Academic Writing: Essays, Reports, Reviews, Abstracts, Proposals.

UNIT – III
Academic Writing Skills
Paraphrasing; Summarizing; Quoting; Rewriting; Expansion.

UNIT – IV
Research Process
Selection of Topic, Formulation of Hypothesis, Collection of Data, Analysis of Data, Interpretation of Data, Presentation of Data.

UNIT – V
Structure of a Research Document
Title, Abstract, Introduction, Literature Survey, Methodology, Discussion, Findings/Results, Conclusion, Documenting Sources (IEEE style)

References:

1 Bailey, S. (2014). *Academic writing: A handbook for international students*. Routledge.
2 Gillett, A., Hammond, A., &Martala, M. (2009). *Inside track: Successful academic writing*. Essex: Pearson Education Limited.
3 Griffin, G. (2006). *Research methods for English studies*. Edinburgh: Edinburgh University Press.
4 Silyn-Roberts, Heather. (2013). *Writing for Science and Engineering: Papers, Presentations and Reports* (2nd Ed.). Elsevier.
5 Lipson, Charles (2011). *Cite right: A quick guide to citation styles; MLA, APA, Chicago, the sciences, professions, and more* (2nd Ed.). Chicago [u.a.]: University of Chicago Press.

AC 032

DISASTER MANAGEMENT
(AUDIT COURSE-I)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters*
- *To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters*
- *To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic, etc.*

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

1. *Learn to demonstrate a critical understanding of key concepts in disaster risk reduction*
2. *Humanitarian response*
3. *Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.*
4. *Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.*
5. *Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.*

UNIT – I

Introduction: Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

UNIT – II

Repercussions of Disasters and Hazards: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.
Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

UNIT – III

*Disasters Prone Areas in India:*Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.

UNIT – IV

Disaster Preparedness and Management
Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluationof Risk: Application of Remote Sensing, Data From Meteorological and OtherAgencies, Media Reports: Governmental and Community Preparedness.

UNIT – V

Risk Assessment

Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and NationalDisaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.

UNIT – VI

Disaster Mitigation

Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends inMitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

References:

1 R. Nishith, Singh AK, *"Disaster Management in India: Perspectives, issues and strategies"*, New Royal Book Company.
2 Sahni, Pardeep (Eds.), *"Disaster Mitigation Experiences and Reflections"*, PHI, New Delhi.
3 Goel S. L., *"Disaster Administration and Management Text and Case Studies",* Deep & Deep Publication Pvt. Ltd., New Delhi.

AC 033

SANSKRIT FOR TECHNICAL KNOWLEDGE
(AUDIT COURSE-I)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *To get a working knowledge in illustrious Sanskrit, the scientific language in the world*
- *Learning of Sanskrit to improve brain functioning*
- *Learning of Sanskrit to develop the logic in mathematics, science & other subjects*
- *enhancing the memory power*
- *The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature*

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

1. *Understanding basic Sanskrit language*
2. *Ancient Sanskrit literature about science & technology can be understood*
3. *Being a logical language will help to develop logic in students*

UNIT – I

- Alphabets in Sanskrit,
- Past/Present/Future Tense,
- Simple Sentences

UNIT – II

- Order
- Introduction of roots
- Technical information about Sanskrit Literature

UNIT – III

- Technical concepts of Engineering-Electrical, Mechanical,Architecture, Mathematics

References:

1 "*Abhyaspustakam*" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2 "*Teach Yourself Sanskrit*" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya SanskritSansthanam, New Delhi Publication
3 "*India's Glorious Scientific Tradition*" Suresh Soni, Ocean books (P) Ltd., New Delhi.

AC 034

VALUE EDUCATION
(AUDIT COURSE-I)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives: *Students will be able to*

- *Understand value of education and self- development*
- *Imbibe good values in students*
- *Let the should know about the importance of character*

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

1. *Knowledge of self-development*
2. *Learn the importance of Human values*
3. *Developing the overall personality*

UNIT – I

Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles .Value judgements

UNIT – II

Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline

UNIT – III

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking .Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth.Aware of self-destructive habits. Association and Cooperation.

UNIT – IV

Doing best for saving nature, Character and Competence –Holy books vs Blind faith, Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively

References:

1 Chakroborty, S.K., *"Values & Ethics for organizations Theory and practice*", Oxford University Press, New Delhi, 1998.

EC 251

ADVANCED DIGITAL SIGNAL PROCESSING LAB

Instruction: 3 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: 1.5

Objectives:

- *Design and implement a DSP system using tools like MATLAB*
- *Analyze and describe the functionality of a real-world DSP system and work in teams to plan and execute the creation of a complex DSP system*
- *Apply DSP system design to real world applications and implement signal processing algorithms on DSP processors.*

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

1. *Understand the handling of discrete/digital signals using MATLAB*
2. *Understand the basic operations of Signal processing*
3. *Analyze the spectral parameter of window functions*
4. *Design IIR, and FIR filters for band pass, band stop, low pass and high pass filters.*
5. *Design the signal processing algorithm using MATLAB & and implementation on DSP processor*

List of Experiments:

1. Basic Signal Representation
2. Correlation Auto and Cross
3. Stability Using Hurwitz Routh Criteria
4. Sampling FFT Of Input Sequence
5. Butterworth Low pass And High pass Filter Design
2. Chebychev Type I, II Filter
3. State Space Matrix from Differential Equation
4. Normal Equation Using Levinson Durbin
5. Decimation and Interpolation Using Rationale Factors
6. Maximally Decimated Analysis DFT Filter
7. Cascade Digital IIR Filter Realization
8. Convolution and M Fold Decimation &PSD Estimator
9. Estimation Of PSD
10. Inverse Z Transform
11. Group Delay Calculation
12. Separation Of T/F
13. Parallel Realization of IIR filter

EC 261

SEMINAR – I

Instruction: 3 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: 1.5

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

1. *Develop the habit of referring the journals for literature review.*
2. *Understand the gist of the research paper.*
3. *Identify the potential for further scope.*
4. *Present the work in an efficient manner.*
5. *Write the documentation in standard format.*

Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the Department.

Guidelines for awarding marks		
S. No.	**Description**	**Max. Marks**
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

Note:

1. The seminar presentation should be a gist of at least five research papers from **Peer-reviewed** or **UGC recognised** journals.
2. **The seminar report should be in the following order:** Background of work, literature review, techniques used, prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secure minimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.

SEMESTER – II
PATTERN RECOGNITION AND MACHINE LEARNING

EC 203

Instruction: 3 periods per week *Duration of SEE: 3hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To equip students with basic mathematical and statistical techniques commonly used in pattern recognition.*
- *To introduce students to a variety of pattern recognition algorithms.*
- *Enable students to apply machine learning concepts in real life problems.*

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

1. *Understand machine learning concepts and range of problems that can be handled by machine learning.*
2. *Compare and parameterize different learning algorithms.*
3. *Study the parametric and linear models for classification*
4. *Design neural network and SVM for classification*
5. *Develop machine independent and unsupervised learning techniques.*

UNIT – I

Introduction to Pattern Recognition: Problems, applications, design cycle, learning and adaptation, examples, Probability Distributions, Parametric Learning - Maximum likelihood and Bayesian Decision Theory- Bayes rule, discriminant functions, loss functions and Bayesian error Analysis.

UNIT – II

Linear models: Linear Models for Regression, linear regression, logistic regression Linear Models for Classification.

UNIT – III

Neural Network: perceptron, multi-layer perceptron, back propagation algorithm, error surfaces, practical techniques for improving back propagation, additional networks and training methods, Adaboost, Deep Learning.

UNIT – IV

Linear discriminant functions -decision surfaces, two-category, multi-category, minimum squared error procedures, the Ho-Kashyap procedures, linear programming algorithms, Support Vector machine.

UNIT – V

Algorithm independent machine learning– lack of inherent superiority of any classifier, bias and variance, re-sampling for classifier design, combining classifiers.

UNIT – VI

Unsupervised learning and clustering **–** k-means clustering, fuzzy k-means clustering, hierarchical clustering

References:

1 Richard O. Duda, Peter E. Hart, David G. Stork*, "Pattern Classification*", 2nd Edition John Wiley & Sons, 2001

2 Trevor Hastie, Robert Tibshirani, Jerome H. Friedman, *"The Elements of Statistical Learning",* 2nd Edition, Springer, 2009.

3 C. Bishop, "*Pattern Recognition and Machine Learning*", Springer, 2006.

EC 204

DETECTION AND ESTIMATION THEORY

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Use classical and Bayesian approaches to formulate and solve problems for parameter estimation from noisy signals.*
- *Use hypothesis testing and Bayesian approaches to formulate and solve problems for signal detection from noisy signals.*
- *Derive and apply linear filtering methods for parameter estimation and signal smoothing*

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

1. *Understand the mathematical background of signal detection and estimation*
2. *Use classical and Bayesian approaches to formulate and solve problems for signaldetection and parameter estimation from noisy signals.*
3. *Derive and apply filtering methods for parameter estimation.*
4. *Understand the mathematical background of signal detection and estimation*
5. *Use classical and Bayesian approaches to formulate and solve problems for signal detection and parameter estimation from noisy signals*

UNIT – I

Random Processes: Discrete Linear Models, Markov Sequences and Processes, Point Processes, and Gaussian Processes.

UNIT – II

Detection Theory: Basic Detection Problem, Maximum A posteriori Decision Rule, Minimum Probability of Error Classifier, Bayes Decision Rule, Multiple-Class Problem (Bayes)- minimum probability error with and without equal a priori probabilities, Neyman-Pearson Classifier, General Calculation of Probability of Error, General Gaussian Problem, Composite Hypotheses.

UNIT – III

Linear Minimum Mean-Square Error Filtering: Linear Minimum Mean Squared Error Estimators, Nonlinear Minimum Mean Squared Error Estimators. Innovations, Digital Wiener Filters with Stored Data, Real-time Digital Wiener Filters, Kalman Filters

UNIT – IV

Statistics: Measurements, Nonparametric Estimators of Probability Distribution and Density Functions, Point Estimators of Parameters, Measures of the Quality of Estimators, Introduction to Interval Estimates, Distribution of Estimators, Tests of Hypotheses, Simple Linear Regression, Multiple Linear Regression.

UNIT – V

Estimating the Parameters of Random Processes from Data: Tests for Stationarity and Ergodicity, Model-free Estimation, Model-based Estimation of Autocorrelation Functions, Power Special Density Functions.

References:

1. K. Sam Shanmugan & A.M. Breipohl, *"Random Signals: Detection, Estimation and Data Analysis"*, Wiley India Pvt. Ltd, 2011.
2. Lonnie C. Ludeman, *"Random Processes: Filtering, Estimation and Detection"*, Wiley India Pvt. Ltd., 2010.
3. Steven.M.Kay, *"Fundamentals of Statistical Signal Processing: Volume I Estimation Theory*", Prentice Hall, USA, 1998.
4. Steven.M.Kay, *"Fundamentals of Statistical Signal Processing: Volume I Detection Theory Prentice"*, Hall, USA, 1998.
5. Srinath, Rajasekaran, Viswanathan, *"Introduction to Statistical Signal Processing with Applications*", 2003, PHI.
6. Louis L.Scharf, *"Statistical Signal Processing: Detection, Estimation and Time Series Analysis"*, 1991, Addison Wesley.
7. Harry L. Van Trees, *"Detection, Estimation and Modulation Theory: Part – I",* 2001, John Wiley & Sons, USA.
8. Mischa Schwartz, Leonard Shaw, *"Signal Processing: Discrete Spectral Analysis – Detection & Estimation"*, 1975, Mc Graw Hill.

EC 114

WIRELESS AND MOBILE COMMUNICATIONS
(PROGRAM SPECIFIC ELECTIVE – III)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *An overview of key wireless technologies: Various generations of mobile communications for voice and data, cordless, paging, fixed and mobile broadband wireless systems, and beyond*
- *Wireless system design fundamentals: channel assignment, handoffs, interference, frequency reuse, capacity planning, large-scale fading, and Outdoor, Indoor propagation models and Path loss, small-scale fading, multipath, reflection, diffraction, scattering and Various statistical models for small-scale fading study*
- *Various Diversity techniques, Equalizers used in communication receivers, Multiple Access techniques and their applications in wireless networks*

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

1. *Develop design models for cellular systems.*
2. *Analyze the various Large-scale fading effects in designing propagation models for Mobile communications in Outdoor environments.*
3. *Analyze the various types of Small-scale fading, measurement techniques, Parameters of multi-path radio and Statistical models.*
4. *Understand Various Diversity techniques and Equalizers used in communication receivers.*
5. *Develop the design models for various multiple access techniques and understand their spectral efficiencies.*

UNIT – I

Introduction to Wireless Communication Systems and the Cellular Concept
Evolution of Mobile Radio Communications, Examples of Wireless Communication Systems, Overview of 1G,2G, 2.5 G,3 G, 4G and 5G Cellular networks.
The Cellular Concept: Introduction, Frequency Reuse, Channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Improving Coverage and Capacity in cellular systems.

UNIT – II

Mobile Radio Propagation: Large-Scale Path Loss: Introduction to Radio wave propagation, Free space propagation model, Relating Power to Electric Field, the three basic propagation mechanisms- Reflection, Ground Reflection (Two Ray) model, Diffraction, Scattering.
Outdoor propagation models: Longley-Rice model, Okumura model, Hata model, PCS Extension to Hata model, Walfisch and Bertoni Model, Wideband PCS Microcell model.
Indoor propagation models: Partition losses (same floor), Partition losses between floors, Log-distance path loss model, Ericsson multiple breakpoint model, Attenuation factor model, and Signal penetration into buildings.

UNIT – III

Mobile Radio Propagation: Small Fading and Multipath: Small scale multipath propagation, Factors influencing small scale fading, Doppler shift, Small scale multipath Measurements-Direct RF Pulse System, Spread Spectrum Sliding correlator Channel Sounding, Frequency Domain Channels Sounding, Parameters of Mobile multipath channels, Types of Small Scale Fading, Statistical models for multipath Fading Channels-Clarke's model for flat fading, spectral shape due to Doppler, Level Crossings and Fading Statistics, Two-ray Rayleigh Fading model.

UNIT – IV

Equalization and Diversity: Introduction, Fundamentals of Equalization, Training a Generic Adaptive Equalizer, Equalizers in a communication Receiver, Linear Equalizers, Nonlinear Equalization-Decision Feedback Equalization (DFE), Maximum Likelihood Sequence Estimation (MLSE) Equalizer, Algorithms for adaptive equalization

Diversity Techniques: Practical Space Diversity Considerations, Selection Diversity, Scanning Diversity, Maximal Ratio Combining, Equal Gain Combining, Polarization Diversity, Frequency Diversity, Time Diversity, RAKE Receiver.

UNIT – V

Multiple Access Techniques for Wireless Communications: FDMA, TDMA, Spread Spectrum Multiple Access- FHMA and CDMA, SDMA, Spectral efficiency analysis for Multiple Access Technologies: FDMA, TDMA and CDMA Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.

References:

1. Theodore, S. Rappaport, *"Wireless Communications, Principles and Practice"*, 2nd Ed., 2002, PHI publication.
2. 2. Andrea Goldsmith, *"Wireless Communications*", 2005, Cambridge University Press.
3. Kaveh pah Laven and P.Krishna Murthy, *"Principles of Wireless networks",* 2002, PE.
4. P.Nicopolitidis, M.S.Obaidat, G.I.Papadimitriou, A.S.Pomportsis, *"Wireless Networks"*, 200, John Wiley & Sons Pte Ltd.
5. Ashok Raj, *"Wireless Communication*", First Edition, 2014, Khanna Publishers.

EC 217

AUDIO PROCESSING
(PROGRAM SPECIFIC ELECTIVE – III)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To introduce the models of speech production and acoustic phonetics*
- *To teach time and frequency domain techniques for estimating speech parameters and teach predictive techniques for speech coding*
- *To introduce speech recognition and speech synthesis applications Course Outcomes*

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

1. *Understand different characteristics of Speech.*
2. *Identify and analyze different speech analysis system.*
3. *Write algorithms for Recognition of speech.*
4. *Demonstrate basic knowledge in speech production mechanism, phoneme classification, digital models for speech production, Homomorphic speech processing and LPC analysis*
5. *Demonstrate applications of signal processing theory for estimation of speech parameters in time and frequency domain including pitch and formants*

UNIT – I

The process of speech production: Production Mechanism and acoustic phonetics. Digital models for speech signals: Vocal Tract, Radiation, Excitation and complete model speech perception: Loudness, Bark Scale, masking, perception and Psychoacoustics.

UNIT – II

Short-time Period analysis: Short-time energy, Average magnitude, zero crossing, Speech vs Silence discrimination and zero crossing rate, Pitch period estimation using parallel processing approach. Autocorrelation function, Pitch period estimation using Auto correlation function, The average magnitude function, median smoothing. Short time Fourier Analysis: Fourier transform interpretation, linear filtering interpretation, sampling rates in time and frequency, Filter banks, Spectrograms, pitch detection. Cepstral analysis, Complex and real cepstrum, pitch detection and Formant estimation.

UNIT – III

Digital speech representation and coding: Review of PCM, adaptive PCM, differential PCM, delta modulation. Linear Predictive coding (LPC) analysis: Basic principles, autocorrelation and covariance methods, Computation of LP coefficients, Cholesky decomposition, Durbin's recursive solution, Frequency domain interpretation of LPC, CELP.

UNIT – IV

Analysis by synthesis: Phase vocoder, subband coding, Formant/homomorphic vocoder, cepstralvocoder, vector Quantizer coder, Speech Enhancement techniques: Spectral subtraction, enhancement by resynthesis.

UNIT – V

Automatic speech recognition: Basic pattern recognition approaches, Evaluating the similarity of speech patterns, Dynamic Time Warping (DTW), HMM's for speech recognition, forward, backword algorithms and parameter estimation. Speaker recognition Features that distinguish speakers.

References:

1 Rabinar and Schafer, "*Digital Processing of Speech Signals",* Pearson Education, 2004.

2 Deller, Hansen, Proakis, *"Discrete-Time Processing of Speech signals*", IEEE presses, 2000

3 R & J Rabinar and Juang, *"Fundamentals of speech recognition",* Prentice Hall, 1993.

4 Douglas O'Shaughnessy, *"Speech Communication: Human and Machine*", 2nd ed., University press, Hyderabad, 2001.

EC218

VOICE AND DATA NETWORKS
(PROGRAM SPECIFIC ELECTIVE – III)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To understand the network design and performance issues*
- *To differentiate between layered and layered less communication*
- *To familiarize with query models and internetwork.*

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

1. *Protocol, algorithms, trade-offs rationale.*
2. *Routing, transport, DNS resolutions*
3. *Network extensions and next generation architectures.*
4. *QoS and packet scheduling algorithms*
5. *To understand the inter-networking and packet scheduling*

UNIT – I

Network Design Issues, Network Performance Issues, Network Terminology, centralizedand distributed approaches for networks design, Issues in design of voice and data networks.

UNIT – II

Layered and Layer less Communication, Cross layer design of Networks, Voice Networks (wired and wireless) and Switching, Circuit Switching and Packet Switching, StatisticalMultiplexing.

UNIT – III

Data Networks and their Design, Link layer design- Link adaptation, Link LayerProtocols, Retransmission. Mechanisms (ARQ), Hybrid ARQ (HARQ), Go Back N, SelectiveRepeat protocols and their analysis.

UNIT – IV

Queuing Models of Networks, Traffic Models, Little's Theorem, Markov chains, M/M/1and other Markov systems, Multiple Access Protocols, Aloha System, Carrier Sensing,Examples of Local area networks,

UNIT – V

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet. End to EndProtocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, SlowStart, Fast Retransmit/ Fast Recovery, Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

References:

1 D. Bertsekas and R. Gallager, *"Data Networks*", 2nd Edition, Prentice Hall, 1992.

2 L. Peterson and B. S. Davie, *"Computer Networks: A Systems Approach",*5th Edition,
Morgan Kaufman, 2011.

3 Kumar, D. Manjunath and J. Kuri, *"Communication Networking: An analytical approach"*, 1st Edition, Morgan Kaufman, 2004.

4 Walrand, *"Communications Network: A First Course*", 2nd Edition, McGraw Hill, 2002.

5 Leonard Kleinrock, *"Queueing Systems, Volume I: Theory"*, 1st Edition, John Wiley andSons, 1975.

6 Aaron Kershenbaum, "*Telecommunication Network Design Algorithms",* McGraw Hill, 1993.

EC 219

ADAPTIVE SIGNAL PROCESSING
(PROGRAM SPECIFIC ELECTIVE – IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To understand the basics of adaptive system*
- *To make familiar with gradient search algorithms and functions*
- *To introduce LMS & RLS algorithms*

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

1. *To understand theory of different filters and algorithms*
2. *To understand theory of multirate DSP, solve numerical problems and write algorithms*
3. *To understand theory of prediction and solution of normal equations*
4. *To know applications of DSP at block level.*
5. To understand Kalman Filter theory

UNIT – I

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

UNIT – II

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

UNIT – III

Applications of adaptive filter to adaptive noise cancelling Echo cancellation in telephone circuits and adaptive beam forming.

UNIT – IV

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

UNIT – V

Vector Kalman filter formulation. Examples. Applications of kalman filter to target tracking.

References:

1 Sophoclas, *J*. Orphanidies, *"Optimum signal processing an introduction*", McMillan,1985
2 Simon Haykins, *"Adaptive signal processing",* PHI, 1986.
3 Bernard Widrow, *"Adaptive signal processing",* PHI, 1986.
4 Bozic. SM., "Digital and Kalman Filtering"

EC 220

ARTIFICIAL NEURAL NETWORKS
(PROGRAM SPECIFIC ELECTIVE – IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To understand the biological neural network and to model equivalent neuron models.*
- *To understand the architecture, learning algorithm and issues of various feed forward and feedback neural networks*
- *To gain knowledge on applications of ANN*

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

1. *learn the ideological basics of artificial neural networks*
2. *Create different neural networks of various architectures*
3. *Learn supervised learning and unsupervised learning.*
4. *Learn SOM in ANN*
5. *To know some application of artificial neural networks*

UNIT – I

*Introduction:*A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process.

UNIT – II

Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron –Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection.

UNIT – III

Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning.

UNIT – IV

Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification.

UNIT – V

Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network Paradigm Hopfield Models – Hopfield Models, Computer Experiment

References:

1 Simon Haykin, "*Neural Networks a Comprehensive Foundations*", PHI edition.
2 B. Vegnanarayana, "*Artificial Neural Networks",*Prentice Hall of India P Ltd 2005
3 Li Min Fu, "*Neural Networks in Computer Inteligance*", MCGRAWHILL EDUCATION 2003
4 James A Freeman David M S Kapura, "*Neural Networks",*Pearson Education 2004.
5 Jacek M. Zurada, "*Introduction to Artificial Neural Systems",* JAICO Publishing House Ed. 2006.

EC221

OPTIMIZATION TECHNIQUES
(PROGRAM SPECIFIC ELECTIVE – IV)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To introduce various optimization techniques i.e classical, linear programming, transportation problem, simplex algorithm, dynamic programming*
- *Constrained and unconstrained optimization techniques for solving and optimizing an electrical and electronic engineering circuits design problems in real world situations*
- *To explain the concept of Dynamic programming and its applications to project implementation*

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

1. *Explain the need of optimization of engineering systems*
2. *Understand optimization of electrical and electronics engineering problems*
3. *Apply classical optimization techniques, linear programming, simplex algorithm, transportation problem*
4. *Apply unconstrained optimization and constrained non-linear programming and dynamic programming*
5. *Formulate optimization problems.*

UNIT – I

Use of optimization methods. Introduction to classical optimization techniques, motivationto the simplex method, simplex algorithm, sensitivity analysis.

UNIT – II

Search methods - Unrestricted search, exhaustive search, Fibonocci method, Golden sectionmethod, Direct search method, Random search methods, Univariate method, simplex method, Pattern search method.

UNIT – III

Descent methods, Gradient of function, steepest decent method, conjugate gradient method.Characteristics of constrained problem, Direct methods, The complex method, cutting plane method.

UNIT – IV

Review of a global optimization techniques such as Monte Carlo method, Simulatedannealing and Tunneling algorithm.

UNIT – V

Generic algorithm - Selection process, Crossover, Mutation, Schema theorem, comparisonbetween binary and floating-point implementation.

References:

1 SS Rao, *"Optimization techniques*", PHI, 1989
2 Zhigmiew Michelewicz, *"Genetic algorithms + data structures = Evaluation programs"*, Springer Verlog - 1992.
3 Merrium C. W., *"Optimization theory and the design of feedback control systems"*, McGraw Hill, 1964.
4 Weldo D.J., *"Optimum seeking method",* PHI, 1964.

AC 035

STRESS MANAGEMENT BY YOGA
(AUDIT COURSE –II)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *To achieve overall health of body and mind.*
- *To overcome stress.*

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

1. *Develop healthy mind in a healthy body thus improving social health also*
2. *Improve efficiency.*

UNIT – I

Introduction: Definition of **Stress** – Types of stress : Acute and chronic - Stressors – Definition of **Yoga** from various sources – Types of yoga – Karma yoga, Gnana yoga, Bhakti yoga and Raja yoga – Concept of Bhagavad Geeta - Yoga versus exercise –Basics of Physiology and Psycholoy – Brain and its parts – CNS and PNS – HPA axis – Sympethetic and Para sympethetic nervous systems – Fight and Flight mechanism - Relationship between stress and yoga.

UNIT – II

Ashtanga Yoga: Do`s and Don'ts in life: i) **Yam -** Ahinsa, satya, astheya, bramhacharya and aparigraha ii) **Niyam -**Shaucha, santosh, tapa, swadhyay, ishwarpranidhan -iii) **Asana** iv) **Pranayama** v) **Prathyahara** vi) **Dharana** vii) **Dhyana** viii) **Samadhi** – Illustrations of eight steps of Ashtanga yoga.

UNIT – III

*Asana and Stress:*Definition of Asana from Pathanjali – Origin of various names of asanas - Various yog poses and their benefits for mind & body – Sequence of performing asanas: Standing, sitting, lying down on stomach, lying down on back and inverted postures – Activation of Annamaya kosha – Effect on various chakras, systems and glands thereby controlling the stress levels through the practice of asanas

UNIT – IV

Pranayama and Stress: Definition of pranayama from Shankaracharya - Regularization of breathing techniques and its effects - Types of pranayama – Heat generating and cold generating techniques – Pranayama versus chakras and systems – Breathing techniques versus seasons - Anger and breathing rate – Activation of pranamaya kosha – Pranayama as the bridge between mind and body – Stress control through pranayama.

UNIT – V

Dhyana and Stress: Distinction between Dhyana and Dharana– Preparation for Dhyana through prathyahara and dharana – Activation of Vignanamaya kosha – Types of mind: conscious, superconscious and subconscious – Activation of manomaya kosha through Dhyana – Silencing the mind thereby controlling the stress levels

References:

1 '*Yogic Asanas for Group Tarining-Part-I*' : Janardan Swami Yogabhyasi Mandal, Nagpur
2 "*Rajayoga or conquering the Internal Nature*" by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata
3 Light on yoga by BKS Iyengar
4 "*The search for happiness and bliss*" by Swami Sarvapriyananda on you tube – https://youtu.be/xfywJTPkw7Y
5 "*Mastering the mind*" by Swamini Vimalananda on you tube - https://youtu.be/EXniWH9DMF8

AC 036

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS (AUDIT COURSE –II)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *To learn to achieve the highest goal happily*
- *To become a person with stable mind, pleasing personality and determination*
- *To awaken wisdom in students*

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

1. *Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.*
2. *The person who has studied Geeta will lead the nation and mankind to peace and prosperity*
3. *Study of Neetishatakam will help in developing versatile personality of students.*

UNIT – I

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

UNIT – II

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

UNIT – III

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta : Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta : Chapter2-Verses 17,Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

References:

1 Swami Swarupananda Advaita Ashram "*Srimad Bhagavad Gita",* (Publication Department), Kolkata

2 P.Gopinath, *"Bhartrihari's Three Satakam (Niti-sringar-vairagya*)", Rashtriya Sanskrit Sansthanam, New Delhi

AC 037

CONSTITUTION OF INDIA
(AUDIT COURSE –II)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective*
- *To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.*
- *To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.*

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

1. *Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.*
2. *Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India*
3. *Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.*
4. *Discuss the passage of the Hindu Code Bill of 1956.*

UNIT – I

History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working)

UNIT – II

Philosophy of the Indian Constitution: Preamble and Salient Features.

UNIT – III

• **Contours of Constitutional Rights & Duties:**
  - Fundamental Rights
  - Right to Equality
  - Right to Freedom
  - Right against Exploitation
  - Right to Freedom of Religion
  - Cultural and Educational Rights
  - Right to Constitutional Remedies
  - Directive Principles of State Policy
  - Fundamental Duties.

UNIT – IV

• Organs of Governance:
  - Parliament
  - Composition

- Qualifications and Disqualifications
- Powers and Functions
- Executive
- President
- Governor
- Council of Ministers
- Judiciary, Appointment and Transfer of Judges, Qualifications
- Powers and Functions

UNIT – V

• Local Administration:
- District's Administration head: Role and Importance,
- Municipalities: Introduction, Mayor and role of Elected Representative, CE of Municipal Corporation.
- Pachayati raj: Introduction, PRI: ZilaPachayat.
- Elected officials and their roles, CEO ZilaPachayat: Position and role.
- Block level: Organizational Hierarchy (Different departments),
- Village level: Role of Elected and Appointed officials,
- Importance of grass root democracy

UNIT-VI

- **Election Commission:**
- Election Commission: Role and Functioning.
- Chief Election Commissioner and Election Commissioners.
- State Election Commission: Role and Functioning.
- Institute and Bodies for the welfare of SC/ST/OBC and women.

References:

1 *"The Constitution of India",* 1950 (Bare Act), Government Publication.
2 Dr. S. N. Busi, *"Dr. B. R. Ambedkar framing of Indian Constitution",* 1st Edition, 2015.
3 M. P. Jain, "*Indian Constitution Law",* 7th Edn. Lexis Nexis, 2014.
4 D.D. Basu, *"Introduction to the Constitution of India",* Lexis Nexis, 2015.

AC 038

PEDAGOGY STUDIES
(AUDIT COURSE –II)

Instruction: 2 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 00

Objectives:

- *Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.*
- *Identify critical evidence gaps to guide the development.*

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

1. *What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?*
2. *What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?*
3. *How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?*

UNIT – I

Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions, Overview of methodology and Searching.

UNIT – II

Thematic Overview: Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT – III

*Evidence on the Effectiveness of Pedagogical Practices***:** Methodology for the in depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches – Teachers attitudes and beliefs and pedagogic strategies.

UNIT – IV

Professional Development: Alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

UNIT – V

Research Gaps and Future Directions: Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

References:

1 Ackers J, Hardman F, *"Classroom Interaction in Kenyan Primary Schools, Compare*", 31 (2): 245 – 261, 2001.

2 Agarwal M, *"Curricular Reform in Schools: The importance of evaluation*", Journal of Curriculum Studies, 36 (3): 361 – 379, 2004.

3 Akyeampong K, "*Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER)",* Country Report 1. London: DFID, 2003.

4 Akyeampong K, Lussier K, Pryor J, Westbrook J, *"Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count?"*International Journal Educational Development, 33 (3): 272- 282, 2013.

5 Alexander R J, *"Culture and Pedagogy: International Comparisons in Primary Education",* Oxford and Boston: Blackwell, 2001.

6 Chavan M, Read India: *"A mass scale, rapid, learning to read campaign",* 2003

7 www.pratham.org/images/resource%20working%20paper%202.pdf.

DIGITAL IMAGE AND VIDEO PROCESSING LABORATORY

EC 252

Instruction: 3 periods per week *Duration of SEE: --*

CIE: 50 marks *SEE: --*

Credits: 1.5

Objectives:

- *Understand the basics of image processing system and the concepts of image transforms.*
- *Gain knowledge in applying image and video processing algorithms to enhance images.*
- *Gain complete knowledge about image compression and segmentation*

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

1. *Analyse relationship between pixels in images and able to apply proper image transform on digital images for the intended application.*
2. *Apply filtering operations to remove noise in images and to segment the digital images.*
3. *Apply proper compression techniques on images to save storage space.*
4. *Analyse the features of the image*
5. *Use MATLAB to perform video processing applications*

List of experiments

1. Perform basic operations on images like addition, subtraction etc.
2. Plot the histogram of an image and perform histogram equalization
3. Implement segmentation algorithms
4. Perform video enhancement
5. Perform video segmentation
6. Perform image compression using lossy technique
7. Perform image compression using lossless technique
8. Perform image restoration
9. Convert a colour model into another
10. Calculate boundary features of an image
11. Calculate regional features of an image
12. Detect an object in an image/video using template matching/Bayes classifier

EC 262

SEMINAR – II

Instruction: 3 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: 1.5

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

1. *Develop the habit of referring the journals for literature review.*
2. *Understand the gist of the research paper.*
3. *Identify the potential for further scope.*
4. *Present the work in an efficient manner.*
5. *Write the documentation in standard format.*

Seminar topics may be chosen by the students with advice from the faculty members and the student shall read further relevant articles in the domain.

The seminar must be clearly structured and the power point presentation shall include following aspects:

1. Introduction to the field
2. Literature survey
3. Consolidation of available information
4. Summary and Conclusions
5. References

Each student is required to:

1. Deliver the seminar for a maximum duration of 30 minutes, where the presentation should be for 20 minutes in PowerPoint, followed by Question and Answers session for 10 minutes.
2. Submit the detailed report of the seminar in spiral bound in a précised format as suggested by the Department.

Guidelines for awarding marks		
S. No.	**Description**	**Max. Marks**
1	Contents and relevance	10
2	Presentation skills	10
3	Preparation of PPT slides	05
4	Questions and answers	05
5	Report in a prescribed format	20

Note:

1. The seminar presentation should be a gist of at least five research papers from **Peer-reviewed** or **UGC recognised** journals.
2. **The seminar report should be in the following order:** Background of work, literature review, techniques used, prospective deliverables, discussion on results, conclusions, critical appraisal and reference.
3. At least two faculty members will be associated with the seminar presentation to evaluate and award marks.
4. Attendance of all the students for weekly seminar presentations is compulsory. If the student fails to secure minimum attendance as per O.U. rules, the marks awarded in the seminar presentation shall remain void.

MINI PROJECT

EC 070

Instruction: 6 periods per week *Duration of SEE: --*
CIE: 50 marks *SEE: --*
Credits: 3

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

1. *Formulate a specific problem and give solution*
2. *Develop model/models either theoretical/practical/numerical form*
3. *Solve, interpret/correlate the results and discussions*
4. *Conclude the results obtained*
5. *Write the documentation in standard format*

Guidelines:

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter-disciplinary/ industry relevance.
- The students can select a mathematical modeling based/Experimental investigations or Numerical modeling
- All the investigations should be clearly stated and documented with the reasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	20	Progress and Review
	05	Report
Departmental Committee	05	Relevance of the Topic
	05	PPT Preparation
	05	Presentation
	05	Question and Answers
	05	Report Preparation

SEMESTER – III

EC 222

CODING THEORY AND TECHNIQUES
(PROGRAM ELECTIVE – V)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Learn about Importance of Information and Error Control*
- *Describe Linear Block Codes and Applications and learn Cyclic Coding and BCH codes*
- *Design Convolutional Encoders and explore latest trends in Coding Theory*

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

1. *Analyse the source of errors present in communication systems*
2. *Perform Error detection and correction using Linear Block Codes*
3. *Differentiate between Linear Block Codes and Cyclic Codes*
4. *Analyse behaviour of convolution encoders*
5. *Design Turbo Encoders/Decoders and LDPC Encoders/Decoders*

UNIT – I

Coding for Reliable Digital Transmission and Storage: Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

UNIT – II

Linear Block Codes: Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Applications of Block codes.

UNIT – III

Cyclic Codes: Generator and parity-check matrices of cyclic codes, Syndrome computation and error detection. Binary BCH codes, Decoding of BCH codes and Reed Solomon codes.

UNIT – IV

Convolutional Codes: Polynomial description of convolution code, Generator matrix of convolution code, State diagram, Tree diagram, Trellis diagram, Sequential decoding and Viterbi decoding.

UNIT – V

Turbo Coding: Introduction to turbo coding, Performance analysis of Turbo codes, Design of Turbo codes, decoding of Turbo codes, Introduction to LDPC Codes, Tanner graph for Linear Block codes.

References:

1 Shu Lin, Daniel J., Costello, Jr., "*Error Control Coding"*, 2nd edition, Pearson, 2011.
2 Simon Haykin, "*Communication Systems"*, 4th Edition, John Wiley & Sons, 2007.
3 Proakis J.G. & M. Salehi, "*Digital Communications"*, Mc Graw-Hill, 2008.
4 Biglieri E., "*Coding for Wireless Channels"*, Springer, 2007.

EC 111

ADVANCED COMPUTER ARCHITECTURE
(PROGRAM ELECTIVE – V)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:
- *To Design Basic Data Path Unit (DPU) and Control Unit (CU) and to Familiarize with Parallel Processing Architectures*
- *To Develop OpenCL Programming Environment and developing Kernel Programming*
- *To Know Heterogeneous Architectures*

Outcomes: *At the end of this course, students will be able to:*
1. *To Realize Data Path Unit (DPU) and Control Unit (CU)*
2. *To Analyze the Performance of Multi-Core Architectures*
3. *To Demonstrate OpenCL Programs for real time applications*
4. *To Implement Kernels for Heterogeneous Architectures in OpenCL*
5. *To List and Describe the Challenges in Advanced Parallel Processing Architectures*

UNIT – I
Processor Design:
CPU Design– CPU Organization – Data Path Design: Fixed Point Booth's Multiplier, Restoring Division Unit and Non-Restoring Division Unit.
Memory Hierarchy **–** Virtual Memory – Cache Memory
Control Unit Design – Hardwired Control Unit Design of Basic CPU.
Case Studies: Verilog HDL Implementation of Booth's Multiplication, Restoring and Non-Restoring Division and Hardwired Control Unit Realization of Basic CPU.

UNIT – II
Multi Core Architectures:
RISC, CISC, Flynn's Classification, Instruction Level Parallelism: Super Scalar, VLIW and EPIC architectures. Scalable, Multithreaded and Dataflow Architectures: Principles of Multithreading, Fine-Grain Multithreading, Scalable and Multithreaded Architectures and Dataflow and Hybrid Architectures.
*Case Studies:*Threads and OpenMP

UNIT – III
Accelerated Architectures:
GPU: nVidia and AMD Architecture – GPU memory and Scheduling, Parallel Programming Development and Environment: MPI – CUDA – OpenCL: Introduction, Platform and Devices, Execution Environment and Memory Model
Case Studies: OpenCL programming.

UNIT – IV
Low Power Architectures: System on Chip Architectures – Raspberry-Pi, nVidia SoC – Basics of Kernels: Kernels, Work-items, Work-groups and Execution Domain, OpenCL Synchronization
Case Studies: Programming on Raspberry Pi.

UNIT – V

Advances in Parallel Processor Architectures:

Hybrid Architectures– Issues and Challenges in Heterogeneous Computing, Schedulers, Process Synchronization and Programming

Virtualization– Processor and Memory

*Case Studies:*Hybrid Programming using CPU and GPU

References:

1. Hayes John P, "*Computer Architecture and organization,"* 3rd edition, McGraw Hill Education, 1998.
2. William Stallings, *"Computer Organization and Architecture: Designing for Performance",* 8th edition, PHI, 2007.
3. Hwang and Naresh Jotwani, *"Advanced Computer Architecture: Parallelism, Scalability and Programmability*," McGraw Hill Education, 2017.
4. Benedict Gaster, Lee Howes, David R. Kaeli, Perhaad Mistry and Dana Schaa, *"Heterogeneous Computing with OpenCL,"* Morgan Kaufmann Publications, 2011.

EC223

MULTISPECTRAL SIGNAL ANALYSIS
(PROGRAM ELECTIVE – V)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To understand the concept of image processing and its applications*
- *To understand the mutual information*
- *To familiarize with ICA and support vector machine*

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

1. *Select appropriate hyper spectral data for a particular application.*
2. *Understand basic concepts of data acquisition and image processing tasks required for multi and hyper spectral data analysis*
3. *Learn techniques for classification and analysis of multi and hyperspectral data.*
4. *To understand the concepts of Independent component analysis*
5. *To understand the basic concepts of support vector machines and its applications*

UNIT – I

*Hyperspectral Sensors and Applications***:** Introduction, Multi-spectral Scanning Systems (MSS),Hyperspectral Systems, Airborne sensors, Space borne sensors, Ground Spectroscopy, Software for Hyperspectral Processing, Applications, Atmosphere and Hydrosphere, Vegetation, Soils and Geology, Environmental Hazards and Anthropogenic Activity.

UNIT – II

*Overview of Image Processing***:** Introduction, Image File Formats, Image Distortion and Rectification, Radiometric Distortion, Geometric Distortion and Rectification, Image Registration, Image Enhancement, Point Operations, Geometric Operation, Image Classification, Supervised Classification, Unsupervised Classification, Crisp Classification Algorithms, Fuzzy Classification Algorithms, Classification Accuracy Assessment, Image Change Detection, Image Fusion, Automatic Target Recognition.

UNIT – III

Mutual Information: A Similarity Measure for Intensity Based Image Registration: Introduction, Mutual Information Similarity Measure, Joint Histogram Estimation Methods, Two-Step Joint Histogram Estimation, One-Step Joint Histogram Estimation, Interpolation Induced Artifacts, Generalized Partial Volume Estimation of Joint Histograms, Optimization Issues in the Maximization of MI.

UNIT – IV

Independent Component Analysis: Introduction, Concept of ICA, ICA Algorithms, Pre-processing using PCA, Information Minimization Solution for ICA, ICA Solution through Non-Gaussianity Maximization, Application of ICA to Hyper spectral Imagery, Feature Extraction Based Model, Linear Mixture Model Based Model, An ICA algorithm for Hyperspectral Image Processing, Applications using ICA.

UNIT – V

Support Vector Machines : Introduction, Statistical Learning Theory, Empirical Risk Minimization, Structural Risk Minimization, Design of Support Vector Machines, Linearly Separable Case, Linearly Non-Separable Case, Non-Linear Support Vector Machines, SVMs for Multiclass Classification, One Against the Rest Classification, Pair wise Classification, Classification based on Decision Directed Acyclic Graph and Decision Tree Structure, Multiclass Objective Function, optimization Methods, Applications using SVM.

References:

1 Pramod K. Varshney, Manoj K. Arora, *"Advanced Image Processing Techniques for Remotely Sensed Hyperspectral Data"*, Springer Science & Business Media

2 S. Svanberg, *"Multi-spectral Imaging– from Astronomy to Microscopy",* from Radio waves to Gamma rays

3 Christopher Bishop, *"Pattern Recognition and Machine Learning",* Mcgraw-Hill

OE 941

BUSINESS ANALYTICS
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Understanding the basic concepts of business analytics and applications*
- *Study various business analytics methods including predictive, prescriptive and prescriptive analytics*
- *Prepare the students to model business data using various data mining, decision making methods*

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

1. *To understand the basic concepts of business analytics*
2. *Identify the application of business analytics and use tools to analyze business data*
3. *Become familiar with various metrics, measures used in business analytics*
4. *Illustrate various descriptive, predictive and prescriptive methods and techniques*
5. *Model the business data using various business analytical methods and techniques*

UNIT – I

Introduction to Business Analytics: Introduction to Business Analytics, need and science of data driven (DD) decision making, Descriptive, predictive, prescriptive analytics and techniques, Big data analytics, Web and Social media analytics, Machine Learning algorithms, framework for decision making, challenges in DD decision making and future.

UNIT – II

Descriptive Analytics: Introduction, data types and scales, types of measurement scales, population and samples, measures of central tendency, percentile, decile and quadrille, measures of variation, measures of shape-skewness, data visualization

UNIT – III

Forecasting Techniques: Introduction, time-series data and components, forecasting accuracy, moving average method, single exponential smoothing, Holt's method, Holt-Winter model, Croston's forecasting method, regression model for forecasting, Auto regression models, auto-regressive moving process, ARIMA, Theil's coefficient

UNIT – IV

Decision Trees: CHAID, Classification and Regression tree, splitting criteria, Ensemble and method and random forest. *Clustering:* Distance and similarity measures used in clustering, Clustering algorithms, K-Means and Hierarchical algorithms, *Prescriptive Analytics* - Linear Programming(LP) and LP model building,

UNIT – V

Six Sigma: Introduction, introduction, origin, 3-Sigma Vs Six-Sigma process, cost of poor quality, sigma score, industry applications, six sigma measures, DPMO, yield, sigma score,

DMAIC methodology, Six Sigma toolbox

References:

1 U Dinesh Kumar, "*Data Analytics*", Wiley Publications, 1st Edition, 2017.
2 Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, "*Business analytics Principles, Concepts, and Applications with SAS*", Associate Publishers, 2015.
3 S. Christian Albright, Wayne L. Winston, "*Business Analytics - Data Analysis and Decision Making"*, 5th Edition, Cengage, 2015.
4 https://onlinecourses.nptel.ac.in/noc18-mg11/preview
5 https://nptel.ac.in/courses/110105089/

OE942

INDUSTRIAL SAFETY
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- *Causes for industrial accidents and preventive steps to be taken.*
- *Fundamental concepts of Maintenance Engineering.*
- *About wear and corrosion along with preventive steps to be taken*
- *The basic concepts and importance of fault tracing.*
- *The steps involved in carrying out periodic and preventive maintenance of various equipments used in industry*

Course Outcomes:

1. *Identify the causes for industrial accidents and suggest preventive measures.*
2. *Identify the basic tools and requirements of different maintenance procedures.*
3. *Apply different techniques to reduce and prevent Wear and corrosion in Industry.*
4. *Identify different types of faults present in various equipments like machine tools, IC Engines, boilers etc.*
5. *Apply periodic and preventive maintenance techniques as required for industrial equipments like motors, pumps and air compressors and machine tools etc*

UNIT-I

Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes, Fire prevention and firefighting, equipment and methods.

UNIT–II

Fundamentals of Maintenance Engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

UNIT–III

Wear and Corrosion and their Prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications of Screw down grease cup, Pressure grease gun, Splash lubrication, Gravity lubrication, Wick feed lubrication, Side feed lubrication, Ring lubrication, Definition of corrosion, principle and factors affecting the corrosion, Types of corrosion, corrosion prevention methods.

UNIT–IV

Fault Tracing: Fault tracing-concept and importance, decision tree concept,need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, any one machine tool, Pump, Air compressor, Internal combustion engine, Boiler, Electrical motors, Types of faults in machine tools and their general causes.

UNIT–V

Periodic and Preventive Maintenance: Periodic inspection-concept and need,degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of Machine tools, Pumps, Air compressors, Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Suggested Reading:

1. H. P. Garg, "Maintenance Engineering", S. Chand and Company
2. Audels, "Pump-hydraulic Compressors", Mcgraw Hill Publication
3. Higgins & Morrow, "Maintenance Engineering Handbook", Da Information Services.
4. Winterkorn, Hans, "Foundation Engineering Handbook", Chapman & Hall London

OE 943

OPERATIONS RESEARCH
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *Introduce the concepts of optimization techniques*
- *Formulation of LPP models*
- *Basic concepts of Non-linear programming, Dynamic programming, Game theory are introduced.*

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

1. *Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.*
2. *Students should able to apply the concept of non-linear programming*
3. *Students should able to carryout sensitivity analysis*
4. *Students should able to model the real world problem and simulate it.*

UNIT – I

Optimization Techniques, Model Formulation, models, General LR Formulation, Simplex Techniques, SensitivityAnalysis, Inventory Control Models.

UNIT – II

Formulation of a LPP-Graphical solution revised simplex method-duality theory-dual simplex method-sensitivity analysis-parametric programming.

UNIT – III

Nonlinear programming problem-Kuhn-Tucker conditions mincost flow problem-max flow problem-CPM/PERT.

UNIT – IV

Scheduling and sequencing- single server and multiple server models-deterministic inventory models-Probabilistic inventory control models-Geometric Programming.

UNIT – V

Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, FlowinNetworks, Elementary Graph Theory, Game Theory Simulation.

References:

1 H.A. Taha, *OperationsResearch, AnIntroduction*, PHI, 2008
2 H.M. Wagner, *Principles of Operations Research*, PHI, Delhi, 1982
3 J.C.Pant, *Introduction to Optimisation: Operations Research*, JainBrothers, Delhi,2008
4 Hitler Libermann*OperationsResearch*:McGrawHillPub.2009
5 Pannerselvam,*OperationsResearch*:PrenticeHallofIndia2010
6 HarveyMWagner,*PrinciplesofOperationsResearch*:PrenticeHallofIndia2010

OE944

COST MANAGEMENT OF ENGINEERING PROJECTS

(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Course Objectives:

- *Introduce the concepts of cost management, inventory valuation , decision making*
- *Fundamentals of cost overruns, project execution and technical activities*
- *Introduce the concepts of Quantitative techniques for cost management, Linear Programming, PERT/CPM*

Course Outcomes:

1. *Understanding of strategic cost management process, control of cost and decision making based on the cost of the project.*
2. *Ability to appreciative detailed engineering activities of the project and execution of projects*
3. *Preparation of project report and network diagram*
4. *Able to plan Cost Behavior, Profit Planning, Enterprise Resource Planning, Total Quality Management.*
5. *Applications of various quantitative techniques for cost management*

UNIT-I

Project Management: Introduction to project managements, stakeholders, roles, responsibilities and functional relationships. Principles of project management, objectives and project management system. Project team, organization, roles, responsibilities. Concepts of project planning, monitoring, staffing, scheduling and controlling.

UNIT-II

Project Planning and Scheduling: Introduction for project planning, definingactivities and their interdependency, time and resource estimation. Work break down structure. Linear scheduling methods-bar charts, Line of Balance (LOB), their limitations. Principles, definitions of network-based scheduling methods: CPM, PERT. Network representation, network analysis-forward and backward passes.

UNIT-III

Project Monitoring and Cost Analysis: introduction-Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making, Time cost tradeoff-Crashing project schedules, its impact on time on time, cost. Project direct and indirect costs.

UNIT-IV

Resources Management and Costing-Variance Analysis: Planning, EnterpriseResource Planning, Resource scheduling and levelling. Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and

Value-Chain Analysis. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis.Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement

UNIT-V

Budgetary Control:: Flexible Budgets; Performance budgets; Zero-basedbudgets. Measurement of Divisional profitability pricing decisions including transfer pricing. Quantitative techniques for cost management: Linear Programming, PERT/CPM, Transportation Assignment problems, Simulation, Learning Curve Theory.

Suggested Reading:

1. Charles T Horngren "Cost Accounting A Managerial Emphasis", Pearson Education; 14 edition (2012),
2. Charles T. Horngren and George Foster, "Advanced Management Accounting" Prentice-Hall; 6th Revised edition (1 February 1987)
3. Robert S Kaplan Anthony A. Atkinson, "Management & Cost Accounting" , Pearson; 2 edition (18 October 1996)
4. K. K Chitkara, "Construction Project Management: Planning, scheduling and controlling", Tata McGraw-Hill Education. (2004).
5. Kumar Neeraj Jha "Construction Project Management Theory and Practice", Pearson Education India; 2 edition (2015)

OE 945

COMPOSITE MATERIALS
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To understand the fundamentals of composite materials and the role of matrix and reinforcement.*
- *To know the principles of manufacturing composite*
- *To understand the strength and failure criteria of lamina and laminate.*

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

1. *Define a composite, identify the matrix and reinforcement and highlighting the features and application of different composite materials.*
2. *Classify composites, illustrate the mechanical behaviour of composites and predict properties using micromechanics principles.*
3. *Illustrate the manufacturing of metal matrix composites and outline the properties and applications.*
4. *Illustrate the manufacturing of Polymer matrix composites and outline the properties and applications.*
5. *Apply various failure criteria to assess the strength of lamina and laminates.*

UNIT – I

Introduction: Definition- Classification and characteristics of composite materials. Advantages and applications of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, distribution, volume fraction) on overall composite performance.

UNIT – II

Reinforcements: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers and Boron fibers. Properties and applications of whiskers, particulate reinforcements. Mechanical Behaviour of composites: Rule of Mixtures, Inverse rule of mixtures. Isostrain and Isostress condition.

UNIT – III

***Manufacturing of Metal Matrix Composites*:** Casting-Solid State diffusion technique, Cladding-Hot Isostatic pressing, Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration-Liquid phase sintering, Manufacturing of Carbon-Carbon composites: Knitting, Braiding, Weaving, Properties and applications

UNIT – IV

***Manufacturing of Polymer Matrix Composites*:** Preparation of Moulding compounds and prepregs-hand layup method-Autoclave method-Filament winding method-Compression moulding-Reaction injection moulding, Properties and applications.

UNIT – V

Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hydrothermal failure. Laminate first ply failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentration.

References:

1 *Material Science and Technology*- Vol 13- Composites by R.W. Cahn-VCH, West Germany.

2 *Materials Science and Engineering, An Introduction*. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley &Sons, NY, Indian edition, 2007.

3 *Composite Materials*- K. K. Chwala.

4 *Composite Materials Science and Applications*-Deborah D.L. Chung.

5 *Composite Materials Design and Applications*-Danial Gay, Suong V. Hoa and Stwphen W. Tsai.

OE 946

WASTE TO ENERGY
(OPEN ELECTIVE)

Instruction: 3 periods per week *Duration of SEE: 3 hours*
CIE: 30 marks *SEE: 70 marks*
Credits: 3

Objectives:

- *To know the various forms of waste*
- *To understand the processes of Biomass Pyrolysis.*
- *To learn the technique of Biomass Combustion.*

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

1. *Understand the concept of conservation of waste*
2. *Identify the different forms of wastage*
3. *Choose the best way for conservation to produce energy from waste*
4. *Explore the ways and means of combustion of biomass*
5. *Develop a healthy environment for the mankind*

UNIT – I

Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors.

UNIT – II

Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal –Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

UNIT – III

Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraftgasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

UNIT – IV

Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

UNIT – V

Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1 *Non Conventional Energy*, Desai, Ashok V., Wiley Eastern Ltd., 1990.

2 *Biogas Technology - A Practical Hand Book* - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.

3 *Food, Feed and Fuel from Biomass,* Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4 *Biomass Conversion and Technology,* C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

OE947

INTERNET OF THINGS
(Open Elective)

Instruction: 3periods per week | Duration of SEE: 3 hours
CIE: 30 marks | SEE: 70 marks
Credits: 3

Course Objectives:

- To understand the concepts of Internet of Things and able to build IoT applications
- To learn the programming and use of Arduino and Raspberry Pi boards.
- To know about data handling and analytics in SDN.

Course Outcomes:

After Completion of the course Student will be able to:

1. Known basic protocols in sensor networks.
2. Program and configure Arduino boards for various designs.
3. Python programming and interfacing for Raspberry Pi.
4. Design IoT applications in different domains.

UNIT – I

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks.

UNIT – II

Machine-to-Machine Communications, Difference between IoT and M2M, Interoperability in IoT, Introduction to Arduino Programming, Integration of Sensors and Actuators with Arduino,

UNIT – III

Introduction to Python programming, Introduction to Raspberry Pi, Interfacing Raspberry Pi with basic peripherals, Implementation of IoT with Raspberry Pi

UNIT - IV

Implementation of IoT with Raspberry Pi, Introduction to Software defined Network (SDN), SDN for IoT, Data Handling and Analytics,

UNIT - V

Cloud Computing, Sensor-Cloud, Smart Cities and Smart Homes, Connected Vehicles, Smart Grid, Industrial IoT, Case Study: Agriculture, Healthcare, Activity Monitoring

Suggested Readings:

1. "The Internet 'of Things: Enabling Technologies, Platforms, and Use Cases", by PethuruRaj and Anupama C. Raman (CRC Press).
2. “Make sensors”: Terokarvinen, kemo, karvinen and villeyvaltokari, 1st edition, maker media, 2014.
3. "Internet of Things: A Hands-on Approach", by ArshdeepBahga and Vijay Madisetti Vijay Madisetti,
4. ArshdeepBahga, “Internet of Things: A Hands-On Approach”
5. WaltenegusDargie,ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice"
6. Beginning Sensor networks with Arduino and Raspberry Pi – Charles Bell, Apress, 2013

OE948

CYBER SECURITY

(Open Elective)

Instruction: 3periods per week
Duration of SEE: 3 hours
CIE: 30 marks
SEE: 70 marks
Credits: 3

Course Objectives

- Learn the various threats in networks and security concepts.
- Apply authentication applications in different networks.
- Understand security services for email.
- Awareness of firewall and IT laws and policies

Course Outcomes:

After completion of this course, the students shall be able to:

1. Understand the various network threats.
2. Analyze the forensic tools for evidence collection.
3. Apply the firewalls for threat analysis.

UNIT-I

Ethical hacking, Attack Vectors, Cyberspace and Criminal Behaviour, Clarification of Terms, Traditional Problems associated with Computer Crimes, Realms of Cyber world, brief history of the internet, contaminants and destruction of data, unauthorized access, computer intrusions, white-collar crimes, viruses and malicious code, virus attacks, pornography, software piracy, mail bombs, exploitation, stalking and obscenity in internet, Cyber psychology, Social Engineering.

UNIT-II

Introduction to Digital forensics, Forensic software and handling, forensic hardware and handling, analysis and advanced tools, forensic technology and practices, Biometrics: face, iris and fingerprint recognition, Audio-video evidence collection, Preservation and Forensic Analysis.

UNIT-III

Investigation Tools, e-discovery, EDRM Models, digital evidence collection and preservation, email investigation, email tracking, IP tracking, email recovery, searc and seizure of computer systems, password cracking.

UNIT-IV

Forensic Analysis of OS artifact, Internet Artifacts, File System Artifacts, Registry Artifacts, Application Artifacts, Report Writing, Mobile Forensic- identification, collection and preservation of mobile evidences, social media analysis, data retrival, Email analysis from mobile phones.

UNIT-V

Ethics, Policies and IT Act Basics of Law and Technology, Introduction to Indian Laws, Scope and Jurisprudence, Digital Signatures, E Commerce-an Introduction, possible crime scenarios, law coverage, data interchange, mobile communication development, smart card and expert systems Indian Laws, Information Technology Act 2000, Indian Evidence Act, India Technology Amendment Act 2008, Indian Penal Code , Computer Security Act 1987, National Information Infrastructure Protection Act 1996, Fraud Act 1997, Children Online Protection Act 1998, Computer Fraud and Abuse Act 2001, Intellectual Property, IP Theft, Copyright, Trademark, Privacy and Censorship, Introduction to Cyber Ethics, rights over intellectual property, Corporate IT Policy Formulations, Compliance Auditing.

Suggested Readings

1. Charles P. Fleeger, "*Security in Computing*", Prentice Hall, New Delhi, 2009.
2. BehrouzA.Forouzan, "*Cryptography & Network Security*", Tata McGraw Hill, India, New Delhi, 2009.
3. William Stallings, "*Cryptography and Network Security*", Prentice Hall, New Delhi, 2006.
4. Chalie Kaufman, Radia Perlman, Mike Speciner, "*Network Security: Private Communication in a Public Network*", Pearson Education, New Delhi, 2004.
5. Neal Krawetz, "*Introduction to Network Security*", Thomson Learning, Boston, 2007.
6. Bruce Schneier, "*Applied Cryptography*", John Wiley & Sons, New York, 2004.

EC 281

MAJOR PROJECTPHASE - I

Instruction: 20 periods per week *Duration of SEE: --*
CIE: 100 marks *SEE: --*
Credits: 10

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

1. *Exposed to self-learning various topics.*
2. *Learn to survey the literature such as books, journals and contact resource persons for the selected topic of research.*
3. *Learn to write technical reports.*
4. *Develop oral and written communication skills to present.*
5. *Defend their work in front of technically qualified audience*

Guidelines:

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Chairperson-BoS, Osmania University and Head, Supervisor & Project coordinator from the respective Department of the Institute.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	30	Project Status / Review(s)
	20	Report
Departmental Committee (Chairperson BoS, Osmania University and Head, Supervisor & Project coordinator from the respective department of the institution)	10	Relevance of the Topic
	10	PPT Preparation
	10	Presentation
	10	Question and Answers
	10	Report Preparation

Note: The Supervisor has to assess the progress of the student regularly.

SEMESTER - IV

EC 282

MAJOR PROJECTPHASE - II

Instruction: 32 periods per week *Duration of SEE: --*
CIE: -- *SEE: 200 marks*
Credits: 16

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

1. *Use different experimental techniques and will be able to use different software/ computational /analytical tools.*
2. *Design and develop an experimental set up/ equipment/test rig.*
3. *Conduct tests on existing set ups/ equipment's and draw logical conclusions from the results after analysing them.*
4. *Either work in a research environment or in an industrial environment.*
5. *Conversant with technical report writing and will be able to present and convince their topic of study to the engineering community.*

Guidelines:

- It is a continuation of Major Project Phase – I started in semester - III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner and Chairperson BoS, & Head, Osmania University and Supervisor from the Institute.
- The candidate has to be in regular contact with his/her Supervisor / Co- Supervisor

Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 200		
Evaluation by	**Max. Marks**	**Evaluation Criteria / Parameter**
Supervisor	10	Regularity and Punctuality
	10	Work Progress
	30	Quality of the work which may lead to publications
	10	Analytical / Programming / Experimental Skills Preparation
	10	Report preparation in a standard format
External Examiner and Chairperson, BoS & Head, Osmania University (All together	20	Power Point Presentation
	60	Quality of thesis and evaluation
	30	Innovations, application to society and Scope for future study
	20	Viva-Voce