List of New Course(s) Introduced

Department : *Electronics and Communication Engineering*

Programme Name : *B.Tech.*

Academic Year : 2021-22

List of New Course(s) Introduced

Sr. No.	Course Code	Name of the Course
1	EC205TPC09	Digital Communication
2	EC206TPC11	CMOS Digital VLSI Design
3	EC206TPC12	Data Communication & Computer Networks
4	EC206TPC13	Microprocessor & Microcontroller
5	EC206TES07	Electronic Measurements and Sensors
6	EC206TPE02	Advance Signal Processing
7	EC206TPE03	Renewable Energy Sources
8	EC07TPE09	Digital Image Processing
9	EC07TPE10	Analog & Digital VLSI
10	EC07TPE11	Estimation and Detection Theory
11	EC07TPE12	Advanced Power Electronics
12	EC07TPE15	Machine Learning
13	EC08TPE16	Millimeter Wave Technology
14	EC08TPE17	Video Processing
15	EC08TPE18	Biomedical Electronics
16	EC08TPE19	Next Gen. Comm. Technology
17	EC08TOE05	Intellectual Property Rights
18	EC08TOE07	Introduction to IOT
19	ECPATT1	Linear Algebra
20	ECPATT2	Wireless Communication & Network
21	ECPATT3	Optoelectronic Devices
22	ECPATP1	Introduction to Signal Processing
23	ECPATP2	Introduction to Embedded & IOT System
24	ECPATP3	Microstrip Antenna
25	ECPATP4	Estimation & Detection Theory
26	ECPATP5	Digital Image Processing
27	ECPATP6	Network Security & Cryptography

28	ECPATP7	Modern Digital Communication
29	ECPATP8	Antenna for Modern wireless Communication
30	IPPATC1	Research Methodology & IPR
31	ECPALT1	Optoelectronic Device Laboratory
32	ECPBTT1	Advanced VLSI Fabrication
33	ECPBTT2	Millimeter Wave Technology
34	ECPBTP1	Machine Learning
35	ECPBTP2	Optical Communication System
36	ECPBTP3	Next Generation Communication Technologies
37	ECPBTP4	Advanced Digital Signal Processing
38	ECPBTP5	Computer Vision
39	ECPBTP6	Digital Communication Receiver
40	ECPBTP7	Optical Instrumentation
41	ECPBTP8	Satellite Communication
42	MSPBTO1	Business Analysis
43	IPPBTO2	Industrial Safety
44	IPPBTO3	Operations Research
45	CEPBTO4	Cost Management of Engineering Projects
46	MEPBTO5	Composite Materials
47	CHPBTO6	Waste to Energy
48	ECPBTO7	Internet of Things
49	ELPBTX1	English for Research Paper Writing
50	PEPBTX2	Stress Management by Yoga
51	CEPBTX3	Disaster Management
52	LAPBTX4	Constitution of India
53	ECPBLT1	Wireless Communication laboratory
54	ECPBLT2	RF & Microwave Component Design Laboratory
55	ECPCPT1	Dissertation Stage–I
56	ECPDPT1	Dissertation Stage–II
57	ECDATP8	Introduction to Signal Processing
58	ECDATP9	Introduction to Embedded & IOT System
59	ECDATP10	Microstrip Antenna
60	ECDATP11	Estimation & Detection Theory
61	ECDATP12	Digital Image Processing
62	ECDATP13	Network Security & Cryptography

63	ECDATP14	Modern Digital Communication
64	ECDATP15	Machine Learning
65	ECDATP16	Optical Communication System
66	ECDATP17	Next Generation Network
67	ECDATP18	Advanced Digital Signal Processing
68	ECDATP19	Computer Vision
69	ECDATP20	Digital Communication Receiver
70	ECDATP21	Optical Instrumentation
71	ECDATP22	Satellite Communication

विभागाध्यक्ष (इलें. एवं संचार अभियाँत्रिकी)
H.O.D. (Elect. & Comm. Engineering)
प्रौद्योगिकी संस्थान
Institute of Technology
गु. घा. वि., बिलासपुर (छ.ग.)
G. G. V. Bilaspur (C.G.)

MICROSTRIP ANTENNA

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP3	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To introduce the basic concept of Rectangular Microstrip Antenna
2. To introduce different Microstrip Antenna feeding techniques
3. To learn different parameters of Rectangular Microstrip Antenna
4. To learn the effect of various parameters on performance of Rectangular Microstrip Antenna
5. To develop the concept of antenna design to control different Antenna characteristics

Unit-1:

Rectangular Microstrip Antenna- Concept, Various Designs, Advantages, Problems, Applications

Unit-2:

Microstrip Antenna feeding techniques- Coaxial feed, Microstrip Line feed, EM Coupled feed, Aperture coupled feed

Unit-3:

Rectangular Microstrip Antenna- Resonance Frequency, Characterization, Design Equations, Design Examples

Unit-4:

Effect of various parameters on performance of Rectangular Microstrip Antenna – Feed point location, Effect of width, Effect of thickness, Effect of probe diameter, Effect of Loss tangent, Effect of Dielectric constant

Unit-5:

Rectangular Microstrip Antenna patterns for different Dielectric constant, Dual Polarization, Effect of finite ground plane, Square and Circular Microstrip Antenna characteristics

Text/Reference Books:

1. Microstrip Antenna Design Handbook, Ramesh Garg, Prakash Bhartia, Inder J. Bahl, A. Ittipiboon
2. Broadband Microstrip Antennas, Girish Kumar, K.P. Ray
3. Microstrip and Printed Antennas: NEW TRENDS, TECHNIQUES AND APPLICATIONS by Debatosh Guha, Yahia M. M. Antar

ESTIMATION & DETECTION THEORY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP4	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To teach students the basics of estimation and detection theory.
2. To introduce the students to estimation bounds.
3. To introduce classical and Bayesian estimators like ML, LS, and MMSE to students.
4. To teach hypothesis testing and a number of detectors of signals in noise.
5. To introduce the likelihood ratio test and GLRT. Exposing the students to applications of estimation and detection is another important goal.

UNIT-I

Recap of probability and linear algebra, Introduction of estimation in signal processing, Minimum variance unbiased estimation, Unbiased estimators, Minimum variance criterion,existence of minimum variance unbiased estimator, Cramer-Rao lower bound (CRLB), scalar parameters, Signal in white Gaussian noise.

UNIT-II

Linear models, General minimum variance unbiased estimation, Sufficient statistic, finding minimum variance unbiased estimators, Best linear unbiased estimators (BLUE),Finding the BLUE, Signal processing example.

UNIT-III

MaximumLikelihood Estimators(MLE), finding the MLE, Properties of the MLE, MLE for transformed parameters, Extension to a vector parameter, Introduction to Least Square (LS) Approach, Linear least square estimation, Geometrical interpretations of LS estimation, Some examples.

UNIT-IV

Bayesian estimators, Priors and Posteriors probabilities, Choosing a Prior PDF, General Bayesian estimators, Minimum mean square estimators (MMSE), Maximum A Posteriori (MAP) Estimators, Linear MMSE Estimation.

UNIT-V

Basics of statistical decision theory, Simple hypothesis testing, Likelihood ratio testing, Neyman-Pearson detectors, Detection of known signals in noise, Composite hypothesis testing, Generalized likelihood ratio tests (GLRTs), Deterministic signals with unknown parameters.

DIGITAL IMAGE PROCESSING

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP5	3	0	0	3 hours	40	60	100	3

Course Objective: The objectives of the course are to make the students:

1. To provide the fundamental knowledge on digital image processing.
2. To develop the ability to understand and implement various digital image processing algorithms.
3. To facilitate the students for analyze and implement various real time digital image processing applications.

Unit-I

Image Representation and Image Processing Paradigm: Introduction and signal digitization, Pixel relationship, Camera models & imaging geometry.

Image Enhancements: Image operations, Image interpolation, Image transformation, histogram equalization and specifications.

Unit-II

Image Filtering and restoration: Noise models, Image Restoration Spatial and Frequency Domain Filtering, Estimation of Degradation Model and Restoration Techniques.

Unit-III

Color Image Processing: Color models, Color transformations, Color image smoothing and sharpening; Color Segmentation.

Wavelets and Multi-resolution image processing- Background of Wavelet transform, Multi-resolution expansions, wavelet transform in one and two dimensions.

Unit-IV

Image Compression:-Fundamentals and models of Image Compression; Lossless compression; Lossy compression, Image compression standards.

Unit-V

Image Segmentation: Detection of discontinuities, edge linking and boundary detection, thresholding, region-based segmentation, Segmentation Using Morphological Watersheds.

Text/Reference Books:

1. Rafael C. Gonzalez and Richard E. Woods, Digital Image Processing, 3rd Edition, Pearson Education 2010
2. Anil Kumar Jain, Fundamentals of Digital Image Processing, Prentice Hall of India.2nd edition 2011
3. William K. Pratt, Digital Image Processing, 4th edition, John Wiley, 2007.
4. John C. Russ, The Image Processing Handbook, 6th edition, CRC Press,2011

NETWORK SECURITY & CRYPTOGRAPHY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP6	3	0	0	3 hours	40	60	100	3

Course Objectives:

This course will enable student to:

1. To provide deeper understanding into cryptography, its application to network security, threats/vulnerabilities to networks and countermeasures.
2. To explain various approaches to Encryption techniques, strengths of Traffic Confidentiality, Message Authentication Codes.
3. To familiarize Digital Signature Standard and provide solutions for their issues.
4. To familiarize with cryptographic techniques for secure communication of two parties over an public channel; verification of the authenticity of the source of a message.

UNIT –I:

INTRODUCTION: Security trends, The OSI Security Architecture, Security Attacks, Security Services and Security Mechanisms, A model for Network security. CLASSICAL ENCRYPTION TECHNIQUES: Symmetric Cipher Modes, Substitute Techniques, Transposition Techniques, Rotor Machines, Stenography.

UNIT –II:

BLOCK CIPHER AND DATA ENCRYPTION STANDARDS: Block Cipher Principles, Data Encryption Standards, the Strength of DES, Differential and Linear Crypt Analysis, Block Cipher Design Principles.

ADVANCED ENCRYPTION STANDARDS: Evaluation Criteria for AES, the AES Cipher. MORE ON SYMMETRIC CIPHERS: Multiple Encryption, Triple DES, Block Cipher Modes of Operation, Stream Cipher and RC4.

INTRODUCTION TO NUMBER THEORY: Prime Numbers, Fermat's and Euler's Theorem, Testing for Primality, The Chinese Remainder Theorem, Discrete logarithms.

UNIT –III:

PUBLIC KEY CRYPTOGRAPHY AND RSA: Principles Public key crypto Systems, Diffie Hellman Key Exchange, the RSA algorithm, Key Management, , Elliptic Curve Arithmetic, Elliptic Curve Cryptography.

MESSAGE AUTHENTICATION AND HASH FUNCTIONS: Authentication Requirement, Authentication Function, Message Authentication Code, Hash Function, Security of Hash Function and MACs.

MODERN DIGITAL COMMUNICATION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP7	3	0	0	3 hours	40	60	100	3

Course Objective:

This course will enable student to:

1. Understand and appreciate the need of various modulation and spread spectrum techniques.
2. Analyze the properties of basic Modulation techniques and apply them to Digital Communication
3. Apply different types of coding techniques to design the optimum receiver for channels with ISI and AWGN.
4. Design and develop the different types of modulation techniques, equalizer to improve the performance under fading channels for various applications.

UNIT I

Baseband Modulation: Line coding - types, criterions for choosing a line code, power spectra. Matched filter – maximization of output SNR, properties, RF and baseband design, integrate and dump filter. Signal space representation, Gram-Schmidt orthogonalization, correlation receiver, equivalence of matched filter and correlation receiver. Baseband transmission of digital signal, eye pattern, inter-symbol interference, Nyquist criterion for zero ISI. Pulse Shaping - raised cosine filtering. Correlative coding – duobinary coding, modified duobinary coding, generalized partial response signaling.

UNIT II

Optimum receivers:channels with ISI and AWGN, linear equalization and decision feed back equalization, adaptive linear and adaptive decision feedback equalizer.

UNIT III

Passband Transmission: Signal space and mathematical representation, transmitter, receiver (coherent and non coherent detection), Carrier modulation – Linear modulation schemes: M-ary ASK, PSK, QAM, FSK etc. Nonlinear Modulation schemes: CPFSK, MSK, GMSK . Non coherent modulations schemes: DPSK Spectral properties of various modulation schemes and their comparison. probability of error for various modulation schemes in AWGN channel. Clock and carrier recovery, synchronization issues.

UNIT IV

Error Control Codes: Examples of the use of error control codes, basic notions, Characterization of Error control codes performance of error control codes, comparison of uncoded and coded systems. Linear Block Codes, Cyclic Codes. Convolution Coding,

ANTENNA FOR MODERN WIRELESS COMMUNICATION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP8	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To understand the concept of radiation and characterizing parameters of Antenna
2. To get the knowledge of working principles of modern Antennas
3. Design the array of Antenna for modern communication
4. To perform analysis of MIMO key technology of 4G/5G System
5. To get the knowledge and design of Antennas for modern wireless system.

Unit I:

Concepts of Radiation and Antenna Fundamentals: Fundamental parameters of antennas, Near and Far Field regions, S Parameters, Antenna Measurements: Radiation pattern, Gain, directivity and polarization measurement.

Unit II:

Printed Antenna: Microstrip Antennas & Dielectric Resonator Antenna: Radiation mechanism - parameters and applications - feeding methods.

Unit-III:

Array of Antennas: Linear and planar array fundamentals, Mutual Coupling in Arrays, Multidimensional Arrays, Phased Arrays, Array Feeding Techniques, Array optimization techniques.

Unit-IV

MIIMO System: Concept of Diversity, Introduction of MIMO, Types of MIMO Systems, Design parameters of MIMO system.

UNIT V:

Antennas for Modern Wireless System: Antennas for space applications, Antennas for 5G System, Reconfigurable Antenna:Reconfigurable methodologies, Design Considerations for Reconfigurable systems, Concept of Smart Antenna.

Text/Reference Books:

1. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.

RESEARCH METHODOLOGY & IPR

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
IPPATC1	3	0	0	3 hours	40	60	100	3

Syllabus Contents:

- **Introduction and Design of research**: Meaning, objectives and significance of research, types and parameters of research, research process, identification and definition of the research problem, definition of construct and variables, pure and applied research design, exploratory and descriptive design methodology, qualitative vs. quantitative research methodology, field studies, field experiments vs. laboratory experiments, research design in social and physical sciences.
- **Data and Methods of Data Collection**: Survey, assessment and analysis: data collection, primary and secondary sources of data, Collection of primary data through questionnaire and schedules. Collection of secondary data, processing and analysis of data. Sample survey, simple random sampling, stratified random sampling, systematic sampling, cluster sampling, area sampling and multistage sampling. Pilot survey, scaling techniques, validity & reliability.
- **Data Analysis:** Procedure for testing of hypothesis, the null hypothesis, determining levels of significance, type i and ii errors, grouped data distribution, measures of central tendency, measures of spread/dispersion, normal distribution, analysis of variance: one way, two way, chi square test and its application, students 'T' distribution, non-parametric statistical techniques, binomial test. Correlation and regression analysis – discriminate analysis – factor analysis – cluster analysis, measures of relationship
- Research report preparation and presentation: Review of literature: historical survey and its necessity, layout of research plan, meaning, techniques and precautions of interpretation, types of report: technical report, popular report, report writing – layout of research report, mechanics of writing a research report. Writing bibliography and references.
- Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

References:

- Research in education, By J W Best and J V Kahn, Pearson/ Allyn and Bacon.
- Research Methodology – Methods and Techniques, C K Kothari, New Age International.
- Design and Analysis of Experiments, D C Montgomery, Wiley.
- Applied Statistics & Probability for Engineers, D C Montgomery & G C Runger, Wiley.
- Management Research Methodology: Integration of Principles, Methods and Techniques, K N Krishnaswamy, A I Sivakumar and M Mathiranjan, Pearson Education.

MTECH SYLLABUS
SEMESTER: II

ADVANCED VLSI FABRICATION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTT1	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To develop the basic concept of IC fabrication.
2. To develop the concept of detailed processes of Oxidation
3. To learn the detail techniques of Ion implantation
4. To learn different Lithography techniques
5. To learn the different techniques and challenges of final thin film integrated transistor devices

Unit-1: Introduction to BJT and MOSFET fabrication for IC, Crystal growth & Defects, Epitaxy Details of Doping during Epitaxy, VPE and MBE,

Unit-2: Oxidation-Kinetics, Rate Constants, Dopant redistribution, Oxide charges and Oxidation systems, Theory of diffusion and Fick's Law, Constant Impurity diffusion, Doping Profiles, Diffusion systems and comparison with Ion implantation,

Unit-3: Ion implantation process and stopping mechanisms, Damages during implantation, Annealing of created damages, Masking during implantation and characterization of doped layers,

Unit-4: Lithography-details, Wet chemical etching, Dry etching, Plasma etching systems, Metallization, Problems in Al metal contacts,

Unit-5: IC BJT-from junction isolation to LOCOS, Problems in LOCOS, Trnch isolation and selective epitaxy, Realization of p-n-p transistor, MOSFET-self aligned poly-gate, Tailoring of device parameter, CMOS Technology, Latch-up in CMOS, BiCMOS Technology

Text/Reference Books:

1. VLSI Fabrication Principles by S K Gandhi
2. Silicon VLSI Technology by J D Plummer, M Deal, P D Griffin
3. VLSI Technology by S M Sze,
4. VLSI Technology by B G Streetman

MILLIMETER WAVE TECHNOLOGY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTT2	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To understand the Characteristics of Millimeter Wave Technology
2. To understand the concepts and working principles of various guiding Structures at Millimeter Wave Technology.
3. To design the Antenna for Millimeter Wave Applications.
4. To perform analysis of passive Components at Millimeter Wave
5. To understand the basic concept of Active Devices and Link Design at Millimeter Wave.

UNIT-I

Introduction to Millimeter wave Technology: Advantages and Challenges of Millimeter Wave Technology, Millimeter Wave Applications, Sources of losses at Millimeter wave; Dielectric Loss, Conduction Loss, Radiation Surface wave losses, Wave propagation, Phase and Group Velocity, Slow and Fast waves.TEM, TE and TM modes

UNIT-II

Guiding Structure: Transmission Lines, Surface Wave in Grounded Dielectric Slab, Parallel Plate Guide, Rectangular Wave Guide, Circular Waveguides, Microstrip Lines, High Frequency Limitation of Microstrip Lines, Microstrip Coupled Lines, Conductor Backed CPW, Substrate Integrated Waveguide (SIW), SIW Losses, Design of SIW

UNIT-III

Antennas at Millimeter wave Frequency: Antennas Parameters, Printed Millimeter Wave Antennas, Dipole and Slot Antenna, Loop Antennas, Printed Millimeter Wave Array Antennas, Waveguide Slot Arrays, On Chip Antennas: Design and Challenges.

UNIT-IV

Passive Components: Dielectric Resonators, Dielectric Resonators Antenna and its modes, filters, Different types of couplings, Power divider, Directional Coupler, Hybrid Coupler.

UNIT-V

Active Components: PIN Diode, Gunn Diode, IMPATT Diode, FET, MOSFET, HEMT, Comparison of Solid State Devices , Noise and Link Budget, Friss Transmission Equation, Millimeter Wave Systems, Noise Figure for Cascaded System Elements.

MACHINE LEARNING

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP1	3	0	0	3 hours	40	60	100	3

Course Objective:

The objectives of the course are to make the students:

1. To provide foundation for Machine learning.
2. Introduce the concept of learning patterns from data.
3. Introduce the linear regression technique and SVM
4. Introduce the basic neural network and concept behind deep learning.
5. Introduce a few standard clustering techniques.

Unit I:

Introduction, Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation. Linear regression, Decision trees, overfitting

Unit II:

Instance based learning, Feature reduction, Collaborative filtering based recommendation. Probability, Probability and Bayes learning.

Unit III:

Supervised Learning, Logistic Regression, Support Vector Machine(SVM), Kernel function.

Unit IV:

Neural network, Perceptron, multilayer network, backpropagation, introduction to deep neural network.

Unit V:

Computational learning theory, PAC, Sample complexity, VC Dimension, Ensemble learning. Clustering: k-means, adaptive hierarchical clustering, Gaussian mixture model.

Text Books/References:

1. "Machine Learning: A Probabilistic Perspective" Book by Kevin P. Murphy, The MIT Press, 2012.
2. "Pattern Recognition and Machine Learning " Book by Christopher M. Bishop, Springer, 2011
3. Tom Mitchell, Machine Learning, McGraw Hill, 2017.
4. T. Hastie, R. Tibshirani, J. Friedman. The Elements of Statistical Learning, 2e, 2011.

OPTICAL COMMUNICATION SYSTEM

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP2	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To understand the transmission mechanism of optical fiber communication system .
2. To understand the working of light source.
3. •To introduce the concept of optical detector and various parameter associated with it.
4. •To get the concept of design of system link and its characteristics.
5. To introduce the concept of optical fiber cable and working principle of amplifier.

Unit 1

Introduction to Guided optical communication system: Review of Unguided optical communication system, Guided optical communication, Optical Fibres Types, Materials, Elements, Fabrication techniques. Signal degradation

Unit 2

Sources for communication: Review of LED, modulation circuits, Laser Diode, Optomechanical switches, Photonic & digital switches.

Unit 3

Detectors for communication: Noise Sources, Noise in Optical detector, Receiver noises preamplifiers, Low impedance, High impedance, Trans impedance amplifiers.

Unit 4

System design considerations: Multiplexing, regenerative repeaters, Link Power Budget Analysis, Line coding, Coherent systems homodyne and heterodyne detection.

Unit 5

Optical fiber cable componenets and amplifier. Optical Fiber Cables, Connectors, Joints, Splicers, Couplers, Fiber amplifiers, Raman Fiber Amplifier, Brillowin fiber Amplifier, Solitons Communication.

Text Books:

1. Optical Fiber Communication G Keiser (4th Ed, TMH)
2. Optical Fiber Communications J M Senior (Pearson Publication)

NEXT GENERATION COMMUNICATION TECHNOLOGIES

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP3	3	0	0	3 hours	40	60	100	3

Course Objective:

3. Tolearn the new communication technologies such as OFDM, MIMO, and massive MIMO used in Next Generation communication systems.
4. To analysis the performance such as capacity/spectral efficiency and energy efficiency of the MIMO and massive MIMO system.

UNIT – I

Introduction and Preliminaries: Introduction to point-to-point Multi-input Multi-output (MIMO), multiuser MIMO, massiveMIMO, Coherence Time, CoherenceBandwidth, Coherence Interval.TDD Coherence Interval structure, Coherence Interval in the context of OFDM modulation, Small-scale and Large-scalefading, Normalized signal model, and SNR.

UNIT –II

OFDM: Principle of Orthogonal Frequency Division Multiplexing (OFDM), Multiple access – OFDMA, Implementation of transceivers, Frequency-selective channels, Cyclic Prefix (CP), Performance in the frequency-selective channel, Pilot based channel estimation, Peak-to-average power ratio, Inter-carrier-interference, Parameter adaptation.

UNIT –III

MIMO Systems: Introduction to MIMO systems, Diversity in wireless channel, Introduction to fading distributions, Analytical MIMO channel models, Independent and identically distributed (uncorrelated) MIMO fading model, Fully correlated MIMO channel model, MIMO channel parallel decomposition.

UNIT –IV

MIMO Channel Capacity and Power Allocation: Power allocation in MIMO systems, Uniform power allocation, Adaptive power allocation, MIMO channel capacity, Capacity of i.i.d. Rayleigh fading MIMO channels, Capacity of separately correlated Rayleigh fading MIMO channel.

UNIT –V

Massive MIMO Systems: Definition of Massive MIMO, Correlated Rayleigh fading, Uplink, and downlink system model, Impact of Spatial channel correlation, Channelhardening and favorable propagation, Pilot transmission and channel estimation, Spectral Efficiency (SE), Transmit precoding and Receive decoding, Single-cell uplink and downlink SE expressions, Asymptotic analysis, Energy efficiency.

ADVANCED DIGITAL SIGNAL PROCESSING

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP4	3	0	0	3 hours	40	60	100	3

Course Objective:

The objectives of the course are to make the students:

1. To impart knowledge about the sampling / reconstruction of signals and their analysis in frequency domain
2. To introduce the fundamental concepts for filter designs, and multi-rate processing.
3. To enable the students to understand the efficient algorithms and their use in real time implementation

Unit-1

Multirate Digital Signal Processing: Decimation and Interpolation, Applications of multirate signal processing, Digital filter banks, two channel quadrature mirror filter banks.

Unit-2
Linear prediction and Optimum Linear Filters: Random signals, Stationary Random Process. Forward and Backward Linear Prediction, The Levinson-Durbin Algorithm. Properties of the Linear Prediction-Error Filters.

Unit-3
Adaptive filters: Applications of Adaptive Filters-Adaptive Channel Equalization, Adaptive noise cancellation, Linear Predictive coding of Speech Signals, Adaptive direct form filters.

Unit-4
Power Spectrum Estimation: Parametric and Non parametric Methods for Power Spectrum Estimation, Methods for the AR Model Parameters, ARMA Model for Power Spectrum Estimation.

Unit-5
Wavelet Transform: Origin of Wavelets, Wavelets and other reality transforms History and future of wavelets, Short Time Fourier Transform, Continuous Wavelet, and Discrete Wavelet Transform

Text/Reference Books:

1. John G. Proakis, Dimitris G. Manolakis, "Digital Signal Processing, Principles, Algorithms and Applications", Pearson, Fourth edition, 2007.
2. S. Haykin, "Adaptive Filter Theory" Prentice Hall, Englewood Cliffs, NJ, 1991.
3. K P Soman, Ramachandran, Resmi, "Insight into Wavelets- from Theory to Practice", PHI, Third Edition, 2010.

COMPUTER VISION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP5	3	0	0	3 hours	40	60	100	3

Course Objective:

The objectives of the course are to make the students:

1. To provide the fundamental concept of Computer Vision.
2. To develop understanding about stereo vision concepts.
3. To identify and analyze various features and its extraction techniques in an Image.
4. To study basic motion detection and object tracking.
5. To Design and develop vision based basic applications.

Unit-I

Image Formation Models: Fundamentals of Image processing and Linear algebra, 2-D Projective Geometry, Homography and Properties of homography, Camera Geometry.

Unit-II

Stereopsis: Camera and EpipolarGeometry; 3-D reconstruction framework; Camera-calibration, Stereo Vision.

Unit-III

Image Descriptors and Features: Texture, Colour, Edge, Histogram of Oriented Gradients (HOG), Scale Invariant Feature Transform (SIFT), Speeded up Robust, Features(SURF).

Unit-IV

Motion Detection and Estimation: Background Subtraction and Modelling, Optical Flow, Kanade–Lucas–Tomasi (KLT), Motion Tracking in Video. Mean Shift and Cam shift object Tracking. **Fundamental Pattern Recognition Concepts**: Classification & Clustering.

Unit-V

Applications of Computer Vision: Medical Images, Biometrics, Image Fusion, Document Image Processing, OCR. Deep Neural Architecture and Applications.

Text Books/References:

1. D. Forsyth and J. Ponce,"Computer Vision - A modern approach", 2nd Edition, Pearson Prentice Hall, 2012
2. Szeliski, Richard, "Computer Vision: Algorithms and Applications", 1st Edition, SpringerVerlag London Limited, 2011.
3. Richard Hartley and Andrew Zisserman, "Multiple View Geometry in Computer Vision", 2nd Edition, Cambridge University Press, 2004.
4. K. Fukunaga,"Introduction to Statistical Pattern Recognition",2ndEdition, Morgan Kaufmann, 1990.

DIGITAL COMMUNICATION RECEIVER

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP6	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To gain knowledge about basic principles of digital communication techniques and Detection of BinarySignal in Gaussian Noise.
2. To gain knowledge about Coherent and Noncoherent Detection
3. To gain knowledge about receivers for AWGN channel and Fading channels.
4. To gain knowledge about concepts of synchronization and
5. To gain knowledge about concepts of adaptive equalization techniques.

Unit-I

Review of Digital Communication Techniques: Base band communication; signal space representation, linear and nonlinear modulation techniques, Error tracking and Spectral characteristics of digital modulation.

Detection of Binary Signal in Gaussian Noise: Detection of Binary signal in Gaussian Noise: Maximum Likelihood Receiver Structure, The Matched Filter, Correlation Realization of Matched Filter, Optimum error performance, Error performance of Binary Signaling.

Unit-II

Coherent and Noncoherent Detection: Coherent Detection: Coherent Detection of PSK,Sampled Matched Filter, Coherent Detection of Multiphase Shift Keying, Coherent Detection of FSK. Noncoherent Detection: Detection of Differential PSK, Binary Differential PSK example, Noncoherent Detection of FSK, Required Tone Spacing for Noncoherent Orthogonal FSK.

Unit-III

Optimum Receivers for AWGN Channel: Correlation demodulator, matched filter, maximum likelihood sequence detector, optimum receiver for CPM signals, M-ary orthogonal signals, envelope detectors for M-aryand correlated binary signals.

Receivers for Fading Channels: Characterization of fading multiple channels, statistical models, flat and frequency selective fading, diversity technique, Optimal receivers for data detection, coded waveform for fading channel.

Unit-IV

Synchronization Techniques: Carrier and signal synchronization, carrier phase estimation-PLL, Decision directed loops, symbol timing estimation, maximum likelihood and non-decision directed timing estimation, joint estimation.

OPTICAL INSTRUMENTATION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP7	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To understand the measuring methods and instruments of electrical quantities.
2. To understand the concept of optical instrumentation.
3. To get the concept of optical switching and various instruments.
4. •To get the concept of optical fiber sensors.
5. To get the measurement concept of optical instrumentation.

UNIT-I

Performance characteristics of instruments: Instrument characteristics - accuracy, resolution, precision, expected value, error and sensitivity. Errors in measurement, speed of response, fidelity, lag and dynamic error.

UNIT-II

Optical Instruments: Interferometric configurations, MachZender, Michelson and FabriPerot configurations components and construction, OTDR and applications.

UNIT-III

Fiber optic components and devices : Direction couplers, beam splitters, switches modulations, connectors, polarizer, polarization controllers, amplifiers, wavelength filters, wavelength division multiplexers, fiber optic isolators.

UNIT-IV

Fibre optic sensors: General features, intensity sensors, simple fibre-based sensors for displacement, temperature and pressure. Fibre Bragg grating based sensors.

UNIT-V

Measurements methods in optical fiber : General experimental consideration, pulse dispersion and bandwidth, Cut off wavelength, mode field diameter and birefringence of single mode fiber.

Text/Reference Books:

1. B. P. Pal : Fundamentals of Fibre Optics in Telecommunication and Sensor Systems, New Age, New Delhi.
2. A. K. Ghatak and K. Thyagarajan, Introduction to Fiber Optics, Cambridge.

SATELLITE COMMUNICATION

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTP8	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To know the evolution of Satellite communication and its concept
2. To know the orbital mechanism and different satellite subsystems.
3. To know the role of different factors affecting satellite and link budget equation.
4. To know the various types of multiple access techniques for satellite communication.
5. To know the basics and details of Earth station.

UNIT-I

An overview of satellite communication, Satellite orbits, Kepler's law, Orbital Elements, Eclipse effect, Sun transit outage, Placement of a satellite in a geostationary orbit, Station keeping and Stabilization.

UNIT-II

Satellite Link Design: Basic transmission theory, Friss transmission equation, EIRP, Completion Link design, System noise temperature G/T ratio, Noise figure and Noise temperature.

UNIT-III

Communication Satellite Subsystems: Space Platform (Bus) and Communication Subsystem (Payload), Satellite Antennas, Frequency reuse Antennas.

UNIT-IV

Earth Stations: Earth station antennas, Tracking, Equipment for earth stations, Equipment Reliability and Space qualification

UNIT-V

Analogue Satellite Communication Vs Digital Satellite Communication, Multiple Access Techniques : FDMA Concept, MCPC & SCPC, TDMA frame efficiency and super frame structure, Frame Acquisition and Synchronisation, CDMA concept, PN system, Spread spectrum, DSSS, DS CDMA, FHSS, FH CDMA.

Text/Reference Books:

5. "Satellite Communication", T. Pratt & C. W. Bostian.
6. "Digital Satellite communication", Tri T. Ha, McGraw Hill.

BUSINESS ANALYSIS

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MSPBTO1	3	0	0	3 hours	40	60	100	3

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

1. Students will demonstrate knowledge of data analytics
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Syllabus Contents:

- Unit1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.
- Unit 2: Trendiness and Regression Analysis: Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology.
- Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.
- Forecasting Techniques: Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.
- Unit 5:Decision Analysis: Formulating Decision Problems, Decision Strategies with the

INDUSTRIAL SAFETY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
IPPBTO2	3	0	0	3 hours	40	60	100	3

Course Outcomes:

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

1 Apply the knowledge of Safety Measures

2 Plan for Engineering maintenance.

3 Determine the wear &Corrosion and apply methods for their prevention.

4 Trace the Fault of machine tools and equipment

5 Plan and implement the periodic and preventive maintenance for machines/equipment.

Syllabus Contents:

- 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.
- 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.
- Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.
- Fault tracing: Fault tracing-concept and importance, decision treeconcept, 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, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.
- Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components,

OPERATIONS RESEARCH

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
IPPBTO3	3	0	0	3 hours	40	60	100	3

Course Outcomes:

At the end of the 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 carry out sensitivity analysis

4 Student should able to model the real world problem and simulate it.

Syllabus Contents:

- Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models
- Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming
- Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT
- Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.
- Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

COST MANAGEMENT OF ENGINEERING PROJECTS

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CEPBTO4	3	0	0	3 hours	40	60	100	3

Course Outcomes:

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

1 Discuss the cost concepts in the cost management process.

2 Able to handle the projects by the application of project cost control methods.

3 Determine all types of costing and carryout the analysis of pricings for profitability.

4 Application of PERT/CPM for cost management.

Syllabus Contents:

- Introduction and Overview of the Strategic Cost Management Process
- 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.
- Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non-technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process
- Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.
- Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting

COMPOSITE MATERIALS

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
MEPBTO5	3	0	0	3 hours	40	60	100	3

Course Outcomes:

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

1 Explain and also implement the composite materials for the required performance based on the characteristics.

2 Adopt the composite materials as reinforcements.

3 Implement the methods of manufacturing of metal matrix composites

4 Adopt the methods of manufacturing of polymer matrix composites

5 Evaluate the strength of laminates.

Syllabus Contents:

- INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.
- REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.
- 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.
- 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.
- Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations

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

WASTE TO ENERGY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CHPBTO6	3	0	0	3 hours	40	60	100	3

Course Outcomes:

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

1 Classify the waste for fuel and identify the devices for conversion of waste to energy.

2 Implement the Biomass Pyrolysis

3 Evaluate the methods of Biomass Gasification and implement their applications.

4 To design, construct and operation the Biomass Combustion devices.

5 Classify biomass, apply the bio energy systems design and construction.

Syllabus Contents:

- Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors
- Biomass Pyrolysis: Pyrolysis – Types, slow, fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.
- Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – 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.
- 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.
- 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.

INTERNET OF THINGS

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBTO7	3	0	0	3 hours	40	60	100	3

Course Outcomes:

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

1 Understand the concepts of Internet of Things.

2 Analyze basic protocols in wireless sensor network.

3 Design IoT applications in different domain and be able to analyze their performance

4 Elaborate the need for Data Analytics and Security in IoT.

5 Understand the concepts of Internet of Things.

Syllabus Contents:

Review of computer communication concepts (OSI layers, components, packet communication, Networks, TCP-IP, subnetting, IPV4 addressing and challenges). IPV6 addressing. IoT architecture reference layer. Characteristics IoT sensor nodes, Edge computer, cloud and peripheral cloud, single board computers, open source hardware, Examples of IoT infrastructure.

IoT and M2M

Software defined networks, network function virtualization, difference between SDN and NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER.

IOT protocols and Communication Technologies

MQTT, UDP, MQTT brokers, publish subscribe modes, HTTP, COAP,XMPP and gateway protocols, IoT Communication Pattern, IoT Protocol Architecture, Selection of Wireless technologies (6LoWPAN, Zigbee, WIFI, BT, BLE,SIG,NFC, LORA, Lifi, Widi).

Data and Analytics for IoT

An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IOT Security, Common Challenges in IOT Security, How IT and OT Security Practices and Systems Vary, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Application of Security in an Operational Environment.

IoT Physical Devices and Endpoints: Introduction to Arduino and Raspberry Pi- Installation,

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ENGLISH FOR RESEARCH PAPER WRITING

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ELPBTX1	2	0	0	2 hours	40	60	100	2

Course Outcomes:

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

1. Understand that how to improve your writing skills and level of readability.
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

Syllabus Contents:

- Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness
- Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction
- Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check
- Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a useful phrases, how to ensure paper is as good as it could possibly be the first- time submission review of the Literature.
- skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions
- useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011