Minutes of Meeting

An online meeting of Board of Studies of Electronics and Communication Engineering department was held on 02.11.2021 at 11:00 AM at Google meet (url: meet.google.com/rdi-dyhs-uaw) to finalize the Scheme/Syllabus of M.Tech. in Electronics & Communication Engineering for the session 2021-22. Following BOS members were present in the meeting:

1. Prof. Shrish Verma , Professor, ECE, NIT Raipur, Subject Expert
2. Mrs. Anita Khanna, HOD(ECE), Chairman BOS
3. Dr. Soma Das, Associate Professor, Department of ECE, Member BOS
4. Mr. Shrawan Kumar Patel, Assistant Professor, Department of ECE, Member BOS

Following special invited members were also present in the BOS meeting:

1. Mrs. Bhawna Shukla, Assistant Professor, Department of ECE
2. Dr. P. S. Srivastava, Assistant Professor, Department of ECE
3. Mrs. Beaulah Nath, Assistant Professor, Department of ECE
4. Mrs. Pragati Patharia, Assistant Professor, Department of ECE
5. Mr. Deepak Rathore, Assistant Professor, Department of ECE
6. Dr. Nipun Kumar Mishra, Assistant Professor, Department of ECE
7. Mr. Sumit Kumar Gupta, Assistant Professor, Department of EE
8. Mr. Jitendra Bhardwaj, Assistant Professor, Department of EE
9. Dr. Anil Kumar Soni, Assistant Professor, Department of ECE
10. Mr. Chandan Tamrakar, Assistant Professor, Department of ECE
11. Mrs. Praveena Rajput, Assistant Professor, Department of ECE

BOS meeting started with welcome of all experts and special invited members by BOS chairman. Further an elaborative discussion on the scheme and syllabus of M.Tech. in Electronics & Communication Engineering for the session 2021-22 took place with all experts and their valuable suggestions are invited.

Meeting was ended with vote of thanks by HOD (ECE) to all experts and invited members for their valuable inputs and kind presence in BOS meeting.

(Online consent)
Prof. Shrish Verma
Professor, ECE NIT Raipur
Subject Expert

(Absent)
Mr. Vikash Patel
Senior SDE, BSNL Bilaspur
Industry Expert

Mrs. Anita Khanna
HOD(ECE)
Chairman, BOS

Dr. Soma Das
Associate Professor
Member, BOS

Mr. Shrawan Kumar Patel
Assistant Professor
Member, BOS

GURU GHASIDAS VISHWAVIDYALAYA
BILASPUR (C.G.)

(A Central University)

Koni, Bilaspur-495009, C.G (India)

OUTCOME BASED EDUCATION
WITH
CHOICE BASED CREDIT SYSTEM (CBCS)

MASTER OF TECHNOLOGY
IN
Electronics & Communication Engineering.

COURSE STRUCTURE AND SYLLABI

M.Tech Regular Two Year Degree Program
(Effective from the academic year 2021-22)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHOOL OF ENGINEERING & TECHNOLOGY,
GGV, BILASPUR, C.G. (INDIA)

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING
SCHOOL OF ENGINEERING & TECHNOLOGY, GGV, BILASPUR, C.G. (INDIA)

SCHEME OF EXAMINATION

M.TECH.ELECTRONICS & COMMUNICATION ENGINEERING

MTech. I-Semester

Sl.	Course Type/Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	ECPATT1	Linear Algebra	3	0	0	40	60	100	3
2.	ECPATT2	Wireless Communication & Network	3	0	0	40	60	100	3
3.	ECPATT3	Optoelectronic Devices	3	0	0	40	60	100	3
4.	ECPATP1 to ECPATP4	Elective-I	3	0	0	40	60	100	3
5	ECPATP5to ECPATP8	Elective-II	3	0	0	40	60	100	3
6.	IPPATC1	Research Methodology & IPR	2	0	0	0	50	50	2
7.	ECPALT1	Optoelectronic Device Laboratory	0	0	4	30	20	50	2
Total			17	0	4	240	370	600	19

List of Electives approved for Semester – I

Elective-I	Elective-II
ECPATP1: Introduction to Signal Processing	**ECPATP5:** Digital Image Processing
ECPATP2: Introduction to Embedded & IOT System	**ECPATP6:** Network Security & Cryptography
ECPATP3: Microstrip Antenna	**ECPATP7:**Modern Digital Communication
ECPATP4: Estimation & Detection Theory	**ECPATP8:** Antenna for Modern wireless Communication

M.Tech. II-Semester

Sl.	Course Type/Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	ECPBTT1	Advanced VLSI Fabrication	3	0	0	40	60	100	3
2.	ECPBTT2	Millimeter Wave Technology	3	0	0	40	60	100	3
3.	ECPBTP1 to ECPBTP4	Elective-III	3	0	0	40	60	100	3
4.	ECPBTP5 to ECPBTP8	Elective-IV	3	0	0	40	60	100	3
5	MSPBTO1, IPPBTO2, IPPBTO3, CEPBTO4, MEPBTO5, CHPBTO6, ECPBTO7, MCPBTO8	Open Elective	3	0	0	40	60	100	3
6.	ELPBTX1, PEPBTX2, CEPBTX3, LAPBTX4	Audit Course/ Value Added Course	2	0	0	40	60	100	2
7.	ECPBLT1	Wireless Communication laboratory	0	0	4	30	20	50	2
8.	ECPBLT2	RF & Microwave Component Design Laboratory	0	0	4	30	20	50	2
Total			17	0	08	300	400	700	21

List of Electives approved for the semester –II

Elective-III	Elective-IV	Open Elective	Audit Course
ECPBTP1: Machine Learning	**ECPBTP5:** Computer Vision	**MSPBTO1:** Business Analysis	**ELPBTX1:** English for Research Paper Writing
ECPBTP2: Optical Communication System	**ECPBTP6:**Digital Communication Receiver	**IPPBTO2:** Industrial Safety	**PEPBTX2:** Stress Management by Yoga
ECPBTP3: Next Generation Communication Technologies	**ECPBTP7:**Optical Instrumentation	**IPPBTO3:** Operations Research	**CEPBTX3:** Disaster Management
ECPBTP4: Advanced Digital Signal Processing	**ECPBTP8:**Satellite Communication	**CEPBTO4:** Cost Management of Engineering Projects	**LAPBTX4:** Constitution of India
		MEPBTO5: Composite Materials	
		CHPBTO6: Waste to Energy	
		ECPBTO7: Internet of Things	
		MCPBTO8: MOOCs	

Note: Under MOOCs, the students have to opt any subject other than ELECTRONICS & COMMUNICATION ENGINEERING from NPTEL/UGC SWAYAM

M.Tech. III-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	ECPCPT1	Dissertation Stage–I	0	0	28	100	100	200	14
Total			0	0	28	100	100	200	14

M.Tech. IV-Semester

Sl.	Course Type/ Code	Subjects	Periods/Week			Evaluation			Credits
			L	T	P	IA	ESE	Total	
1.	ECPDPT1	Dissertation Stage–II	0	0	32	100	200	300	16
Total			0	0	32	100	200	300	16

Total Credits for the Program = 19 + 21 +14 +16 = 70

MTECH SYLLABUS
SEMESTER: I

LINEAR ALGEBRA

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATT1	3	0	0	3 hours	40	60	100	3

Course Objective:

The objectives of the course are to make the students:

1. Formulate, solve, apply, and interpret systems of linear equations in several variables
2. Compute with and classify matrices
3. Master the fundamental concepts of abstract vector spaces
4. Decompose linear transformations and analyze their spectra (eigenvectors and eigenvalues)
5. Utilize length and orthogonality in each of the above contexts
6. Apply orthogonal projection to optimization (least-squares) problems

UNIT-I

Introduction to Vectors: Vectors and Linear Combinations, Dot Products.

Solving linear Equations: Matrices and Linear Equations, Gaussian Elimination, Rules for Matrix Operations, Row-Reduced Echelon Form (RREF), Rank of a Matrix, Solution set of a Linear System, Inverse Matrices, Factorization: A=LUs.

UNIT-II

Vector Spaces and Subspaces: Properties, Rank, Nullspace, Solving $Ax= 0$, The Complete Solution $Ax= b$, Independence, Basis of a Vector Space, Dimension, Linear Span and Linear Independence, Dimensions of the Four Subspaces, Sums and Direct Sums.

Orthogonality: Orthogonality of the Four Subspaces, Projections and Least Square, Orthogonal Bases and Gram-Schmidt Process, QR Decomposition, The Fast Fourier Transform.

UNIT-III

Eigenvalues and Eigenvectors: The Characteristic Polynomial**,** Eigenvalues of a Square Matrices, Invariant Subspaces, Diagonalization, Applications to Differential Equations, Upper-Triangular Matrices, Symmetric Matrices, Spectrum of a Matrix. **Positive Definite Matrices:** Tests for Positive Definiteness**,** Similar Matrices, Singular Value Decomposition (SVD).

Complex Vector Spaces: Complex Vectors and Matrices: Hermitian and Unitary Matrices, Generalized Eigenvectors, Decomposition, Square Roots, The Minimal Polynomial, Jordan Form**.**

UNIT-IV

Linear Transformations: Linear Maps: Definitions and Examples, Null Spaces, Ranges and Domain, Rank-Nullity Theorem, Invertibility, Ordered Bases, Change of Basis, Pseudoinverse.

Trace and Determinant: The Properties of Determinants, Permutations and Cofactors, Cramer's Rule. Inverses, and Volumes.

UNIT-V

Inner-Product Spaces: Norms, Orthonormal Bases, Orthogonal Projections, Linear Functionals and Adjoints, Self-Adjoint and Normal Operators, Intersection and Sum of Two Vector Spaces, Cauchy-Schwartz Inequality, The Kronecker Product $A \otimes B$. Isometries.

Applications: Graphs and Networks, Markov Matrices, Linear Programming, Fourier Series, Computer Graphics. **Numerical linear Algebra:** Gaussian Elimination in Practice, Iterative Methods for Linear Algebra.

Text/Referenced Books & Resources: -

1. Strang, Gilbert,"Introduction to Linear Algebra",4th/5th Edition,Wellesley-Cambridge Press.
2. Axler, Sheldon, "Linear Algebra Done Right", 2nd/3rd edition, Springer.
3. K.Hoffman and R.Kunze, "Linear Algebra", 2nd Edition, Prentice- Hall of India, 2005.

Course Outcome:

On successful completion of the course the students will:

1. Acquire the knowledge of all the basic linear algebraic concepts and will be able to solve the Systems of linear equations via Elimination methods.
2. Get familiar with vector space and basis, able to do the matrix factorization.
3. Learn the Eigenvalues and Eigenvectors and the process and application of matrix diagonalization.
4. Understand the Linear Transformation and Inner product space.
5. Able to use Numerical linear algebra in real-life applications such as networks, graphs, computer graphics, big data, IoT, machine learning, and Artificial Intelligence.

WIRELESS COMMUNICATION & NETWORK

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATT1	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To know the evolution of wireless communication, its types and concept.
2. To know basics of recent wireless technologies.
3. To know the different multiple access techniques in wireless communication.
4. To know the details of Ad-hoc wireless network.
5. To know the basics and details of wireless personal local area network.

UNIT-I

Overview of wireless communication, cellular communication, different generations of Cellular communication system, satellite communication including wireless local loop cordless phone.

UNIT-II

Recent wireless technologies; multicarrier modulation, OFDM, MIMO system, diversity-multiplexing trade off; MIMO OFDM system; smart antenna; beam forming and MIMO, cognitive radio.

UNIT-III

Multiple access techniques in wireless communication: contention free multiple access Schemes {FDMA TDMA, CDMA, SDMA and Hybrid}, contention-based multiple access schemes (ALOHA and CSMA).

UNIT-IV

Wireless personal local area networks {Bluetooth, UWB and ZigBee), wireless local area network, IEEE 802.11, network architecture, medium access methods, WLAN standards

UNIT-V

Ad-Hoc wireless network: Design Challenges in Ad-hoc wireless networks, concept of cross layer design, security in wireless networks MANET and WSN, Wireless system protocols.

Text Books

1. Andrea Goldsmith, “Wireless Communications Cambridge University press, 2005.
2. Sanjay Kumar, “wireless communication the fundamental and advanced concepts, River publisher, Denmark ,2015 {Indian reprint}

Referenced Books

1. Vijay K Garg, “Wireless communication and Network, Pearson education ,2012
2. Iti Saha Misra,” Wireless Communication ,2/e, MGH,2013.

Course Outcomes:

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

1. Visualize the architecture of different types of wireless systems as a means of high speed, high range communication system.
2. State various aspects related to recent wireless technologies.
3. State details of Multiple access techniques in wireless technologies
4. State various aspects related to wireless personal local area network.
5. State various aspects of Ad -hoc wireless network.

OPTOELECTRONIC DEVICES

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATT3	3	0	0	3 hours	40	60	100	3

Course Objective:

1. To develop the basic concept of solid state physics and characteristics of light.
2. To develop the concept of luminescence, display devices, laser and their applications.
3. To learn the principle of optical detection mechanism in detection devices.
4. To learn different light modulation techniques and applications of optical switching
5. To develop the concept of opto electronic integrated circuits in transmitters and receivers.

UNIT I

WAVE NATURE OF LIGHT AND SOLID STATE PHYSICS

Wave nature of light, Polarization, Interference, Diffraction, Review of Semiconductor Physics and Junction Device.

UNIT II

DISPLAY DEVICES AND LASERS

Introduction, Photo Luminescence, LED, Plasma Display, Liquid Crystal Displays, Laser Emission, Absorption, Radiation, Optical Feedback, Threshold condition, Laser Modes, laser applications.

UNIT III

OPTICAL DETECTION DEVICES

Photon devices Photo emissive detectors, Photo conductive detectors, Photomultipliers (PMT), Photo diodes PIN & APD, photo transistors, Solar cells.

UNIT IV

OPTOELECTRONICS MODULATOR

Opto Electronic Modulators, Polarization, birefringence's, Electro optic effect, EO materials. Magneto Optic Modulators Faraday effect, Accusto Optic Modulators.

UNIT V

OPTOELECTRONICS INTEGRATED CIRCUITS

Introduction, hybrid and Monolithic Integration, Application of Opto Electronic Integrated Circuits, Integrated transmitters and Receivers, Guided wave devices.

Text Books

1. Opto electronics Anintroduction JWilson and J F B Hawkes. (PHI, 1989)
2. Optical fiber communication J M Senior (Pearson, 2nd Ed)
3. Fiber Optics and Optoelectronics – R P Khare, (Oxford University Press, 4th Ed)

Referenced Books

1. Optical Electronics – Ghattak& Thyagarajan, (Cambridge University Press,1984)
2. Essentials of OptoElectronics – A Rogers, CRC Press, 1st ed,1997
3. Optical fibre communication systems J Gowar (Prentice Hall, 2nd 1995).
4. Semiconductor Optoelectronics – Physics and Technology Jasprit Singh (McGraw Hill, 1995)

Course Outcomes:

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

1. Outline the concept of light and solid state physics
2. Outline the Mechanism of various Display devices and light sources.
3. Distinguish between various detection methods.
4. Outline the various modulator and different mechanism of it.
5. Analyze between various type of integrated circuits.

INTRODUCTION TO SIGNAL PROCESSING

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP1	3	0	0	3 hours	40	60	100	3

Course Objective:

The objectives of the course are to make the students:

1. Review of signal and system, Fourier transforms, the Z-transform
2. To impart knowledge of mathematical concept involved in signal processing.
3. To introduce mathematical modeling for Statistical Signals processing.
4. To apply optimization techniques for signal processing applications.

Unit-I

Discrete and Continuous time signals and systems, LTI systems, Convolution, Difference equations, z-transforms, Fourier transform and its properties.

Unit -II

Sampling and reconstruction, Review of vector spaces, Eigenvectors and Eigen-values. Hilbert transforms, matched filtering, equalization. Coherent and Non-coherent detection.

Unit-III

Probability theory review, Random variables, statistical averages, Random processes, Transmission of random process through an LTI system.

Unit-IV

Statistical Signal Processing: Power Spectrum Estimation Parametric and Maximum Entropy Methods, Wiener, Kalman Filtering, and the Poisson process, Levinson Durbin Algorithms Least Square Method.

Unit -V

Optimization techniques for linear and nonlinear problems, Applications in various areas of signal processing.

Text/Reference Books:

1. Proakis, John G. - Digital signal processing: principles algorithms and applications, PHI.
2. Oppenheim, Alan V - Discrete-time signal processing, Pearson Education India.
3. Vaidyanathan, Parishwad P - Multirate systems and filter banks, Pearson Education India.
4. Monson H. Hayes, “Statistical Digital Signal Processing And Modeling”, 1st Edition, Wiley India Pvt Ltd, 2008.
5. Vaidyanathan, Palghat P- The theory of linear prediction, Morgan and Claypool Publishers.
6. Haykin, Simon S. - Adaptive filter theory, Pearson Education India.
7. Henry Stark and John W. Woods, “Probability and Random Processes with Applications to Signal Processing”, Prentice Hall, 3rd Edition 2001

8. Sanjit K. Mitra. “Digital Signal Processing: A computer based approach.” McGraw Hill. 1998.
9. Steven M. Kay, “Fundamentals of Statistical Signal Processing, Volume I: Estimation Theory”, Prentice Hall, 1993

MOOCs:

1. https://nptel.ac.in/courses/108/108/108108109/
2. https://nptel.ac.in/courses/117/105/117105075/

Course Outcomes:

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

1. Apply the basic concept of frequency domain analysis for signal processing.
2. Utilize the linear analysis concept for signal processing.
3. Describe and apply probability theory concept for random signals.
4. Apply basic statistical signal processing filtering techniques.
5. Design and demonstrate basic optimization techniques for the applications based on signal processing.

INTRODUCTION TO EMBEDDED & IOT SYSTEM

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPATP2	3	0	0	3 hours	40	60	100	3

Course Objective:

This course will enable student to:

1. To introduce the Building Blocks of Embedded System
2. To understand the life cycle and applications of embedded system.
3. To understand the fundamentals about IoT, IoT Access technologies and IOT case studies.
4. To understand the design methodology and different IoT hardware platforms.
5. To study the basics of IoT Data Analytics and supporting services.

UNIT-I

Introduction and functioning: Review of Microcontroller concept. Functional block diagram of 8051 microcontroller. Introduction to Embedded system, characteristic of Embedded system. Functional building blocks of embedded systems, processor and controller.

UNIT-II

Life cycles and Applications: Interfacing of memory between analog and digital blocks, interfacing with external systems, Temperature control, stepper motor and keyboard interface. user interfacing, Embedded Life cycle, Water Fall Model , Spiral Model, RAD Model.

UNIT-III:

Introduction to IOT: Definition and characteristics of IOT, Physical design of IOT, Logical design of IOT, IoT Protocols, IoT communication models, IoT Communication APIs, IOT enabling technologies: Wireless Sensor Networks, Cloud Computing, Embedded Systems, IoT Levels and Templates, Domain Specific IoTs – Home, City, Environment, Energy, Agriculture,Industry, and health and life style.

UNIT IV:

IoT and M2M- Software defined networks, network function virtualization, difference between SDNand NFV for IoT, Basics of IoT System Management with NETCOZF, YANG- NETCONF, YANG, SNMP NETOPEER.

Design Methodology, Embedded computing logic, Microcontroller, System on Chips, IoT system building blocks IoT Platform overview: Overview of IoT supported Hardware platforms such as: Raspberry pi, Arduino Board details.

UNIT V:

Data Analytics and Supporting Services: Data Analytics: Introduction, Structured Versus Unstructured Data, Data in Motion versus Data at Rest, IoT Data Analytics Challenges, Data Acquiring, Organizing in IoT/M2M,

Supporting Services: Computing Using a Cloud Platform for IoT/M2M Applications/Services, Everything as a service and Cloud Service Models.

Text/Reference Books:

1. IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, Cisco Press, 2017
2. Internet of Things – A hands-on approach, Arshdeep Bahga, Vijay Madisetti, Universities Press, 2015
3. Internet of Things: Architecture, Design Principles And Applications, Rajkamal, McGraw Hill Higher Education.
4. The Internet of Things – Key applications and Protocols, Olivier Hersent, David Boswarthick, Omar Elloumi and Wiley, 2012

Course Outcomes:

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

1. Understand the basics of Embedded System.
2. Implement the state of the Architecture of an Embedded system.
3. Understand the basics of IoT and Implement the state of the Architecture of an IoT.
4. Understand design methodology and hardware platforms involved in IoT.
5. Understand how to analyze and organize the data.

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

Course Outcome:

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

1. Outline the different Microstrip Antenna feeding techniques
2. Outline the basic concept of Smart Antenna
3. Apply the Concept of different parameters of Rectangular Microstrip Antenna for its design
4. Apply the Concept of effect of various parameters on performance of Rectangular Microstrip Antenna
5. Apply the Concept of antenna design to control different Antenna characteristics

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.

Books & References: -

1. S. M. Kay, "Fundamentals of Statistical Signal Processing: Estimation Theory, vol. I" Prentice-Hall, 1993.
2. S. M. Kay, "Fundamentals of Statistical Signal Processing: Detection Theory, vol. II" Prentice-Hall, 1998.
3. H. Vincent Poor, "An Introduction to Signal Detection and Estimation" Springer, Second Edition, 1998
4. H. L. Van Trees, "Detection, Estimation, and Modulation Theory, Part I," John Wiley, 1968

Course Outcome:

1. The students will understand the principle of estimation and detection.
2. The students will learn different estimation and detection techniques like ML, LS, MMSE.
3. The students will be able to solve problems that involve estimation of the signal parameters or detection of the presence of a signal.
4. The students will compare and evaluate the performance of different estimation technique in different setups.
5. The students will also be able to apply these skills to solve problems with practical context.

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

5. Maria M. P. Petrou and Costas Petrou, Image Processing: The Fundamentals, 2nd Edition, John Wiley & Sons, Ltd, 2010.

MOOCs:

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://nptel.ac.in/courses/117/105/117105135/

Course Outcomes:

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

1. Apply the mathematical knowledge for basic understanding for image enhancement
2. Demonstrate image restoration process and its respective filters required.
3. Illustrate the color image processing and various multi-resolution techniques
4. Outline the various image compression techniques and their applications.
5. Design the various image segmentation operations for a meaningful partition of objects

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.

HASH AND MAC ALGORITHM: Secure Hash Algorithm, Whirlpool, HMAC, CMAC.

DIGITAL SIGNATURE: Digital Signature, Authentication Protocol, Digital Signature Standard

UNIT –IV:
AUTHENTICATION APPLICATION: Kerberos, X.509 Authentication Service, Public Key Infrastructure.

EMAIL SECURITY: Pretty Good Privacy (PGP) and S/MIME.

IP SECURITY: Overview, IP Security Architecture, Authentication Header, Encapsulating Security Payload, Combining Security Associations and Key Management.

UNIT –V:
WEB SECURITY: Requirements, Secure Socket Layer (SSL) and Transport Layer Security (TLS), Secure Electronic Transaction (SET), Intruders, Viruses and related threats.

FIREWALL: Firewall Design principles, Trusted Systems**.**

Text/Reference Books:

1. William Stallings, "Cryptography and Network security Principles and Practices", Pearson/PHI.
2. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", Pearson.
3. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education.
4. Charles P.Pfleeger, Shari Lawrence Pfleeger – Securityin computing –Prentice Hall of India.

Course Outcomes:

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

1. Identify basic security attacks and services and Use symmetric and asymmetric key algorithms for cryptography
2. Design a security solution for a given application
3. Analyze Key Management techniques and importance of number Theory.
4. Understanding of Authentication functions the manner in which Message Authentication Codes and Hash Functions works.
5. To examine the issues and structure of Authentication Service and Electronic Mail Security

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,

Representation, properties of convolution codes, Reed Solomon coding, Interleaving and concatenated codes, Turbo Codes.

UNIT V

Spread Spectrum Signals for Digital Communication: Model of spread spectrum digital communication system, Direct sequence spread spectrum signals, Frequency hopped spread spectrum signals, CDMA, Time hopping SS, Synchronization of SS systems.

Text/Reference Books:

1. 1.Bernard Sklar, "Digital Communication, Fundamentals and Application", Pearson Education Asia, 2nd Edition, 2001.
2. Simon, Hinedi, Lindsey, “Digital Communication Techniques, Signal Design and Detection", Prentice Hall of India Private Limited, New Delhi - 11, 1999.
3. John .G.Proakis, "Digital Communication", McGraw Hill Inc 2001.
4. Simon Haykin, "Digital Communications", John Wiley and Sons, 1998.
5. B.P.Lathi, "Modern Digital and Analog and communication systems", 3rd Edition Oxford university press 1998.

Course Outcomes:

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

1. Understand baseband data transmission over AWGN and band-limited channels
2. Understand and explain different digital modulation schemes
3. Analyze the performance of optimum receivers for different modulation schemes for AWGN channels
4. Analyze different techniques for carrier recovery and symbol synchronization in signal demodulation.
5. Understand and explain the concepts of spread spectrum for digital communication system.

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.

2. Balanis C A, "Antenna Theory: Analysis and Design" ,4th Edition, John Wiley and Sons, New Jersey, 2016.
3. Kraus J D and Marhefka R J, "Antennas for All Applications", 3rd. Edition, Tata McGraw Hill, 2002.
4. Girish Kumar and Ray K P, "Broadband Microstrip Antennas", Artech House, 2003

Course Outcome:

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

1. To Measurement of Antenna's parameters
2. To select the suitable antennas for Modern Wireless Communication
3. To design of array of Antenna to meet the requirement of Modern Wireless Communication
4. To perform analysis of key technology of 4G/5G wireless system
5. To design antennas for various applications of modern wireless communication

RESEARCH METHODOLOGY & IPR

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
IPPATC1	2	0	0	2 hours	0	50	50	2

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.

Course Outcomes

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

1. Understand research problem formulation.
2. Analyze research related information
3. Follow research ethics
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property
5. Right to be promoted among students in general & engineering in particular.
6. Understand research problem formulation.

OPTOELECTRONIC DEVICE LABORATORY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPALT1	0	0	4	4 hours	30	20	50	2

Course Objective:

1. To understand the working principles of various light source

2 To understand the various detection mechanism in optical detector

3 To get the concept of various performing parameters of light source.

4 To get the concept of various performing parameter of optical detector.

5 To analysis the performance OFC by losses measurement.

List of experiments

1. Study the VI characteristics of LED and photo detector.
2. Study the VI characteristics of optical detector
3. Study the VI characteristics of LASER source.
4. Study of chromatic dispersion.
5. Measurement of attenuation in attenuator.
6. Study the PI characteristic of LASER source.
7. Study the Analog signal transmitter using LASER source.
8. Study the OTDR using source of 1550 nm LASER diode and PIN photo detector.
9. Comparison of effect of EMI interference on copper medium and on optical fiber.
10. To study and plot the VI characteristics for 1550 nm LASER source.

Course outcomes:

1. Apply knowledge of optical communication to various application areas
2. Optical fiber is compatible for both analog and digital data transmission.
3. Can analyze the performance of optical detector and light source by its VI characteristics.
4. Performance of optical fiber in presence of dispersion.
5. Performance of optical fiber in comparison to the copper wire system in presence of EMI.

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

Course Outcome:

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

1. Outline the basic concept of IC fabrication.
2. Outline the basic concept of Oxidation processes
3. Outline and Apply the Ion implantation technique
4. Apply the concept of different Lithography techniques
5. Apply the concept of different device parameters of the integrated device for the characterization

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.

Text/Reference Books:

1. S. Rappaport, R.W. Heath, R.C. Daniels and J.N. Murdock, Millimeter Wave Wireless Communication, Prentice Hall
2. NPTEL Lectures by Dr M K Mondal IIT Kharagpur on Millimeter Wave Technology

Course Outcomes:

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

1. Need of Millimeter Wave Technology for Communication
2. Understand the Selection of suitable Guiding Structure at Millimeter Wave Technology
3. Design of Antenna for Millimeter wave Frequency
4. Analyze the various Passive Devices at MM Wave Systems
5. Understand the principle of Active Devices and Design of MM Wave System

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.

5. Yuxi (Hayden) Liu, “Python Machine Learning by Example”, Packet Publishing Limited, 2017.

MOOCs:

1. https://nptel.ac.in/courses/106/105/106105152/
2. https://nptel.ac.in/courses/106/106/106106198/
3. https://nptel.ac.in/courses/106/106/106106139/

Course Outcomes:

After completion of course, students would be able to:

1. Identify and classify elementary machine learning concepts.
2. Apply Bayesian concepts in learning data.
3. Apply support vector machine concept on discrete data set.
4. Explain neural networks and identify the role of deep learning in a large data set.
5. Apply basic clustering techniques for a given data set

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)

References:

1. Introduction to Optical Fibre Communication Suematsu and Iga, (John Wiley)
2. Fiber Optic Communication – Joseph C Palais, (PHI)
3. Optical Communication Components and Systems – J H Franz, V K Jain (Narosa Publishing House)
4. Optical Fiber Communication Systems J Gowar (Prentice Hall India,)
5. Fiber Optic Communication Systems D C Agarwal (S Chand).
6. An Introduction to Fiber Optic Systems – John Powers(McGraw Hill Irwin)
7. Fiber optic Communications Technology – Djafar K Mynbaev& Lowell L Scheiner, (Pearson Education)

Course Outcomes:

At the end of the semester students will be able to

1. Outline the performance of OFC system.
2. Distinguish between various emission approaches and also light source based on it
3. Outline the noise performance of optical detector.
4. Outline the design of system link and performance of the OFC system.
5. Distinguish between the working of electrical and optical amplifier and analyse the performance of optical amplifiers.

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.

Text Books/References:

1. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communications," Cambridge Univ. Press, 2005.
2. A. J. Goldsmith, "Wireless Communications," Cambridge Univ. Press, 2005.
3. R. S. Kshetrimayum, "Fundamentals of MIMO Wireless Communications,"Cambridge University Press,2017.
4. T. L. Marzetta, E. G. Larsson, H. Yang, and H. Q. Ngo, "Fundamentals of Massive MIMO," Cambridge Univ. Press, 2016.
5. Emil Björnson, Jakob Hoydis, and Luca Sanguinetti, "Massive MIMO Networks: Spectral, Energy, and Hardware Efficiency," Foundations and Trends® in Signal Processing: Vol. 11: No. 3-4, pp 154-655 (2017).

Course Outcome:

1. The student will learn and understand the different physical layer wireless communication technologies used in 4G and 5G communication systems.
2. The student will be able to apply the concept of CoherenceBandwidth, Coherence Time, Coherence Interval, Small-scale and Large-scale fading to analyze the physical layer performance of 4G and 5G communication systems.
3. The student will evaluate the channel capacity of the MIMO and massive MIMO Systems.
4. The student will analyze the communication system performance under OFDMA.
5. The student will evaluate the spectral efficiency and energyefficiency of massive MIMO technology used in 5G.

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.

4. P.P.Vaidyanathan, “Multi rate systems and filter banks”, Prentice Hall, 1993.
5. S.Mallet,“A Wavelet tour of Signal Processing”, Academic Press, 1998.

MOOCs:

1. https://nptel.ac.in/courses/117/105/117105075/
2. https://nptel.ac.in/courses/117/101/117101123/
3. https://nptel.ac.in/courses/117/101/117101001/

Course Outcomes:

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

1. Apply knowledge of Multi-rate signal processing and concept of decimators and interpolators.
2. Analyze the signals using prediction based filtering
3. Design adaptive filters for a given application
4. Implement various estimation algorithm for signal analysis
5. Understand advanced signal processing techniques, including wavelet transform

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.

5. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.
6. B. K. P. Horn, "Robot Vision", 1st Edition, McGraw-Hill, 1986.
7. E. R. Davies"Computer and Machine Vision: Theory, Algorithms, Practicalities", 4th Edition, Elsevier Inc,2012.

MOOCs:

1. https://nptel.ac.in/courses/106/105/106105216/
2. https://nptel.ac.in/courses/106/106/106106224/

Course Outcome:

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

1. Explain the concept behind Image formation and camera models.
2. Comprehend the concept of calibration and stereo vision.
3. Identify and extract features in Images
4. Apply basic level object tracking techniques in frame sequence.
5. Identify vision relevant problems and Develop vision-based applications.

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.

Unit-V

Adaptive Equalization: Zero forcing algorithm, LMS algorithm, adaptive decision-feedback equalizer and Equalization of Trellis-coded signals. Kalman algorithm, blind equalizers and stochastic gradient algorithm.

Text Books:

1. Digital Communications, 2ndEd, Bernard Sklar, Pearson Education, 2001.
2. Digital Communication Microwave Applications By Kamilo Feher, PHI, 1987.
3. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
4. H.Meyr&G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990
5. Simon Marvin, "Digital communication over fading channel; An unified approach to performance Analysis ", John Wiley, New York, 2000.
6. U. Mengali&A.N.D"Andrea, Synchronization Techniques for Digital Receivers, Kluwer, 1997

Reference Books:

1. Digital Communication, Prokis, John G. Tata McGraw Hill.
2. Digital Communication Technique, Signal Design & Detection By Simon, Marvin K, Hinedi,Sami M & Lindsey, William C, PHI.
3. Heinrich Meyer, Mare Moeneclacy, Stefan.A.Fechtel, " Digital communication receivers ", Vol I & Vol II, John Wiley, New York, 1997.
4. H.Meyr&G.Ascheid, Synchronization in Digital Communications, John Wiley, 1990
5. John.G.Proakis, "Digital communication "4th Edition, McGraw-Hill, New York, 2001.
6. R.G. Gallager, "Principles of Digital Communication", New York, Cambridge University Press, 2008

Course Outcomes:

At the end of this course students will able to:

1. Analyse concept of basic modulation technique and detection technique of Binary Signal in Gaussian Noise
2. Apply concept of Coherent and Non-Coherent detection technique.
3. Design the optimum receiver for AWGN channels and Analyse concept ofReceivers for Fading Channels
4. Apply Synchronization Techniques for Receivers and various estimation techniques
   Design and develop the different types of equalizers

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.

3. S.M. Senior : Optical Fibre Communication: Principles and Practice, PHI, New Delhi.
4. A.K.Ghatak, M.R. Shenoy : Fibre Optics Measurements, Viva, New Delhi.

Course Outcomes:

At the end of the semester students will be able to

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.

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.

Course Outcomes:

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

1. Visualize the architecture of satellite systems as a means of high speed, high range communication system.
2. State various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget.
3. Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.
4. Explain how satellite is controlled to become stationary w.r.t a point on the earth.
5. Explain how a single satellite is shared by large number of earth stations on the earth by using multiple access schemes.

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

without Outcome Probabilities, Decision Trees, the Value of Information, Utility and Decision Making.

- Unit 6:Recent Trends in Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

References:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education..

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,

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: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

References:

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

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

4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

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

R.
3. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.
4. Hand Book of Composite Materials-ed-Lubin.
5. Composite Materials – K.K.Chawla.
6. Composite Materials Science and Applications – Deborah D.L. Chung.
7. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

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.

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.

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,

Interfaces (serial, SPI, I2C), Programming – Python program with Raspberry PI with focus on interfacing external gadgets, controlling output, reading input from pins.

IoT Physical Servers and Cloud Offerings: Introduction to Cloud Storage models and communication APIs WebServer: Web server for IoT, Cloud for IoT, Python web application framework Designing a RESTful web API.

IoT application and its Variants: Case studies: IoT for smart cities, smart grid, health care, agriculture, smart meters.M2M, Web of things, Cellular IoT, Industrial IoT, Industry 4.0,IoT standards.

Text/Reference Books:

1. "Internet of Things - A Hands-on Approach", Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015, ISBN: 9788173719547
2. "Internet of Things",Srinivasa K G, CENGAGE Leaning India, 2017.
3. " IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry1stEdition, Pearson Education (Cisco Press Indian Reprint). (ISBN: 978-9386873743)
4. "Getting Started with Raspberry Pi", Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2014, ISBN: 9789350239759.
5. "From Machine to Machine to Internet of Things", Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand, David Boyle, Elsevier Publications, 2014.

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

STRESS MANAGEMENT BY YOGA

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
PEPBTX2	**2**	**0**	**0**	**2 hours**	**40**	**60**	**100**	**2**

Course Outcomes:

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

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

Syllabus Contents:

- Definitions of Eight parts of yog. (Ashtanga).
- Yam and Niyam, Do`s and Don't's in life, i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.
- Asan and Pranayam, i) Various yog poses and their benefits for mind &body, ii) Regularization of breathing techniques and its effects-Types of pranayam.

References:

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

DISASTER MANAGEMENT

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
CEPBTX3	2	0	0	2 hours	40	60	100	2

Course Outcomes:

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

1 Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.

2 Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives

3 Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations

4 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

Syllabus Contents:

- Introduction Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.
- 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.
- Disaster 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.
- Disaster Preparedness and Management: Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and other agencies, Media Reports: Governmental and Community Preparedness.
- Risk Assessment: Disaster Risk: Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk

Assessment. Strategies for Survival.

- Disaster Mitigation: Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. 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 Et. al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall of India, New Delhi.
3. Goel S. L. , Disaster Administration and Management Text and Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.

CONSTITUTION OF INDIA

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
LAPBTX4	2	0	0	2 hours	40	60	100	2

Course Outcomes:

At the end of the 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.

Syllabus Contents:

- History of Making of the Indian Constitution: History Drafting Committee, (Composition & Working).
- Philosophy of the Indian Constitution: Preamble, Salient Features
- 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.
- 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.
- Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO 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.
- 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.

WIRELESS COMMUNICATION LABORATORY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBLT1	0	0	4	4 hours	30	20	50	2

Course Objective

Student will try to learn

1. To understand working principle of wireless communication.
2. To analyse capacities of different multiple access techniques.
3. To know the concept of densification factor of network, cell load, spectral efficiency and energy efficiency of latest mobile communication.

List of experiments:

1. Programme to calculate SNR using channel capacity theorem.
2. Programme to calculate Channel capacity for variable SINR and its plot using channel capacity theorem.
3. Programme to show relationship between E_b/N_0 and SINR and its plot.
4. Programme to calculate channel capacity of FDMA system and its plot.
5. Programme to calculate channel capacity of TDMA system and its plot.
6. Programme to calculate channel capacity of CDMA system and its plot.
7. Programme for comparison of channel capacity of FDMA, TDMA and CDMA systems and its plot.
8. Programme to calculate channel capacity of latest mobile communication system and its plot.
9. Programme to calculate spectral efficiency of latest mobile communication system and its plot.
10. Programme to calculate energy efficiency of latest mobile communication system and its plot.

Course outcomes:

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

1. Understand the concept of channel capacity.
2. Understand and analyse SINR for wireless communication system.
3. Understand and analyse the different multiple access techniques for wireless system.
4. Understand and analyse the capacity, spectral efficiency and energy efficiency for latest cellular network.

RF & MICROWAVE COMPONENT DESIGN LABORATORY

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
ECPBLT2	0	0	4	4 hours	30	20	50	2

Course Objective

1. To understand the concepts and working principles of the feeding techniques used in RF and Microwave Communication
2. Hands on Experience of High frequency Software
3. To understand the concepts and working principles of the microwave filters
4. To understand the concepts and working principles of the microwave Antennas

List of Experiments

1. Design and Simulate Rectangular Waveguide at f = ____Ghz
2. Design and Simulate Microstrip feed
3. Design and Simulate CPW feed
4. Design and Simulate SIW feed
5. Design and Simulate power divider at f = _____GHz.
6. Design and Simulate planar band reject filter at frequency of f =_____GHz
7. Design and Simulate planar band pass filter at frequency of f =_____GHz
8. Design and Simulate microstrip patch antenna at resonating frequency of f = ___GHz.
9. Design and Simulate Dielectric Resonator Antenna at resonating frequency of f =GHz
10. Design and Simulate array of Antennas

Course Outcomes:

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

1. to select the suitable feed at microwave component design
2. to design the microwave filter
3. to design the Microwave Antennas
4. to design the Arrays of Antennas
5. Operate high frequency design software tools