SCHOOL OF STUDIES OF ENGINEERING & TECHNOLOGY
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)
(A CENTRAL UNIVERSITY)
CBCS-NEW SYLLABUS
B. TECH. FINAL YEAR (Electronics and Communication Engineering)
(W.E.F. SESSION 2021-22)

Vision and Mission of the Institute

Vision		To be a leading technological institute that imparts transformative education to create globally competent technologists, entrepreneurs, researchers and leaders for a sustainable society
Mission	1	To create an ambience of teaching learning through transformative education for future leaders with professional skills, ethics, and conduct.
	2	To identify and develop sustainable research solutions for the local and global needs.
	3	To build a bridge between the academia, industry and society to promote entrepreneurial skills and spirit

Vision and Mission of the Department

Vision		The Department endeavours for academic excellence in Electronics & Communication Engineering by imparting in depth knowledge to the students, facilitating research activities and cater to the ever-changing industrial demands, global and societal needs with leadership qualities.
Mission	1	To be the epitome of academic rigour, flexible to accommodate every student and faculty for basic, current and future technologies in Electronics and Communication Engineering with professional ethics.
	2	To develop an advanced research centre for local & global needs.
	3	To mitigate the gap between academia, industry & societal needs through entrepreneurial and leadership promotion.

Program Educational Objectives (PEOs)

The graduate of the Electronics and Communication Engineering Program will

PEO1: Have fundamental and progressive knowledge along with research initiatives in the field of Electronics & Communication Engineering.

PEO2: Be capable to contrive solutions for electronic & communication systems for real world applications which are technically achievable and economically feasible leading to academia, industry, government and social benefits.

PEO3: Have performed effectively in a multi-disciplinary environment and have self-learning & self-perceptive skills for higher studies, professional career or entrepreneurial endeavors to be confronted with a number of difficulties.

PEO4: Attain team spirit, communication skills, ethical and professional attitude for lifelong learning.

Programme Outcomes: Graduates will be able to:

PO1: Fundamentals: Apply knowledge of mathematics, science and engineering.

PO2: Problem analysis: Identify, formulate and solve real time engineering problems using first principles.

PO3: Design: Design engineering systems complying with public health, safety, cultural, societal and environmental considerations

PO4: Investigation: Investigate complex problems by analysis and interpreting the data to synthesize valid solution.

PO5: Tools: Predict and model by using creative techniques, skills and IT tools necessary for modern engineering practice.

PO6: Society: Apply the knowledge to assess societal, health, safety, legal and cultural issues for practicing engineering profession.

PO7: Environment: Understand the importance of the environment for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics, and responsibilities and norms of the engineering practice.

PO9: Teamwork: Function effectively as an individual and as a member or leader in diverse teams and multidisciplinary settings.

PO10: Communication: Communicate effectively by presentations and writing reports.

PO11: Management: Manage projects in multidisciplinary environments as member or a team leader.

PO12: Life-long learning: Engage in independent lifelong learning in the broadest context of technological change.

Programme Specific Outcomes:

PSO1: Identify, formulate and apply concepts acquired through Electronics & Communication Engineering courses to the real-world applications.

PSO2: Design and implement products using the cutting-edge software and hardware tools to attain skills for analyzing and developing subsystem/processes.

PSO3: Ability to adapt and comprehend the technology advancement in research and contemporary industry demands with demonstration of leadership qualities and betterment of organization, environment and society.

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CBCS-NEW, EVALUATION SCHEME

(W.E.F. SESSION 2021-22)

B. TECH. FOURTH YEAR (SEMESTER- VII)

(Electronics and Communication Engineering)

Sr. No.	Course Code	Course Title	L	T	P	Periods / week	Evaluation Scheme			Credit
							IA	ESE	Total	
Theory										
1	EC07TPC14	Fiber Optics Communication	3	1	0	4	30	70	100	**3**
2	EC07TPC15	Embedded Systems	3	1	0	4	30	70	100	**3**
3	EC07TPC16	Mobile Communication & Network	3	1	0	4	30	70	100	**3**
4	EC07TPE09 EC07TPE10 EC07TPE11 EC07TPE12	**Program Elective - 3** • Digital Image Processing • Analog & Digital VLSI Design • Estimation and Detection Theory • Advanced Power Electronics	3	1	0	4	30	70	100	**3**
5	EC07TPE13 EC07TPE14 EC07TPE15	**Program Elective - 4** • Microwave Theory & Techniques • Radar & Satellite Comm. • Machine Learning	3	1	0	4	30	70	100	**3**
Practical										
1	EC07PPC12	Fiber Optics Communication Lab	0	0	2	2	30	20	50	**1**
2	EC07PPC13	Design and Simulation Lab	0	0	2	2	30	20	50	**1**
3	EC07PPS01	Seminar on Industrial Training	0	0	0	0	30	20	50	**1**
4	EC07PPS02	Project - I	0	0	10	10	60	40	100	**5**
Total						**34**	**300**	**450**	**750**	**23**

Total Credits: **23** Total Contact Hours**: 34** Total Marks**: 750**

L**:** LECTURE, T**:** TUTORIAL, P**:** PRACTICAL, IA**:** INTERNAL ASSESSMENT, ESE**:** END SEMESTER EXAMINATION

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.

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CBCS-NEW, EVALUATION SCHEME

(W.E.F. SESSION 2021-22)

B. TECH. FOURTH YEAR (SEMESTER- VIII)

(Electronics and Communication Engineering)

Sr. No.	Course Code	Course Title	L	T	P	Periods / week	Evaluation Scheme			Credit
							IA	ESE	Total	
Theory										
1	EC08TPC17	VLSI Fabrication Technology	3	1	0	4	30	70	100	**3**
2	EC08TPE16 EC08TPE17 EC08TPE18	**Program Elective - 5** • Millimeter Wave Technology • Video Processing • Biomedical Electronics	3	1	0	4	30	70	100	**3**
3	EC08TPE19 EC08TPE20 EC08TPE21	**Program Elective - 6** • Neural Network & Fuzzy logic • Next Gen. Comm. Technology • Wireless Sensor Networks	3	1	0	4	30	70	100	**3**
4	EC08TOE05 EC08TOE06 EC08TOE07	**Open Elective - 3** • Intellectual Property Rights • Principles of Management • Introduction to IOT	3	1	0	4	30	70	100	**3**
Practical										
1	EC08PPS03	Project - II	0	0	18	18	120	80	200	**9**
2	EC08PPS04	Comprehensive viva	0	0	0	0	30	20	50	**1**
		Total				**34**	**270**	**380**	**650**	**22**

Total Credits: **22** Total Contact Hours**: 34** Total Marks**: 650**

L**:** LECTURE, T**:** TUTORIAL, P**:** PRACTICAL, IA**:** INTERNAL ASSESSMENT, ESE**:** END SEMESTER EXAMINATION

*INTERNAL ASSESSMENT- Two Class Test of 15 Marks each will be conducted.

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPC14	3	1	-	4 Hours	30	70	100	3

FIBER OPTICS COMMUNICATION

Course Objectives:

- To introduce the concept of signal propagation through the optical fiber.
- Discuss the channel impairments like losses and dispersion
- To learn the various components of optical fiber Communication system.
- Discuss the concept of optical networking and signal booster devices.
- To familiar with the concept of advance optical communication system.

UNIT-I

Introduction to optical communication, Principle of light transmission, Propagation of light in to fiber, Mode theory of a cylindrical waveguide, Ray model.

UNIT-II

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation, Fabrication of fibers and measurement techniques like OTDR.

UNIT-III

Optical sources, LEDs and lasers, Photo-detectors, Pin-diodes, APDs, Detector responsitivity, Noise, Optical receivers, Optical link design, BER calculation, power penalties.

UNIT-IV

Optical switches, Coupled mode analysis of directional couplers, Electro-optics switches, Optical amplifiers, EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

UNIT-V

Nonlinear effects in fiber optic links, Concept of self-phase modulation, Group velocity Dispersion and solition based communication.

Text/Reference Books:

1. G. Keiser, "Optical Fiber Communication," 4th ed., McGraw-Hill, 2000.
2. T. Tamir, "Integrated Optics," in Topics in Applied Physics vol.7, Springer-Verlag, 1975.
3. J. Gowar, "Optical Communication Systems," Prentice Hall India, 1987.
4. S. E. Miller and A. G. Chynoweth, "Optical Fibre Telecommunications," Academic Press, 1979.
5. G. P. Agrawal, "Nonlinear Fibre Optics," 2nd ed., Academic Press, 1994.
6. G. P. Agrawal, "Fiber Optic Communication Systems," John Wiley and Sons, New York, 1997.
7. F.C. Allard, "Fiber Optics Handbook for Engineers and Scientists," McGraw Hill, New York, 1990.

Course Outcomes:

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

CO1 Demonstrate the optical fiber communication system, fiber structure, propagation and transmission properties of an optical fiber.

CO2 Analyze the losses and propagation characteristics of an optical signal in different types of fibers.

CO3 Demonstrate the functionality of elements of optical fiber system and analyse the performance of the elements.

CO4 Estimate the power budget of the system and can understand the designing of the link.

CO5 Comprehend the different techniques to improve the efficiency of the system.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	2	-	-	3	-	-	3	3	3	3
CO2	3	3	3	3	3	2	-	-	3	-	-	3	3	3	3
CO3	3	3	3	3	2	3	-	-	3	-	-	3	3	3	3
CO4	3	2	3	2	3	2	-	-	2	-	-	3	2	2	3
CO5	2	3	3	2	3	3	-	-	3	-	-	3	2	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPC15	3	1	-	4 Hours	30	70	100	3

EMBEDDED SYSTEMS

Course Objectives:

- To introduce the building blocks of embedded system.
- To educate in various embedded development strategies.
- To introduce bus communication in processors, input/output interfacing.
- To impart knowledge in various processor scheduling algorithms
- To introduce basics of real time operating system.

UNIT-I

Embedded System Introduction: Overview of microcomputer systems and their building blocks, Review of 8051 microcontroller, Basic idea of system, Introduction of embedded system, Characteristic of embedded system.

UNIT-II

Components of Embedded System: Functional building blocks of embedded systems, Processor and controller, Interfacing of memory between analog and digital blocks, Interfacing with external systems, User interfacing.

UNIT-III

Layers of an Embedded System: Introduction, Need for layering, Middleware layer, The application layer, Introduction to real time operating systems, Design trade-offs due to process compatibility, Thermal considerations.

UNIT-IV

Networks for Embedded Systems: Serial communication RS 232 model, I square model, CAN and CAN open, SPI and SCI, USB, HDLC, Parallel communication basics, PCI interface and PCI X-interface, Device driver serial port and parallel port.

UNIT-V

Methodologies, Life Cycle and Modelling: Software life cycle, Embedded life cycle, Water fall model, Spiral model, RAD model and modelling of embedded system, Simulation and emulation, Software aspects of embedded systems: Real time programming languages and operating systems for embedded systems.

Text/Reference Books:

1. J. W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. J. Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V. K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. D. Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K. J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996.

Course Outcomes:

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

CO1 Comprehend the basic architecture of embedded systems.

CO2 Demonstrate the interfacing concept with microcontroller and its functioning.

CO3 Analyze the layered model and operating system of embedded system.

CO4 Compare the networking of embedded system with general communication system.

CO5 Demonstrate the programming efficiency and analyze the various designing methodology of embedded product.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	-	-	3	-	-	3	3	3	3
CO2	3	3	3	3	2	3	-	-	3	-	-	3	3	3	3
CO3	3	3	3	3	3	2	-	-	3	-	-	3	3	3	3
CO4	3	3	2	2	3	2	-	-	3	-	-	3	3	3	3
CO5	3	3	2	2	2	3	-	-	3	-	-	3	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPC16	3	1	-	4 Hours	30	70	100	3

MOBILE COMMUNICATION & NETWORKS

Course Objectives:

- To know the evolution of mobile communication and cell concept.
- To know the fading mechanism and types of fading and effect of fading on Mobile communication.
- To know the role of equalization and diversity techniques in mobile communication.
- To know the various types of multiple access techniques.
- To know the higher generation cellular standards.

UNIT-I

Introduction to Mobile Communication: Evolution of mobile communications, Mobile radio around the world, Types of wireless communication system, Second generation cellular networks, GSM, The cellular concept-system design fundamentals: Cellular system, Hexagonal geometry cell and frequency reuse concept, Channel assignment strategies, Distance to frequency reuse ratio, Channel & co-channel interference reduction factor, S/I ratio consideration and calculation for minimum co-channel and adjacent interference, Handoff strategies, Umbrella cell concept, Improving coverage & capacity in cellular system : Splitting, Cell sectorization, Repeaters, Micro cell zone concept.

UNIT-II

Mobile Radio Propagation: Free space propagation model, The three basic propagation mechanism: Reflection, Diffraction, Scattering, Practical link budget design, Outdoor propagation models, Indoor propagation models, Small scale multipath propagation, Impulse response model of a multipath channel, Small scale multipath measurements, Parameters of mobile multipath channels, Types of small scale fading, Time delay spread: Flat & frequency selective, Doppler spread: Fast and slow fading Rayleigh and Ricean distributions.

UNIT-III

Receiver Structure: Diversity receivers- selection and MRC receivers, RAKE receiver, Equalization: linear-ZFE and adaptive, Transmit diversity-Alamouti scheme, MIMO and space time signal processing, Spatial multiplexing, Diversity/multiplexing, Tradeoff, Performance measures- Probability of outage, Average SNR, Average symbol/bit error rate.

UNIT-IV

Multiple Access Techniques for Wireless Communication: Introduction, FDMA, TDMA, CDMA: DS-SS, FH-SS, Space division multiple access, Capacity of a cellular systems, Modulation schemes and bit error rate analysis- BPSK, QPSK, QAM and variants.

UNIT-V

Higher Generation Cellular Standards: Evolution of wireless LANs, Wireless LAN topologies, IEEE 802.11 standards, Wireless LAN applications, Trunking and grade of service (GOS),

Enhancements in 3G standards, Architecture and representative protocols in 4G standard, Call flow for LTE/ VoLTE, Introduction to 5G.

Text/Reference Books:

1. T. S. Rappaport, "Wireless Communication-Principles & Practice," 2nd ed., Pearson Education India, 2010.
2. V. Garg, "Wireless Communications and Networking," Morgan Kaufmann Publishers, 2008.
3. K. Feher, "Wireless Digital Communication: Modulation and Spread Spectrum Applications," PHI, 1995.
4. W. C. Y. Lee, "Mobile Communications Engineering," Mc Graw Hill Publications, 1982.
5. J. Goldsmith, "Wireless Communications," Cambridge Univ. Press, 2005.
6. D. Tse and P. Vishwanath, "Fundamentals of Wireless Communications," Cambridge Univ. Press, 2005.
7. R. Pandya, "Mobile & Personal Communication System," Wiley–Blackwell, 1999.

Course Outcomes:

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

CO1 Understand the evolution of cellular communication systems upto and beyond 3G

CO2 Design a cellular link and estimate the power budget.

CO3 Choose proper multiple accessing methods depending on channel model

CO4 Identify traffic channels for call processing.

CO5 Calculate key performance metrics of a cellular communication system.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	1	1			1		2	1	1	1
CO2	3	3	3	3	3	1	1			1		2	2	2	2
CO3	3	3	3	3	3	1	1			1		2	3	2	2
CO4	3	3	3	3	3	1	1			1		2	3	2	2
CO5	3	3	3	3	3	1	1			1		2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE09	3	1	-	4 Hours	30	70	100	3

DIGITAL IMAGE PROCESSING

Course Objectives:

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

UNIT-I

Image Representation and Image Processing Paradigm: Image, Elements of image perception, Image sensing and acquisition, Image sampling and quantization, Basic relationships between pixels, Image enhancements: Point operations, Arithmetic operations, Logical operation, Gray level transformations, Histogram equalization, Histogram specifications, Pixel-domain smoothing filters, Pixel-domain sharpening filters, Two-dimensional DFT and its inverse, Cosine transform.

UNIT-II

Image Filtering and Restoration: Noise models, Restoration in the presence of noise only using spatial filtering and frequency domain filtering, Linear position-invariant degradations, Estimating the degradation function, Inverse filtering, Minimum mean square error (Wiener) filtering, Constrained least squares filtering.

UNIT-III

Color Image Processing: Color models, Color transformations, Color image smoothing and sharpening, Color segmentation, Wavelets and multi-resolution image processing: Uncertainty principles of Fourier transform, Time-frequency localization, Continuous wavelet transforms, Wavelet bases and multi-resolution analysis, Wavelets and sub-band filter banks, Wavelet packets.

UNIT-IV

Image Compression: Redundancy–inter-pixel and psycho-visual, Lossless compression–predictive, Entropy, Lossy compression-predictive and transform coding, Still image compression standards-JPEG and JPEG-2000.

UNIT-V

Image Segmentation: Detection of discontinuities, Edge linking and boundary detection, Thresholding, Region-based segmentation, Segmentation using morphological watersheds.

Text/Reference Books:

1. R. C. Gonzalez and R. E. Woods, "Digital Image Processing," 3rd ed., Pearson Education, 2010.
2. A. K. Jain, "Fundamentals of Digital Image Processing," 2nd ed., Prentice Hall of India, 2011.

3. W. K. Pratt, "Digital Image Processing," 4th ed., John Wiley, 2007.
4. J. C. Russ, "The Image Processing Handbook," 6th ed., CRC Press, 2011.
5. M. M. P. Petrou and C. Petrou, "Image Processing: The Fundamentals," 2nd ed., John Wiley & Sons, Ltd, 2010.

Course Outcomes:

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

CO1 Acquire the knowledge of basic image processing concept and image enhancement techniques involved.

CO2 Demonstrate image restoration process and its respective filters required.

CO3 Illustrate the color image processing and various multi-resolution techniques.

CO4 Interpret the various image compression techniques and their applications.

CO5 Design the various image segmentation operations for a meaningful partition of objects.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	1			1			3	3	2	1
CO2	3	3	3	2	3	1			1			3	3	2	1
CO3	3	3	3	2	3	1			1			3	3	2	1
CO4	3	3	3	2	3	1			1			3	3	2	1
CO5	3	3	3	2	3	1			1			3	3	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE10	3	1	-	4 Hours	30	70	100	3

ANALOG AND DIGITAL VLSI DESIGN

Course Objectives:

- To demonstrate the ability to analyze and design the basic & advance analog integrated circuit.
- To develop skills in designing CMOS amplifier and reference circuits.
- To gain knowledge of strengths and weaknesses of basic CMOS fabrication technology.
- To analyze and perform the theoretical concepts through VHDL and simulation experiments.
- To develop skills in designing different ASICs.

UNIT-I

Introduction to MOS and CMOS: General considerations, C-V characteristics, Short channel effect, Scaling of MOSFET, Constant field scaling and its effects, Constant voltage scaling and its effect, Second order effect for calculation.

UNIT-II

MOSFET Models: Low frequency models and its analysis, High frequency models and its analysis, Frequency response, Basic concepts different types of amplifier.

UNIT-III

CMOS Fabrication Technology: VLSI design flow chart, Y-diagram, CMOS design flow, N-well, P-well, Twin-Tub, CMOS process enhancement, BI-CMOS technology and its application.

UNIT-IV

VHDL Application: Hardware modeling with verilog HDL, Encapsulation, Verilog models of propagation delay, Net delay, Path delay and simulation, Design examples in verilog.

UNIT-V

Introduction to ASIC's: Programmable logic devices, Programmable array logic, Concepts of FPGA, CPLD, Different design styles and its comparison.

Text Books/References:

1. P. R. Gray, P. Hurst, S. H. Lewis, and Robert G. Meyer, "Analysis and Design of Analog Integrated Circuits", 5th ed., Wiley, 2009.
2. Razavi, "Design of Analog CMOS Integrated Circuits", 2nd ed., TMH, 2001.
3. Grebene, "Bipolar and MOS Analog Integrated Circuit Design", John Wiley & sons, 2003.
4. P. E. Allen and D. R. Holberg, "CMOS Analog Circuit Design", 2nd ed., Oxford University Press, 2002.
5. A. Sarkar, S. De, and C. K. Sarkar, "VLSI Design and EDA Tools", 2nd ed., SCITECH Publication, 2000.

Course Outcomes:

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

CO1 Realize the concepts of analog CMOS design including various effects.

CO2 Realize the concepts of different types of amplifier including small & large signal models.

CO3 Illustrate the concept of fabrication technology and its design parameters and application.

CO4 Design and simulate different types of digital circuits using VHDL language.

CO5 Realize the concepts of advance circuits and find its application.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1			1			2	3	1	2
CO2	3	3	2	1	1	1			1			2	3	2	2
CO3	3	3	2	1	1	1			1			2	3	1	1
CO4	3	3	2	3	3	3			1			2	3	2	2
CO5	3	3	2	1	1	1			1			2	3	1	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE11	3	1	-	4 Hours	30	70	100	3

ESTIMATION AND DETECTION THEORY

Course Objectives:

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

UNIT-I

Introduction: 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 Model and Estimation: 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

Likelihood Estimation: Maximum likelihood 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 Estimation: 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

Detection and Decision: 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.

Text 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. V. Poor, "An Introduction to Signal Detection and Estimation" 2nd ed., Springer, 1998
4. H. L. Van Trees, "Detection, Estimation, and Modulation Theory", Part I John Wiley, 1968.

Course Outcomes:

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

CO1 Understand the principle of estimation and detection.

CO2 Learn different estimation and detection techniques like ML, LS, MMSE.

CO3 Solve problems that involve estimation of the signal parameters or detection of the presence of a signals.

CO4 Compare and evaluate the performance of different estimation technique in different setups.

CO5 Apply these skills to solve problems with practical context.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	2	2			1	1	2	3	2	2
CO2	3	3	3	3	3	2	2			1		2	3	2	2
CO3	3	3	3	3	3	2	2			1		2	3	2	2
CO4	3	3	3	3	3	2	2			1		2	3	2	2
CO5	3	3	3	3	3	2	2		1	1	1	2	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE12	3	1	-	4 Hours	30	70	100	3

ADVANCED POWER ELECTRONICS

Course Objectives:

- To provide the students with deep insights of different rectifier configurations and their applications.
- To make the student, analyse the DC- DC converters for different modes of operation
- To provide the students with a knowledge of resonant converters and multilevel inverters
- To provide the students with knowledge of multilevel inverters configuration, operation, and applications.
- To make the students learn the principle and working of Inverters and AC voltage controllers

UNIT-I

Phase Controlled Rectifiers: Principle of phase control, Single phase full wave-controlled converters: Midpoint and bridge type, Analysis of two pulse bridge converter with continuous current, Single phase two pulse converters with discontinuous current.

UNIT-II

DC to DC Switch Mode Regulators: Introduction, Review of linear power supply and basic dc-dc voltage regulator configurations, Buck converters, Boost converters, Buck-boost converters and their analysis for continuous and discontinuous conduction mode, Other converter configurations.

UNIT-III

Resonant Converters: Introduction, Need of resonant converters, Classification of resonant converters, Load resonant converters, Resonant switch converters, Zero voltage switching DC-DC converters, Zero current switching DC-DC converters, Applications of resonant converters.

UNIT-IV

Multi-Level Converters: Need for multi-level inverters, Concept of multi-level, Topologies for multi-level: Diode clamped, Cascaded H-bridge multilevel converters configurations, Features and relative comparison of these configurations with applications.

Unit-V

Review of Inverters and Controllers: Review of single-phase half bridge, Full bridge, Bipolar, Unipolar, VSI and CSI, Review of single-phase ac to ac controllers, Phase-controlled, Three-phase AC voltage controllers.

Text Books/References:

1. N. Mohan, T. M. Undeland, and W. P. Robbins, "Power Electronics – Converters, Applications and Design," 3rd ed., John Wiley & Sons, Inc., 2003.
2. M. H. Rashid, "Power Electronics - Circuits, Devices and Applications," 3rd ed., Prentice Hall of India, 2009.

3. B. K. Bose, "Modern Power Electronics and AC Drives," Pearson Publications, 2002.
4. L. Umanand, "Power Electronics Essentials and Applications," Wiley India Ltd., 2009.
5. P. C. Sen, "Thyristor DC Drives," John Wiley and Sons, New York, 1981.

Course Outcomes:

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

CO1 Analyse phase-controlled rectifier for continuous and discontinuous mode.

CO2 Build and test DC- DC converters circuits and various configurations.

CO3 Study and design resonant converters for different applications.

CO4 Analyse multilevel inverters and understand various topologies.

CO5 Review the working of CSI, VSI inverters and AC voltage Controllers

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	3		2						2	2	3	1
CO2	3	3	1	3		2						2	2	3	1
CO3	3	3	1	3		2						2	2	3	1
CO4	3	3	1	3		2						2	2	3	1
CO5	3	3	1	3		2						2	2	3	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE13	3	1	-	4 Hours	30	70	100	3

MICROWAVE THEORY AND TECHNIQUES

Course objectives:

- To understand the concepts of waveguides and modes.
- To understand the basic concept of various types of guiding structure and passive components at microwave.
- To understand the concepts and working principles of microwave active components.
- To understand the concepts and working principles of microwave system design and antenna
- To understand the applications and effect of microwave in various system

UNIT-I

Introduction to Microwaves: History of microwaves, Microwave frequency bands, Applications of microwaves, Mathematical model of microwave transmission-Concept of mode, Features of TEM, TE and TM modes in rectangular and circular waveguide, Losses associated with microwave transmission, Concept of impedance in microwave transmission, Introduction of microwave systems.

UNIT-II

Analysis of RF and Microwave Transmission Lines: Coaxial line, Strip line, Micro strip line, Microwave network analysis, Equivalent voltages and currents for non-TEM lines, Network parameters for microwave circuits, Scattering parameters, Passive microwave Devices, Microwave passive components: Directional coupler, Power divider, Magic Tee, Resonator.

UNIT-III

Microwave Active Components: Microwave semiconductor devices: Gunn diodes, IMPATT diodes, Schottky barrier diodes, PIN diodes, Microwave tubes: Klystron, Travelling wave tube amplifier, Magnetron.

UNIT-IV

Microwave Design Principles: Impedance transformation, Impedance matching, Introduction of microwave filter design, Microwave antennas, Antenna parameters, Introduction of antennas for ground based systems, Airborne and satellite systems, Introduction of planar antennas for microwave frequency.

UNIT-V

Microwave Measurements: Power, Frequency and impedance measurement at microwave frequency, Noise at microwave frequency and measurement of noise figure, Electromagnetic interference and electromagnetic compatibility (EMI & EMC), Modern trends in microwaves engineering, Microwave imaging, Effect of microwaves on human body.

Text/Reference Books:

1. R. E. Collins, "Microwave Circuits," 2nd ed., John Wiley & Sons, Inc., 2001.
2. S. Y. Liao, "Microwave Devices and circuits," 3rd ed., Pearson Education, 2003.
3. D. M. Pozar, "Microwave Engineering," John Wiley & Sons, 2001.

4. R. K. Shevgaonkar, "Electromagnetic Waves," Tata McGraw Hill, 2005.
5. S. Das, "Microwave Engineering," 2nd ed., Oxford Higher Education, 2015

Course Outcomes:

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

CO1 Comprehend the need of various microwave system components and their properties.

CO2 Evaluate the various guiding structures and passive components along with their properties.

CO3 Appreciate that during analysis/synthesis of microwave active systems, the different mathematical treatment is required compared to general circuit analysis.

CO4 Analyze to design the microwave devices.

CO5 Evaluate the measurement of microwave properties and will learn latest development in microwave technology.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	3				2			3	3	2	1
CO2	3	3	2	2	3				2			3	3	2	2
CO3	3	3	2	1	1				2			3	3	2	1
CO4	3	3	3	3	3				2			3	3	2	2
CO5	3	1	1	1	1				2			3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE14	3	1	-	4 Hours	30	70	100	3

RADAR & SATELLITE COMMUNICATION

Course Objectives:

- To know the evolution of satellite communication and its concept
- Understand the orbital and functional principles of satellite communication systems.
- Analyse and evaluate a satellite link and suggest enhancements to improve the link performance.
- Select an appropriate modulation, multiplexing and multiple access schemes for a given satellite communication link.
- Understand the basics and functional principles of different types of RADAR.

UNIT-I

Introduction to Satellite Communication: Principles and architecture of satellite communication, Brief history of satellite systems, Advantages, Disadvantages, Applications and frequency bands used for satellite communication.

UNIT-II

Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and perigee for an elliptical orbit, Evaluation of velocity, Orbital period, Angular velocity etc. of a satellite, Concepts of solar day and sidereal day, Satellite sub-systems: Study of architecture and roles of various sub-systems of a satellite system such as telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, Power sub-systems etc.

UNIT-III

Typical Phenomena in Satellite Communication: Solar eclipse on satellite & its effects, Remedies for eclipse, Sun transit outage phenomena & its effects and remedies, Doppler frequency shift phenomena and expression for doppler shift, Satellite link budget, Flux density and received signal power equations, Calculation of system, Noise temperature for satellite receiver, Noise power calculation, Drafting of satellite link budget and C/N ratio calculations in clear air and rainy conditions.

UNIT-IV

Modulation and Multiple Access Schemes: Various modulation schemes used in satellite communication, Meaning of multiple access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.

UNIT-V

RADAR: Introduction, Radar block diagram and operation, Radar frequencies, Simple form of radar equation, Prediction of range performance, Minimum detectable signals, CW radar, Tracking radar, MTI radar.

Text/Reference Books:

1. T. Pratt, C. W. Bostian, and J. E. Allnutt, "Satellite Communications," Wiley India, 2nd ed., 2002.

2. T. T. Ha, "Digital Satellite Communications," Tata McGraw Hill, 2009.
3. D. Roddy, "Satellite Communication," 4th ed., McGraw Hill, 2009.

Course Outcomes:

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

CO1 Visualize the architecture of satellite systems as a means of high speed, high range communication system

CO2 Analyze various aspects related to satellite systems such as orbital equations, sub-systems in a satellite, link budget, modulation and multiple access schemes.

CO3 Solve numerical problems related to orbital motion and design of link budget for the given parameters and conditions.

CO4 Explain how satellite is controlled to become stationary w.r.t a point on the earth.

CO5 Explain how a single satellite is shared by large number of earth stations on the earth.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1									2	3		1
CO2	3	3	1									2	3		1
CO3	3	3	2	2								2	3		1
CO4	3	2	1									2	3		3
CO5	3	2	1									2	2		1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07TPE15	3	1	-	4 Hours	30	70	100	3

MACHINE LEARNING

Course Objectives:

- To review and strengthen important mathematical concepts required for ML.
- Introduce the concept of learning patterns from data.
- Introduce the linear regression technique and SVM.
- Introduce the basic neural network and provide background knowledge for deep learning.
- Introduce a few standard clustering techniques.

UNIT-I

Review Artificial Intelligence and Mathematical Foundations: Matrix theory and statistics for machine learning, Introduction: Basic definition, Idea of machines learning from data, Types of learning, Classification of problem-regression and classification, Supervised and unsupervised learning.

UNIT-II

Linear Regression: Model representation for single variable, Single variable cost, Function, Gradient descent for linear regression, Gradient descent in practice.

UNIT-III

Logistic Regression: Classification, Hypothesis representation, Decision boundary, Cost function, Advanced optimization, Multi-classification (One vs All), Problem of over fitting, Support vector machine, Kernel function and kernel SVM.

UNIT-IV

Discussion on clustering algorithms and use-cases cantered around clustering and classification, K-means, Adaptive hierarchical clustering, Gaussian mixture model.

UNIT-V

Neural Network: Perceptron, Multilayer network, Back propagation, Introduction to deep neural network.

Text/Reference Books:

1. K. P. Murphy, "Machine Learning: A Probabilistic Perspective," The MIT Press, 2012.
2. C. M. Bishop, "Pattern Recognition and Machine Learning," Springer, 2011.
3. T. Mitchell, "Machine Learning," McGraw Hill, 2017.
4. T. Hastie, R. Tibshirani, and J. Friedman, "The Elements of Statistical Learning," 2nd ed., 2011.
5. Y. (Hayden) Liu, "Python Machine Learning by Example," Packet Publishing Limited, 2017.

Course Outcomes:

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

CO1 Identify and classify learning types for given data or problems.

CO2 Apply regression techniques for ML

CO3 Design and implement machine learning solutions to classification, regression and clustering problems.

CO4 Evaluate and interpret the results of the different ML techniques.

CO5 Explain the basic concept behind deep learning.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	3	1			1			3	3	2	1
CO2	3	3	3	2	3	1			1			3	3	2	1
CO3	3	3	3	2	3	1			1			3	3	2	1
CO4	3	3	3	2	3	1			1			3	3	2	1
CO5	3	3	3	2	3	1			1			3	3	2	1

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07PPC12	-	-	2	2 Hours	30	20	50	1

FIBER OPTICS COMMUNICATION LAB

Course Objectives:

- Align light waves into small optical components with high precision
- Calculate and simulate the attenuation and signal degradation due to intermodal and intramodal distortion.
- Calculate power coupling losses due to connectors, splices, source output pattern and fiber numerical aperture.
- Understand, compute and simulate the modes in step index fiber and graded index fiber.
- Understand the reliability issues of the highly delicate optical devices.

LIST OF EXPERIMENTS:

1. Study of initial fiber end preparation and connecting plastic fiber to the connector.
2. Study of numerical aperture.
3. Setting up a fiber optic analog link and measurement of propagation loss in the fiber.
4. Study of effect of lateral, longitudinal and angular displacement.
5. Study of time division multiplexing.
6. Comparison of effect of EMI interference on copper medium and on optical fiber.
7. Study of characteristics of fiber optic LED and photo detector.
8. Setting up simple fiber optic Voice link.
9. Setting up fiber optic digital link.
10. Study of Pulse width modulation and demodulation over fiber optic digital link.
11. Study of frequency division multiplexing and demultiplexing.
12. Measurement of bit error rate.
13. V-I characteristics of LASER source.
14. Analog and digital signal transmission using LASER source.
15. Study of chromatic dispersion.
16. Measurement of attenuation in attenuator.
17. Measurement of propagation delay time in fiber cable.

Course Outcomes:

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

CO1: Apply knowledge of optical communication to various application areas

CO2: Optical fiber is compatible for both analog and digital data transmission.

CO3: VI characterstics of LED and photo diode.

CO4: Performance of optical fiber in presence of dispersion.

CO5: Performance of optical fiber in comparison to the copper wire system in presence of EMI.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3				2			3	3	3	2
CO2	3	2	2	2	3				2			3	3	3	2
CO3	3	2	2	2	3				2			3	3	3	2
CO4	3	2	2	2	3				2			3	3	3	2
CO5	3	2	2	2	3				2			3	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC07PPC13	-	-	2	2 Hours	30	20	50	1

DESIGN AND SIMULATION LAB

Course Objectives:

- To make students familiar with different simulation software like Matlab, Octave, R, and Python.
- To teach basics of simulation and programming used.
- To design a simple system model and simulate their performance.
- The lab will help students in their project work.

LIST OF EXPERIMENTS:

1. Introduction to different simulation tools like Matlab, Octave, R, and Python.
2. Basic operations on matrices.
3. Generation of various signals and sequences (periodic and aperiodic), such as unit-impulse, unit-step, square, sawtooth, triangular, sinusoidal, ramp, and sinc.
4. Perform operations like addition, multiplication, scaling, shifting, and folding on signals.
5. Dealing with complex signal/sequence.
6. To perform convolution between signals and sequences.
7. Find the Fourier transform of a given signal and plotting its magnitude and phase spectrum.
8. Computation of unit samples, unit step, and sinusoidal response of the given LTI system and verifying its physical realizability and stability properties.
9. Generation of random number sequence.
10. Plot the PDF and CDF for Gaussian, Rayleigh, Rician random variables
11. Plot the frequency histogram for the given data sample
12. Find the mean and variance of the given data sample
13. To perform autocorrelation and cross-correlation between signals and sequences
14. Introduction to simulink
15. A simple control system simulink model.

Further Topics:

1. Simulate the BER for i) AWGN and ii) Rayleigh fading + AWGN channel for ASK, BPSK, QPSK, and QAM modulation. 2. GSM IS-95 simulink model analysis. 3. Simple image processing examples.
4. Simple machine learning examples.

Course Outcomes:

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

CO1 Learn the different simulation software available.

CO2 Apply the mathematical operations on signals and data sets

CO3 Evaluate & simulate the performance of a simple communication and control system.

CO4 Analyze the sample data set and evaluates its statistical parameters.

CO5 Help for completing their project work and future higher studies.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3				2			3	3	3	2
CO2	3	2	2	2	3				2			3	3	3	2
CO3	3	2	2	2	3				2			3	3	3	2
CO4	3	2	2	2	3				2			3	3	3	2
CO5	3	2	2	2	3				2			3	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

B. TECH. IV YEAR VIII SEMESTER SCHEME

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPC17	3	1	-	4 Hours	30	70	100	3

VLSI FABRICATION METHODOLOGY

Course Objectives:

- To introduce the brief concept of fabrication technology of both BJT & MOS.
- To learn difficulties in single crystal development and wafer design.
- To learn different epitaxial growth techniques and their associated problems.
- To introduce the concept of Si atomic structure, atomic planes and structural defects.

UNIT-I

Introduction to VLSI: Brief overview of processing steps of BJT & MOSFET fabrication, Concept of photolithography, Epitaxy, Self-aligned technique, Polysilicon & its advantages etc.

UNIT-II

Silicon Crystal Structure: Basics of crystal structure and its types and different formations, Hard sphere model of diamond lattice and its packing densities, Concept of misfit factor and its importance, Details of crystal plane-miller's indices, Packing densities, Interplane distances and angles between the planes, V-groove etching concept, Direction of line on Si-wafer.

Defects in crystal structure: Point defects, Line defects, Area dislocation, Volume defects.

UNIT-III

Crystal Growth of Si: Carbothermic reduction process, Bridgemann technique and its problems, Czochralski technique & its thermodynamics and effect of pull rate on wafer size, Dopant incorporation in Si crystal: Segregation coefficient, O_2 incorporation and its removal.

UNIT-IV

Crystal Refinement & Wafer Preparation: Zone refining technique and its advantages, Wafer preparation, Gettering process and metallic contaminant removal. Epitaxy: Types, 3 cardinal rules and their importance, Liquid phase epitaxy, Vapour phase epitaxy, Reactor configuration.

UNIT-V

Chemical Vapour Deposition for Si Epitaxy: Silane route, Doping during epitaxy-auto doping, Molecular beam epitaxy.

Text/Reference Books:

1. S. M. Sze, "VLSI Technology," 2nd ed., McGraw Hill Book Co., 1998.
2. S. K. Gandhi, "VLSI Fabrication Principles," 2nd ed., John Wiley and Sons, NY, 2008.
3. Chen, "VLSI Technology," Wiley, March 2003.
4. G. S. May and S. M. Sze, "Fundamentals of Semiconductor Fabrication," Wiley, 2004.
5. J. D. Plummer, M. D. Deal, and F. B. Griffin, "Silicon VLSI Technology: Fundamentals, Practice & Modeling," PH, 2001.

Course Outcomes:

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

CO1 Comprehend the concept of fabrication technology.

CO2 Analyze the challenge of single crystal development and wafer design.

CO3 Apply the epitaxial growth techniques and their associated problems.

CO4 Illustrates the concept of Si atomic structure, atomic planes.

CO5 Comprehend the structural defects and their effects on wafer quality.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	1								3	3	1	2
CO2	3	2	1	1								3	3	1	2
CO3	3	2	1	1								3	3	1	2
CO4	3	2	1	1								3	3	1	2
CO5	3	2	1	1								3	3	1	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE16	3	1	-	4 Hours	30	70	100	3

MILLIMETER WAVE TECHNOLOGY

Course Objectives:

- To understand the characteristics of millimeter wave technology
- To understand the concepts and working principles of various guiding structures at millimeter wave technology.
- To design the antenna for millimeter wave applications.
- To perform analysis of passive components at millimeter wave.
- 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, 2014.
2. K.C. Huang and Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, 2011.
3. M. K. Mondal, "NPTEL Lectures on Millimeter Wave Technology," IIT Kharagpur, 2021.

Course Outcomes:

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

CO1 Realize the need of millimeter wave technology for communication.

CO2 Comprehend the selection of suitable guiding structure at millimeter wave technology.

CO3 Design of antenna for millimeter wave frequency.

CO4 Analyze the various passive devices at mm wave systems.

CO5 Comprehend the principle of active devices and design of millimeter wave system.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1				2			2	3	1	2
CO2	3	3	2	3	1				2			2	3	2	2
CO3	3	2	2	3	3				2			2	3	2	2
CO4	3	1	2	1	3				2			3	3	2	2
CO5	3	2	1	1	3				2			3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE17	3	1	-	4 Hours	30	70	100	3

VIDEO PROCESSING

Course Objectives:

- To acquire the fundamental knowledge on digital video processing.
- To develop the ability to understand and implement various digital video processing and estimation algorithms.
- To facilitate the students for analyze and implement various real time digital video processing applications.

UNIT-I

Basic Steps of Video Processing: Video capture and display, Analog video, Digital video, Time varying image formation models-3D motion models, Geometric image formation, Photometric image formation, Sampling of video signals, Filtering operations.

UNIT-II

Video Modeling: Camera model-pinhole model, CAHV model, Camera motions, Object model-shape model, Motion model, Scene model, Two-dimensional motion models**.**

UNIT-III

2-D Motion Estimation: Optical flow, General methodologies, Pixel based motion estimation, Block matching algorithm, Multi resolution motion estimation, Application of motion estimation in video.

UNIT-IV

Video Coding: Waveform based coding, Block based transform coding-Unitary transform, Discrete cosine transform, Bit allocation and transform coding gain, DCT-based image coders and the JPEG standard, Predictive coding, Video coding using temporal prediction and transform coding.

UNIT-V

Video Compression: H.261, H.263, MPEG-1, MPEG-2, and MPEG-4.

Text/Reference Books:-

1. A. Bovik, "The Essential Guide to Video Processing," Academic Press, 2009.
2. A. C. Bovik, "Handbook of Image and Video Processing," Academic Press, 2005.
3. A. M. Tekalp, "Digital Video Processing," Prentice Hall, 1995.
4. Y. Wang, J. Ostermann, and Ya-Q. Zhang, "Video Processing and Communications," Prentice Hall, 2002.
5. D. Bull, "Video Coding for Mobile Communications," Academic Press, 2002.

Course Outcomes:

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

CO1 Comprehend the basic concept of digital Image formation and sampling of video signals.

CO2 Explain the various video models.

CO3 Apply appropriate motion estimation model for specific application

CO4 Illustrate the video coding techniques for input video

CO5 Identify and analyze the standard video compression techniques and their applications

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	1	3	1			2	1			3	2	2
CO2	3	3	2	2	2	2			1			1	3	2	2
CO3	3	3	3	3	3	2			2			1	3	2	2
CO4	3	3	3	2	3	1			2	2		1	3	2	2
CO5	3	3	3	3	3	2			2			2	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC208TPE18	3	1	-	4 Hours	30	70	100	3

BIOMEDICAL ELECTRONICS

Course Objectives:

- To introduce the concept of biomedical electronics and instrument system.
- To introduce the concept of physiological system of human Body.
- To learn different biomedical transducers.
- To learn the radiology, X-ray and angiography.
- To learn the biotelemetry system and their different application in patient care.

UNIT-I

Concept of biomedical electronics, Biomedical engineering, Biometrics, Components of man instrument system, Data acquisition techniques.

UNIT-II

Brief introduction to human physiology, Physiological system of the body, Cells & their structure, Resting & action, Bioelectric potential, The heart & cardiovascular system, Physiological system & mechanical activity of heart, Electrocardiographic lead system, Electrocardiogram, Electrocardiography, Other physiological systems.

UNIT-III

Biomedical Transducers: Displacement, Velocity, Force, Acceleration, Flow, Temperature, Potential, Dissolved ions and gases, Bio-electrodes and bio-potential amplifiers for ECG, EMG, EEG, etc.

UNIT-IV

Radiology introduction, Generation of ionizing radiation, X-Ray system, Radiography, X-Ray diagnostic, Special techniques in X-Ray, Angiography.

UNIT-V

Biotelemetry-Introduction, Physiological parameters, Biotelemetry system, Radio telemetry system, Problems in implant telemetry, Application of telemetry in patient care, EEG measurements, EMG measurement, Working principle of PACE MAKERS.

Text /Reference Books:

1. L. Cromwell, F. J. Weibell, and E. A. Pfeiffer, "Biomedical Instrumentation & Measurement," 2nd ed., PHI, 1990.
2. C. R. Rao and S. K. Guha, "Principles of Medical Electronics & Biomedical Instrumentation," University Press, 2015.
3. R. S. Khandpur, "Handbook of Biomedical Instrumentation," 3rd ed., TMH Pub. Co., 2014.
4. R. Aston, "Principles of Biomedical Instrumentation," Pearson Prentice Hall, 1990.
5. N. K. Jog, "Electronics in Medicine and Biomedical Instrumentation," PHI, 2013.
6. M. Arumugam, "Biomedical Instrumentation," Anuradha Agencies, Chennai, 2017.

Course Outcomes:

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

CO1 Comprehend the concept of biomedical electronics and instrument system.

CO2 Comprehend the concept of physiological system of human body.

CO3 Analyze the radiology, x-ray and angiography techniques.

CO4 Analyze the biotelemetry system and their different application in patient care.

CO5 Comprehend the concept of biomedical transducers.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO1	PO2	PO6	PO1	PO2	PO9	PO1	PO2	PO12	PO1	PO2	PSO3
CO1	3	3	2	1					3	1		2	3	2	2
CO2	3	3	2	3	3	3			3	1		2	3	2	3
CO3	3	3	2	3	3	3			3	1		2	3	3	3
CO4	3	3	2	3	3	3			3	1		2	3	3	3
CO5	3	3	2	3	3	3			3	1		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC08TPE19	3	1	0	4 Hours	30	70	100	3

NEURAL NETWORKS AND FUZZY LOGIC

Course Objectives:

- To introduce the origin and terminology of the neural network.
- To understand the basic structure of the artificial neural network (ANN).
- To understand the single layer neural network and concept of perceptrons.
- To introduce the concept of back propagation and deep learning at an elementary level.
- To introduce basic concepts and terminology of fuzzy logic and systems.

UNIT-I

Introduction to Neural Networks: Introduction humans and computers, Organization of the brain, Biological neuron, Biological and artificial neuron models, Hodgkin-Huxley neuron model, Integrate-and-fire neuron model, Spiking neuron model, Characteristics of ANN, McCulloch-pitts model, Historical developments, Potential applications of ANN.

UNIT-II

Essentials of artificial neural networks, Artificial neuron model, Operations of artificial neuron, Types of neuron activation function, ANN architectures, Classification taxonomy of ANN-connectivity, Neural dynamics (activation and synaptic), Learning strategy (supervised, unsupervised, reinforcement), Learning rules, Types of application.

UNIT-III

Single Layer Feed Forward Neural Networks: Introduction, Perceptron models: discrete, continuous and multi-category, Training algorithms: discrete and continuous perceptron networks, Perceptron convergence theorem, Limitations of the perceptron model, Applications.

UNIT-IV

Multilayer Feed Forward Neural Networks: Credit assignment problem, Generalized delta rule, Derivation of back propagation (BP) training, Summary of back propagation algorithm, Kolmogorov theorem, Learning difficulties and improvements.

Introduction of RBF neural network, MLP network, Self-organizing feature map, Counter-propagation neural network, Recurrent neural network, Deep learning (Introductory).

Applications of neural networks: Pattern classification/handwritten character recognition/ face recognition/image compression and decompression.

UNIT-V

Fuzzy logic & System: Basic fuzzy logic theory, Sets and their properties, Operations on fuzzy sets, Fuzzy relation and operations on fuzzy relations and extension principle, Fuzzy membership functions and linguistic variables, Fuzzy rules and fuzzy reasoning, Fuzzification and defuzzification and their methods, Fuzzy inference systems, Mamdani Fuzzy models, and Fuzzy knowledge based controllers

Basic applications of Fuzzy Logic and Fuzzy Systems: In controllers /fuzzy pattern recognition/ fuzzy image processing/popular applications of fuzzy sets, namely fuzzy reasoning and fuzzy clustering.

Text /Reference Books:

1. S. Haykin, "Neural Networks: A Comprehensive Foundation," 2nd ed., Pearson Education Asia, 1999.
2. B. Kosko, "Neural Networks and Fuzzy Systems: A Dynamical Systems Approach to Machine Intelligence," Prentice Hall India, 1994.
3. T. J. Ross, "Fuzzy Logic with Engineering Applications," Wiley India Publications, 2004.
4. D. L. Fausett, "Fundamentals of Neural Networks," Pearson Education, 2004.
5. S. Rajasekaran and G. A. V. Pai, "Neural Networks, Fuzzy Logic, and Genetic Algorithms," PHI, 2011.
6. S. N. Sivanandam, S. Sumathi, and S. N. Deepa, "Introduction to Neural Network Using MATLAB," Tata McGraw-Hill Publications, 2006.
7. J. A. Freeman and D. Skapura, "Neural Networks," Pearson Education, 2002.
8. G. J. Klir and B. Yuan, "Fuzzy Sets and Fuzzy Logic," Prentice Hall India, 1997.

Course Outcomes:

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

CO1 Describe artificial neurons and its role in ANN.

CO2 Explain learning types and elementary structures of ANN.

CO3 Describe perceptron model and single layer neural networks with application.

CO4 Describe back propagation and its role in deep learning.

CO5 Identify and apply basic techniques of fuzzy logic and systems**.**

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1	1			1	1		1	3	3	2
CO2	3	3	3	2	3	2			1	1		1	3	3	2
CO3	3	3	3	2	3	2			2			1	3	3	2
CO4	3	3	3	2	3	1			2	2		1	3	3	2
CO5	3	3	3	3	3	2			2	2		2	3	3	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC08TPE20	3	1	-	4 Hours	30	70	100	3

NEXT-GENERATION COMMUNICATION TECHNOLOGY

Course Objectives:

- To learn the new communication technologies such as OFDM and MIMO used in next generation communication systems.
- To understand and apply the fundamental concept of coherence time, coherence bandwidth.
- To learn the different fading model and evaluate the SNR.
- To learn and analyse the performance of a massive MIMO system.
- 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, Massive MIMO, Coherence time, Coherence bandwidth, Coherence interval, TDD coherence interval structure, Coherence interval in the context of OFDM modulation, Small-scale and large-scale fading, 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, Channel hardening and favourable 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. E. Björnson, J. Hoydis, and L. 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 Outcomes:

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

CO1 Learn and understand the different physical layer wireless communication technologies used in 4G and 5G communication systems.

CO2 Apply the concept of coherence bandwidth, coherence time, coherence interval, small-scale and large-scale fading to analyze the physical layer performance of 4G and 5G communication systems.

CO3 Evalute the channel capacity of the MIMO and massive MIMO systems.

CO4 Analyze the communiation system performance under OFDMA.

CO5 Evalute the spectral efficiency and energy efficiency of massive MIMO technology used in 5G.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	1	1	1	1		1	2	2	2	3	3	3
CO2	3	3	2	2	2	1			1	2	2	2	3	3	2
CO3	3	3	2	3	2	1			1	2	2	2	3	3	1
CO4	3	3	2	3	2	1			1	2	2	2	3	3	1
CO5	3	3	2	3	2	1	1		1	2	2	2	3	3	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Credit
EC08TPE21	3	1	0	4 Hours	30	70	3

WIRELESS SENSOR NETWORKS

Course Objectives:

- To introduce and understand the concept of wireless sensor network and its applications.
- To identify various network technologies and its challenges.
- To know about various protocols used in wireless sensor networks.
- To understand the networking concept in wireless sensor networks.
- To introduce operating system in field of sensor networks.

UNIT-I

Introduction to sensor networks, Unique constraints and challenges, Advantage of sensor networks, Applications of sensor networks, Types of wireless sensor networks.

UNIT-II

Mobile ad-hoc networks (MANETs) and wireless sensor networks, Enabling technologies for wireless sensor networks, Issues and challenges in wireless sensor networks.

UNIT-III

MAC protocols and Routing Protocols for Wireless Sensor Networks: Classification of MAC protocols, S-MAC protocol, B-MAC protocol, IEEE 802.15.4 standard and zigbee, Dissemination protocol for large sensor network, Data dissemination, Data gathering, and data fusion, Quality of a sensor network, Real-time traffic support and security protocols.

UNIT-IV

Design principles for WSNs, Gateway concepts, Need for gateway and WSN to internet communication and internet to WSN communication, Single-node architecture, Hardware components & design constraints.

UNIT-V

Operating systems and execution environments, Introduction to TinyOS and nesC.

Text/Reference Books:

1. W. Dargie and C. Poellabauer, "Fundamentals of Wireless Sensor Networks: Theory And Practice," John Wiley & Sons, 2011.
2. S. Soloman, "Sensors Handbook," McGraw Hill, 2009.
3. F. Zhao and L. Guibas, "Wireless Sensor Networks," Elsevier, 2004.
4. T. Z. K. Sohrby and D. Minoli, "Wireless Sensor Networks: Technology, Protocols, and Applications," Wiley-Inter science, 2010.
5. P. Levis and D. Gay, "TinyOS Programming," Cambridge University Press, 2009.

Course Outcomes:

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

CO1 Design wireless sensor networks for a given application.

CO2 Comprehend emerging research areas in the field of sensor network.

CO3 Comprehend MAC and Routing protocols used for different communication standards used in WSN.

CO4 Design network like internet to wireless sensor and vice versa using different hardware component.

CO5 Create programming environment for designing to run on small, wireless sensors.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	3	3	1	1				1		2	1	1	1
CO2	3	3	3	3	1	1				1		2	2	1	2
CO3	3	3	3	3	2	1				1		2	2	2	2
CO4	2	2	3	3	3	2				1		2	3	2	3
CO5	2	2	3	3	3	2				1		2	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC08TOE05	3	1	-	4 Hours	30	70	100	3

INTELLECTUAL PROPERTY RIGHTS

Course Objectives:

- Introduce fundamental aspects of intellectual property rights.
- Understand rationale behind patent system.
- Understand WTO, TRIPS and WIPO.
- To get insight about an overview of the IPR regime.

UNIT-I

Overview of IPR and its Classification: Introduction to IPRs, Basic concepts and need for intellectual property, Patents, Copyrights, Geographical indications, IPR in India and abroad, Genesis and development, The way from WTO to WIPO, TRIPS, Nature of intellectual property, Industrial property, Technological research, Inventions and innovations, Important examples of IPR.

UNIT-II

Patents: Patents, Elements of patentability: Novelty, Non obviousness (Inventive Steps), Industrial application , Non patentable subject matter, Registration procedure, Rights and duties of patentee, Assignment and licence, Restoration of lapsed patents, Surrender and revocation of patents, Infringement, Remedies & penalties, Patent office and appellate board.

UNIT-III

Registration of IPRs: Meaning and practical aspects of registration of copy rights, Trademarks, Geographical indications, Trade secrets, Plant variety protection and industrial design registration in India and Abroad.

UNIT-IV

Agreement and Legislation: International treaties and conventions on IPRs, TRIPS agreement, PCT agreement, Intellectual property, History of GATT & TRIPS agreement , Berne convention, Madrid agreement, Hague agreement concerning the International deposit of industrial designs, Lisbon agreement patent Act of India, Patent amendment Act, Design Act, Trademark Act, Geographical indication Act.

UNIT-V

Digital Products and Law: Digital innovations and developments as knowledge assets, IP laws, Cyber law and digital content protection, Unfair competition, Meaning and relationship between unfair competition and IP laws, Case studies.

Enforcement of IPRs: Infringement of IPRs, Enforcement measures, Emerging issues, Case studies.

Text/Reference books:

1. K. Bansal and P. Bansal, "Fundamentals of IP for Engineers," BSP, 2013.
2. D. E. Bouchoux, "Intellectual Property Right- The Law of Trademarks, Copyrights, Patents and Trade Secrets," 4th ed., Cengage Learning, 2013.
3. P. Ganguli, "Intellectual Property Rights: Unleashing the Knowledge Economy," McGraw Hill Education, 2017.
4. R. P. Merges, P. S. Menell, and M. A. Lemley, "Intellectual Property in New Technological Age," 2016.
5. T. Ramappa, "Intellectual Property Rights Under WTO," S. Chand, 2008.

Course Outcomes:

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

CO1 Comprehend intellectual property assets.

CO2 Rules and process for IPR registration.

CO3 Assist individuals and organizations in capacity building

CO4 Work for development, promotion, protection, compliance, and enforcement of intellectual property and patenting.

CO5 Legal concepts in science, engineering, technology and creative design.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1	1	2				2			3	3	2	1
CO2	3	1	1	1	2				2			3	3	2	2
CO3	3	1	1	1	2				2			3	3	2	2
CO4	2	1	1	1	2				2			3	3	2	2
CO5	2	1	1	1	2				2			3	3	2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC08TOE06	3	1	-	4 Hours	30	70	100	3

PRINCIPLES OF MANAGEMENT

Course Objectives:

- Help the students gain an understanding of the functions and responsibilities of managers.
- Provide them tools and techniques to be used in the performance of the managerial job.
- Enable them to analyse and understand the environment of the organization.
- help the students to develop cognizance of the importance of management principles

UNIT-I

Introduction: Definition of management, Science or art, Manager Vs entrepreneur, Types of managers, Managerial roles and skills, Evolution of management, Scientific, Human relations, System and contingency approaches, Types of Business organization, Sole proprietorship, Partnership, Company-public and private sector enterprises, Organization culture and environment -Current trends and issues in management.

UNIT-II

Planning: Nature and purpose of planning, Planning process, Types of planning, Objectives, Setting objectives, Policies, Planning premises, Strategic management, Planning tools and techniques, Decision making steps and process.

UNIT-III

Organization: Nature and purpose of organizing, Formal and informal organization, Organization chart, Organization structure, Types, Line and staff authority, Departmentalization, Delegation of authority, Centralization and decentralization, Job design, Human resource management, HR planning, Recruitment, Selection, Training and development, Performance management, Career planning and management.

UNIT-IV

Direction and Leadership: Directing, individual and group behaviour, Motivation, Motivation theories, Motivational techniques, Job satisfaction, Job enrichment, Leadership, Types & theories of leadership and effective communication.

UNIT-V

Controlling: System and process of controlling, Budgetary and non-budgetary control techniques, Use of computers and IT in management control, Productivity problems and management, Control and performance, Direct and preventive control, Reporting.

Text/Reference Books:

1. R. Robbins, D. A. Decenzo, and M. Coulter, "Fundamentals of Management," 7th ed., Pearson Education, 2011.

2. R. Kreitner and M. Mohapatra, "Management," Biztantra, 2008.
3. P. C. Tripathy and P. N. Reddy, "Principles of Management," Tata McGraw Hill, 1999.

Course Outcomes:

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

CO1 Describe the basis of management and its types, skills, management roles, types of business organization, and current trends in business.

CO2 Explain the nature and purpose of planning, types, objectives of planning and decision process.

CO3 Compare the different organization structures, authorities and responsibilities, human resource management, and training and development.

CO4 Estimate the individual and group behavior, motivation, job satisfaction types and theories of leadership, communication, and IT.

CO5 Apply the knowledge using the various system and processes of controlling, budgetary and non-budgetary control techniques, and use of computer and IT in management control, and reporting.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		2	1	2	1	2			3		3	3		2	2
CO2		2	1	2	1	3			3		3	3		2	2
CO3		2	1	2	1	3			3		3	3		2	2
CO4		2	1	2	1	3			3		3	3		2	2
CO5		2	1	2	1	3			3		3	3		2	2

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**

Sub Code	L	T	P	Duration	IA	ESE	Total	Credits
EC08TOE07	3	1	-	4 Hours	30	70	100	3

INTRODUCTION TO IOT

Course Objectives:

- It will enable student to understand the basics of internet of things and protocols.
- It introduces some of the application areas where internet of things can be applied.
- Students will learn about the middleware for internet of things.
- It will enable to understand the concepts of web of things.

UNIT-I

Introduction to Internet of Things:

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.

UNIT-II

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.

UNIT-III

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).

UNIT-IV

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.

UNIT-V

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, Web server: 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. A. Bahga and V. Madisetti, "Internet of Things - A Hands-on Approach," Universities Press, 2015.
2. S. K. G. Srinivasa, "Internet of Things," CENGAGE Learning India, 2017.
3. D. Hanes, G. Salgueiro, P. Grossetete, R. Barton, and J. Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things," 1st ed., Pearson Education (Cisco Press Indian Reprint).
4. M. Richardson and S. Wallace, "Getting Started with Raspberry Pi," O'Reilly (SPD), 2014.
5. J. Holler, V. Tsiatsis, C. Mulligan, S. Karnouskos, S. Avesand, and D. Boyle, "From Machine to Machine to Internet of Things," Elsevier Publications, 2014.

Course Outcomes:

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

CO1 Comprehend the concepts of internet of things.

CO2 Analyze basic protocols in wireless sensor network.

CO3 Design IoT applications in different domain and be able to analyze their performance

CO4 Elaborate the need for data analytics and security in IoT.

CO5 Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in Industry.

Course Outcomes and their mapping with Program Outcomes & Program Specific Outcomes:

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	1				2			3	3	2	2
CO2	3	2	2	2	1				2			3	3	2	2
CO3	3	2	2	2	2				2			3	3	2	2
CO4	3	2	2	2	2				2			3	3	2	3
CO5	3	2	2	2	3				2			3	3	2	3

Weightage: **1-Sightly; 2-Moderately; 3-Strongly**