Dr. Babasaheb Ambedkar Technological University

(Established a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)

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POST GRADUATE PROGRAMME

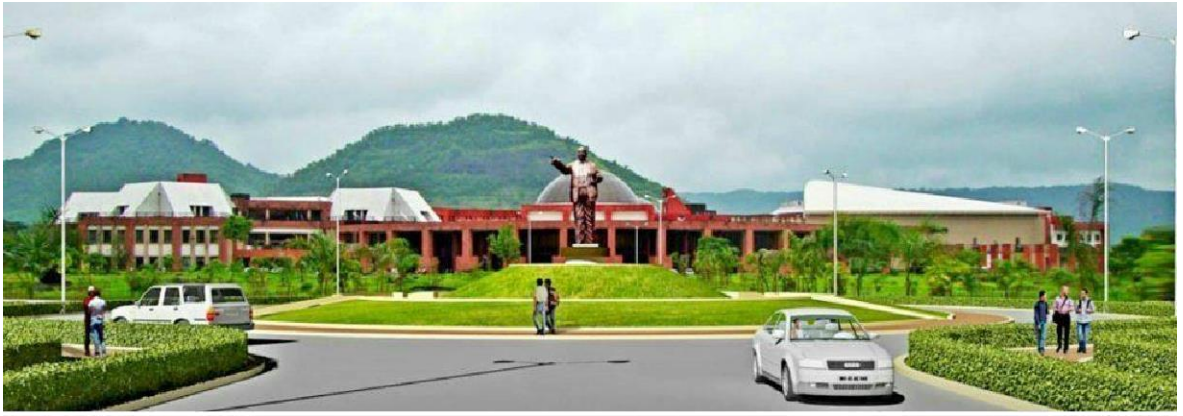
M. TECH

Structure and Syllabus for

Advanced Communication Technology, Communication Engineering

Two Year (Four Semesters) Course

In line with New Education Policy 2020 guidelines
WITH EFFECT FROM THE ACADEMIC YEAR 2024-2025 for Affiliated Colleges Only



Dr. Babasaheb Ambedkar Technological University
M. Tech (Advanced Communication Technology, Communication Engineering)
In line with New Education Policy 2020 guidelines
(Effective from Academic Year 2024-25 for Affiliated Colleges Only)

Semester I (Term 1 First Year)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Credit
							Theory			Practical		
				L	T	P	CA	MSE	ESE	CA	PR/OR	
1	PCC	24AF2969PC101	5G Technology – 1	3	1	0	20	20	60	--	--	4
2	PCC	24AF2969PC102	Digital Communication Techniques	3	1	0	20	20	60	--	--	4
3	PEC	24AF2969PE103A	RF Engineering	3	1	0	20	20	60	--	--	4
		24AF2969PE103B	Advanced Computer Networks									
		24AF2393PE103C	Software Defined Radio									
		24AF2393PE103D	Advanced Wireless Communication									
4	PEC	24AF2969PE104A	Advanced Antenna Technology	3	1	0	20	20	60	--	--	4
		24AF2969PE104B	Telecom Network Management									
		24AF2393PE104C	Mobile Handset Design									
		24AF2393PE104D	Advanced Digital Signal Processing									
5	ELC	24AF2969RM105	Research Methodology	3	0	0	20	20	60	--	--	3
6	PCC	24AF2969PC106L	PG Lab – I	0	0	2	--	--	--	50	50	1
7	PCC	24AF2969PC107L	PG Lab – II	0	0	2	--	--	--	50	50	1
8	Audit Course	24AF2969AU108	Yoga and Stress Management	2	0	0	--	--	--	--	--	--
	Total for Semester I			**17**	**04**	**04**	**100**	**100**	**300**	**100**	**100**	**21**

Semester II (Term 2 First Year)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Credit
							Theory			Practical		
				L	T	P	CA	MSE	ESE	CA	PR/OR	
1	PCC	24AF2969PC201	5G Technology – 2	3	1	0	20	20	60	--	--	4
2	PCC	24AF2969PC202	Smart Antennas for 5G Communication	3	1	0	20	20	60	--	--	4
3	PEC	24AF2372PE203A	Embedded System Design	3	1	0	20	20	60	--	--	4
		24AF2372PE203B	Multirate Digital Signal Processing									
		24AF2969PE203B	Cryptography & Network Security									
		24AF2969PE203C	Information Theory and Coding									
4	OE	24AF2372OE204A	New Labour Codes of India	3	0	0	20	20	60	--	--	3
		24AF2372OE204B	Urban Utilities Planning: Water Supply, Sanitation and Drainage									
		24AF2372OE204C	Environment and Development									
		24AF2372OE204D	Entrepreneurship									

5	ELC	24AF2969IPR205	Intellectual Property Rights	3	0	0	20	20	60	--	--	3
6	AEC/VEC/IKS	24AF2372AE206	IKS Bucket	2	0	0	20	20	60	--	--	2
7	PCC	24AF2969PC207L	PG Lab – III	0	0	2	--	--	--	50	50	1
8	PCC	24AF2969PC208L	PG Lab – IV	0	0	2	--	--	--	50	50	1
9	Audit Course	24AF2369AU209	Disaster Management	2	0	0	--	--		--	--	--
	Total for Semester II			**19**	**03**	**04**	**120**	**120**	**360**	**100**	**100**	**22**

Semester III (Term 1 Second Year)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Credit
							Theory			Practical		
				L	T	P	CA	MSE	ESE	CA	PR/OR	
1	PEC	24AF2969PE301A	Estimation and Detection Theory	3	0	0	20	20	60	--	--	3
		24AF2969PE301B	Radar Signal Processing									
		24AF2969PE301C	Fuzzy Systems and Neural Networks									
		24AF2969PE301D	Optical Networks									
2	OE	24AF2372OE302A	Student Psychology	3	0	0	20	20	60	--	--	3
		24AF2372OE302B	Business To Business Marketing (B2B)									
		24AF2372OE302C	Organizational Behaviour									
		24AF2372OE302D	Principles Of Economics									
		24AF2372OE302F	Introduction to Public Administration									
3	MDM	24AF2372MD303A	Design Of Mechatronic Systems	3	0	0	20	20	60	--	--	3
		24AF2372MD303B	Ethical Hacking									
		24AF2372MD303C	Sustainable Power Generation Systems									
		24AF2372MD303D	Components And Applications of Internet of Things									
4	HSSM	24AF2969ES304	Environmental studies	3	0	0	20	20	60	--	--	3
5	ELC	24AF2969PR305	Project – I	--	--	--	--	--		50	50	10
	Total for Semester III			**12**	**0**	**0**	**80**	**80**	**240**	**50**	**50**	**22**

Semester IV (Term 2 Second Year)

Sr. No.	Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme					Credit
							Theory			Practical		
				L	T	P	CA	MSE	ESE	CA	PR/OR	
1	ELC	24AF2969PR401	Project – II	--	--	--	--	--	--	50	50	20
	Total for Semester IV			--	--	--	--	--	--	**50**	**50**	**20**

Abbreviations: PCC (Programme Core Course), PEC (Programme Elective Course), ELC (Experiential Learning Courses), OE (Open Elective), AEC (Ability Enhancement Courses), VEC (Value Education Courses), IKS (Indian Knowledge System), MDM (Multidisciplinary Minor).

Credit Distribution				
SEM I	**SEM II**	**SEM III**	**SEM IV**	**Total**
21	**22**	**22**	**20**	**85**

Program Elective -I		**Program Elective -II**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
24AF2969PE103A	RF Engineering	24AF2969PE104A	Advanced Antenna Technology
24AF2969PE103B	Advanced Computer Networks	24AF2969PE104B	Telecom Network Management
24AF2393PE103C	Software Defined Radio	24AF2393PE104C	Mobile Handset Design
24AF2393PE103D	Advanced Wireless Communication	24AF2393PE104D	Advanced Digital Signal Processing

Program Elective -III		**Program Elective -IV**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
24AF2372PE203A	Embedded System Design	24AF2969PE301A	Estimation and Detection Theory
24AF2372PE203B	Multirate Signal Processing	24AF2969PE301B	Radar Signal Processing
24AF2969PE203B	Cryptography & Network Security	24AF2969PE301C	Fuzzy Systems and Neural Networks
24AF2969PE203C	Information Theory and Coding	24AF2969PE301D	Optical Networks

Open Elective I		**Open Elective II**	
Subject Code	**Subject Name**	**Subject Code**	**Subject Name**
24AF2372OE204A	New Labour Codes of India	24AF2372OE302A	Student Psychology
24AF2372OE204B	Urban Utilities Planning: Water Supply, Sanitation and Drainage	24AF2372OE302B	Business To Business Marketing (B2B)
24AF2372OE204C	Environment and Development	24AF2372OE302C	Organizational Behaviour
24AF2372OE204D	Entrepreneurship	24AF2372OE302D	Principles Of Economics
		24AF2372OE302F	Introduction to Public Administration

Multidisciplinary Minor	
Subject Code	**Subject Name**
24AF2372MD303A	Design Of Mechatronic Systems
24AF2372MD303B	Ethical Hacking
24AF2372MD303C	Sustainable Power Generation Systems
24AF2372MD303D	Components And Applications of Internet of Things

Indian Knowledge System (IKS)	
Subject Code	**Subject Name**
24AF2372AE206A	Indian Knowledge System (IKS): Concepts and Applications in Engineering
24AF2372AE206B	Indian Knowledge System (IKS): Humanities and Social Sciences

First Year (Semester –I)
5G Technology-1

24AF2969PC101	5G Technology-1	PCC	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. The aim of this course is to let the students understand that air Interface is one of the most important elements that differentiate between 2G, 3G, 4G and 5G. While 3G was CDMA based, 4G was OFDMA based.
2. This course reveals the contents of air interface for 5G. While 4G brought in a deluge of infotainment services, 5G aims to provide extremely low delay services, great service in crowd, enhanced mobile broadband (virtual reality being made real), ultra-reliable and secure connectivity, ubiquitous QoS, and highly energy efficient networks.

Course Outcomes:

After the completion of course, the student will able to

1. Learn 5G Technology advances and their benefits
2. Learn the key RF, PHY, MAC and air interface changes required to support 5G
3. Learn Device to device communication and millimetre wave communication
4. Implementation options for 5G

UNIT I

Overview of 5G Broadband Wireless Communications: Evaluation of mobile technologies 1G to 4G (LTE, LTEA, LTEA Pro), An Overview of 5G requirements, Regulations for 5G, Spectrum Analysis and Sharing for 5G.

UNIT II

The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling, Channel Models for mmWave MIMO Systems.

UNIT III

Transmission and Design Techniques for 5G: Basic requirements of transmission over 5G, Modulation Techniques – Orthogonal frequency division multiplexing (OFDM), generalized frequency division multiplexing (GFDM), filter bank multi-carriers (FBMC) and universal filtered multi-carrier (UFMC), Multiple Accesses Techniques – orthogonal frequency division multiple accesses (OFDMA), generalized frequency division multiple accesses (GFDMA), non-orthogonal multiple accesses (NOMA).

UNIT IV

Device-to-device (D2D) and machine-to-machine (M2M) type communications – Extension of 4G D2D standardization to 5G, radio resource management for mobile broadband D2D, multihop and multi-operator D2D communications.

UNIT V

Millimeter-wave Communications – spectrum regulations, deployment scenarios, beamforming, physical layer techniques, interference and mobility management, Massive MIMO propagation channel models, Channel Estimation in Massive MIMO, Massive MIMO with Imperfect CSI, Multi-Cell Massive MIMO, Pilot Contamination, Spatial Modulation (SM).

Textbooks / References:

1. Martin Sauter ―From GSM From GSM to LTE–Advanced Pro and 5G: An Introduction to Mobile Networks and Mobile Broadband‖, Wiley-Blackwell.
2. Afif Osseiran, Jose.F.Monserrat, Patrick Marsch, ―Fundamentals of 5G Mobile Networks‖, Cambridge University Press.
3. Athanasios G.Kanatos, Konstantina S.Nikita, Panagiotis Mathiopoulos, ―New Directions in Wireless Communication Systems from Mobile to 5G‖, CRC Press.
4. Theodore S.Rappaport, Robert W.Heath, Robert C.Danials, James N.Murdock ―Millimeter Wave Wireless Communications‖, Prentice Hall Communications.
5. Jonathan Rodriguez, ―Fundamentals of 5G Mobile Networks‖, John Wiley & Sons.
6. Amitabha Ghosh and Rapeepat Ratasuk ―Essentials of LTE and LTE-A‖, Cambridge University Press.

First Year (Semester –I)
Digital Communication Techniques

24AF2969PC102	**Digital Communication Techniques**	**PCC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To know the principles of sampling & quantization
2. To study the various waveform coding schemes
3. To learn the various baseband transmission schemes
4. To understand the various band pass signalling schemes
5. To know the fundamentals of channel coding

Course Outcomes:

After the completion of course, the student will able to

1. Design PCM systems
2. Design and implement base band transmission schemes
3. Design and implement band pass signalling schemes
4. Analyse the spectral characteristics of band pass signalling schemes and their noise performance
5. Design error control coding schemes

UNIT I

Base Band Modulation

Base band system, sampling theorem, Sampling and signal reconstruction, Aliasing, Types of sampling, Quantization, PCM, Companding, DPCM, ADPCM, Delta modulation, Adaptive delta modulation, T1 carrier system.

UNIT II

Digital Data Transmission

Components of digital communication system, line coding, pulse shaping, Scrambling, Regenerative Repeater, Eye Diagram, Timing Extraction, Detection Error Probability, M-ary communication, Digital Carrier Systems

UNIT III

Digital Modulation Techniques

Modulation techniques for ASK, QASK, FSK, M-ary FSK, BPSK, DPSK, DEPSK, QPSK, M-ary PSK, QAM, MSK, GMSK

UNIT IV

Probability Theory and Random Variable

Concept of probability, Conditional probability and independent event, random variable, types of random variable, CDF, PDF, Statistical Averages, Chebyshev,,s inequality, Central limit theorem, Concept of correlation.

UNIT V

Information Theory

Measure of information, Entropy, Source encoding, Error free communication over noisy channel, channel capacity of discrete memory less channel, Channel capacity of continuous channel, Practical communication system in lights of Shannon theorem

Reference Books/Text Books:

1. Modern Digital and Analog Communication Systems, B. P. Lathi, (3rd Edition), Oxford Publication
2. Principles of Communication Systems, Taub & Schilling, (2nd Edition), Tata McGraw Hill Publication
3. S. Haykin, Communication systems, John Wiley 2001
4. Bhattacharya Amitabh, "Digital Communication", Tata McGraw-Hill, 1st Ed., 2006.

First Year (Semester –I)
RF Engineering

24AF2969PE103A	RF Engineering	PEC	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To inculcate understanding of the basics required for circuit representation of RF networks.
2. To deal with the issues in the design of microwave amplifier.
3. To instil knowledge on the properties of various microwave components.
4. To deal with the microwave generation and microwave measurement techniques

Course Outcomes:

After the completion of course, the student will able to

1. Explain the active & passive microwave devices & components used in Microwave communication systems.
2. Analyze the multi- port RF networks and RF transistor amplifiers.
3. Generate Microwave signals and design microwave amplifiers.
4. Measure and analyze Microwave signal and parameters.

UNIT I

Two Port Network Theory

Review of Low frequency parameters: Impedance, Admittance, Hybrid and ABCD parameters, Different types of interconnection of Two port networks, High Frequency parameters, Formulation of S parameters, Properties of S parameters, Reciprocal and lossless Network, Transmission matrix, RF behaviour of Resistors, Capacitors and Inductors.

UNIT II

RF Amplifiers and Matching Networks

Characteristics of Amplifiers, Amplifier power relations, Stability considerations, Stabilization Methods, Noise Figure, Constant VSWR, Broadband, High power and Multistage Amplifiers, Impedance matching using discrete components, Two component matching Networks, Frequency response and quality factor, T and Pi Matching Networks, Microstrip Line Matching Networks.

UNIT III

Passive and Active Microwave Devices

Terminations, Attenuators, Phase shifters, Directional couplers, Hybrid Junctions, Power dividers, Circulator, Isolator, Impedance matching devices: Tuning screw, Stub and quarter wave transformers. Crystal and Schottkey diode detector and mixers, PIN diode switch, Gunn diode oscillator, IMPATT diode oscillator and amplifier, Varactor diode, Introduction to MIC.

UNIT IV

Microwave Generation

Review of conventional vacuum Triodes, Tetrodes and Pentodes, High frequency effects in vacuum Tubes, Theory and application of two cavity Klystron Amplifier, Reflex Klystron

oscillator, Traveling wave tube amplifier, Magnetron oscillator using Cylindrical, Linear, Coaxial Voltage tunable Magnetrons, Backward wave Crossed field amplifier and oscillator.

UNIT V

Microwave Measurements

Measuring Instruments : Principle of operation and application of VSWR meter, Power meter, Spectrum analyzer, Network analyzer, Measurement of Impedance, Frequency, Power, VSWR, Q- factor, Dielectric constant, Scattering coefficients, Attenuation, S-parameters.

References/Text Books:

1. David M. Pozar, ―Microwave Engineering‖, Wiley India (P) Ltd, New Delhi, 2008.
2. Thomas H Lee, ―Planar Microwave Engineering: A Practical Guide to Theory, Measurements and Circuits‖, Cambridge University Press, 2004.
3. Mathew M Radmanesh, ―RF and Microwave Electronics‖, Prentice Hall, 2000.
4. Annapurna Das and Sisir K Das, ―Microwave Engineering‖, Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2005.
5. Reinhold Ludwig and Gene Bogdanov, ―RF Circuit Design: Theory and Applications‖, Pearson
6. Education Inc., 2011
7. Robert E Colin, ―Foundations for Microwave Engineering‖, John Wiley & Sons Inc, 2005

First Year (Semester –I)
Advanced Computer Networks

24AF2969PE103B	**Advanced Computer Networks**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives

1. Gain core knowledge of Network layer routing protocols and IP addressing.
2. Study Session layer design issues, Transport layer services, and protocols.
3. Acquire knowledge of Application layer and Presentation layer paradigms and protocols.
4. Provide the mathematical background of routing protocols.
5. To develop some familiarity with current research problems and research methods in advance computer networks.

Course Outcomes

After the completion of the course, student will be able to

1. Illustrate reference models with layers, protocols and interfaces
2. Describe the routing algorithms, Sub netting and Addressing of IP V4and IPV6
3. Describe and Analysis of basic protocols of computer networks, and how they can be used to assist in network design and implementation.
4. Describe the concepts Wireless LANS, WIMAX, IEEE 802.11, Cellular telephony and Satellite networks

UNIT-I

Network layer: Network Layer Services, Packet Switching, Performance, provided transport layers, implementation connectionless services, implementation connection oriented services, comparison of virtual –circuit and datagram subnets.IPV4 Address, Forwarding of IP Packets, Internet Protocol, ICMP v4, Mobile IP

UNIT-II

Routing Algorithms–Distance Vector routing, Link State Routing, Path Vector Routing, Unicast Routing Protocol-Internet Structure, Routing Information Protocol, Open Source Path First, Border Gateway Protocol V4, Broadcast routing, Multicasting routing, Multicasting Basics, Intra domain Muticast Protocols, IGMP.

UNIT-III

IPv6 Addressing, IPv6 Protocol, Transition from IPv4 to IPv6.Transport Layer Services, connectionless versus connection oriented protocols. Transport Layer Protocols: Simple Protocol, Stop and Wait, Go-Back-N, Selective repeat, Piggy Backing. UDP: User datagram, Services, Applications. TCP: TCP services, TCP features, segments, A TCP connection, Flow control, error control, congestion control.

UNIT-IV

SCTP: SCTP services SCTP features, packet format, An SCTP association, flow control, error control. QUALITY OF SERVICE: flow characteristics, flow control to improve QOS: scheduling, traffic shaping, resource reservation, admission control.

UNIT-V

WWW and HTTP, FTP, Telnet, Domain name system, SNMP, Multimedia data, Multimedia in the Internet.

References/Text Book(s)

1. Data Communication and Networking, Behrouz A. Forouzan, McGraw Hill, 5th Edition
2. Computer Networks, Andrew S. Tanenbaum, David J. Wetherall, Pearson Education India; 5 editions, 2013.
3. Computer Networks: A Systems Approach, LL Peterson, BS Davie, Morgan-Kauffman, 5th Edition, 2011.
4. Computer Networking: A Top-Down Approach JF Kurose, KW Ross, Addison-Wesley, 5th Edition, 2009.

First Year (Semester –I)
Software Defined Radio

24AF2393PE103C	**Software Defined Radio**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Understand the principles of Software Defined Radio (SDR) technology, including signal processing and modulation techniques.
2. Gain hands-on experience in designing and implementing SDR systems for wireless communication applications.
3. Explore advanced SDR topics such as spectrum sensing, cognitive radio, and security in SDR networks.
4. Analyze the impact of SDR on current and future communication systems, including its role in 5G and beyond.

Course Outcomes:

After the completion of course, the student will able to

1. Understand the principles of Software Defined Radio.
2. Choose appropriate digital signals for RF signal processing/ implementation.
3. Apply Digital Signal Synthesis for Generation and Implementation
4. Analyse RF Signals and digital systems.

UNIT I

Introduction to Software Radio

The Need for Software Radios, What Is a Software Radio, Characteristics and Benefits of a Software Radio, Design Principles of a Software Radio.

UNIT II

Radio Frequency Implementation Issues

The Purpose of the RF Front-End, Dynamic Range: The Principal Challenge of Receiver Design, RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Importance of the Components to Overall Performance, Transmitter Architectures and Their Issues.

UNIT III

Multirate Signal Processing

Introduction, Sample Rate Conversion Principles, Polyphase Filters, Digital Filter Banks, Timing Recovery in Digital Receivers Using Multirate Digital Filters.

UNIT IV

Digital Generation of Signals

Introduction, Comparison of Direct Digital Synthesis with Analog Signal Synthesis, Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Bandpass Signal Generation.

UNIT V

Digital Hardware Choices

Introduction, Key Hardware Elements, DSP Processors.

References/Text Book(s)

1. Jeffrey H.Reed, ―Software Radio: A Modern Approach to Radio Engineering‖ Reprint by Pearson Education & Inc 2002.
2. Joseph Mitola, III, Software Radio Architecture: Object Oriented Approaches to Wireless Systems Engineering, John Wiley and Sons, 2000.
3. Markus Dillinger, K.Madani and N. Alonistioti, Soft Defined Radio, 1st Ed., Wiley.

First Year (Semester –I)
Advanced Wireless Communication

24AF2393PE103D	**Advanced Wireless Communication**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objective

1. To learn the fundamentals and advanced concepts in wireless communication.
2. Analyze and design wireless communication systems for a variety of applications
3. Select and implement appropriate wireless communication technologies to meet specific requirements

Course Outcomes

After the completion of course, the student will able to

1. Review the fundamentals of wireless communication.
2. Compare the performance of different digital modulation techniques over wireless channels.
3. Design OFDM system and data transmission through multicarrier modulation.
4. Describe OFDMA system, its operation and applications.

UNIT-I
Review of Fundamentals of Wireless Communication
Multipath fading, multipath channel models, and capacity of wireless channels.

UNIT-II
Performances of Digital Modulation over Wireless Channels
AGWN channels signal to noise power ratio and bit/symbol energy, error probability for BPSK, QPSK, MPSK, MPAM, MQAM- their comparison.

UNIT-III
Multicarrier Modulation
Data transmission using multiple carriers, multicarrier modulation with overlapping sub channels, mitigation of subcarrier fading, discrete implementation of multicarrier modulation, challenges in multicarrier systems.

UNIT-IV
Introduction to Wireless OFDM
OFDM principles, system model, generation of sub carrier using IFFT, guard time, cyclic extension, windowing, OFDM parameters, OFDM signal processing, coherent and differential detection.

UNIT-V
OFDMA
Frequency hopping in OFDMA, difference between OFDMA and MC-CDMA, OFDMA system description-channel coding, frequency synchronization, initial modulation timing and frequency offset synchronization accuracy, random frequency hopping operation, applications of OFDMA.

References/Textbooks

2. Goldsmith, Wireless Communications, Cambridge Univ. Press, 2005
3. R. Vannee, R. Prasad, OFDM for Wireless Multimedia Communication, Artech House, 2000
4. M. Engels, Wireless OFDM systems, Klumer Academic Publishers, 2002

First Year (Semester –I)
Advanced Antenna Technology

24AF2969PE104A	**Advanced Antenna Technology**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To provide an in-depth understanding of modern antenna concepts and practical antenna design for various applications.
2. To explain the theory of different types of antennas used in communication systems. Starting from the basic antenna parameters, the course will discuss various types of antennas including the planar printed antennas.
3. An in-depth study will be made for the analysis and design of arrays.
4. A brief introduction of smart antenna concept will be given at the end with a view that the student can further explore the topic, if interested.

Course Outcomes:

After the completion of course, the student will able to

1. Understand the fundamental concepts of antenna signal propagation
2. Analyze radiation patterns from wire and loop antennas
3. Understand operation of Aperture Antennas
4. Understand operation of Broadband Antennas
5. Understand operation of Microstrip Antennas

UNIT I

Fundamental Concepts

Physical concept of radiation, Radiation pattern, near- and far-field regions, reciprocity, directivity and gain, effective aperture, polarization, input impedance, efficiency, Friis transmission equation, radiation integrals and auxiliary potential functions.

UNIT II

Radiation from Wires and Loops

Infinitesimal dipole, finite-length dipole, linear elements near conductors, dipoles for mobile communication, small circular loop.

UNIT III

Aperture Antennas

Huygens‟ principle, radiation from rectangular and circular apertures, design considerations, Babinet„s principle, Radiation from sectoral and pyramidal horns, design concepts.

UNIT IV

Broadband Antennas

Broadband concept, Log-periodic antennas, frequency independent antennas.

UNIT V

Microstrip Antennas
Basic characteristics of microstrip antennas, feeding methods, methods of analysis, design of rectangular and circular patch antennas.

References/Text Book(s)

1. C.A. Balanis, "Antenna Theory and Design", 3rd Ed., John Wiley & Sons., 2005.
2. W. L. Stutzman, and G.A. Thiele, "Antenna Theory and Design", 2nd Ed., John Wiley & Sons. 1998.
3. R. S. Elliot, "Antenna Theory and Design", Revised edition, Wiley-IEEE Press., 2003.

First Year (Semester –I)
Telecom Network Management

24AF2969PE104B	**Telecom Network Management**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To understand the principles of network management, different standards and protocols used in managing complex networks.
2. To understand the Automation of network management operations and making use of readily available network management systems.

Course Outcomes:
After the completion of course, the student will able to

1. Acquire the knowledge about network management standards (OSI and TCP/IP)
2. Acquire the knowledge about various network management tools and the skill to use them in monitoring a network
3. Analyse the challenges faced by Network managers
4. Evaluate various commercial network management systems and open network management systems.
5. Analyse and interpret the data provided by NMS and take suitable actions.

UNIT-I
Data Communication And Network Management Overview: Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information Technology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.

UNIT-II
SNMPV1 Network Management Managed Network: Organization and Information Models MANAGED NETWORK: Case Histories and Examples, The History of SNMP Management, The SNMP Model, The Organization Model, System Overview, The

Information Model.
SNMPV1 NETWORK MANAGEMENT: Communication and Functional Models The SNMP Communication Model, Functional model.
SNMP MANAGEMENT: SNMPv2 Major Changes in SNMPv2, SNMPv2 System architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility with SNMPv1.

UNIT-III
SNMP MANAGEMENT: RMON: What is Remote Monitoring? RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, A Case Study of Internet Traffic Using RMON

TELECOMMUNICATIONS MANAGEMENT NETWORK: Why TMN, Operations Systems, TMN Conceptual Model, TMN
Standards, TMN Architecture, TMN Management Service Architecture, An Integrated View of TMN, Implementation Issues.

UNIT-IV
Network Management Tools and Systems: Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network Management systems, Commercial Network management Systems, System Management, Enterprise Management Solutions.

UNIT-V
Web-Based Management: NMS with Web Interface and Web-Based Management, Web Interface to SNMP Management, Embedded Web-Based Management, Desktop management Interface, Web-Based Enterprise Management, WBEM: Windows Management Instrumentation, Java management Extensions, Management of a Storage Area Network , Future Directions. Case Studies:

Text Book/ References:

1. Mani Subrahmanian, ―Network Management Principles and Practice‖, 2nd Edition, Pearson Education, 2010.
2. Morris, ―Network management‖, 1st Edition, Pearson Education, 2008.
3. Mark Burges, ―Principles of Network System Administration‖, 1st Edition, Wiley Dream Tech, 2008.

First Year (Semester –I)
Mobile Handset Design

24AF2393PE104C	Mobile Handset Design	PEC	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Understand the basic architecture and components of a mobile handset.
2. Explain the operation of the various subsystems in a mobile handset, such as the radio frequency (RF) subsystem, baseband subsystem, and power management subsystem.
3. Identify and analyse the key design considerations for mobile handsets.
4. Apply the principles of mobile handset design to solve real-world problems.

Course Outcomes:

After the completion of course, the student will able to

1. Students will be able to explain the basic concepts of mobile handset design.
2. Students will be able to design and implement mobile handset subsystems.
3. Students will be able to apply mobile handset design principles to solve real-world problems.
4. Students will be able to evaluate the performance of mobile handsets.

UNIT I

Introduction to Telecommunication: Basic Elements of Telecommunication. Introduction to Wireless Telecommunication Systems: Generation of Electromagnetic Carrier Waves for Wireless Communication, Concept of the Antenna, Basic Building Blocks of a Wireless Transmitter and Receiver, the Need for a Communication Protocol.

UNIT II

Evolution of Wireless Communication Systems: Introduction of Low Mobility Supported Wireless Phones, Introduction to Cellular Mobile Communication, Introduction to Mobile Handsets. Introduction to Wireless Channels: Impact of Signal Propagation on Radio Channel, Reflection, Diffraction, Scattering, Signal Attenuation and Path Loss, Empirical Model for Path Loss.

UNIT III

Link Budget Analysis, Multipath Effect: Two Ray Ground Reflection Model, Delay Spread, Coherent BW (Bc), Doppler Spread: Coherence Time (Tc), Fading: Large-Scale Fading, Small-Scale Fading, Flat Fading, Frequency-Selective Fading, Fast Fading, Slow Fading.

UNIT IV

Signal Fading Statistics: Rician Distribution, Rayleigh Distribution, Log-Normal Distribution, Interference: Inter-Symbol Interference, Co-Channel Interference, Adjacent Channel Interference, Noise: Noise in a Two-Port Circuit, Thermal Noise, White Noise, Flicker Noise, Phase Noise, Burst Noise, Shot Noise, Avalanche Noise, Noise Figure (NF).

UNIT V

Diversity: Time Diversity, Frequency Diversity, Space Diversity, Channel Estimation and Equalization: Study of Channel Characteristics – Channel Estimation, Equalization, Equalizer Implementation, Signal Model, Types of Equalizers, Different Techniques for Interference Mitigation: Frequency Hopping, Discontinuous Transmission (DTX), Cell Sectorization, Use of Adaptive Multi-Rate (AMR) Codec, MIMO.

References/Text Books

1. Mobile Handset Design, Sajal Kumar Das, John Wiley & Sons, 29-May-2013
2. Mobile Phone Systems Engineering by William C.Y. Lee (2nd Edition, 2007)
3. Mobile Handset Design by Nigel S. Smith (3rd Edition, 2012)
4. Mobile Phone Design by Alan Bensky (2nd Edition, 2014)

First Year (Semester –I)
Advanced Digital Signal Processing

24AF2393PE104D	**Advanced Digital Signal Processing**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To provide students with a deep understanding of the theory and practice of advanced digital signal processing techniques.
2. To develop students' ability to design and implement efficient and effective digital signal processing algorithms.
3. To prepare students to apply advanced digital signal processing techniques to solve real-world problems.
4. To develop students' critical thinking and problem-solving skills in the context of advanced digital signal processing.

Course Outcomes:

After the completion of course, the student will able to

1. Explain the fundamental concepts of advanced digital signal processing techniques, such as multirate signal processing, adaptive filtering, and wavelet analysis.
2. Design and implement efficient and effective digital signal processing algorithms for a variety of applications.
3. Apply advanced digital signal processing techniques to solve real-world problems in areas such as audio processing, image processing, and communication systems.
4. Critically analyze and evaluate digital signal processing algorithms and systems.

UNIT I

Multirate Digital Signal Processing

Introduction, Decimation by a Factor D, Interpolation by a Factor I, Sampling Rate Conversion by a Rational Factor I/D, Filter Design and Implementation for sampling rate Conversion

UNIT II

Multirate Digital Signal Processing Multistage Implementation of Sampling Rate Conversion, Applications of Multirate Signal Processing, Sampling Rate Conversion of Bandpass Signals

UNIT III

Linear Prediction And Optimum Linear Filters: Innovations Representation of a Stationary Random Process, Forward and Backward linear prediction, Solution of the Normal Equations, Properties of linear prediction-Error Filter, AR Lattice and ARMA Lattice-Ladder Filters.

UNIT IV

Power Speciral Estimation: Estimation of Spectra from Finite Duration Observations of a

signal, the Periodogram, Use DFT in power Spectral Estimation, Bartlett, Welch and Blackman, Tukey methods, Comparison of performance of Non-Parametric Power Spectrum Estimation Methods

UNIT V

Parametric Method Of Power Spectrum Estimation: Parametric Methods for power spectrum estimation, Relationship between Auto-Correlation and Model Parameters, AR (Auto-Regressive) Process and Linear Prediction, Yule-Walker, Burg and Unconstructrained Least Squares Methods, Sequential Estimation, Moving Average(MA) and ARMA Models Minimum Variance Method, Piscaranko's Harmonic Decomposition Methods, MUSIC Method**.**

References/Text Books

1. Proakis JG and Manolakis DG Digital Signal Processing Principles, Algorithms Application, PHI.
2. Openheim AV & Schafer RW, Discrete Time Signal Processing PHI.
3. Samuel D Stearns, ―Digital Signal Processing with examples in Matlab. ― CRC Press.
4. ES Gopi. ―Algorithm collections for Digital Signal Processing Applications using Matlab, ―Springer.
5. Taan S.Elali, ―Discrete Systems and Digital Signal Processing with Matlab, ―CRC Press, 2005.

First Year (Semester –I)
Research Methodology

24AF2969RM105	Research Methodology	ELC	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objectives:

1. To give an overview of the research methodology and explain the technique of defining a research problem
2. To explain the functions of the literature review in research.
3. To explain carrying out a literature search, its review, developing theoretical and conceptual frameworks and writing a review.
4. To explain various research designs and their characteristics.
5. To explain the details of sampling designs, and also different methods of data collections.
6. To explain the art of interpretation and the art of writing research reports

Course outcomes:

After the completion of course, the student will able to

1. Discuss research methodology and the technique of defining a research problem
2. Explain the functions of the literature review in research, carrying out a literature search, developing theoretical and conceptual frameworks and writing a review.
3. Explain various research designs and their characteristics.
4. Explain the art of interpretation and the art of writing research reports

Unit 1: Introduction to Research and Problem Definition

Meaning, Objective and importance of research, Types of research, steps involved in research, defining research problem

Unit 2: Research Design

Research design, Methods of research design, research process and steps involved, Literature Survey

Unit 3: Data Collection

Classification of Data, Methods of Data Collection, Sampling, Sampling techniques procedure and methods, Ethical considerations in research

Unit 4: Data Analysis and interpretation

Data analysis, Statistical techniques and choosing an appropriate statistical technique, Hypothesis, Hypothesis testing, Data processing software (e.g. SPSS etc.), statistical inference, Interpretation of results

Unit 5: Technical Writing and reporting of research

Types of research report: Dissertation and Thesis, research paper, review article, short communication, conference presentation etc., Referencing and referencing styles, Research

Journals, Indexing and citation of Journals, Intellectual property, Plagiarism

Text Books:

1. C. R. Kothari, Gaurav Garg, Research Methodology Methods and Techniques , New Age International publishers, Third Edition.
2. Ranjit Kumar, Research Methodology: A Step-by-Step Guide for Beginners, 2nd Edition, SAGE, 2005.
3. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
4. Creswell, John W. Research design: Qualitative, quantitative, and mixed methods approaches. Sage publications, 2013.

First Year (Semester –I)
PG Lab – I

24AF2969PC106L	**PG Lab – I**	**PCC**	**0L- 0T - 2P**	**1 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 0 hrs./week Tutorial: 0 hr./week Practical: 2 hrs./week	Continuous Assessment: 50 Marks End Semester Exam: 50 Marks

Practical's of the PG Lab - I shall be based on the courses of first semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.

First Year (Semester –I)
PG Lab – II

24AF2969PC107L	**PG Lab – II**	**PCC**	**0L- 0T - 2P**	**1 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 0 hrs./week Tutorial: 0 hr./week Practical: 2 hrs./week	Continuous Assessment: 50 Marks End Semester Exam: 50 Marks

Practical‟s of the PG Lab - II shall be based on the courses of first semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.

First Year (Semester –I)
Yoga and Stress Management

24AF2969AU108	Yoga and Stress Management	Audit Course	0L- 0T - 2P	0 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: -- End Semester Exam: --

Course Objectives:

1. Understand the physiological and psychological aspects of stress and its impact on overall well-being.
2. Learn and practice specific yoga postures, breathing exercises, and relaxation techniques to alleviate stress.
3. Explore the connection between mindfulness, meditation, and stress reduction, fostering mental clarity.
4. Discover holistic practices that promote better sleep, nutrition, and overall lifestyle habits for stress management.
5. Develop practical skills to manage stress in daily life, enhancing resilience and promoting emotional balance.

Course Outcomes:

After the completion of course, the student will able to

1. Recognize the signs and sources of stress, understanding its effects on mental and physical well-being.
2. Master a variety of yoga techniques, including postures, breathing, and meditation, to effectively manage stress.
3. Acquire relaxation strategies that promote calmness, reduce anxiety, and enhance overall mental clarity.
4. Incorporate healthy habits inspired by yoga principles to foster better sleep, nutrition, and self-care routines.
5. Develop practical skills to navigate and cope with stress, enhancing emotional balance and promoting a more harmonious life.

UNIT I

Introduction to Yoga for Stress Management - 1 Introduction to Yoga for Stress Management - 2
Stress according to Western perspective
Stress Eastern Perspective
Developmental process: Western and Eastern Perspective, Stress Hazards and Yoga

UNIT II

Meeting the challenges of Stress - 1 Meeting the challenges of Stress - 2 Introduction to Stress Physiology
Stress, Appetite and Dietary management- Modern and Yogic perspective
Sleep and Stress: understanding the relationship for effective management of stress

UNIT III

Stress Assessment methods- a valuable tool toward stress management
Role of Yoga in prevention and management of stress related disorders – a summary of research evidence
Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 1
Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 2
Concept of stress and its management - perspectives from Patanjali Yoga Sutra - Part 3

UNIT IV

Concept of stress and its management - perspectives from Bhagavad Gita - Part 1 Concept of stress and its management - perspectives from Bhagavad Gita - Part 2 Concept of stress and its management - perspectives from Bhagavad Gita - Part 3

UNIT V

Bio-Psycho-Socio-Spiritual model of stress management Yoga practices for Stress Management
Breathing practices – 1: Hands in and out breathing, Hands stretch breathing, Ankle stretch breathing
Breathing practices – 2: Dog Breathing, Rabbit breathing, Tiger breathing, Sashankasana breathing Breathing practices – 3: Bhujangasana breathing, Ardha Shalabhasana breathing (alternate legs), Straight leg raising (alternate legs), Straight leg raising (both legs), Sethubandhasana lumbar stretch, Instant Relaxation Technique (IRT)
Loosening Practices – 1: Shoulder Rotation, Side bending, standing twist, Hip rotation, Thigh strengthening
Loosening practices – 2: Chakki chalan, Bhunamasana Chalana, Alternative toe touching
Loosening practices – 3: Side leg raising, Pavana muktasana kriya: Wind releasing pose movements, Quick Relaxation Technique (QRT)

Hands-on Practice on following asanas and pranayamas:

Asana practices – 1: Tadasana, Ardhakati Chakrasana, Ardha Chakrasana, Trikonasana, Vrikshasana Asana practices – 2: Vakarasana, Janu Sirshasana, Ushtrasana, Sashankasana,
Asana practices – 3: Ardhamatseyndrasana, Paschimottanasana, Poorvottanasana, Gomukhasana
Asana practices – 4: Makarasana, Bhujangasana, Salambha Shalabahasana, Dhanurasana
Asana practices – 5: Setubandhasana, Sarvangasana, Mastyasana, Deep Relaxation Technique (DRT) Soorya Namaskar
Pranayama – 1: Kapalbhati kriya and Sectional Breathing
Pranayama – 2: Nadishuddhi Pranayama
Pranayama – 3: Bhramari, Sheetali, Sitkari and Ujjayi
Om Meditation, Cyclic Meditation

Textbooks / References:

1. H R Nagendra and R Nagarathna. Yoga for Promotion of Positive Health. Swami Vivekananda Yoga Prakashana. 2011.
2. Contrada, R., & Baum, A. (Eds.). The handbook of stress science: Biology, psychology, and health. Springer Publishing Company. 2010
3. Al'Absi, M. (Ed.). Stress and addiction: Biological and psychological mechanisms. Elsevier. 2011.
4. Van den Bergh, O. Principles and practice of stress management, Guilford Publications. 2021.
5. Swami Muktibodhananda, Hatha Yoga Pradipika, Bihar Scool of Yoga, 1998
6. Swami Satyananda Saraswati, Four Chapters on Freedom, Bihar Scool of Yoga, 1975

7. Swami Tapasyananda, Srimad Bhagavat Gita, Sri Ramakrishna Math, 2012

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
Yoga for Stress Management	Dr H R Nagendra, Dr Mithila M V, Dr Rajesh Nair	Swami Vivekananda Yoga Anusandhana Samsthana	https://onlinecourses.swayam2.ac.in/aic23_ge10/preview#:~:text=In%20this%20course%20we%20intend,meeting%20the%20challenges%20of%20stress

First Year (Semester –II)
5G Technology – 2

24AF2969PC201	**5G Technology – 2**	**PCC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objectives:

1. Understand the fundamental principles of 5G technology and its key components.
2. Explore the applications and potential use cases of 5G networks across various industries.
3. Learn to design and implement 5G networks, considering factors like capacity, latency, and security.
4. Gain insights into the future developments and challenges of 5G technology and its evolution towards 6G.

Course Outcomes:

After the completion of course, the student will able to

1. Understand 5G spectrum requirement, its channel model and use cases
2. Familiarize with 5G architecture options and physical layer concepts
3. Examine the multicarrier techniques and new waveform options for 5G communication
4. Appraise the current research avenues in 5G domain
5. Illustrate the concept of network slicing and V2V Communication
6. Interpret the Interference and Mobility management in 5G networks

UNIT I

5G Radio Spectrum: 5G spectrum landscape and requirements, Spectrum access modes and sharing scenarios, 5G spectrum technologies.

5G Channel Model: The 5G wireless Propagation Channels: Channel modeling requirements, propagation scenarios and challenges in the 5G modeling. 5G Use Cases and System Concept: Use cases and requirements, 5G system concept.

UNIT II

Radio Interface Architecture: 5G architecture options, core network architecture, RAN architecture. 5G Physical Layer: Physical channels and signals, 5G frame structure, physical layer procedures (MIMO, Power control, link adaptation, beam forming).

UNIT III

5g Radio-Access Technologies: Access design principles for multi-user communications, multi-carrier with filtering: a new waveform, non-orthogonal schemes for efficient multiple access.

UNIT IV

Introduction to 5g Network Slicing: Network Slicing, E2E Slicing, SDN and NFV Slicing. Vehicular Communications: From V2V to AV2X, key standards, VC architectures, V2X Use cases.

UNIT V

Mobility and Handoff Management In 5G: Network deployment types, Interference management in 5G, Mobility management in 5G, Dynamic network reconfiguration in 5G

Textbooks/ References:

1. Afif Osseiran, Jose F Monserrat, Patrick Marsch, ―5G Mobile and Wireless Communications Technology‖, Cambridge University Press, 2016
2. Saad Z. Asif, ―5G Mobile Communications Concepts and Technologies‖, CRC Press, Taylor & Francis Group, First Edition, 2018
3. Harri Holma, Antti Toskala, Takehiro Nakamura, ―5G Technology 3GPP NEW RADIO‖, John Wiley & Sons First Edition,2020
4. Gordon L. Stuber, ―Principles of Mobile Communication‖, KLUWER ACADEMIC PUBLISHERS, 2nd Edition, 2002
5. Joseph C. Liberti, Theodore S. Rappaport, ―Smart Antennas for Wireless Communications‖, Prentice Hall PTR, 1999
6. Ying Zhang, ―Network Function Virtualization Concepts and Applicability in 5G Networks‖, John Wiley & Sons, 2018.

First Year (Semester –II)
Smart Antennas for 5G communications

24AF2969PC202	**Smart Antennas for 5G communications**	**PCC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Comprehend Smart Antenna Fundamentals: Understand the core principles of smart antennas, including beam forming and MIMO, and their relevance in 5G networks.
2. Design and Optimize 5G Antenna Systems: Develop and optimize smart antenna systems, accounting for factors like interference mitigation and power efficiency.
3. Analyse 5G Smart Antenna Performances: Evaluate smart antenna performance metrics like SNR, SINR, and capacity enhancements in 5G scenarios.
4. Implement Smart Antenna Algorithms: Apply practical knowledge to implement smart antenna algorithms and protocols for improved 5G network performance.

Course Outcomes:

After the completion of course, the student will able to

1. Familiarize with smart and adaptive antennas.
2. Apply different adaptive algorithms for 5G antenna.
3. Understanding the concept of direction of arrival and angle of arrival
4. Design of antenna array architectures to meet 5G requirement.

UNIT I

5G Concepts

5G Objectives and Usage Scenarios, 5G Activities, Channel Access Method/Air Interface, 5G Policy, 5G Timelines, 4G/5G Radio Access Network, 5G system concept, LTE-Advanced, LTE-Advanced Pro, 5G NR, The 5G architecture, Spectrum Analysis and Regulations for 5G

UNIT II

Introduction to smart antenna

Introduction to Smart Antennas, Architecture of a Smart Antenna System: Transmitter and Receiver, Types of Smart Antennas, Benefits and Drawbacks of Smart Antennas, Applications of Smart Antennas.

UNIT III

Smart Antenna Configurations

Fixed Side lobe Canceling, Retro directive Arrays, Beam forming, Adaptive Arrays, Butler Matrix, Spatial Filtering with Beam formers, Switched Beam Systems, Multiple Fixed Beam System. Uplink Processing, Diversity Techniques, Angle Diversity, Maximum Ratio Combining, Adaptive Beam forming, Fixed Multiple Beams versus Adaptive Beam forming, Downlink Processing.

UNIT IV

Angle-of-Arrival Estimation

Fundamentals of Matrix Algebra, Array Correlation Matrix, AOA Estimation Methods: Bartlett AOA Estimate, Capon AOA Estimate, Linear Prediction AOA Estimate, Maximum Entropy AOA Estimate, Pisarenko Harmonic Decomposition AOA Estimate, Min-Norm AOA Estimate, MUSIC AOA Estimate, ESPRIT AOA Estimate.

UNIT V

MIMO Antennas

Introduction, Multiple-Antenna MS Design, RAKE Receiver Size, Mutual Coupling Effects, Dual-Antenna Performance Improvements, Downlink Capacity Gains, Principles of MIMO systems: SISO, SIMO, MISO,MIMO, Hybrid antenna array for mmWave massive MIMO: Massive Hybrid Array Architectures, Hardware Design for Analog Subarray.

References/Text Books:

2. Ahmed El Zooghby, _Smart Antenna Engineering,,, ARTECH HOUSE, INC, 2005.
3. Frank B. Gross, _Smart antenna with MATLAB,,, 2nd Edition, McGraw-Hill, 2015.
4. Lal Chand Godara , ―SMART ANTENNAS‖ , CRC PR ESS, 2004
5. Shahid Mumtaz, Jonathan Rodriguez, Linglong Dai mmWave Massive MIMO: A Paradigm for 5G.

First Year (Semester –II)
Embedded System Design

24AF2372PE203A	Embedded System Design	PEC	3L- 1T - 0P	4 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 1 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To introduce students to the modern embedded systems and to show how to understand and program such systems using a concrete platform built around a modern embedded processor.

Course Outcomes:

After the completion of course, the student will able to

1. Understand fundamental embedded systems design paradigms, architectures, possibilities, and challenges, both with respect to software and hardware.
2. Analyze various types memories used in embedded and smart device applications.
3. Analyze deep state-of-the-art theoretical knowledge in the areas of real-time systems.
4. Ability to analyze a system both as whole and in the included parts, to understand how these parts interact in the functionality and properties of the system

UNIT I

Fundamentals of Embedded System

Embedded System overview, Design challenges, Processor Technology, IC Technology, Design Technology.

UNIT II

Embedded System Hardware

Evaluation of Processors, Microprocessor architecture overview- CISC and RISC, Case study of Pentium processor architecture.

UNIT III

Microcontroller Architecture and Interfacing

Architecture of 8051, Instruction set, Addressing modes, Programming Examples. Interfacing of LED/LCD, keyboard, stepper motor, ADC/DAC and sensors, RTC, serial communication with micro-controller.

UNIT IV

Study of semiconductor memory

Memory device characteristics, SRAM, DRAM, SSRAM, SDRAM, RDRAM, FLASH, Smart card memory and interfacing of memory with micro-controller.

UNIT V

Introduction to DSP Processors

Architecture, features, instruction set, typical applications (TMS320XX or ADSP 21010).

UNIT VI

Embedded software and Applications

Introduction to software Engineering, C cross compiler, Computational models, FSM, Concurrent state model, Concurrent Processes, Communication among processes, synchronization among processes. Introduction to RTOS: Windows CE, VX works.

Applications: Network protocols- TCP/IP, Embedded Ethernet, CANBUS, I2C bus, Mod Bus, Digital Camera.

Textbooks / References:

1. Frank Vahid and Tony Givargis, ―Embedded System Design A Unified Hardware/Software Introduction‖, Wiley; 1. Edition (24 Oct. 2001).
2. M.A. Mazidi and J.G. Mazidi, ―The 8051 Micro-controller and Embedded System‖ Pearson Education Asia, 2000
3. K.J. Ayala, ―The 8051 Micro-controllers‖, Cengage India; 3rd edition (8 Nov. 2007).
4. INTEL Microcontroller Manual
5. J. Zimmermann: ―Fuzzy set theory and its applications, second edition, Allied Publishers limited, New Delhi, 1996.

First Year (Semester –II)

Multirate Digital Signal Processing

24AF2372PE203B	**Multirate Digital Signal Processing**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To master the fundamentals of multi-rate signal processing and demonstrate the ability to solve problems in sample rate conversion, filter banks, and transmultiplexers.

Course Outcomes:

1. Learner will be able to develop efficient realizations for up sampling and down sampling of signals using the polyphase decomposition.
2. Learner will be able to design and implement Finite Impulse Response (FIR) and Infinite Impulse Response (IIR) digital filters to meet specifications.
3. Learner will be able to design digital filter banks based on the techniques presented.
4. Learner will be able to analyze fundamental concepts of wavelets.
5. Learner will be able to distinguish between wavelets and multirate filter banks, from the point of view of implementation.

UNIT I

Fundamentals of Multi-rate Systems

Introduction, Basic multi-rate operations, Interconnection of building blocks, Polyphase representation, Multistage implementation, Some application of multi-rate systems, Special filter, and filter banks.

UNIT II

Maximally Decimated Filter Banks

Introduction, Errors created in the QMF bank, a simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Transmultiplexer.

UNIT III

Paraunitary Perfect Reconstruction Filter Banks

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Transform coding and LOT.

UNIT IV

Linear Phase and Cosine Modulated Filter Banks

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT V

The Wavelet Transform and its Relation to Multi-rate Filter Banks

Introduction, Background and outline, Short time Fourier transform, The Wavelet transform, DT orthonormal Wavelets, Continuous time orthonormal Wavelet basis.

UNIT VI

Multidimensional, Multivariable and Lossless Systems

Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multi-rate fundamentals. Review of discrete time multi-input multi-output LTI System, Paraunitary and lossless system.

Textbooks / References:

1. P.P.Vaidyanathan , Multirate System and Filter Banks, Pearson College Div; 1st edition (January 1, 1992)
2. N.J.Fliege, Multirate Digital Signal Processing, Wiley (January 13, 2000).
3. Raghuveer Rao, Ajit Bopardikar,Wavelet Transforms Introduction to Theory and Application, Longman Pub Group; Har/Dskt edition (January 1, 1998)
1. C. Sidney Burrus, R.A.Gopianath , Introduction to wavelet and wavelet Transform, Pearson; 1st edition (August 14, 1997).

First Year (Semester –II)
Cryptography & Network Security

24AF2969PE203B	**Cryptography & Network Security**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To understand basics of Cryptography and Network Security.
2. To be able to secure a message over insecure channel by various means.
3. To learn about how to maintain the Confidentiality, Integrity and Availability of a data.
4. To understand various protocols for network security to protect against the threats in the networks.

Course Outcomes:

After the completion of course, the student will able to

1. Provide security of the data over the network.
2. Do research in the emerging areas of cryptography and network security.
3. Implement various networking protocols.
4. Protect any network from the threats in the world.

Unit I

Introduction to Cryptography and Block Ciphers

Introduction to security attacks - services and mechanism - introduction to cryptography - Conventional Encryption: Conventional encryption model - classical encryption techniques - substitution ciphers and transposition ciphers – cryptanalysis – steganography - stream and block ciphers - Modern Block Ciphers: Block ciphers principals - Shannon„s theory of confusion and diffusion - fiestal structure - data encryption standard(DES) - strength of DES - differential and linear crypt analysis of DES - block cipher modes of operations - triple DES – AES.

Unit II

Confidentiality and Modular Arithmetic

Confidentiality using conventional encryption - traffic confidentiality - key distribution - random number generation - Introduction to graph - ring and field - prime and relative prime numbers - modular arithmetic - Fermat„s and Euler„s theorem - primarily testing - Euclid„s Algorithm - Chinese Remainder theorem - discrete algorithms.

Unit III

Public key cryptography and Authentication requirements

Principles of public key crypto systems - RSA algorithm - security of RSA - key management – Diffle-Hellman key exchange algorithm - introductory idea of Elliptic curve cryptography – Elgamel encryption - Message Authentication and Hash Function: Authentication requirements - authentication functions - message authentication code - hash functions - birthday attacks – security of hash functions and MACS.

Unit IV

Integrity checks and Authentication algorithms

MD5 message digest algorithm - Secure hash algorithm (SHA) Digital Signatures: Digital Signatures - authentication protocols - digital signature standards (DSS) - proof of digital signature algorithm - Authentication Applications: Kerberos and X.509 - directory authentication service - electronic mail security-pretty good privacy (PGP) - S/MIME.

Unit V

IP Security and Key Management

IP Security: Architecture - Authentication header - Encapsulating security payloads - combining security associations - key management.

Text Books/ Reference Books

1. William Stallings, ―Crpyptography 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 – Security in computing – Prentice Hall of India.

First Year (Semester –II)
Information Theory and Coding

24AF2969PE203C	**Information Theory and Coding**	**PEC**	**3L- 1T - 0P**	**4 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 1 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To provide in-depth understanding of principles and applications of information theory.
2. To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
3. To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

After the completion of course, the student will able to

1. Formulate equations for entropy mutual information and channel capacity for all types of channels.
2. Distinguish between different types error correcting codes based on probability of

error.

3. Design a digital communication system by selecting an appropriate error correcting codes for a particular application.
4. Explain various methods of generating and detecting different types of error correcting codes.
5. Formulate the basic equations of linear block codes.

UNIT I

Theory of Probability and Random Processes

Concept of probability, Random variables, Probability models, Statistical averages, Central limit theorem, Correlation, Linear mean square estimation.

UNIT II

Random Processes

Random variable and random process, Power spectral density of a random process, Multiple random processes, Transmission of random processes through linear systems, Band-pass random processes, Optimum filtering.

UNIT III

Noise in Communication Systems

Behaviour of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT V

Error Correcting Codes

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ, Performance of codes, Comparison of coded and un-coded systems.

UNIT IV

Information Theory

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem

Textbooks / References:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; Oxford Publication.
2. Das, Mullick, Chaterjee; Principles of Digital Communication; New Age International.
3. Taub, Schilling, Principles of Communication Engineering (2^{nd} Edition); TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory; Wiley Inter science.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital; TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2nd Edition); Pearson India.

First Year (Semester –II)
New Labour Codes of India

24AF2372OE204A	New Labour Codes of India	OE	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Gain a clear understanding of the key Labour Codes, namely the Code on Wages, Code on Social Security, Code on Occupational Safety, Health, and Working Conditions, and the Industrial Relations Code.
2. Explore the legal structure and scope of each Labour Code, understanding their applicability to different categories of workers and industries.
3. Examine the provisions related to wages, including wage definitions, payment structures, deductions, and methods for calculating wages
4. Analyse the components of social security as outlined in the Code on Social Security, including provident funds, health insurance, maternity benefits, and pensions.
5. Explore the mechanisms for resolving disputes and conflicts between employers and employees, including the role of labour courts, tribunals, and the appellate process.

Course Outcomes:

After the completion of course, the student will able to

1. Understand the historical context and reasons behind the overhaul of labour laws in India.
2. Analyze the economic, social, and administrative motivations driving the implementation of the new labour codes.
3. Evaluate the impact of the new Industrial Relations Code on trade unions, collective bargaining, and dispute resolution mechanisms.
4. Analyze the potential effects of these provisions on both workers and employers.
5. Speculate on the possible evolution of labour practices and employer-employee relations in response to these codes.

UNIT I

History of Labour Laws

Introduction**,** Government Policies, History of Labour Laws in the Country, History: Previous Social Legislations in India, National Labour Commission Reports

Trade Unions

Evolution of Trade Unions in India, Constitutional Freedom to Form Association and Unions, International Labour Organization on Trade Unions, Trade Union – Definition, Registration, Cancellation, Management of Funds, Trade Union – Recognition, Immunities.

UNIT II

Strikes & Layoffs

Industrial Dispute – Introduction, Definitions, Resolution of Industrial Disputes, Concept of Workmen, Contract of service, Contract for service, Strike, Lock-out, Retrenchment, Closure of Undertakings, Industrial Employment (Standing Orders), Disciplinary Action and

Procedures**.**

UNIT III

Payment of Wages

The Code on Wages 2019 – An Introduction, Minimum Wages, Floor Wages, Central and State Advisory Board, Payment of Wages, Deductions & Recovery, Fines, Equal Remuneration, Bonus, Minimum Wage Fixing Convention, 1970, Protection of Wages Convention, 1949, Equal Remuneration Convention, 1951: International Instruments on Equality of Pay, Protection of Workers,, Claims (Employer,,s Insolvency) Convention, 1992, Discrimination (Employment and Occupation) Convention, 1992

UNIT IV

Social security & Insurance

Employees State Insurance, Different Benefits under the ESI Scheme, Employee,,s Provident Fund, Gratuity, Maternity Benefit, Social Security in case of Building and other Construction Workers, Social Security for Unorganized sector and Platform workers, Bonded Labour System Abolition and Regulation, Child Labour Prohibition, Plantation Labour.

UNIT V

Factories & various types of workers

The Meaning of Factory, Manufacturing Process, Approval and Licensing of Factories, Role of Inspector-cum-facilitator and Other Authorities, Social Security Fund, Offences and Penalties, Contract Labour and Proposed ILO Convention, Inter-State Migrant Workers**,** Mines Workers, Beedi and Cigar Workers (Kerala & West Bengal Legislations), Audio-Visual workers, Cine-workers and Dock workers, The Effective Abolition of Child Labour (ILO: C029, C105, C138 & C182), The Governance Convention of ILO Labour Standards.

Textbooks / References:

1. Labour Law (Taxman)
2. E-book of the Ministry of Labour and Employment - https://labour.gov.in/e-book-1
3. Reading material prepared by the Course Co-ordinator.
4. Avtar Singh and Harpreet Kaur, Introduction to Labour and Industrial Laws, 2nd ed., Lexis Nexis Butterworths Wadhwa.

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
New Labour Codes of India	Prof. KD Raju	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_lw05/preview

First Year (Semester –II)
Urban Utilities Planning: Water Supply, Sanitation and Drainage

24AF2372OE204B	**Urban Utilities Planning: Water Supply, Sanitation and Drainage**	**OE**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To develop a clear understanding of the significance of water supply, sanitation, and drainage systems in urban areas.
2. To explore different sources of water supply for urban areas, including surface water, groundwater, and treated wastewater.
3. To delve into various sanitation systems, such as sewerage networks, on-site sanitation solutions, and wastewater treatment plants.
4. To learn about hydraulic calculations, pipe sizing, pump station design, and related technical aspects.

Course Outcomes:

After the completion of course, the student will able to

1. Students should be able to demonstrate a clear understanding of the fundamental concepts related to water supply, sanitation, and drainage systems in urban settings.
2. Students should be capable of applying design principles to develop efficient and sustainable water supply, sanitation, and drainage systems that meet the needs of urban populations while considering factors such as population growth, climate change, and land use.
3. Students should be able to outline strategies for the effective management, operation, and maintenance of water supply, sanitation, and drainage infrastructure to ensure long-term sustainability and functionality.

UNIT-I

Urban Utilities

Urban utilities planning: Introduction, Urban Water Supply, Collection of water.

UNIT-II

Water Storage & Distribution

Pumping and storage, Water supply Distribution system and Plans, Water Quality, testing, treatment, and cost.

UNIT-III

Sanitation

Sanitation and Drainage Fundamentals, Water carriage system, Sewer design,

UNIT-IV

Sewage treatment

Sewer appurtenances and master plans, Sewage treatment, drainage, and recharge

UNIT-V

Case Study of Smart Cities in India for good water storage and distribution, sanitation and sewage treatment

Textbooks / References:

1. Water Supply Engineering, S. K. Garg (18th ed.), Khanna Publishers.
2. Water Supply and Sanitary Engineering, G. S. Birdie & J. S. Birdie (8th ed.), Dhanpat Rai Publishing Company, New Delhi.
3. Stormwater drainage manual Planning, Design and Management, Drainage services department, Government of the Hong Kong Special Administrative Region.

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
Urban Utilities Planning: Water Supply, Sanitation and Drainage	Prof. Debapratim Pandit	IIT Kharagpur	https://onlinecourses.nptel.ac.in/noc23_ar08/preview

First Year (Semester –II)
Environment and Development

24AF2372OE204C	**Environment and Development**	**OE**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To help students comprehend the complex interconnections between environmental factors and development processes, highlighting how they can either support or impede each other.
2. To identify and analyze key environmental challenges arising from development activities, such as pollution, resource depletion, deforestation, loss of biodiversity, and climate change.
3. To study the effect of climate change on environment.
4. To analyze real-world case studies of both successful and unsuccessful attempts to integrate environmental considerations into development projects and policies

Course Outcomes:

After the completion of course, the student will able to

1. Demonstrate a deep understanding of the complex interrelationships between environmental factors and socioeconomic development, including how they influence and shape each other.
2. Identify and critically analyze key environmental challenges resulting from development activities, and evaluate their impacts on ecosystems, natural resources, and human well-being.

UNIT I

Environmental movement

Introduction: Development, economic growth and sustainable development, Basic ecosystem ecology, Environmentalism, Environmental Movement, Environmentalism in the global south,

UNIT II

Social ecology

Approaches to environment: Ecofeminism, Feminist political ecology, Marxism and ecology, Debates on environmental ethics: Deep ecology, Gandhi and ecology, social ecology.

UNIT III

Impact of Religion on environment

Religion, environment, and conservation: Religion, environment and historical roots of ecological crisis, Biodiversity conservation ethics in Buddhism and Hinduism, Christian religion in the age of ecological crisis

UNIT IV

Natural Resources & development

Natural resource management, Common property vs. private property, Livelihoods, forests, and conservation, Displacement, dispossession, and development: Conservation-induced displacement, Environment impact assessment and national rehabilitation & resettlement policy, Dispossession, and land acquisition.

UNIT V

Belief and local knowledge of environment

Belief and knowledge systems, biodiversity conservation and sustainability: Ecological knowledge, biodiversity conservation and sustainability, Traditional religion and conservation of nature in Northeast India: Case study

Local knowledge in the environment-development discourse: Indigenous knowledge, environment and development, Relevance of indigenous knowledge: case study

Textbooks / References:

1. Arnold, David, and Guha, Ramchandra, (eds.), 1997. Nature, Culture and Imperialism, New Delhi: Oxford University Press.
2. Baviskar, Amita. 1997. In the Belly of the River: Tribal Conflicts over Development in the Narmada Valley, OUP, Delhi.
3. Barnhill, David Landis & Roger S. Gottlieb. (eds.) 2001. Deep Ecology and World Religions: New Essays on Sacred Grounds. State Univ. of New York Press, Albany.
4. Bicker, Alan, Paul Sillitoe and Johan Pottier. 2004. Development and Local Knowledge: New Approaches to Issues in Natural Resources Management, Conservation and Agriculture. Routledge, London & New York.
5. Esteva, G. 1997. _Development,, in W. Sachs, ed., The Development Dictionary, Orient Longman, pp. 8-34.
6. Gadgil, Madhav and Guha, Ramchandra. 1995. Ecology and Equity: The use and Abuse of Nature in Contemporary India, New Delhi: Oxford University.
7. Gottlieb, Roger S. 2004. This Sacred Earth: Religion, Nature, Environment. Routledge, New York, and London.
8. Merchant, Carolyn. 1994. Ecology: Key Concepts in Critical Theory, Humanities Press, New Jersey.
9. Ramakrishnan, P.S. 1992. Shifting Agriculture and Sustainable Development: An Interdisciplinary Study from North-Eastern India, Man and the Biosphere Series, Volume 10, UNESCO.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Environment and Development	Prof. Ngamjahao Kipgen	IIT Guwahati	https://onlinecourses.nptel.ac.in/noc21_hs83/preview

First Year (Semester –II)
Entrepreneurship

24AF2372OE204D	Entrepreneurship	OE	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To understand the role of entrepreneurs in driving innovation and economic growth.
2. Guide students through the process of developing a comprehensive business plan, including market research, financial projections, competitive analysis, and risk assessment.
3. Provide students with essential financial literacy skills, including budgeting, financial forecasting, and understanding different funding options such as bootstrapping, loans, venture capital, and angel investment.
4. Guide students through the process of developing, prototyping, and refining their products or services to meet customer needs and expectations.

Course Outcomes:

After the completion of course, the student will able to

1. Generate innovative business ideas by identifying market gaps, customer needs, and emerging trends.
2. Capable of developing comprehensive business plans that encompass market research, financial projections, and strategic goals.
3. Gain skills in budgeting, financial forecasting, and managing financial resources for their entrepreneurial ventures.
4. Identify and manage potential risks associated with entrepreneurship, including financial, operational, and market risks.

UNIT I

Entrepreneurial Journey, Entrepreneurial Discovery, Ideation and Prototyping,

UNIT II

Testing, Validation and Commercialization, Disruption as a Success Driver

UNIT III

Technological Innovation and Entrepreneurship – 1, Technological Innovation and Entrepreneurship – 2, Raising Financial Resources.

UNIT IV

Education and Entrepreneurship, Beyond Founders and Founder-Families, India as a Start-up Nation

UNIT V

National Entrepreneurial Culture, Entrepreneurial Thermodynamics, Entrepreneurship and

Employment, Start-up Case Studies

Textbooks / References:

1. Zero to One: Notes on Startups, or How the Build the Future by Peter Thiel.
2. The Lean Startup: How Today,,s Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses by Eric Ries.
3. India as Global Start-up Hub: Mission with Passion by C B Rao.
4. Elon Musk: Tesla, SpaceX, and the Quest for a Fantastic Future by Ashlee Vance.
5. Steve Jobs by Walter Isaacson.
6. Innovation and Entrepreneurship: Practice and Principles by Peter F Drucker.
7. The Innovator,,s Solution: Creating and Sustaining Successful Growth by Clayton M Christensen.

NPTEL platform:

NPTEL Course	**Name of Instructor**	**Host Institute**	**Link**
Entrepreneurship	Prof. C Bhaktavatsala Rao	IIT Madras	https://onlinecourses.nptel.ac.in/noc20_mg35/preview

First Year (Semester –II)
Intellectual Property Rights

24AF2969IPR205	Intellectual Property Rights	ELC	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. The main objective of the IPR is to make the students aware of their rights for the protection of their invention done in their project work.
2. To get registration in our country and foreign countries of their invention, designs and thesis or theory written by the students during their project work and for this they must have knowledge of patents, copy right, trademarks, designs and information Technology Act.
3. Further teacher will have to demonstrate with products and ask the student to identify the different types of IPR,,s.

Course Outcomes:

After the completion of course, the student will able to

1. Know the process of drafting and filing patent.
2. Apply the knowledge of writing copyright for their innovative works.
3. Acquire the knowledge of plagiarism in their innovations which can be questioned legally.

UNIT-I

Introduction to IPR

Meaning of property, Origin, Nature, Meaning of Intellectual Property Rights, Introduction to TRIPS and WTO, Kinds of Intellectual property rights - Copy Right, Patent, Trade Mark, Trade; Secret and trade dress, Design, Layout Design, Geographical Indication, Plant. Varieties and Traditional Knowledge.

UNIT-II

Patent Rights

Origin, Meaning of Patent, Types, Inventions which are not patentable, Registration Procedure, Rights and Duties of Patentee, Assignment and license, Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties.

UNIT-III

Copy Right

Origin, Definition, Types of Copy Right, Registration procedure, Assignment & license, Terms of Copy Right, Piracy, Infringement, Remedies, Copy rights with special reference to software.

UNIT-IV

Trade Marks

Origin, Meaning & Nature of Trade Marks, Types, Registration of Trade Marks, Infringement & Remedies, Offences relating to Trade Marks, Passing Off, Penalties. Domain Names on cyber space.

UNIT V

Design

Meaning, Definition, Object, Registration of Design, Cancellation of Registration, International convention on design, functions of Design. Semiconductor Integrated circuits and layout design Act-2000.

Textbooks / References:

1. Intellectual Property Rights and the Law, Gogia Law Agency, by Dr. G.B. Reddy
2. Law relating to Intellectual Property, Universal Law Publishing Co, by Dr. B.L.Wadehra
3. IPR by P. Narayanan
4. Law of Intellectual Property, Asian Law House, Dr.S.R. Myneni.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Intellectual Property & Rights	Prof. Feroz Ali	IIT Madras	https://onlinecourses.nptel.ac.in/noc23_hs55/preview

First Year (Semester –II)
Indian Knowledge System (IKS): Concepts and Applications in Engineering

24AF2372AE206A	**Indian Knowledge System (IKS): Concepts and Applications in Engineering**	**AEC/VEC/IKS**	**2L- 0T - 0P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Introduce students to the foundational concepts, philosophies, and components of Indian knowledge systems, including ancient scriptures, philosophies, and traditional practices.
2. Introduce students to Vedic mathematical principles and computational techniques from ancient Indian texts, demonstrating their practical use in engineering calculations.
3. Explore the potential benefits of incorporating yogic and meditative practices into engineering to enhance focus, creativity, and overall well-being.
4. Study architectural concepts from Indian traditions and evaluate how they can inform modern urban planning and sustainable architecture.
5. Encourage students to draw inspiration from IKS to develop innovative engineering solutions that align with ancient wisdom while meeting contemporary needs.

Course Outcomes:

After the completion of course, the student will able to

1. Gain a comprehensive understanding of the philosophical, scientific, and technological aspects of Indian Knowledge Systems and their historical development.
2. Understand the philosophical underpinnings of IKS, including concepts like dharma, karma, and holistic thinking, and explore their relevance to engineering.
3. Understand Vedic mathematical principles and computational methods, and their potential relevance in solving modern engineering problems.
4. Investigate the connections between yoga, meditation, and stress management, and their potential impact on mental well-being in engineering contexts.
5. Reflect on the ethical, cultural, and social dimensions of integrating IKS concepts into engineering practices and applications.

UNIT I

Indian Knowledge System – An Introduction & Vedic Corpus

What is IKS? Why do we need IKS? Organization of IKS, Historicity of IKS, Some salient aspects of IKS,

Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

UNIT II

Number system & Mathematics

Number systems in India - Historical evidence, Salient aspects of Indian Mathematics, Bhūta-Saṃkhyā system, Kaṭapayādi system, Measurements for time, distance, and weight, Piṅgala

and the Binary system.
Introduction to Indian Mathematics, Unique aspects of Indian Mathematics, Indian Mathematicians and their Contributions, Algebra, Geometry, Trigonometry, Binary mathematics, and combinatorial problems in Chandaḥ Śāstra, Magic squares in India

UNIT III
Engineering Technology: Metal & Other applications
Wootz Steel: The rise and fall of a great Indian technology, The Indian S & T heritage, Mining and ore extraction, Metals and metalworking technology, Iron and steel in India, lost wax casting of idols and artefacts, Apparatuses used for extraction of metallic components.
Irrigation systems and practices in South India, literary sources for science and technology, Physical structures in India, irrigation and water management, dyes and painting technology, the art of making perfumes, Surgical techniques, shipbuilding, sixty-four art forms (64 Kalās) status of Indigenous S & T.

UNIT IV
Town Planning and Architecture:
Perspective of Arthaśāstra on town planning, Vāstu-śāstra – The science of architecture eight limbs of Vāstu, town planning, temples in India: Marvelous stone architecture for eternity, temple architecture in India, Iconography.

UNIT V
Knowledge Framework and classifications:
Indian scheme of knowledge, The knowledge triangle, Prameya – A vaiśeṣikan approach to physical reality, Dravyas – the constituents of the physical reality, Attributes – the properties of substances and Action – the driver of conjunction and disjunction, Sāmānya, viśēṣa, samavāya, Pramāṇa – the means of valid knowledge, Saṃśaya – ambiguities in existing knowledge, Framework for establishing valid knowledge, Deductive or inductive logic framework, Potential fallacies in the reasoning process, Siddhānta: established tenets in a field of study.

UNIT VI
Linguistics
Introduction to Linguistics, Aṣṭādhyāyī, Phonetics, word generation, computational aspects, Mnemonics, Recursive operations, Rule based operations, Sentence formation verbs and prefixes, role of Sanskrit in natural language processing.

Textbooks / References:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), ―Introduction to Indian Knowledge System: Concepts and Applications‖, PHI Learning Private Ltd. Delhi.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Indian Knowledge System (IKS): Concepts and Applications in Engineering	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	(IIMB), Chanakya University, Bangalore	https://onlinecourses.swayam2.ac.in/imb23_mg53/preview

First Year (Semester –II)
Indian Knowledge System (IKS): Humanities and Social Sciences

24AF2372AE206B	**Indian Knowledge System (IKS): Humanities and Social Sciences**	**AEC/VEC/IKS**	**2L- 0T - 0P**	**2 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 2 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Introduce students to the diverse range of Indian philosophical, cultural, and social knowledge systems that have evolved over millennia.
2. Encourage students to critically compare Indian knowledge systems with other global philosophies and social theories, fostering a nuanced understanding.
3. Study Vedic texts, ancient scriptures, and philosophical treatises to understand the core ideas and insights that inform Indian knowledge systems.
4. Investigate the intersections of spirituality, psychology, and well-being in Indian knowledge systems, exploring practices like meditation, yoga, and mindfulness.
5. Study the role of language, symbols, and communication in Indian knowledge systems, including Sanskrit as a language of knowledge transmission.

Course Outcomes:

After the completion of course, the student will able to

1. Recognize the interdisciplinary nature of IKS, integrating traditional knowledge with contemporary concepts in humanities and social sciences.
2. Explore India's rich cultural heritage, including literature, art, music, dance, and rituals, and analyze their significance in shaping identity and social cohesion.
3. Explore Indian philosophical schools and their insights into consciousness, self-awareness, and psychological well-being.
4. Analyze India's cultural diversity, pluralism, and the coexistence of various belief systems, contributing to tolerance and social harmony.

UNIT I

Indian Knowledge System – An Introduction & Vedic Corpus

What is IKS? Why do we need IKS? Organization of IKS, Historicity of IKS, Some salient aspects of IKS,

Introduction to Vedas, A synopsis of the four Vedas, Sub-classification of Vedas, Messages in Vedas, Introduction to Vedāṅgas, Prologue on Śikṣā and Vyākaraṇa, Basics of Nirukta and Chandas, Introduction to Kalpa and Jyotiṣa, Vedic Life: A Distinctive Features.

UNIT II

Philosophical Systems

An introduction to philosophical systems, development of philosophy unique features of philosophy, Sāṅkhya approach of philosophy, Introduction to Yoga, tenet of Nyāya philosophy principles of Vaiśeṣika, doctrine of Pūrva-Mīmāṃsā Darśana, thesis of Vedānta and synopsis of Advaita philosophy of Viśiṣṭādvaita.

UNIT III

Wisdom through ages

Gateways of ancestral wisdoms, introduction to Purāṇa, the Purāṇic repository, Issues of interest in Purāṇas, Introduction to Itihāsas, Key messages in Itihāsas, Wisdom through Nīti-śāstras, Wisdom through Subhāṣita.

UNIT IV

Health Wellness and Psychology:

Introduction to health, Āyurveda: approach to health, Sapta-dhātavaḥ: seven-tissues, role of agni in health, tri-doṣas, Āyurveda: definition of health, Psychological aspects of health, disease management elements, Dinacaryā: daily regimen for health & wellness, Importance of sleep, Food intake methods and drugs, Approach to lead a healthy life, Indian approach to psychology, the tri guṇa system & holistic picture of the individual, the Nature of Consciousness, consciousness studies and issues

UNIT V

Linguistics:

Introduction to Linguistics, Aṣṭādhyāyī, phonetics, word generation, computational aspects, mnemonics, recursive operations, rule-based operations, sentence formation, verbs and prefixes, role of Sanskrit in natural language processing.

UNIT VI

Governance and Public Administration:

Introduction to raja dharma, Arthaśāstra: a historical perspective, Elements of a kauṭilyan state, The king & the amātya, Janapada & durga, treasury and the state economy (Kośa), danda, Mitra, the administrative setup, relevance of Arthaśāstra, public administration in Epics.

Textbooks / References:

1. Mahadevan, B., Bhat Vinayak Rajat, Nagendra Pavana R.N. (2022), ―Introduction to Indian Knowledge System: Concepts and Applications‖, PHI Learning Private Ltd. Delhi.
2. Pride of India: A Glimpse into India„s Scientific Heritage, Samskrita Bharati, New Delhi.
3. Sampad and Vijay (2011). ―The Wonder that is Sanskrit‖, Sri Aurobindo Society, Puducherry.
4. Acarya, P.K. (1996). Indian Architecture, Munshiram Manoharlal Publishers, New Delhi.
5. Kapoor Kapil, Singh Avadhesh (2021). ―Indian Knowledge Systems Vol – I & II‖, Indian Institute of Advanced Study, Shimla, H.P.
6. Dasgupta,S. (1975). A History of Indian Philosophy- Volume 1, Motilal Banarsidass, New Delhi.
7. PLofker, K. (1963). Mathematics in India, Princeton University Press, New Jeresy, USA"

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link

Indian Knowledge System(IKS): Humanities and Social Sciences	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	IIM, Bangalore, Chanakya University, Bangalore	https://onlinecourses.swayam2.ac.in/imb23_mg55/preview

First Year (Semester –II)
PG Lab – III

24AF2969PC207L	**PG Lab – III**	**PCC**	**0L- 0T - 2P**	**1 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 0 hrs./week Tutorial: 0 hr./week Practical: 2 hrs./week	Continuous Assessment: 50 Marks End Semester Exam: 50 Marks

Practicals of the PG Lab - III shall be based on the courses of second semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.

First Year (Semester –II)
PG Lab – IV

24AF2969PC208L	**PG Lab – IV**	**PCC**	**0L- 0T - 2P**	**1 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 0 hrs./week Tutorial: 0 hr./week Practical: 2 hrs./week	Continuous Assessment: 50 Marks End Semester Exam: 50 Marks

Practical‟s of the PG Lab - IV shall be based on the courses of second semester. The lab work shall consists of hands on experiments on the different software and hardware platforms related to the syllabus.

First Year (Semester –I)
Disaster Management

24AF2369AU209	Disaster Management	Audit Course	2L- 0T - 0P	0 Credits

Teaching Scheme	Examination Scheme
Lecture: 2 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: -- End Semester Exam: --

Course Objectives:

1. Mastering strategies to manage disasters and ensure public safety during emergencies.
2. Identifying hazards, vulnerabilities, and crafting plans to reduce disaster impact.
3. Collaborative Skills: Working across disciplines to address complex disaster challenges.
4. Developing, improving, and implementing disaster management policies. Community Empowerment: Educating and engaging communities for proactive disaster readiness.

Course Outcomes:

After the completion of course, the student will able to

1. Understand the basic concept of disaster(s) and disaster management, their significance, and types.
2. Develop the analytical skills to study relationship between vulnerability, disasters, disaster prevention and risk reduction
3. Gain a preliminary understanding of approaches to Disaster Risk Reduction (DRR)
4. Empowered with the awareness of institutional processes in the country for Disaster Management

UNIT I

Disaster Management: Disaster and Disaster Management – Concepts, Issues Concerned with Disaster Management.

Disaster Management: Phases of Disaster Management, Phases of Disaster Management Types of Disasters: Bhopal Disaster: A Case Study, Types of Disasters-An Introduction, Natural Disaster, Man-made Disaster

UNIT II

Types of Disasters: Slow onset Disasters & Rapid onset Disasters, Simple and Complex, Tsunami: A Case Study Disasters, Tsunami: A Case Study, Cyclone Phallin 2013: A Case Study

UNIT III

Disaster Management in India -An overview: Evolution of Disaster Management in India, Disaster and Disaster Management in India, National institute of Disaster Management, National Disaster Management Act 2005.

UNIT IV

Disaster Management in India -An Over View: The National Policy on Disaster Management, 2009.

Refugee Problem: National Plan on Disaster Management 2016, Refugee Problems, Impact of Disaster on the lives of Refugees.

Refugee Problem: Problems of Women and Children during disasters, Principles of Psychosocial Care, Issues and Recovery during Emergency.
Refugee Problem: Relationship between Disasters, Development and Vulnerabilities, Relationship between Disasters, Development and Vulnerabilities.

UNIT V

Stakeholders in Disaster Relief Management: Para-Military Forces, Fire Services. Disaster Risk Reduction: Disaster Risk Reduction Strategies, Risk Reduction Preparedness Plans.
Disaster Risk Reduction: Action Plans and Procedures, Early Warning Systems, Components of Disaster Relief, Factors contributing to Vulnerability.
Disaster Risk Reduction: Disaster Risk Reduction - Master Planning for the Future, Capacity Building Rehabilitation measures and long-term reconstruction, Understanding Kerala Disaster 2018.

Textbooks / References:

1. Coppola D P, 2007. Introduction to International Disaster Management, Elsevier Science (B/H), London.
2. Manual on natural disaster management in India, M C Gupta, NIDM, New Delhi
3. An overview on natural & man-made disasters and their reduction, R K Bhandani, CSIR, New Delhi
4. World Disasters Report, 2009. International Federation of Red Cross and Red Crescent, Switzerland
5. Encyclopaedia of disaster management, Vol I, II and IIIL Disaster management policy and administration, S L Goyal, Deep & Deep, New Delhi, 2006
6. Encyclopaedia of Disasters – Environmental Catastrophes and Human Tragedies, Vol. 1 & 2, Angus M. Gunn, Greenwood Press, 2008
7. Disasters in India Studies of grim reality, Anu Kapur & others, 2005, 283 pages, Rawat Publishers, Jaipur.
8. Management of Natural Disasters in developing countries, H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi, 2006, 201 pages
9. Natural Disasters, David Alexander, Kluwer Academic London, 1999, 632 pages
10. Disaster Management Act 2005, Publisher by Govt. of India
11. Publications of National Disaster Management Authority (NDMA) on Various Templates and Guidelines for Disaster Management
12. NIDM Publications
13. High Power Committee Report, 2001, J.C. Pant
14. Disaster Mitigation in Asia & Pacific, Asian Development Bank
15. National Disaster Management Policy, 2009, GoI
16. Disaster Preparedness Kit, American Red Cross

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Disaster Management	Naveen Kumar Nanjundan	University Of Hyderabad	https://onlinecourses.swayam2.ac.in/cec19_hs20/preview

Second Year (Semester –III)
Estimation and Detection Theory

24AF2969PE301A	Estimation and Detection Theory	PEC	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To provide in-depth understanding basics of detection and estimation theory.
2. To be able to design and analyze optimum detection schemes

Course Outcomes:

After the completion of course, the student will able to

1. Understand basic knowledge of linear algebra.
2. Acquire basics of statistical decision theory used for signal detection and estimation.
3. Examine the detection of deterministic and random signals using statistical models.
4. Examine the performance of signal parameters using optimal estimators.
5. Study different estimation schemes such as ML and MMSE estimators.

UNIT I

Linear Algebra

Vector space: linear dependence, Basis and dimension, vector subspace, inner product spaces, orthonormal basis and Gram- Schmidt Process of orthogonalisation, computation of linear dependence, linear transformation and matrices, change of basis, orthogonal and unitary transformation, Eigenvalue, Eigen vectors and characteristics equation. Systems theory, stochastic processes, Gauss Markov models, representation of stochastic processes, likelihood and sufficiency.

UNIT II

Binary Decision: Single Observation

Introduction to structure of decision and estimation problems. Maximum Likelihood decision criterian, Neyman-person criterian, Probability of error criterian, Bays risk criterian, MinMax criterian, problems

UNIT III

Binary Decision: Multiple Observations

Vector observation, the general Gaussion problem, Waveform observations and additive Gaussion noise, problems

Multiple Decision: Multiple Decision

Bays risk, Probability of error: General case, Probability of error: Gaussion case, Ensure decision problems.

UNIT IV

Composite and Nonparametric Decision Theory, Composite decisions Sign test, Wilason test, problems

UNIT V

Fundamentals of Estimation

Maximum likelihood method, Bays cost method, Relationship of Estimation, Linear minimum, Variance and Least-square methods. Properties of Estimations: Unbiased estimators, Efficient estimators, Asymphotic properties.

Textbooks / References:

1. James Melsa and David Cohn, Decision and Estimation Theory, Mc-Graw Hill
2. Harry L, Van Trees, Detection, Estimation, and Modulation Theory , John Wiley and Sons Inc

Second Year (Semester –III)
Radar Signal Processing

24AF2969PE301B	Radar Signal Processing	PEC	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. To provide in-depth understanding of working principle of basic RADAR. List RADAR terminologies. Derive the simple form of RADAR range equation.
2. To provide in-depth understanding of different types of RADAR and its performance parameters

Course Outcomes:

After the completion of course, the student will able to

1. understand the history and application of radar system
2. understand the signal models of radar system
3. sample and quantize the signals in radar system
4. analyze the different waveforms and match filters in radar system
5. modify the radar system models by analyzing the Doppler frequency

UNIT I

Introduction to radar systems, History and applications of radar, Basic radar function, Radar classifications, elements of pulsed radar, The radar equation. A preview of basic radar signal processing, Signal models, Components of a radar signal, Amplitude models, Clutter, Noise model and signal-to-noise ratio, Jamming, Frequency models: the Doppler shift, spatial models.

UNIT II

Sampling and quantization of pulsed radar signals, Domains and criteria for sampling radar signals, Sampling in the fast time dimension, Sampling in slow time: selecting the pulse repetition interval, Sampling the Doppler spectrum,

UNIT III

Radar waveforms, Introduction, The waveform matched filter, Matched filtering of moving targets, The radar ambiguity function, The pulse burst waveform, frequency-modulated pulse compression waveforms, The stepped frequency waveform, Phase-modulated pulse compression waveforms, Costas frequency codes.

UNIT IV

Doppler processing, Alternate forms of the Doppler spectrum, Moving target indication (MTI), Pulse Doppler processing, Dwell-to-dwell stagger, Additional Doppler processing issues, Clutter mapping and the moving target detector,

Textbooks / References:

1. Fundamentals of Radar Signal Processing, Mark A. Richards 2005
2. Adaptive Radar Signal Processing, Simon Haykin 2006
3. Skolnik, M.I., "Introduction to Radar Systems", 2nd Ed., McGraw-Hill. 1997

Second Year (Semester –III)
Fuzzy Systems and Neural Networks

24AF2969PE301C	**Fuzzy Systems and Neural Networks**	**PEC**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objectives:

1. Introduce the fundamental concepts of fuzzy sets and logic.
2. Describe the architecture and learning algorithms of neural networks.
3. Apply the knowledge of fuzzy systems and neural networks to solve real-world problems.
4. Evaluate the performance of fuzzy systems and neural networks.

Course outcomes:

After the completion of course, the student will able to

1. Explain the basic concepts of fuzzy sets and logic.
2. Design and implement fuzzy systems and neural networks.
3. Apply fuzzy systems and neural networks to solve real-world problems.
4. Evaluate the performance of fuzzy systems and neural networks.

UNIT I

Fundamentals of Fuzzy Logic

Basic concepts: fuzzy set theory- basic concept of crisp sets and fuzzy sets- complements-union intersection- combination of operation- general aggregation operations- fuzzy relations compatibility relations-orderings- morphisms- fuzzy relational equations-fuzzy set and systems

UNIT II

Architecture of Neural Networks

Architectures: motivation for the development of natural networks-artificial neural networks-biological neural networks-area of applications-typical Architecture-setting weights-common activations functions Basic learning rules- Mcculloch-Pitts neuron- Architecture, algorithm, applications-single layer net for pattern classification- Biases and thresholds, linear separability - Hebb,,srule- algorithm -perceptron - Convergence theorem-Delta rule.

UNIT III

Basic Neural Network Techniques

Back propagation neural net: standard back propagation-architecture algorithm- derivation of learning rules number of hidden layers--associative and other neural networks- hetro associative memory neural net, auto associative net- Bidirectional associative memory-applications-Hopfield nets-Boltzman machine

UNIT IV

Competitive Neural Networks

Neural network based on competition: fixed weight competitive nets- Kohonenself organizing maps and applications-learning vector quantization-counter propagation nets and

applications adaptive resonance theory: basic architecture and operation-architecture, algorithm, application and analysis of ART1 & ART2

UNIT V

Special Neural Networks

Cognitron and Neocognitron - Architecture, training algorithm and application-fuzzy associate memories, fuzzy system architecture- comparison of fuzzy and neural systems.

Reference Books/Text book(s)

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall, First Edition.
3. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
4. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
5. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.
6. VallusuRao and HayagvnaRao , C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.

Second Year (Semester –III)
Optical Networks

24AF2969PE301D	Optical Networks	PEC	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Provide students with a fundamental understanding of the principles and technologies of optical networks.
2. Develop students' ability to design and implement optical networks for a variety of applications.
3. Prepare students to troubleshoot and maintain optical networks.
4. Enable students to apply optical network technologies to solve real-world problems.

Course Outcomes:

After the completion of course, the student will able to

1. Explain the basic concepts of optical networks, including optical fibers, optical components, and optical transmission systems.
2. Design and implement optical networks for a variety of applications, such as metropolitan area networks (MANs), wide area networks (WANs), and access networks.
3. Troubleshoot and maintain optical networks, identifying and resolving common problems.
4. Apply optical network technologies to solve real-world problems in areas such as telecommunications, data center networking, and high-performance computing.

UNIT I

Optical Networking Components

First- and second-generation optical networks, Components: couplers, isolators, circulators, multiplexers, filters, amplifiers, switches, and wavelength converters.

UNIT II

SONET and SDH Networks

Integration of TDM signals, Layers, Framing, Transport overhead, Alarms, Multiplexing, Network elements, Topologies, Protection architectures, Ring architectures, Network Management.

UNIT III

Broadcast and Select Networks

Topologies, Single-hop, Multi hop, and Shuffle net multi hop networks, Media-Access control protocols, Test beds.

UNIT IV

Wavelength-Routing Networks

Node designs; Issues in Network design and operation, Optical layer cost Trade offs, Routing and Wavelength assignment, Wavelength routing test beds.

UNIT V

High Capacity Networks

SDM, TDM, and WDM approaches, Application areas, Optical TDM Networks: Multiplexing and de multiplexing, Synchronization, Broadcast networks, Switch-based networks, OTDM test beds.

Textbooks / References:

1. Rajiv Ramaswami and Kumar Sivarajan, Optical Networks: A practical perspective, Morgan Kaufmann, 2nd edition, 2001.
2. Vivek Alwayn, Optical Network Design and Implementation, Pearson Education, 2004.
3. Hussein T.Mouftab and Pin-Han Ho, Optical Networks: Architecture and Survivability, Kluwer Academic Publishers, 2002.
4. Biswanath Mukherjee, Optical Communication Networks, McGraw Hill, 1997.

Second Year (Semester –III)
Student Psychology

24AF2372OE302A	Student Psychology	OE	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Gain an understanding of prominent learning theories and models, enabling you to grasp the foundational concepts that influence effective teaching and learning.
2. Acquire skills to assess and appreciate diverse student characteristics, including learning styles, cultural backgrounds, and individual differences that impact learning.
3. Gain proficiency in understanding, administering, and interpreting psychological tests and inventories to assess cognitive abilities, personality traits, and emotional development in learners.
4. Examine psychological theories of motivation and cultivate the skills needed to apply motivational strategies that enhance student engagement, commitment, and achievement.
5. Investigate the stages of physical, cognitive, emotional, and social development in individuals, equipping you to design instructional methods that support comprehensive growth.
6. Acquire an understanding of NLP concepts and techniques that can be used to improve communication, establish rapport, and optimize teaching and learning experiences.

Course Outcomes:

After the completion of course, the student will able to

1. Gain a comprehensive understanding of the psychological factors that influence students' learning, behaviour, and overall well- being in educational settings.
2. Develop the ability to recognize and appreciate the diverse cognitive, emotional, and social needs of students, enabling tailored support and fostering inclusive learning environments.
3. Apply psychological theories and principles to address various challenges in student development, including motivation, learning difficulties, and behavioural issues.
4. Acquire skills in utilizing psychological assessment tools to evaluate students' cognitive abilities, emotional states, and learning styles, informing instructional strategies and support plans.
5. Learn to create positive and conducive learning experiences by integrating insights from student psychology, fostering engagement, motivation, and holistic growth among learners.

UNIT I

Teaching Learning Process

UNIT II

Student Characteristics, Types and Problems

UNIT III

Psychological Tests and Inventories, Student Motivation

UNIT IV
Physical and Cognitive Development

UNIT V
Emotional and Social Development

Textbooks / References:

1. Sharma, R.A. (2007). Training Technology. Meerut: Surya Publications.
2. Sharma, R.A. (2007). Psychology of Teaching-Learning Process. Meerut: Surya Publications.
3. B.Mukhopadhyay(1997). Motivation in Educational Management. New Delhi: Sterling Publishers.
4. Barki & Mukhopadhyay. (1995). Guidance and Counselling. New Delhi: Sterling Publishers.
5. Agochya, D. (2010). Life competencies for adolescents. New Delhi: Sage Publications.
6. Davies, I.K. (1971). Management of Learning. Berkshire: McGraw Hill.
7. Dusay. (1980). Egograms. New York: harper & Row.
8. Goleman, D. (1996). Emotional Intelligence. New York: Bantom Books.
9. Anastasi. (2016). Psychological Testing. New Delhi: Pearson Education. Psychological Tests.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Student Psychology	Dr. S. Renukadevi	NITTTR, Chennai	https://onlinecourses.swayam2.ac.in/ntr19_ed23/preview

Second Year (Semester –III)
Business To Business Marketing (B2B)

24AF2372OE302B	**Business To Business Marketing (B2B)**	**OE**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Develop a comprehensive understanding of the unique characteristics, dynamics, and complexities that define business-to-business (B2B) marketing, including the role of intermediaries, supply chains, and collaborative relationships.
2. Learn how to segment B2B markets based on factors such as industry, company size, and purchasing behaviour. Understand the significance of effective market segmentation in tailoring marketing strategies to specific B2B customer segments.
3. Explore the elements of the B2B marketing mix, including product/service offerings, pricing strategies, distribution channels, and promotional approaches. Develop the ability to design marketing strategies that align with the unique needs and preferences of B2B customers.
4. Gain insights into relationship-building strategies in B2B contexts. Learn how to nurture long-term, mutually beneficial partnerships with B2B clients through effective communication, trust-building, and value delivery.
5. Acquire skills in B2B sales processes, negotiations, and contract management. Understand the intricacies of negotiation dynamics, procurement processes, and key decision-making factors in B2B transactions.

Course Outcomes:

After the completion of course, the student will able to

1. Gain a strong grasp of the core concepts and theories that form the basis of B2B marketing, enabling practical application.
2. Develop skills to analyse B2B markets, segment customers effectively, and make informed marketing decisions.
3. Acquire the ability to design and execute B2B marketing strategies tailored to the unique needs of business customers.
4. Learn how to build and nurture enduring relationships with B2B clients through effective communication and collaboration.
5. Master the art of B2B sales, negotiation strategies, and contract management for successful transactions.

UNIT I

Introduction to B2B Marketing: Business marketing, Classifying goods for the business market, Business market customers, Market structure, Environment and Characteristics of Business Marketing, Strategic role of marketing, Commercial enterprises, Commercial and institutional customers, B2B vs B2C Marketing.

Organizational Buying and Buyer Behaviour: Organizational buyers,, decision process - A Stepwise Model and A Process Flow Model, Organizational and business markets - Government as a customer - Commercial enterprises - Commercial and institutional customers, Value analysis, Buygrid framework, Strategic procurement.

UNIT II

B2B Marketing Strategy: Strategy making and strategy management process, Industrial product strategy– Managing Products for Business Markets-Managing Services for Business Markets-Managing Business Market Channels the Growth-Share Matrix, Multifactor Portfolio Matrix, The Balanced Scorecard.

B2B Marketing STP: Market Segmentation, bases for segmenting business markets, basic framework of segmentation, choosing target segments and positioning.

UNIT III

Business Marketing Communications- B2B Advertising, Digital marketing, - Trade shows, exhibitions, business meets - Managing the sales force - Deployment analysis, Direct marketing

Demand forecasting: industrial market, Forecasting- meaning, importance and relevance, issues related to forecasting, forecasting measurement models, sales force forecasting, estimating segment demand, Collaborative approach to estimate demand, qualitative and quantitative forecasting methods.

UNIT IV

Product management: (existing and new) in industrial market, role of product in the industrial market, new product development, industrial product life cycle, product evaluation matrix, techniques for identifying new products QFD, perceptual mapping, reverse engineering, fish bone diagram, role of service and maintenance in industrial markets, customer experience life cycle, service quality.

Pricing: Pricing strategies; the pricing policy; Price on the Internet; Financial marketing, competitive bidding, commercial terms and conditions, role of leasing.

Buyer seller relationship, types of relationships, transactional and collaborative relationships, influencing industrial customers, role of service in industrial markets. CRM.

UNIT V

B2B marketing research, challenges in B2B research, developing a marketing information system, role of qualitative research techniques in B2B research.

Business marketing channels and participants - Channel design and management decisions - B2B logistics management, types of industrial middlemen and intermediaries, marketing logistics and physical distribution.

Strategic decision making in industrial markets, strategic planning at corporate levels, allocation of resources, portfolio analysis, developing SBU„S objectives and goals, implementing and controlling marketing plan. Marketing through electronic commerce.

Textbooks / References:

1. Business Market Management Understanding, Creating and Delivering Value by James C. Anderson, Das Narayandas, James A. Narus and D.V.R. Seshadri Pearson, 2010 3rd edition
2. Business Marketing Management b2b By Hutt and Speh South-Western CENGAGE Learning www.cengagebrain.com 2013
3. B2B Brand Management by Kotler and Pfoertsch Springer www.springer.com 2006
4. Business Marketing: Text and Cases by Krishna K Havaldar, McGraw Hill Publications, 2014 4th edition.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Business To Business Marketing (B2B)	Prof. J. K. Nayak	IIT Roorkee	Business To Business Marketing (B2B) – Course (nptel.ac.in)

Second Year (Semester –III)
Organizational Behavior

24AF2372OE302C	Organizational Behavior	OE	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Explore how personality, motivation, perception, attitudes, and emotions impact employee performance and job satisfaction.
2. Study group formation, communication, decision-making, conflict resolution, and leadership's role in fostering teamwork.
3. Learn about the role of organizational culture in shaping behaviour, and develop skills to manage and align culture with goals.
4. Gain insights into leadership styles, communication, and team management for enhancing performance and satisfaction.
5. Navigate change, promote inclusivity, and address diversity-related challenges to cultivate adaptability and resilience in the workplace.

Course Outcomes:

After the completion of course, the student will able to

1. Develop a grasp of how individual factors influence workplace behaviour, impacting job satisfaction and performance.
2. Acquire skills to foster productive group dynamics, facilitating better communication, decision-making, and conflict resolution.
3. Understand the role of organizational culture, and learn to manage and cultivate cultures aligned with organizational goals.
4. Gain insights into diverse leadership styles, enhancing the ability to manage teams and guide them towards success.
5. Develop the capacity to navigate change, promote diversity, and create an inclusive work environment, fostering resilience.

UNIT I

Introduction – a) defining organization, behavior and organizational behavior, b) assumptions of OB, c) principles of OB, d) levels of OB, e) scope of OB, f) OB and Human Resource Management, g) Applications of OB, h) Historical developments of OB, i) emerging concerns

Perception and Learning – a) understanding perception, b) Basic elements of perception, c) Principles of perceptual selection, d) Perceptual grouping, e) Social Perception, f) Self-perception and identity, g) attribution of causality, h) Perceptual biases in social perception, i) Implications for human resource management, j) defining learning, k) classical and operant conditioning l) learning in organizations.

UNIT II

Personality – a) Defining Personality, b) History of the concept, c) Key assumptions, d) biological and social determinants, e) Theories – Intrapsychic theory, social learning theory, self-theory, Trait, and type theories f) Related concepts (locus of control, dogmatism,

authoritarianism, Machiavellianism), g) measuring personality.
Attitudes – a) Definition, b) Key elements of attitudes, c) Attitudes and related concepts (Values, opinion, belief, and ideology), e) Characteristics of attitudes, f) Attitude formation, g) Attitude measurement, h) Changing attitudes, i) Attitudes at workplace (job satisfaction, work attitude and organizational commitment), j) Prejudice and discrimination at workspace.

UNIT III

Emotions in workplace - a) Definition, b) Types of emotions, c) Related concepts (mood, temperament), d) Stress in workplace, e) General Adaptation Syndrome, f) Managing Stress, g) Psychosomatic disorders and stress h) emotional labor and emotional contagion.
Motivation – a) Definition, b) Process of motivation, c) Types of motives, d) Motivators at workplace, e) Motivation theories (Process and Content theories).

UNIT IV

Interpersonal Dynamics – a) Definition, b) Psychological Contract, c) Trust and trust building, d) Prosocial behaviour, e) Cooperation Vs Competition f) Conflict management, g) Levels and types of conflict at workplace, h) Conflict management Styles, i) Managing Negotiations
Power and Leadership - a) Defining Power, b) Sources of Power, c) Organizational politics, d) Leadership e) Managers Vs Leaders, f) Trait and Type approach to leadership g) Leadership style, h) Leadership Grid, i) Contingency Theories j) Contemporary issues

UNIT V

Organization Change – a) Change in Organizations, b) Nature of the chance process, c) Types of chance, d) Impact of change, e) Managing resistance to change, f) Organizational Development interventions
Organizational Structure and Design – a) Basic dimensions of structure, b) Departmentalization, c) Organizational life cycle, d) Organizations as socio-technical systems, e) Organizational design and its impact on employees, f) Organizational boundary spanning.

Textbooks / References:

1. Behaviour in Organizations by Jerald Greenberg and Robert A. Baron, PHI learning private Ltd, New Delhi (Ninth Edition).
2. Understanding Organizational Behaviour by Udai Pareek, Oxford University Press (Third Edition).
3. ORGB by Nelson, Quick and Khandelwal, Cengage Learning New Delhi (second edition).

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Organizational Behaviour	Prof. M. P. Ganesh	IIT Hyderabad	Organizational Behaviour – Course (nptel.ac.in)

Second Year (Semester –III)
Principles of Economics

24AF2372OE302D	Principles of Economics	OE	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Introduce essential economic terms and concepts for analysing real-world situations.
2. Understand market dynamics, supply and demand, and resource allocation.
3. Study national indicators, inflation, unemployment, and government policies' effects.
4. Learn to make informed choices using opportunity cost, utility, and cost analysis.
5. Explore global interdependencies, trade, exchange rates, and policy impacts.

Course Outcomes:

After the completion of course, the student will able to

1. Grasp key economic principles, like supply and demand, opportunity cost, and marginal analysis, forming a foundation for economic understanding.
2. Gain insights into market structures, pricing mechanisms, and factors influencing consumer and producer behaviour.
3. Understand the role of government interventions, regulations, and fiscal/monetary policies in shaping economic outcomes.
4. Learn how societies allocate scarce resources efficiently, exploring topics like production, distribution, and factors of production.
5. Develop analytical thinking by applying economic principles to real-world scenarios, making informed personal and business decisions.

UNIT I

Principles of Economics, Thinking like an Economist; Interdependence and the gains from Trade.

UNIT II

Market forces of supply and Elasticity, Application of elasticity; supply, demand, and government policies

UNIT III

Consumer and producer surplus; cost of taxation and international trade, Externalities, and cost of production

UNIT IV

Competitive market and monopoly market, Game theory and oligopoly, measures national income, measuring cost of living

UNIT V

Production and growth; Saving, Investment and the financial system, the monetary system, Money growth and inflation

Textbooks / References:

1. N. Gregory Mankiw, Principles of Economics.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Principles Of Economics	Prof. Sabuj Kumar Mandal	IIT Madras	Principles Of Economics – Course (nptel.ac.in)

Second Year (Semester –III)
Introduction to Public Administration

24AF2372OE302F	**Introduction to Public Administration**	**OE**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Define public administration and explain its role in society.
2. Identify and analyze the different types of public organizations.
3. Apply public administration theories and principles to real-world problems.
4. Develop the skills and knowledge necessary to pursue a career in public administration.

Course Outcomes:

After the completion of course, the student will able to

1. Define public administration and explain its role in society.
2. Identify and analyze the different types of public organizations.
3. Apply public administration theories and principles to real-world problems.
4. Develop the skills and knowledge necessary to pursue a career in public administration.

UNIT – I

Public Administration: Meaning Nature, Scope and Significance of Public, Administration. Difference between Public and Private Administration, Administration as an Art or Science, New Public Administration, New Public Management, E-Governance: Concept, Rationale and significance.

UNIT – II

Theories of Organization – Classical, Neo classical and Modern theory, Approaches to the study of Public Administration: Structural – functional, systems, approach, Behavioral approach, Public Choice approach, Bureaucracy: Meaning types and Weberian model of Bureaucracy.

UNIT – III

Organization: formal and informal organizations, Principles of organization – Hierarchy, Span of control, unity of command and Coordination.

UNIT IV

Concepts of Public Administration: Power, Authority, and responsibility, Decision Making: Meaning, Classification and Essentials of decision making, Process of decision making, techniques of decision making, approaches to decision making.

UNIT – V

Good Governance: Concept, characteristics, elements. Issues and Challenges, Leadership: Development of leadership, Qualities of leadership, Accountability and control –Executive, Legislative, Judicial. Citizen and Administration: Issues and problems, Methods to promote

good relationship.

References/Textbooks:

1. Felix, A. Nigro and C. Nigro Modern Public Administration (New York: Lloyd Harper and Row, Latest edition)
2. John Pfiffiner and Frank Sherwood Administrative Organization (New Delhi: Prentice Hall, Latest ed.).
3. Peter F. Drucker Management: Tasks, Responsibilities, Practices (Bombay: Allied Publishers, latest ed.).
4. H. Koontz and Cyril O,,Donnell Principles of Management, (Tokyo: McGraw Hill, latest ed).
5. Amitai Etzioni Modern Organizations (New Delhi: Prentice Hall, latest ed.).
6. Robert T. Golembiewsky Public Administration as a Developing Discipline (New York: Marcel, latest ed.).
7. Mohit Bhattacharya Public Administration (Calcutta: World Press, latest ed).
8. Mamta Mokta, S.S.Chauhan, S.K. Mahajan and Simmi Agnihotri Challenges in Governance(ed) Anamica Publishers,New Delhi 2011
9. C.P. Bhambri Public Administration (Theory and Practice (Meerut: Educational Publishers, latest ed.).
10. Bertram Gross The Managing of Organisations (London: Free Press, latest ed.).
11. W.M. Newman, C. Summer and E.Warren Management Concepts, behaviour & practice, edu. Publishers Meerut.
12. P. Herseay and K.H. Blanchard Management of Organisational Behaviour (New Delhi:latest ed.).
13. Nicholas Henry Public Administration and Public Affairs, (New Jersey: Prentice Hall, latest ed.).
14. Herbert G. Hicks and Ray C. Gutlet Organisations: Theory and Behaviour (New York: McGraw Hill, latest ed.).
15. Ramesh, K. Arora (ed.) Perspective in Administrative Theory (New Delhi: Associated, latest ed.).
16. S.L. Kaushik and Pardeep Sahni (eds.) Public Administration in India: Emerging Trends (Allahabad: Kitab Mehal, latest ed.).
17. J.S. Vickers and George K. YarrowPrivatization: An Economic Analysis (Cambridge: MIT Press, latest ed.).
18. David Osborne and T. Gaebler Re-inventing Government: How the Entrepreneurial Spirit is Transforming the Public Sector (New York: Addison Wesley, latest ed.).

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Introduction to Public Administration	By Prof. Y. Pardhasaradhi	Osmania University Hyderabad.	https://onlinecourses.swayam2.ac.in/cec21_hs06/preview

Second Year (Semester –III)
Design of Mechatronic Systems

24AF2372MD303A	**Design of Mechatronic Systems**	**MDM**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Introduce students to the interdisciplinary nature of mechatronics, emphasizing the integration of mechanical engineering, electronics, control systems, and computer science.
2. Familiarize students with a variety of sensors and actuators commonly used in mechatronic systems, and explain their principles of operation and selection criteria.
3. Provide an understanding of control system theory, enabling students to design and implement closed-loop control strategies for mechatronic systems.
4. Demonstrate techniques for integrating mechanical components, electronics, and software modules seamlessly, ensuring proper communication and synchronization.
5. Introduce software development concepts, including programming languages, real-time operating systems, and software architecture for mechatronic applications.

Course Outcomes:

After the completion of course, the student will able to

1. Apply knowledge to select appropriate sensors and actuators based on system requirements, considering factors such as accuracy, range, and compatibility.
2. Analyze and process sensor data using signal processing techniques, demonstrating the capability to extract meaningful information from noisy sensor measurements.
3. Proficiently program microcontrollers and embedded systems to interface with sensors, actuators, and other hardware components.
4. Integrate mechanical components and subsystems with electronics and software, ensuring seamless communication and optimal functionality.

UNIT I

Introduction: Elements of mechatronics system: Sensor, actuator, plant, and controller. Applications of mechatronics system. Systems like CDROM, scanner opened to see whats there inside and why? Integrated mechanical-electronics design philosophy. Examples of real-life systems. Smart sensor concept and utility of compliant mechanisms in mechatronics

UNIT II

Microprocessor building blocks, combinational and sequential logic elements, memory, timing, and instruction execution fundamentals with example of primitive microprocessor. Microcontrollers for mechatronics: Philosophy of programming interfaces, setting sampling

time, and getting started with TIVA programming. programming different interfaces PWM, QEI etc. Mathematical modeling of mechatronic systems,

UNIT III
Modeling friction, DC motor, Lagrange formulation for system dynamics. Dynamics of 2R manipulator, Simulation using Matlab, Selection of sensors and actuators.

UNIT IV
Concept of feedback and closed loop control, mathematical representations of systems and control design in linear domain. Basics of Lyapunov theory for nonlinear control, notions of stability, Lyapunov theorems and their application

UNIT V
Trajectory tracking control development based on Lyapunov theory, Basics of sampling of a signal, and signal processing.

Textbooks / References:

1. Devdas Shetty, Richard A. Kolk, ―Mechatronics System Design,‖ PWS Publishing company.
2. Boukas K, Al-Sunni, Fouad M ―Mechatronic,Systems Analysis, Design and Implementation,‖ Springer,
3. Sabri Cetinkunt, ―Mechatronics with Experiments,‖ 2nd Edition, Wiley.
4. Janschek, Klaus, ―Mechatronic Systems Design,‖ Springer.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Design Of Mechatronic Systems	Prof. Prasanna Gandhi	IIT Bombay	Design Of Mechatronic Systems – Course (nptel.ac.in)

Second Year (Semester –III)
Ethical Hacking

24AF2372MD303B	Ethical Hacking	MDM	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. Introduce students to the concept of ethical hacking, its importance in cybersecurity, and the role of ethical hackers in identifying vulnerabilities.
2. Provide an overview of cybersecurity principles, threats, and attacks, highlighting the need for ethical hacking to strengthen defences.
3. Teach students a structured approach to hacking, including reconnaissance, scanning, gaining access, maintaining access, and covering tracks.
4. Cover essential network concepts to help students understand how networks function, including protocols, IP addressing, and network architecture.

Course Outcomes:

After the completion of course, the student will able to

1. Gain a comprehensive understanding of ethical hacking concepts, methodologies, and its role in enhancing cybersecurity.
2. Acquire a solid grasp of cybersecurity principles, types of threats, and the importance of proactive defence strategies.
3. Develop proficiency in various hacking techniques, including reconnaissance, scanning, exploitation, and post-exploitation activities.
4. Perform effective vulnerability assessments on systems and networks, identifying potential security weaknesses and exposures.
5. Demonstrate the ability to conduct penetration tests, simulating real-world attacks to evaluate the strength of security measures.

UNIT I

Introduction to ethical hacking. Fundamentals of computer networking. TCP/IP protocol stack. IP addressing and routing. TCP and UDP. IP subnets. Routing protocols. IP version 6.

UNIT II

Installation of attacker and victim system. Information gathering using advanced google search, archive.org, netcraft, whois, host, dig, dnsenum and NMAP tool**.**

UNIT III

Vulnerability scanning using NMAP and Nessus. Creating a secure hacking environment. System Hacking: password cracking, privilege escalation, application execution. Malware and Virus. ARP spoofing and MAC attack.

UNIT IV

Introduction to cryptography, private-key encryption, public-key encryption. Cryptographic hash functions, digital signature and certificate, applications. Steganography, biometric authentication, network-based attacks, DNS, and Email security.

UNIT V

Packet sniffing using Wireshark and Burpsuite, password attack using burp suite. Social engineering attacks and Denial of service attacks. Elements of hardware security: side-channel attacks, physical inclinable functions, hardware trojans.

Textbooks / References:

1. Data and Computer Communications -- W. Stallings.
2. Data Communication and Networking -- B. A. Forouzan
3. TCP/IP Protocol Suite -- B. A. Forouzan
4. UNIX Network Programming -- W. R. Stallings
5. Introduction to Computer Networks and Cybersecurity -- C-H. Wu and J. D. Irwin
   Cryptography and Network Security: Principles and Practice -- W. Stalling

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Ethical Hacking	Prof. Indranil Sengupta	IIT Kharagpur	Ethical Hacking – Course (nptel.ac.in)

Second Year (Semester –III)
Sustainable Power Generation Systems

24AF2372MD303C	**Sustainable Power Generation Systems**	**MDM**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. The course content is designed to provide comprehensive knowledge of various renewable energy systems. Specifically, in this course, the design and analysis of renewable energy power plants will be discussed.
2. The concepts will be illustrated with practical examples, schematics and block diagrams wherever required. Enough numerical problems with solutions will be discussed in the course.
3. This course is specifically designed for undergraduate and postgraduate students of Energy Engineering and Technology.
4. Further, the course will be very much useful for students and researchers from varied academic backgrounds for the synthesis of novel energy conversion devices and processes.

Course Outcomes:

After the completion of course, the student will able to

1. Explain the principles of sustainability in the context of power generation and understand its significance in the global energy transition.
2. Identify and describe various renewable energy sources, including solar, wind, hydro, geothermal, and biomass, and explain their potential for power generation.
3. Compare and contrast the advantages and limitations of different sustainable power generation technologies, considering factors such as efficiency, scalability, reliability, and intermittency.
4. Analyse the environmental, social, and economic impacts of both conventional and sustainable power generation methods, and evaluate their contributions to mitigating climate change and reducing pollution.

UNIT I

Introduction to power generation:

Global and Indian scenario, an overview of current technologies available for power generation, Concept of the renewable energy- based power plant

Solar Thermal Power Generation:

Fundamentals of Solar thermal energy conversion, solar thermal based power plant design and analysis (flat plate and concentrator), ORC, RC, and Stirling engine.

UNIT II

Solar Photovoltaic Power Generation:

Fundamentals of Solar photovoltaic energy conversion, Solar PV power plant design, Performance analysis of standalone and grid connected PV systems.

Wind Power Generation:

Introduction to wind turbine, classification and analysis of different components, Theory,

design, and analysis of wind turbines (horizontal axis and vertical axis) and wind farms.

UNIT III

Hydro Power Generation:

Introduction to hydro power plant, overview of micro, mini and small hydro power plants, hydraulic turbines, Selection and design criteria of pumps and turbines, Brief theory, design, and analysis of hydro power plants

Biomass Power Generation:

Fundamentals of bioenergy production technologies through different routes, design, and analysis of biochemical and thermochemical reactors for clean power generation and value-added products, IGCC.

UNIT IV

Hydrogen energy and fuel cells

Importance, various routes of hydrogen generation, basic principle, and design of different types of fuel cells and their applications, prospects, IGFC

Geothermal Energy

Fundamentals, classification, theory, design, and analysis of geothermal power plant

UNIT V

Ocean Thermal Energy

Fundamentals, classification, theory, design, and analysis of ocean thermal power plant Wave and Tidal Energy

Fundamentals, classification, theory, design, and analysis of wave and tidal power plant

Textbooks / References:

1. J. Twidell, T. Weir, Renewable Energy Resources, Taylor and Francis, 4th Edition, 2021.
2. G. Boyle (Editor), Renewable Energy: Power for a Sustainable Future, Oxford University press, 3rd Edition, 2012.
3. G. N. Tiwari, Solar Energy, Fundamentals, Design, Modeling and Applications, Narosa, 2002.
4. J. A. Duffie and W. A. Beckman, Solar Engineering of Thermal Processes, John Wiley, 4th Edition, 2013.
5. R. Gasch, J. Twele, Wind Power Plants: Fundamentals, Design, Construction and Operation, Springer, 2nd Edition, 2012.
6. P. Breeze, Hydropower, Elsevier, 1st Edition, 2018.
7. S. C. Bhattacharyya, Energy Economics Concepts, Issues, Markets and Governance, springer, 2nd Edition, 2019.
8. S.p Sukhatme and J.K. Nayak, Solar Energy: Principles of Thermal Collection and Storage, Tata Mc-Graw Hill Education Private Limited, 3rd Edition, 2010.

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Sustainable Power Generation Systems	Dr. Pankaj Kalita	IIT Guwahati	Sustainable Power Generation Systems – Course (nptel.ac.in)

Second Year (Semester –III)
Components and Applications of Internet of Things

24AF2372MD303D	**Components and Applications of Internet of Things**	**MDM**	**3L- 0T - 0P**	**3 Credits**

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course Objectives:

1. The objective of this course is to learn about Basics of IoT, Components of IoT including Sensors and actuators, computing, and communication systems.
2. It will also cover IoT Protocols, Security of IoT, Cloud based design and AI/Deep learning-based analytics.

Course Outcomes:

After the completion of course, the student will able to

1. Identify IoT Components: Recognize and classify key components of IoT systems, including sensors, actuators, communication protocols, and data processing units.
2. Explore IoT Communication: Understand various wireless and wired communication technologies used in IoT networks and their suitability for different application scenarios.
3. Design IoT Applications: Create IoT solutions by integrating hardware and software components, demonstrating proficiency in prototyping, programming, and data handling.
4. Analyse Data from IoT Devices: Collect, analyse, and interpret data generated by IoT devices to extract meaningful insights and support informed decision-making.

UNIT I

Basics of IoT

Introduction to Internet of things, various sensors, and sensing techniques. Technological trends in IoT. Impact of IoT on society. Review of various IoT application domain including agriculture, healthcare, manufacturing, device management, and vehicle to vehicle communication and wearable computing devices.

UNIT II

Microcontroller and Interfacing Techniques for IoT Devices

Introduction to IoT and architecture layers, IoT smart devices, Typical embedded computing systems, Introduction to ARM architecture and programming method, embedded system development: a case study, Introduction to interfacing techniques.

UNIT III

IoT Protocols & Security

Networking and basic networking hardware. Networking protocols, Interaction between software and hardware in an IoT device. IoT components and technologies to secure systems and devices. Various security issues related to the IoT and security architectures. Hardware security threats and security vulnerabilities; protecting physical hardware

UNIT IV

Location Tracking

Introduction to device localization and tracking; different types of localization techniques: time-of-arrival (TOA) based, time-difference-of-arrival (TDOA) based, angle-of-arrival (AOA) based, received signal strength (RSS) based, Radio-Frequency Identification (RFID) based and fingerprinting based; Monte-Carlo tracking; Kalman filter based tracking; Cramer- Rao lower bound (CRLB) for device location estimator; Device diversity/heterogeneity issue in IoT networks.

UNIT V

Internet of Robotic Things (IoRT)

Introduction to stationary and mobile robots; Brief introduction to localization, mapping, planning, and control of robotic systems; Introduction to cloud-enabled robotics; Applications of IoT in robotics; Architectures for IoRT; Examples and case studies; Open issues and challenges.

Textbooks / References:

NPTEL platform:

NPTEL Course	Name of Instructor	Host Institute	Link
Components And Applications of Internet of Things	Dr. Sanjoy Kumar Parida	Indian Institute of Technology Patna	https://onlinecourses.swayam2.ac.in/arp20_ap03/preview

Second Year (Semester –III)
Environmental Studies

24AF2969ES304	Environmental Studies	HSSM	3L- 0T - 0P	3 Credits

Teaching Scheme	Examination Scheme
Lecture: 3 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks

Course objectives:

1. To create environmental awareness among the students.
2. To gain knowledge on different types of pollution in the environment.

Course outcomes:

After the completion of course, the student will able to

1. Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
2. Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
3. Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
4. Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Unit I

Ecosystems (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Unit II

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, case studies, and Carbon Trading.

Unit III

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Unit IV

Global Environmental Concerns (Concept, policies and case-studies): Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Unit V:

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs. Field work: Visit to an Environmental

Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Text Books:

1. Environmental studies, Benny Joseph, Tata Mcgraw-Hill 2nd edition 2012
2. Environmental studies, S M Prakash, pristine publishing house, Mangalore 3rd edition-2018

Reference Books:

1. Benny Joseph, Environmental studies, Tata Mcgraw-Hill 2nd edition 2009
2. M.Ayi Reddy Textbook of environmental science and Technology, BS publications 2007
3. Dr. B.S Chauhan, Environmental studies, university of science press 1st edition

Second Year (Semester –III)
Project – I

24AF2969PR305	**Project – I**	**ELC**	**0L- 0T - 0P**	**10 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 0 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 50 Marks End Semester Exam: 50 Marks

Project-I is an integral part of the final project work. In this, the student shall complete the partial work of the project which will consist of problem statement, literature review, project overview, scheme of implementation that may include mathematical model/SRS/UML/ERD/block diagram/ PERT chart, and layout and design of the proposed system/work. As a part of the progress report of project-I work; the candidate shall deliver a presentation on progress of the work on the selected dissertation topic.

It is desired to publish the paper on the state of the art on the chosen topic in international conference / journal.

The student shall submit the duly certified progress report of project -I in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.

Second Year (Semester –IV)
Project – II

24AF2969PR401	**Project – II**	**ELC**	**0L- 0T - 0P**	**20 Credits**

Teaching Scheme	**Examination Scheme**
Lecture: 0 hrs./week Tutorial: 0 hr./week Practical: 0 hrs./week	Continuous Assessment: 50 Marks End Semester Exam: 50 Marks

In Project - II, the student shall complete the remaining part of the project which will consist of the simulation/ analysis/ synthesis/ implementation / fabrication of the proposed project work, work station, conducting experiments and taking results, analysis and validation of results and drawing conclusions.

It is mandatory to publish the paper on the state of the art on the chosen topic in international conference/ journal.

The student shall prepare the duly certified final report of project work in standard format for satisfactory completion of the work duly signed by the concerned guide and head of the department/institute.