SRI MANAKULA VINAYAGAR
ENGINEERING COLLEGE
(An Autonomous Institution)

Puducherry

DEPARTMENT OF
ELECTRONICS AND COMMUNICATION ENGINEERING

M.TECH.
ELECTRONICS AND COMMUNICATION ENGINEERING

(REGULATIONS - 2020)

CURRICULUM AND SYLLABI

VISION AND MISSION OF THE INSTITUTE

Vision

To be globally recognized for excellence in quality education, innovation and research for the transformation of lives to serve the society

Mission

M1 - Quality Education	To provide comprehensive academic system that amalgamates the cutting-edge technologies with best practices.
M2 -Research and Innovation	To foster value-based research and innovation in collaboration with industries and institutions globally for creating intellectuals with new avenues.
M3 - Employability and Entrepreneurship	To inculcate the employability and entrepreneurial skills through value and skill-based training
M4: - Ethical values	To instill deep sense of human values by blending societal righteousness with academic professionalism for growth of society

VISION AND MISSION OF THE DEPARTMENT

Vision

Facilitate academic excellence and research among Electronics and Communication Engineers to meet the global needs with high competence and ethical professionalism

Mission

M1 - Academic Excellence	To impart learning skills to meet the global challenges in the field of Electronics and Communication Engineering
M2 - Research and Innovation	To provide excellence in research and innovation through multidisciplinary specialization
M3 - Employability and Entrepreneurship	To enhance inter and intrapersonal skills among students to make them employable and entrepreneurs
M4 - Ethics	To inculcate the significance of human values and professional skills to serve the society

PROGRAMME OUTCOMES (POs)

PO1: Exploration of Research: An ability to independently carry out research/investigation and development work to solve practical problems.

PO2: Technical Skill: An ability to write and present a substantial technical report/document.

PO3: Expertise in Academics: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: Scholarship of Knowledge: Acquire in-depth knowledge of specific discipline or professional area, including wider and global perspective, with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge, and integration of the same for enhancement of knowledge.

PO5: Usage of Modern Tools: Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities with an understanding of the limitations.

PO6: Ethical Practices and Social Responsibility: Acquire professional and intellectual integrity, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Technical Knowledge	To develop intellectual combination of technology with modern electronics and communication systems through well-built technical acquaintance
PEO2: Leadership Skill	To endure changes and challenges in the areas of Electronics and Communication Engineering with good leadership skills
PEO3: Research and Development	To identify the requisite of the nation, industry and come out with innovative solutions to maintain a sustainable position
PEO4: Professional Behavior	To promote competitive graduates global wise in the area of Electronics and Communication Engineering

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1- Technical Knowledge in Electronics and Communication Engineering	Ability to understand the technological advancements in the field of electronics and communication by using modern design tools and sub system end processes.
PSO2- Competency in Electronics	Apply research ideas to offer solutions for extant problems in areas including signal processing, image processing, consumer electronics, VLSI, Embedded with given requirements
PSO3- Competency in Communication	Ability to develop and provide optimal solutions to subsystems like RF, baseband of modern communication systems and networks.

SEMESTER – I										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20BST101	Advanced Engineering Mathematics	BS	2	2	0	3	40	60	100
2	P20ECT101	Advanced Digital Communication	PC	3	0	0	3	40	60	100
3	P20ECT102	Embedded System Design	PC	3	0	0	3	40	60	100
4	P20ECT103	Machine Learning in Communication Networks	PC	3	0	0	3	40	60	100
5	P20CCT101	Research Methodology and IPR	PC	2	0	0	2	40	60	100
6	P20ECE1XX	Professional Elective I	PE	3	0	0	3	40	60	100
Practical										
7	P20ECP101	Wireless and Mobile Communication Lab	PC	0	0	4	2	50	50	100
8	P20CCP101	Technical Report Writing & Seminar	PC	0	0	4	2	100	0	100
Audit Course										
9	P20ACT10X	Audit Course - 1	AC	2	0	0	-	100	-	100
Employability Enhancement Course										
10	P20ECC1XX	Employability Enhancement Course-I	EEC	0	0	4	-	100	-	100
Total for semester I							**21**	**590**	**410**	**1000**

SEMESTER – II										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20VET204	Advanced Digital System Design	PC	3	0	0	3	40	60	100
2	P20ECT205	Digital Image and Video Processing	PC	3	0	0	3	40	60	100
3	P20ECT206	Modelling and Simulation Techniques	PC	3	0	0	3	40	60	100
4	P20ECT207	Millimeter Wave Communication Networks	PC	3	0	0	3	40	60	100
5	P20ECE2XX	Professional Elective-II	PE	3	0	0	3	40	60	100
6	P20ECE2XX	Professional Elective III	PE	3	0	0	3	40	60	100
Practical										
7	P20ECP202	Digital Image and Video Processing lab	PC	0	0	4	2	50	50	100
8	P20CCP202	Seminar on ICT-a hands on approach	PC	0	0	4	2	100	0	100
Audit Course										
9	P20ACT20X	Audit Course - 2	AC	2	0	0	-	100	-	100
Employability Enhancement Course										
10	P20ECC2XX	Employability Enhancement Course-II	EEC	0	0	4	-	100	-	100
Total for semester II							**22**	**590**	**410**	**1000**

SEMESTER – III										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Theory										
1	P20ECE3XX	Professional Elective -IV	PE	3	0	0	3	40	60	100
2	P20ECE3XX	Professional Elective- V	PE	3	0	0	3	40	60	100
3	P20ECE3XX	Professional Elective- VI	PE	3	0	0	3	40	60	100
Practical										
4	P20ECW301	Project Phase-I	PW	0	0	12	6	50	50	100
5	P20ECW302	Internship	PW	0	0	0	2	100	-	100
Employability Enhancement Course										
6	P20ECS301	NPTEL/GIAN/MOOC Course	EEC	0	0	0	-	100	-	100
Total for semester III							**17**	**370**	**230**	**600**

SEMESTER – IV										
Sl. No.	Course Code	Course Title	Category	Periods			Credits	Max. Marks		
				L	T	P		CAM	ESM	Total
Practical										
1	P20ECW403	Project Phase-II	PW	0	0	24	12	50	50	100
Total for semester IV							12	50	50	100

BS – Basic Science
PC – Professional Core
PE – Professional Elective
PW – Project Work
CC – Common Course
AC – Audit Course
EEC – Employability Enhancement Course

Credit Distribution

Semester- I	Semester - II	Semester - III	Semester - IV	Total
21	**22**	**17**	**12**	**72**

Total number of credits required to complete M.Tech in Electronics and Communication: 72 credits

Annexure-I
PROFESSIONAL ELECTIVE COURSES

Sl. No.	Course Code	Course Title
Professional Elective – I		
1	P20ECE101	Wireless Sensor Networks
2	P20ECE102	Image Processing and Recognition
3	P20ECE103	Advanced Data Structures and Algorithms
4	P20ECE104	MIMO Systems
5	P20ECE105	Optical Communication and Networking
Professional Elective – II		
1	P20ECE206	Advanced Satellite Communication
2	P20ECE207	Advanced Communication Network
3	P20ECE208	Statistical Information Processing
4	P20ECE209	Artificial Intelligence
5	P20ECE210	Mobile Communication System
Professional Elective – III		
1	P20ECE211	Advanced Radiation Systems
2	P20ECE212	Design of Analog and Mixed VLSI Circuits
3	P20ECE213	Machine Learning Techniques
4	P20ECE214	High Performance Communication Networks
5	P20ECE215	Industrial Electronics
Professional Elective – IV		
1	P20ECE316	Information and Network Security
2	P20ECE317	Markov Chains and Queuing Systems
3	P20ECE318	RF and Microwave Circuit Design
4	P20ECE319	Voice and Data Networks
5	P20ECE320	Modeling and Simulation of Wireless Communication Systems
Professional Elective – V		
1	P20ECE321	Advanced Technologies in Wireless Networks
2	P20ECE322	RF System Design
3	P20ECE323	Cognitive Radio Technology
4	P20ECE324	Advanced High-Speed Networks
5	P20ECE325	Embedded Real Time System
Professional Elective – VI		
1	P20ECE326	Free Space Optical Networks
2	P20ECE327	Wireless Sensor Network and IOT
3	P20ECE328	Multicarrier Wireless Communication
4	P20ECE329	Cloud Computing
5	P20ECE330	Remote Sensing

Annexure-II

EMPLOYABILITY ENHANCEMENT COURSES

Sl. No.	Course Code	Course Title
1	P20ECCX01	Video & Image processing Development System
2	P20ECCX02	Android Programming
3	P20ECCX03	Artificial Intelligence and Edge Computing
4	P20ECCX04	CCNA (Routing and Switching)
5	P20ECCX05	CCNA (Wireless)
6	P20ECCX06	Cloud Computing
7	P20ECCX07	Cyber Security
8	P20ECCX08	Data Science
9	P20ECCX09	Data Science and Data Analytics
10	P20ECCX10	Data Science Using R
11	P20ECCX11	Bio signal and Image processing development system
12	P20ECCX12	Google Analytics
13	P20ECCX13	Google Cloud
14	P20ECCX14	Industry 4.0
15	P20ECCX15	Internet of Things
16	P20ECCX16	IoT using Python
17	P20ECCX17	Java Programming
18	P20ECCX18	Android Medical app development
19	P20ECCX19	Machine Learning and Deep Learning
20	P20ECCX20	Web Programming (HTML, CSS, JAVA Script)
21	P20ECCX21	Advanced Java Programming
23	P20ECCX22	Advanced Python Programming
24	P20ECCX23	Android Medical app development
25	P20ECCX24	Artificial Intelligence and Edge Computing
26	P20ECCX25	Embedded System Using Arduino
27	P20ECCX26	Embedded System Using C
28	P20ECCX27	Embedded System with IoT
29	P20ECCX28	Introduction to C Programming
30	P20ECCX29	Introduction to C++ Programming

Sl. No.	Course Code	Course Title
31	P20ECCX30	Mobile Edge Computing
32	P20ECCX31	Python Programming
33	P20ECCX32	Web Programming -I
34	P20ECCX33	Web Programming-II
35	P20ECCX34	VLSI Design
36	P20ECCX35	Machine Learning
37	P20ECCX35	Block chain
38	P20ECCX35	Speech Processing
39	P20ECCX35	Digital Signal Processing Development System
40	P20ECCX35	Data Science using Python
41	P20ECCX35	Solar and Smart Energy System with IoT
42	P20ECCX35	Fuzzy Logic and Neural Networks
43	P20ECCX35	Digital Signal Processing Development System

Annexure-III

AUDIT COURSES

Sl. No.	Course Code	Course Title
1	P20ACTX01	English for Research Paper Writing
2	P20ACTX02	Disaster Management
3	P20ACTX03	Sanskrit for Technical Knowledge
4	P20ACTX04	Value Education
5	P20ACTX05	Constitution of India
6	P20ACTX06	Pedagogy Studies
7	P20ACTX07	Stress Management by Yoga
8	P20ACTX08	Personality Development Through Life Enlightenment Skills
9	P20ACTX09	Unnat Bharat Abhiyan

P20BST101	ADVANCED ENGINEERING MATHEMATICS	L	T	P	C	Hours
		2	2	0	3	60

Course Objectives

- To discuss the basics of random process techniques
- To familiarize about multiple Random Variables
- To know about stochastic process
- To learn about finite difference time domain method
- To simulate response of Finite difference method

Course Outcomes

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

CO1 -Illustrate about random process **(K2)**
CO2 - Distinguish multiple random variables **(K2)**
CO3 - Analyze stochastic process **(K4)**
CO4 - Application of FDTD **(K3)**
CO5 - Simulate the response of LTI system using MATLAB **(K4)**

UNIT I RANDOM VARIABLES (12 Hrs)

Random variables: Probability axioms - conditional probability - discrete and continuous random variables, Cumulative Distribution Function (CDF) - Probability Mass Function (PMF) - Probability Density Function (PDF) - Conditional PMF/PDF - Expected value - Variance; Functions of a random variable; Expected value of the derived random variable

UNIT II MULTIPLE RANDOM VARIABLES (12 Hrs)

Multiple random variables: Joint CDF/PMF/PDF - functions of multiple random variables - multiple functions of multiple random variables - independent/uncorrelated random variables - sums of random variables - moment generating function - random sums of random variables.

UNIT IIISTOCHASTIC PROCESSES (12 Hrs)

Classification of stochastic process - stationary process (SSS and WSS) - ergodic process - independent increment process - counting process - narrowband process - normal process - Wiener process - Shot noise process - autocorrelation function.

UNIT IVFINITE DIFFERENCE TIME DOMAIN METHOD (12 Hrs)

Wave Equation: Dispersion and Stability ; The FDTD method: Staggered Grids- one space dimension- three space dimensions-integral interpretation of the FDTD method- dispersion analysis in three Dimensions ; Boundary conditions for open regions: The perfectly matched Layer - near to far field transformation.

UNIT V INSTRUCTIONAL ACTIVITIES (12 Hrs)

Response of LTI system's - probability distribution and density function - Weiner and Shot noise process- Practical applications of wave scattering in FDTD using related platforms.

Text Books

1. Anders B, Thomas R, Ingelstro P, "Computational Electromagnetics", 2nd Edition, Springer, 2013.
2. Michel K.O, "Applied Probability and Stochastic Processes", John Wiley and Sons, 2008.
3. Paboulis A, Unnikrishna P S, "Probability, Random Variables and Stochastic Processes", 4th Edition, Tata McGraw Hill, 2002.

Reference Books

1. Steven K. "Intuitive Probability and Random Processes using MATLAB", Springer, 2006.
2. Sadiku M N O, "Numerical Techniques in Electromagnetics", 2nd Edition, CRC Press, 2000.
3. Sankaran K, "Accurate Domain Truncation Techniques for Time-Domain Conformal Methods", ETH Zurich, 2007.
4. "Introduction to ordinary differential equations" by E. Coddington. 2003
5. "Differential Equations" by Polking, Boggess and Arnold. Second Edition.

Web References

1. http://users.ece.utexas.edu/~gustavo/ee381j.html
2. http://www2.math.uu.se/research/telecom/software.html
3. http://www.ifp.illinois.edu/~hajek/Papers/randomprocesses.html
4. http://www.feynmanlectures.caltech.edu/II_toc.html
5. http://nptel.ac.in/courses/111105035/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	1	-	-	-	1	2	1
2	2	-	1	-	-	-	1	2	1
3	2	-	1	1	-	-	1	2	1
4	2	-	1	1	-	-	1	2	1
5	2	-	1	1	-	-	1	2	1

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECT101	ADVANCED DIGITAL COMMUNICATION	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To know the basics of digital modulation technique
- To understand the receivers and its impact of noise in it
- To discuss about different Equalizers
- To understand about signal estimation parameter in synchronization
- To apply various simulation tools in modulation, equalization and synchronization areas

Course Outcomes

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

CO1 - Develop the ability to understand the concepts of signal space analysis and apply it in digital modulation technique **(K3)**

CO2 - Establish knowledge on different digital receivers with different type of noise **(K3)**

CO3 - Conceptually appreciate different Equalization techniques **(K3)**

CO4 - Comprehend the synchronization methods **(K2)**

CO5 - Develop the ability to comprehend various digital communication techniques using simulation tools **(K4)**

UNIT I DIGITAL MODULATION TECHNIQUES (9 Hrs)

Elements of Digital Communication system - Factors influencing digital modulation techniques; Linear Modulation Techniques: BPSK - QPSK - DPSK; Constant envelope modulation techniques: MSK- GMSK; Linear and constant envelope modulation techniques: M- ary PSK and M- aryQAM.

UNIT II ADDITIVE WHITE GAUSSIAN NOISE CHANNEL (9 Hrs)

Optimum receiver for signals corrupted by AWGN - performance of the optimum receiver for memory less modulation; optimum receiver for CPM signals - optimum receiver for signals with random phase in AWGN channel.

UNIT III EQUALIZATION TECHNIQUES (9 Hrs)

Optimum receiver for channels with ISI and AWGN – Nyquist criterion for zero ISI - linear equalization and its variations - Decision Feedback Equalization - Predictive Decision Feedback Equalization -Turbo equalization.

UNIT IV SYNCHRONIZATION (9 Hrs)

Signal Parameter Estimation: Carrier phase estimation - symbol timing estimation - joint estimation of carrier phase and symbol timing - performance characteristics of ML estimators.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation: Different digital modulation - AWGN channel - equalization techniques and synchronization using any related platforms

Text Books

1. John GProakis ,"Digital-communications" 5th edition, 2008.
2. John G P, Masoud S, "Digital Communications," 5th Edition, McGraw Hill Book Company, 2014.
3. Don Torrieri, "Principles of Spread Spectrum Communication Systems", Springer, 2005

Reference Books

1. Bernard S, "Digital Communication fundamentals and applications," 2nd Edition, Pearson Education, 2009.
2. Theodire S R, "Wireless Communications", 2nd Edition Pearson Education, 2010.
3. A B Carlson, "Communication. Systems". Tata Mc Graw Hill, 2000.
4. B P Lathi, " Modern Digital & Analog Communication" ,Willey2000.
5. Simon S. Haykin,Michael Moher, David Koilpillai, "Modern Wireless Communication ", Pearson Publication 2011

Web References

1. http://nptel.iitm.ac.in/courses/117101051.html
2. http://nptel.ac.in
3. https://nptel.ac.in/courses/108/101/108101113/
4. https://nptel.ac.in/courses/117/101/117101051/
5. https://nptel.ac.in/courses/117/105/117105144/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	-	3	3	-	-	1	3	3
2	3	-	3	3	-	-	1	3	3
3	3	-	3	3	-	-	1	3	3
4	3	-	3	3	-	-	1	3	3
5	3	-	3	3	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECT102	EMBEDDED SYSTEM DESIGN	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To understand the basics of Embedded Systems
- To know about program design and analysis
- To acquire knowledge on real time scheduling
- To learn about real time operating systems
- To study both hardware and software architecture of digital camera

Course Outcomes

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

CO1 - Analyze various architectures **(K4)**
CO2 - Discuss about the performance evaluation of OS. **(K1)**
CO3 - Discuss about scheduling **(K1)**
CO4 - Evaluate RTOS **(K4)**
CO5 - Analyze on digital camera architecture **(K4)**

UNIT IINTRODUCTION TO EMBEDDED SYSTEMS (9 Hrs)

Introduction to Embedded systems – Embedded hardware, Embedded software, Classification and Examples of embedded systems, System on Chip, Design process. Skills required for an embedded system designer. Overview of 8051 Architecture, Real world Interfacing, Introduction to advanced architectures – x86, ARM and SHARC architectures - Processor and Memory organization, Instruction level parallelism, Performance metrics, Processor and Memory selection.

UNIT II PROGRAM DESIGN AND ANALYSIS (9 Hrs)

Formalism for system design using UML (Unified Modelling Language), Model for Program flow graph (flow graphs). Basic Compilation techniques, Optimization of execution time, program size, energy and power. Processes and Operating system: Multiple tasks and processes, context switching, OS states, structure, timing requirements, Scheduling policies, and Inter- process communication Mechanisms. Performance Evaluation of OS.

UNIT III REAL TIME SCHEDULING (9 Hrs)

State-machines, State charts, traditional logics and real-time logic. Deterministic scheduling: assumptions and candidate Algorithms, RM (rate monotonic) and EDF (earliest deadline first),realizing the assumptions, priority inversion and inheritance, Execution time prediction: Approaches and issues, measurement of S/W by S/W, program analysis by timing scheme, prediction by optimization, system interferences and architectural complexities.

UNIT IVREAL TIME OPERATING SYSTEMS (9 Hrs)

OS services, Process management, timer and event functions, Memory management, Device, file and I/O management, Interrupt Routines in RTOS environment, basic design using RTOSes, Performance metrics, OS security issues, Comparative study of sample of RTOS such as eCOS, real time Linux, Windows CE.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Case studies: Digital Camera hardware and software architecture, Mobile phone software for key inputs.

Text Books

1. Wayne Wolf, “Computers as Components: Principles of Embedded Computing system Design,” 2nd Edition, Morgan Kaufmann Publishers, 2008.
2. Steve Furber, “ARM System-on-Chip Architecture”, 2nd Edition, Pearson Education, 2001
3. Raj Kamal, “Embedded Systems-Architecture, Programming and Design,” The McGraw Hill Companies, 2nd Edition, 2008.

Reference Books

1. Allan C. Shaw, “Real time systems & Software,” John Wiley & Sons, India Reprint, 2001.
2. Richard Zurawski, “Embedded Systems Handbook,” Industrial Information Technology series, Taylor and Francis group, the academic division of T&F Informa plc.
3. The Definitive Guide to the ARM Cortex-M3, Joseph Yiu, Second Edition, Elsevier Inc. 2010
4. Andrew N Sloss, Dominic Symes, Chris Wright, “ARM System Developer's Guide - Designing and Optimizing System Software”, 2006, Elsevier.
5. Arnold. S. Berger, “Embedded Systems Design - An introduction to Processes, Tools and Techniques”, Easwer Press.

Web References

1. https://nptel.ac.in/courses/108/102/108102045/
2. https://nptel.ac.in/courses/106/105/106105193/
3. https://nptel.ac.in/courses/106/105/106105159/
4. https://nptel.ac.in/courses/106/103/106103182/
5. http://www.nptelvideos.in/2012/11/embedded-systems.html

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	1	-	1	1	-	-	1	-	3
CO2	1	-	1	1	-	-	1	-	3
CO3	1	-	1	1	-	-	1	-	3
CO4	1	-	1	1	-	-	1	-	3
CO5	1	-	1	1	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECT103	MACHINE LEARNING IN COMMUNICATION NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To enable the student to understand the concept of machine learning and its application in wireless communication and bio-medical
- To expose the student to be familiar with a set of well-known supervised, semi-supervised and unsupervised learning algorithms
- To make students well exposed to neural network algorithms
- To Understand the concept of machine learning in communication
- To know the concept of machine learning in bio medical application

Course Outcomes

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

CO1-Demonstrate understanding of the mathematical principles underlying machine learning **(K3)**
CO2-Familiar with the different machine learning techniques and their use cases **(K1)**
CO3-In a position to formulate machine learning problems corresponding to different applications **(K3)**
CO4-Able to recognize the characteristics of machine learning techniques that are useful to solve real-world problems **(K1)**
CO5- In a position to read current research papers, understand the issues and the machine learning based solution approaches **(K4)**

UNIT I: MATHEMATICAL BACKROUND (9 Hrs)

Linear Algebra – Arithmetic of matrices, Norms, Eigen decomposition, Singular value decomposition, Pseudo inverse, Principal Component analysis. Probability theory – probability distribution, conditional probability, Chain rule, Bayes rule, Information theory, Structured Probabilistic models.

UNIT II: MACHINE LEARNING BASICS (9 Hrs)

Supervised and Unsupervised learning, Capacity, Overfitting and Underfitting, Cross Validation, Linear regression, Logistic Regression, Regularization, Naive Bayes, Support Vector Machines (SVM), Decision tree, Random forest, K-Means Clustering, k nearest neighbor.

UNIT III: NEURAL NETWORKS (9 Hrs)

Feedforward Networks, Backpropagation, Convolutional Neural Networks-LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation, Deep Dream, Deep Art, Fooling Convolutional Neural Networks. Recurrent Neural Network (RNN) – Backpropagation through time (BPTT), Vanishing and Exploding Gradients.

UNIT IV:ML IN WIRELESS AND SECURITY (9 Hrs)

Water-filling power allocation, Optimization for MIMO Systems, OFDM Systems and MIMO-OFDM systems. Optimization in beamformer design – Robust receive beamforming, Transmit downlink beamforming. Application: Radar for target detection, Array Processing, MUSIC, ML inside channel analysis.

UNIT V: INSTRUCTIONAL ACTIVITIES (9 Hrs)

Case studies on Machine Learning in Medical Imaging. Deep Learning for Health Informatics. Deep Learning Automated ECG Noise Detection and Classification System for Unsupervised Healthcare Monitoring. Techniques for Electronic Health Record (EHR) Analysis.

Text Books

1. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, “Deep learning”, Cambridge, MA”, MIT Press, 2017.
2. Tom M. Mitchell, “Machine Learning”, McGraw Hill, 1997.
3. Ethem Alpaydın, “Introduction to machine learning”, MIT Press, 3rd Edition, 2014.

Reference Books

1. Kevin P. Murphy, "Machine Learning - A Probabilistic Perspective", The MIT Press, Cambridge, 2012.
2. Josh Patterson and Adam Gibson, "Deep Learning - A Practitioner's Approach", O'Reilly Media, Inc, 2017.
3. Francesco Camastra, Alessandro Vinciarelli," Machine Learning for Audio, Image and Video Analysis", Springer,2015
4. Patanjali Kashyap "Machine Learning for Decision Makers" Apress, 2017

Web References

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://nptel.ac.in/noc/courses/noc18/SEM2/noc18-ee31/
3. https://nptel.ac.in/courses/117/108/117108048/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	-	3	3	-	-	1	-	3
2	3	-	3	3	-	-	1	-	3
3	3	-	3	3	-	-	1	-	3
4	3	-	3	3	-	-	1	-	3
5	3	-	3	3	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20CCT101 RESEARCH METHODOLOGY AND IPR

L	T	P	C	Hours
2	0	0	2	30

Course Objectives

- To impart knowledge and skills required for research and IPR
- Problem formulation, analysis and solutions
- Technical paper writing / presentation without violating professional ethics
- Patent drafting and filing patents
- Case studies of IPR

Course Outcomes

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

CO1 - Formulate research problem **(K2)**

CO2 - Carry out research analysis. **(K2)**

CO3 - Follow research ethics **(K2)**

CO4 - Describe today's world is controlled by Computer, Information Technology, but tomorrow world will beruled by ideas, concept, and creativity. **(K2)**

CO5 - Interpret IPR and filing patents in R & D. **(K3)**

UNIT I RESEARCH PROBLEM FORMULATION (6 Hrs)

Meaning of research problem- Sources of research problem, criteria characteristics of a good research problem, errors in selecting a research problem, scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, necessary instrumentations

UNIT II LITERATURE REVIEW (6 Hrs)

Effective literature studies approaches, analysis, plagiarism, and research ethics.

UNIT III TECHNICALWRITING /PRESENTATION (6 Hrs)

Effective technical writing, how to write report, paper, developing a research proposal, format of research proposal, a presentation and assessment by a review committee.

UNIT IV INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (IPR) (6 Hrs)

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

UNIT V INTELLECTUAL PROPERTY RIGHTS (IPR) (6 Hrs)

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

Text Books

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students'" Kenwyn Publisher, 1996
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"2nd edition, Lansdowne publisher, 2001
3. C.R. Kothari, Gaurav Garg, New Age International, Research Methodology: Methods and Techniques 4th Edition, 2018.

Reference Books

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd, 2007.
2. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners" 2010.
3. C.R. Kothari, Gaurav Garg, New Age International, Research Methodology: Methods and Techniques 4th Edition, 2018.
4. Trochim, Research Methods: the concise knowledge base, Atomic Dog Publishing 2005.
5. Fink A, Conducting Research Literature Reviews: From the Internet to Paper, Sage Publications,2009.

Web References

1. https://www.scribd.com/document/427419672/Research-Methodology-and-Ipr
2. https://www.isical.ac.in/~palash/research-methodology/RM-lec9.pdf
3. https://www.wipo.int/edocs/pubdocs/en/intproperty/958/wipo_pub_958_3.pdf
4. https://lecturenotes.in/m/21513-research-methodology-
5. https://iare.ac.in/sites/default/files/MTECH-CAD.CAM-R18-RM-IP-NOTES.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	2	1	1	2	1	1	-	-
2	3	2	1	1	2	1	1	-	-
3	3	2	1	1	2	1	1	-	-
4	3	2	1	1	2	1	1	-	-
5	3	2	1	1	2	1	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECP101	WIRELESS AND MOBILE COMMUNICATION LAB	L	T	P	C	Hours
		0	0	4	2	30

Course Objectives

- To expose and prepare the students to be able to understand the concept of base band communication
- To get exposed to band pass communication systems
- To know how to synthesize digital communication modules such as GMSK, DPCM, ADPCM and BER with the given specifications
- Apply the concepts of measurement in passive component using analysers
- Design of antennas and their radiation patterns

Course Outcomes

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

CO1 - Design the base band requirement of communication systems. **(K4)**
CO2 - Understand the concept of different modulation techniques using MATLAB/ Lab view **(K4)**
CO3 - Analyze and visualize practical implementation of mobile application-based modulation techniques. **(K4)**
CO4 - Understand the types of analyzers used at high frequency analysis **(K4)**
CO5 - To analyze the radiation pattern of antennas. **(K4)**

LIST OF EXPERIMENTS (Given the list is minimal, however, the course teacher can decide the levelof experiments)

Simulation based experiments: (Matlab/Labview simulation)

1. Sampling & reconstruction of low pass signals
2. BPSK Modulation & detection
3. BER of BPSK in AWGN channel
4. QPSK generation & detection
5. BER of QPSK in AWGN channel
6. QAM generation & detection
7. 16 QAM constellation diagram
8. Measurement of passive components using Vector Network Analyzer, Spectrum Analyzer and Signal Generator.

Communication Based Experiments

9. Design and analysis of GMSK modulator and demodulator
10. Data transmission, Multiplexing and BER measurement through optical fiber
11. Characterization of Directional Coupler and Power Divider using microstrip trainer kit
12. Measurement of radiation pattern of microstrip patch antenna
13. Study of DPCM and ADPCM using Advanced Digital Modulator trainer kit

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	3	3	3	-	1	3	3
2	3	1	3	3	3	-	1	3	3
3	3	1	3	3	3	-	1	3	3
4	3	1	3	3	3	-	1	3	3
5	3	1	3	3	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20CCP101	TECHNICAL SEMINAR AND REPORT WRITING	L	T	P	C	Hours
		0	0	4	2	45

Course Objectives

- Selection of topic based on interest
- Formulate the Objective
- To develop their scientific and technical reading and writing skills that they need to understand and construct research articles.
- To obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas.
- Preparation of report

Course Outcomes

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

CO1 - Select a subject, narrowing the subject into a topic**. (K2)**

CO2 - Explain objective and collect the relevant bibliography**. (K2)**

CO3- Describe the papers and understand the author's contributions and critically analyzing each paper. **(K3)**

CO4 -Prepare a working outline and linking the papers and preparing a draft of the paper. **(K2)**

CO5- Prepare conclusions based on the reading of all the papers, Writing the Final Paper, and giving final Presentation. **(K3)**

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic	select an area of interest, topic and state an objective	2nd week	**3 %** Based on clarity of thought, current relevance and clarity in writing
Stating an Objective			
Collecting Information about area & topic	• List 1 Special Interest Groups or professional society • List 2 journals • List 2 conferences, symposia or workshops • List 1 thesis title • List 3 web presences (mailing lists, forums, news sites) • List 3 authors who publish regularly in your area • Attach a call for papers (CFP) from your area.	3rd week	**3%** (The selected information must be area specific and of international and national standard)
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• Provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: - Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them. - Favour papers from well-known journals and conferences,in the field (as indicated in other Favour more recent papers, - Pick a recent survey of the field so you can quickly gain an overview,Find relationships with respect to each other and to your topic area(classification scheme/categorization)	4th week	6% (The list of standard papers and reason for selection)

	- Mark in the hard copy of papers whether complete work or section/sections of the paper are being considered		
Reading and notes for first 5 papers	Reading Paper Process For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the limitations of their research? • What did the author say were the important directions for future research? • Conclude with limitations/issues not addressed by the paper (from the perspective of survey)	6th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)
Reading and notes for next 5 papers	Repeat Reading Paper Process	7th week	8% (The table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (This component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11thweek	10% (this component will be evaluated based on the linking and classification among the papers)

Conclusions	Write your conclusions and future work	12th week	5% (conclusions)
Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th week	10% (based on presentation and Viva-voce)

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	3	3	1	3	3	3	-	-
2	2	3	2	1	3	2	3	-	-
3	2	3	2	1	3	2	3	-	-
4	2	3	2	1	3	2	3	-	-
5	2	3	2	1	3	2	3	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECC1XX EMPLOYABILITY ENHANCEMENT COURSES	L	T	P	C	Hrs
	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

P20VET204	ADVANCED DIGITAL SYSTEM DESIGN	L	T	P	C	Hours
		3	-	-	3	45

Course Objectives

- To learn about sequential machines and ASM charts
- To design asynchronous and to learn about hazards and race occurrences in it
- To learn and design Finite State Machines
- To identify faults in circuits using various design methods
- To simulate the designed digital circuits

Course Outcomes

After completion of the course, students will be able to

CO1 - Realize the Algorithmic State Machine. **(K3)**
CO2 - Design and analyze the asynchronous sequential digital circuits. **(K3)**
CO3 - Design and analyze the synchronous sequential circuits using PLDs. **(K3)**
CO4 - Identify the fault in the digital circuits. **(K3)**
CO5 - Simulate and synthesis the sequential circuits. **(K4)**

UNIT I SEQUENTIAL CIRCUIT DESIGN (9 Hrs)

Analysis of clocked synchronous sequential circuits and modeling- state diagram - state table - state table assignment and reduction - design of iterative circuits - ASM chart and realization using ASM

UNIT II ASYNCHRONOUS SEQUENTIAL CIRCUIT DESIGN (9 Hrs)

Analysis of asynchronous sequential circuit: Design of asynchronous sequential circuit - static and dynamic methods - flow table reduction - races - state assignment transition table and problems in transition table - essential hazards - data synchronizers - mixed operating mode asynchronous circuits

UNIT III SYNCHRONOUS DESIGN USING PROGRAMMABLE DEVICES (9 Hrs)

Programming logic device families: Designing a synchronous sequential circuit using PLA/PAL - realization of finite state machine using PLD/FPGA.

UNIT IV FAULT DIAGNOSIS AND TESTABILITY ALGORITHMS (9 Hrs)

Fault diagnosis method: Path sensitization method - Boolean difference method - D – algorithm - tolerance techniques - compact algorithm - fault in PLA/PAL- test generation - DFT schemes - built in self-test

UNIT V INSTRUCTIONAL ACTIVITY (9 Hrs)

Simulation of synchronous/ asynchronous sequential circuits: Logic compilation - two level and multi-level logic synthesis - sequential logic synthesis -technology mapping - tools for mapping to PLDs and FPGAs

Text Books

1. Charles H R Jr, Larry L K, “Fundamentals of Logic Design “, 7th Edition, Global Engineering, 2014.
2. Parag K L, ‘Fault Tolerant and Fault Testable Hardware Design” 1st Edition, B S Publications, 2002.
3. ParagK.L, “Digital system Design using PLD “, B S Publications,2003

Reference Books

1. Nripendra N B, Logic Design Theory Prentice Hall of India, 1993.
2. Charles H RJr, Digital System Design using VHDL ǁ, 2nd Edition, CL Engineering, 2007
3. Michael D C, “Modeling, Synthesis, and Rapid Prototyping with the VERILOG HDL”, Prentice Hall, 2006.
4. O. Hamblen, T. S. Hall, and M. D. Furman, "Rapid Prototyping of Digital Systems", SPOC Edition, Springer, 2008
5. Stephen Brown, and Zvonko Vranesic, "Fundamentals of Digital Logic with Verilog Design", Third Edition, McGraw-Hill, 2014.

Web References

1. http://nptel.ac.in/courses/117108040/downloads/Digital%20System%20Design.pdf
2. https://www.doulos.com/knowhow/verilog_designers_guide/
3. https://www.nandland.com/
4. https://lecturenotes.in/notes/15423-note-for-digital-system-design-dsd-by-vtu-rangers
5. https://www.sjsu.edu/people/thuy.le/docs/271syl.pdf

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
CO1	2	-	3	3	-	1	3	3	-
CO2	2	-	3	3	-	1	3	3	-
CO3	2	-	3	3	-	1	3	3	-
CO4	2	-	3	3	-	1	3	3	-
CO5	2	2	3	3	2	1	3	3	-

P20ECT205	DIGITAL IMAGE AND VIDEO PROCESSING	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Learn different techniques for image enhancement, video and image recovery
- Understand techniques for image and video segmentation
- Study techniques for image and video compression and object recognition
- Deals about different colour models in video processing
- Learn about the noise model for real time environment

Course Outcomes

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

CO1 - Learn different techniques for image enhancement, video and image recovery **(K1)**
CO2 - Understand techniques for image and video segmentation **(K2)**
CO3 - Study techniques for image and video compression and object recognition **(K2)**
CO4 - Study about different colour models and processing techniques **(K2)**
CO5 - Analysis the noise in real time environment**(K4)**

UNIT I DIGITAL IMAGE AND VIDEO FUNDAMENTALS (9 Hrs)

Digital image and video fundamentals and formats, 2-D and 3-D sampling and aliasing, 2-D/3-D filtering, image decimation/interpolation, video sampling and interpolation, Basic image processing operations, Image Transforms Need for image transforms, DFT, DCT, Walsh, Hadamard transform, Haar transform, Wavelet transform

UNIT II IMAGE AND VIDEO ENHANCEMENT AND RESTORATION (9 Hrs)

Histogram, point processing, filtering, image restoration, algorithms for 2-D motion estimation, change detection, motion-compensated filtering, frame rate conversion, deinterlacing, video resolution enhancement, Image and Video restoration (recovery).

UNIT III IMAGE AND VIDEO SEGMENTATION 9 Hrs)

Discontinuity based segmentation- Line detection, edge detection, thresholding, Region based segmentation, Scene Change Detection, Spatiotemporal Change Detection, Motion Segmentation, Simultaneous Motion Estimation and Segmentation Semantic Video Object Segmentation, Morphological image processing.

UNIT IVWAVELET TRANSFORM (9 Hrs)

Colour fundamentals, Colour models, Conversion of colour models, Pseudo colour image processing, Full colour processing

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Audio and video analysis for the real time environment; noise cancellation in image using adaptive filters; Video recognition and speech-to-text conversion using related tools.

Text Books

1. Ed. Al Bovik," Handbook of Image and Video Processing", 2nd Edition, Academic Press, 2000.
2. J. W. Woods, "Multidimensional Signal, Image and Video Processing and Coding", 2nd Edition, Academic Press, 2011.
3. Rafael C. Gonzalez and Richard E. Woods," Digital Image Processing", 3rd Edition, Prentice Hall, 2008.

Reference Books

1. J.G.Proakis and D.G.Manolakis "Digital signal processing: Principles, Algorithm and Applications", 4tj Edition, Prentice Hall, 2007.
2. N. J. Fliege, "Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets", 3rdEdition, John Wiley and Sons Ltd, 2009.
3. Lokenath D and Firdous A S, "Wavelet Transforms and Their Applications", 2nd Edition, Birkhauser, Springer, 2014.
4. A. M. Tekalp, "Digital Video Processing", 2nd Edition, Prentice Hall, 2015.
5. S. Shridhar, "Digital Image Processing", 2nd Edition, Oxford University Press, 2016.

Web References

1. www.ece.umd.edu/class/enee630.F2012.html
2. http://ar.book.org/s/?q=DSP+PROAKIS&yearFrom=&yearTo=&language=&extension=&t=0
3. https://www.coursera.*org*/learn/digital
4. http://www.nptelvideos.in/2012/12/digital-image-processing.html
5. https://nptel.ac.in/courses/117/105/117105079/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	2	2	-	-	1	-	3
2	3	1	2	2	-	-	1	-	3
3	3	1	2	2	-	-	1	-	3
4	3	1	2	2	-	-	1	-	3
5	3	1	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECT206	MODELLING AND SIMULATION TECHNIQUES	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Identify and model discrete systems (deterministic and random)
- Identify and model discrete signals (deterministic and random)
- Understand modelling and simulation techniques to characterize systems/processes.
- To provide an exposure to error performance analysis of wireless communication models
- To design wireless communication models through simulation tools

Course Outcomes

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

CO1 - Identify and model discrete systems (deterministic and random) **(K4)**
CO2 - Identify and model discrete signals (deterministic and random) **(K4)**
CO3 - Understand modelling and simulation techniques to characterize systems/processes. **(K2)**
CO4 - Explain an error performance analysis of wireless communication models **(K2)**
CO5 - To analyze wireless communication system model simulation tools**(K4)**

UNIT I INTRODUCTION (9 Hrs)

Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.

UNIT II STATISTICAL MODEL (9 Hrs)

Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.

UNIT III RANDOM MODELS (9 Hrs)

Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, Monte Carlo Methods.

UNIT IV MODELING (9 Hrs)

Stochastic Processes and Markov Chains, Time Series Models. Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics.

Text Books

1. R. L. Woods and K. L. Lawrence, “Modeling and Simulation of Dynamic Systems”, Prentice-Hall, 1997.
2. Z. Navalih, “VHDL Analysis and Modelling of Digital Systems”, McGraw-Hill, 1993.
3. J. Banks, JS. Carson and B. Nelson, “Discrete-Event System Simulation”, 2nd Edition, Prentice-Hall of India, 1996.

Reference Books

1. David Tse and Pramod Viswanath, “Fundamentals of Wireless Communication”, Cambridge University Press, 2005.
2. Guillaume De La Roche, Andres Alayon Glazunov and Ben Allen, “LTE – Advanced and Next Generation Wireless Networks: Channel Modelling and Propagation”, John Wiley and Sons Ltd., 2013
3. Andrea Goldsmith, “Wireless Communications”, Cambridge University Press, 2005.
4. Michel DaoudYacoub, “Wireless Technology: Protocols, Standards, and Techniques”, CRC Press, 2002.
5. Jafarkhani H, “Space-Time Coding: Theory & Practice”, Cambridge University Press, 2005.

Web References

1. https://saravanyablog.files.wordpress.com/2017/04/andreas-f-molisch-wireless-comm.pdf
2. http://freevideolectures.com/Course/2329/Wireless-Communication
3. https://videoken.com/search-results
4. http://ee.sharif.edu/~wireless.comm.net/references/Tse,FundamentalsofWirelessCommunication.pdf
5. http://ee.sharif.edu/~pr.wireless.comm/references/Goldsmith.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	2	1	-	-	1	1	3
2	3	1	2	1	-	-	1	1	3
3	3	1	2	1	-	-	1	1	3
4	3	1	2	1	-	-	1	1	3
5	3	1	2	1	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECT207	MILLIMETER WAVE COMMUNICATION NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To make students aware about the Millimeter wave characteristics
- The student must be able to estimate the Millimeter wave design consideration
- To introduce the students some practical aspects of link budget in Millimeter wave
- Understand the theory and concepts of beam steering
- Comprehend the fundamentals of MIMO

Course Outcomes

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

CO1 - Develop an understanding on standards of Millimeter wave **(K3)**
CO2 - Have an ability to analyze various antennas used in millimeter **(K4)**
CO3 - Develop an ability to use different modulation techniques **(K4)**
CO4 - Have an ability to analyze various Beam steering and beam forming technology **(K4)**
CO5 - Simulate various MIMO configurations **(K4)**

UNIT I MULTI-GIGABIT 60-GHz MILLIMETER WAVE RADIOS (9 Hrs)

Millimeter wave characteristics-Channel performance at 60GHz, Gigabit wireless communication, Standards-WiGig, IEEE 802.11ad, IEEE 802.15.3c,WirelessHD,ECMA-387/ISO/IEC 13156,Coexistence with wireless backhaul, Millimeter wave applications- WLAN, WPAN, Outdoor point to point.

UNIT II MILLIMETER WAVE ANTENNAS (9 Hrs)

Path loss and antenna directivity, Antenna beam width, Maximum possible gain to Q, Polarization, Beam steering antenna, Millimetre wave design consideration

UNIT III MILLIMETER WAVE TRANSCEIVERS (9 Hrs)

Millimeter wave link budget, Transceiver architecture, Receiver without local oscillator, Millimeter wave calibration, Modulation techniques-OOK, PSK, FSK, QAM, OFDM.

UNIT IV ADVANCED BEAM STEERING AND BEAM FORMING (9 Hrs)

Need for beam steering and beam forming, Adaptive frame structure-Advanced beam steering technology, Advanced beam forming technology, Advanced antenna ID technology.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulations on Spatialdiversity of antenna arrays, Multiple antennas, Multiple transceivers, Noise coupling in MIMO system.

Text Books

1. Kao-Cheng Huang, Zhaocheng Wang, “Millimeter wave communication systems”,John Wiley & Sons, Hoboken, New Jersey, 2011.
2. Jonathan Wells, “Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications”,Artech House, 2010.
3. Asif Oseiran, Jose F.Monserrat and Patrick Marsch, “5G Mobile and Wireless Communications Technology”, Cambridge University Press, 2016.

Reference Books

1. Jonathan Wells, “Multi-Gigabit Microwave and Millimeter-Wave Wireless Communications”,Artech House, 2010.
2. Su-Khiong Yong, Pengfei Xia and Alberto Valdes-Garcia, “60GHz Technology for Gbps WLAN and WPAN: From Theory to Practice”, Wiley 2010
3. Jonathan Rodriquez, “Fundamentals of 5G Mobile Networks”, Wiley, 2015
4. Patrick Marsch, Omer Bulakci, Olav Queseth and Mauro Boldi, “5G System Design – Architectural and Functional Considerations and Long-Term Research”, Wiley, 2018
5. Randy. L, Haupt, “Antenna Arrays, A Computational Approach”, John Wiley & Sons, 2010.

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1. https://nptel.ac.in/courses/117/105/117105139/
2. https://onlinecourses.nptel.ac.in/noc20_ee71/preview
3. https://web.stanford.edu/class/ee359/lectures.html
4. https://www.digimat.in/nptel/courses/video/117105139/L01.html
5. https://www.youtube.com/watch?v=QE-GmtXIKGs

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	3	3	-	-	2	-	3
2	3	1	3	3	-	-	2	-	3
3	3	1	3	3	-	-	2	-	3
4	3	1	3	3	-	-	2	-	3
5	3	1	3	3	3	-	2	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECP202	DIGITAL IMAGE AND VIDEO PROCESSING LAB	L	T	P	C	Hours
		0	0	4	2	60

Course Objectives

- Perform image and video enhancement
- Perform image and video segmentation
- Detect an object in an image/video
- Analysis the image restoration
- Learn the boundary features

Course Outcomes

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

CO1 - Perform image and video enhancement **(K4)**
CO2 - Perform image and video segmentation **(K4)**
CO3 - Detect an object in an image/video **(K4)**
CO4 - Estimate the image restoration **(K3)**
CO5 - Perform the boundary features **(K3)**

LIST OF EXPERIMENTS (Given the list is minimal, however, the course teacher can decide the level of experiments)

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

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	3	1	3	3	3	-	1	2	2
2	3	1	3	3	3	-	1	2	2
3	3	1	3	3	3	-	1	2	2
4	3	1	3	3	3	-	1	2	2
5	3	1	3	3	3	-	1	2	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20CCP202	SEMINAR ON ICT: A HANDS-ON APPROACH	L	T	P	C	Hrs
		0	0	4	2	45

Course Objectives

- To develop their technical reading and presentation skills that they need to understand and present using ICT Tools.
- To obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and practice to present.

Course Outcomes

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

CO1 - Select a topic, narrowing the topic into presentation.
CO2 - State an objective and use the relevant ICT tools to make the presentation effective.
CO3 - Study the topic and understanding the contributions and prepare report.
CO4 - Prepare a working demo.
CO5 - Prepare conclusions based on the reading of the topic and giving final Presentation.

The methodology used is “learning by doing”, a hands-on approach, enabling the students to follow their own pace. The teacher, after explaining the project, became a tutor, answering questions and helping students on their learning experience.

ICT skills

- Understand ICT workflow in the respective domain choose.
- Manage multitasking.
- Deal with main issues using tech in class.
- Record, edit and deliver audio and video.
- Automate assessments and results.

Scope

- Perspective in order to design activities in class.
- Understand the process of creating audiovisuals.

Teaching tools

- Different ways to create audiovisual activities.
- Handle audiovisual editors.
- Collaborative working.
- Individualize learning experience.
- Get instant feedback from students.

Each one of the students will be assigned an ICT Topic and the student has to conduct a detailed study on the assigned topic and prepare a report, running to 30 or 40 pages for which a demo to be performed followed by a brief question and answer session. The demo will be evaluated by the internal assessment committee (comprising of the Head of the Department and two faculty members) for a total of 100 marks.

COs/POs/PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	-	3	1	1	3	3	3	-	-
2	-	3	1	1	3	2	3	-	-
3	-	3	1	1	3	2	3	-	-
4	-	3	1	1	3	2	3	-	-
5	-	3	1	1	3	2	3	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECC2XX EMPLOYABILITY ENHANCEMENT COURSES	L	T	P	C	Hrs
	0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined based on participation, attendance, performance and completion of the course. If a candidate fails, he/she must repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

P20ECW301	PROJECT PHASE I	L	T	P	C
		0	0	12	6

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

The student is required to undertake the project phase I during the third semester and the same shall be continued in the 4thsemester (Phase II). Phase I consist of preliminary thesis work, three reviews of the work and the submission of preliminary report. First review shall highlight the topic, objectives and origin of problem, second review shall highlight, Literature survey, methodology and expected results. Third review shall evaluate the progress of the work, preliminary report and scope of the work which shall be completed in the 4thsemester. Also, the evaluation of project phase - I shall be done externally.

P20ECW302	INTERNSHIP	L	T	P	C
		0	0	0	2

Students should undergo training or internship during summer / winter vacation at Industry/ Research organization / University (after due approval from the Programme Academic Coordinator and Department Consultative Committee (DCC). In such cases, the internship/training should be undergone continuously (without break) in one organization. Normally no extension of time is allowed. However, DCC may provide relaxation based on the exceptional case. The students can undergo three to four weeks of internship in established industry / Esteemed institution during vacation period. The student should give presentation and send report to DCC. The Internship is assessed internally for 100 marks.

P20PEO3XX	NPTEL/GIAN/MOOC	L	T	P	C
		0	0	0	-

Student should register online courses like MOOC / SWAYAM / NPTEL etc. approved by the Department committee comprising of HoD, Programme Academic Coordinator and Subject Experts. Students have to complete relevant online courses successfully. The list of online courses is to be approved by Academic Council on the recommendation of HoD at the beginning of the semester if necessary, subject to ratification in the next Academic council meeting. The Committee will check the progress of the student and recommend the grade (100% Continuous Assessment pattern) based on the marks secured in online examinations. The marks attained for this course is not considered for CGPA calculation.

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		L	T	P	C
P20ECW403	**` PROJECT PHASE II**	**0**	**0**	**24**	**12**

Aim & Objective:

The project work aims to develop the work practice and to apply theoretical and practical tools/techniques for solving real life problems related to industry and current research. The objective of the project work is to improve the professional competency and research attitude by touching the areas which are not covered in theory or laboratory classes.

- The project work shall be a design project/experimental project and/or computer simulation project on any of the topic in manufacturing engineering or related field.
- The project work shall be allotted individually on different topics.
- The students shall be encouraged to do their project work in the parent institute itself. In exceptional cases the students shall be permitted to undertake continue their project outside the parent institute with appropriate permission from Head of the institution through the Project Coordinator.
- Department shall constitute an Evaluation Committee to review the project work.
- The Evaluation committee shall consist of at least three faculty members namely internal guide, project coordinator and another expert in the specified area of the project.

Project phase II is a continuation of project phase I which started in the third semester. There shall be three reviews in the fourth semester, first in the beginning of the semester, second in the middle of the semester and the Third at the end of the semester. First review is to evaluate the progress of the work and planned activity; second review shall be presentation and discussion. Third review shall be a pre-submission presentation before the evaluation committee to assess the quality and quantity of the work done. This would be a prequalifying exercise for the students for getting approval for the submission of the thesis. At least one technical paper shall be prepared for possible publication in journals or conferences. The technical paper shall be submitted along with the thesis. The final evaluation of the project shall be done externally.

P20ECE101	WIRELESS SENSOR NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To learn about wireless sensor network system for different applications under consideration
- Know about the hardware details of different types of sensors and select right type of sensorfor various applications
- Learn radio standards and communication protocols to be used for wireless sensor network-based systems and application
- Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms
- Handle special issues related to sensors like energy conservation and security challenges

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Design wireless sensor network system for different applications under consideration **(K4)**

CO2 - Understand the hardware details of different types of sensors and select right type of sensor for various applications **(K2)**

CO3 - Understand radio standards and communication protocols to be used for wireless sensor network-based systems and application **(K2)**

CO4 - Use operating systems and programming languages for wireless sensor nodes, performance of wireless sensor networks systems and platforms **(K4)**

CO5 - Handle special issues related to sensors like energy conservation and security challenges**(K4)**

UNIT I INTRODUCTION (9 Hrs)

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

UNIT II ARCHITECTURE (9Hrs)

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

UNIT III NETWORK SIMULATIONS (9Hrs)

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

UNIT IVSENSOR NETWORK PROTOCOLS (9Hrs)

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

UNIT VINSTRUCTIONAL ACTIVITY (9Hrs)

Simulation: Energy preservation and efficiency; security challenges; fault tolerance, Issues related to Localization, connectivity and topology, Sensor deployment mechanisms; coverage issues; sensor Web; sensor Grid, Open issues for future research, and Enabling technologies in wireless sensor network.

Text Books

1. H. Karl and A. Willig, “Protocols and Architectures for Wireless Sensor Networks”, JohnWiley & Sons, India, 2012.
2. C. S. Raghavendra, K. M. Sivalingam, and T. Znati, Editors, “Wireless Sensor Networks”, Springer Verlag, 1st Indian reprint, 2010.
3. S. R. Vijayalakshmi , S. Muruganand, “Wireless Sensor Networks “, Mercury Learning & Information , 2018

Reference Books

1. F. Zhao and L. Guibas, “Wireless Sensor Networks: An Information Processing Approach”, Morgan Kaufmann, 1st Indian reprint, 2013.
2. YingshuLi, MyT. Thai, Weili Wu, “Wireless sensor Network and Applications”, Springer series on signals and communication technology, 2008.
3. Ian F. Akyildiz , By (author) Mehmet Can Vuran, “Wireless Sensor Networks“ ,John Wiley & Sons Inc, 201
4. Kazem Sohraby , Daniel Minoli , Taieb Znati , “Wireless Sensor Networks : Technology, Protocols, and Applications “,John Wiley & Sons Inc, 2007
5. Shuang-Hua Yang ,” Wireless Sensor Networks: Principles, Design and Applications “,Springer London Ltd, 2013.

Web References

1. https://nptel.ac.in/courses/106/105/106105160/
2. https://nptel.ac.in/content/syllabus_pdf/106105160
3. https://freevideolectures.com/course/3489/ocean-structures-and-materials/
4. https://www.ida.liu.se/~petel71/SN/lecture-notes/sn.pdf
5. http://www.tfb.edu.mk/amarkoski/WSN/Kniga-w02

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	3
2	1	-	1	1	-	-	1	-	3
3	1	-	1	1	-	-	1	-	3
4	1	-	1	1	-	-	1	-	3
5	1	-	1	1	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE102	IMAGE PROCESSING AND RECOGNITION	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To understand the fundamentals image processing
- To segment given images in terms of edge, threshold and region
- To apply morphological operations like dilation, erosion, opening and closing on given images
- To represent, recognize and classify objects from the given images
- Analyze different case studies like Face image feature extraction, video Motion imaging, watermarking

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Understand the fundamentals of image processing **(K2)**
CO2 - Understand image analysis algorithms **(K2)**
CO3 - Understand the basic theory and algorithms that are widely used in digital image processing **(K3)**
CO4 - Develop hands-on experience in using computers to process images **(K4)**
CO5 - Understand current applications in the field of Image Processing **(K2)**

UNIT I AM IMAGING FUNDAMENTALS(9Hrs)

Introduction to Imaging Technologies-Photographic- X-Ray-MRI-SAR-IR imaging–Image Representations- Image Transforms- DCT- Walsh-Hadamard - Hoteling- Wavelet–Curvelet.

UNIT II IMAGE QUALITY ENHANCEMENT (9Hrs)

Contrast- noise- Sharpness –Gray level Transformation – Histogram processing –Spatial Domain spatial filtering – smoothing, sharpening filters- Frequency Domain Smoothing, sharpening Image Restoration Techniques – Inverse-Wiener

UNIT III PROCESSING AND ANALYZING IMAGES (9Hrs)

Point Detection- Line Detection – Edge Detection – Scene Segmentation and labeling – Counting objects – Perimeter measurement- Hough Transform – Shape of Regions- Morphological operations –Texture

UNIT IV STATISTICAL DECISION MAKING (9Hrs)

Bayes Theorem – Multiple features- Decision Boundaries- Confusion matrices- Nonparametric Histogram- Single nearest neighbor technique-K-NN

UNIT V IMAGING APPLICATIONS (9Hrs)

System design**-** Optical character Recognition- Rule based Character Recognition- Face and Facial feature Extraction - Video motion Analysis- Image Fusion- Watermarking – spatial & frequency domain.

Text Books

1. Rafael.C.Gonzalez and Richard.E. Woods, “Digital Image Processing”, Pearson Education, 2003
2. William.K.Pratt, “Digital Image Processing”, Fourth edition, A John Wiley and Publications.2013
3. Earl Gose, Richard Johnson Baugh, “Pattern Recognition and Image analysis”, Prentice Hall India Pvt Ltd, 2004

Reference Books

1. Rafael.C.Gonzalez and Richard.E. Woods, “Digital Image Processing”, Pearson Education, 2003.
2. Earl Gose, Richard Johnson Baugh, “Pattern Recognition and Image analysis”, Prentice Hall India Pvt Ltd, 2004
3. Frank Y. Shih , “Image Processing and Pattern Recognition : Fundamentals and Techniques”, John Wiley & Sons Inc, 2010
4. Stepan Bilan ,” Image Processing and Pattern Recognition Based on Parallel Shift Technology”, Taylor & Francis Ltd, CRC Press,2018
5. Kenneth R Castleman ,” Digital Image Processing”, Pearson Education, 2007

Web References

1. https://nptel.ac.in/courses/1183641105/
2. https://nptel.ac.in/courses/117/105/117105079/
3. https://staff.fnwi.uva.nl/r.vandenboomgaard/IPCV20172018/LectureNotes/index.html
4. http://www.vssut.ac.in/lecture_notes/lecture1423722885.pdf
5. https://shodhganga.inflibnet.ac.in/bitstream/10603/152244/8/08_chapter%201.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	-	2
2	1	-	2	2	-	-	1	-	2
3	1	-	2	2	-	-	1	-	2
4	1	-	2	2	-	-	1	-	2
5	1	-	2	2	3	-	1	3	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE103	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To know the underlying structure behind intelligence mathematically
- To know the logical implications in computational intelligence
- To know the automated learning techniques
- To study the techniques of Knowledge Representation
- To explore Artificial Intelligence techniques in real–time scenarios

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Understand the search techniques **(K2)**
CO2 - Apply the search techniques to real–time problems**(K3)**
CO3 - Apply the reasoning techniques to real world problems**(K3)**
CO4 - Understand the representation of knowledge **(K2)**
CO5 - Understand the learning techniques**(K4)**

UNIT IINTELLIGENT AGENTS AND KNOWLEDGE REPRESENTATION (9 Hrs)

Agents and Environments – Good Behavior: The concepts of Rationality – The Nature of Environments – The Structure of Agents – Knowledge Representation – Object Oriented Approach – Semantic Nets – Frames – Semantic Web – Ontology

UNIT II SEARCH TECHNIQUES (9Hrs)

Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search – Heuristic Search: – Problem Reduction Search – Game Search – Constraint Satisfaction Problems.

UNIT IIIREASONING WITH LOWER ORDER LOGICS (9 Hrs)

Logical Agent – Proposition Logic – Syntax and Semantics – Theorem Proving – Model Checking – Inference in First Order Logic

UNIT IV ARTIFICIAL INTELLIGENCE PLANNING (9Hrs)

Classical Planning – Partial Order Planning – Graph Plan and SAT Plan – Hierarchical Planning – Planning and Acting in Nondeterministic Domains – Multiagent Planning.

UNIT V INSTRUCTIONAL ACTIVITY (9Hrs)

Flipped classroom on theoretical study of learning methods, Assignment on solving problem in statistical learning, Practical – Programming exercises using Python/ other programming languages.

Text Books

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Third Edition, Pearson Education, 2015.
2. Robert Lafore , “Data Structures and Algorithms in Java”, Pearson Education (US), Sams Publishing, 2002.
3. Bradley W. Miller , David L. Ranum,” Problem Solving with Algorithms and Data Structures Using Python”, Franklin, Beedle & Associates Inc, Second Edition, 2013.

Reference Books

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill, 2008.
2. Dheepak Khermani, “A First Course in Artificial Intelligence”, McGraw-Hill, 2013
3. Robert Sedgewick, Kevin Wayne, “Algorithms”, Fourth Edition, Pearson Education. 2011.
4. Michael T. Goodrich , Roberto Tamassia , Michael H. Goldwasser , “Data Structures and Algorithms in Python”, John Wiley & Sons Inc, 2013
5. Peter Brass , “Advanced Data Structures”, Cambridge University Press, 2014.

Web References

1. http://nptel.ac.in/courses/106105079/2
2. Sebastian Thrun, Peter Norvig, Udacity: Introduction to Artificial Intelligence,
3. https://in.udacity.com/course/intro–to–artificial–intelligence—cs271
4. https://nptel.ac.in/courses/106/102/106102064/
5. https://nptel.ac.in/courses/106/105/106105225/
6. http://www.nptelvideos.in/2012/11/data-structures-and-algorithms.html

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	-	-	-	-	1	-	-
2	1	-	-	-	-	-	1	-	-
3	1	-	-	-	-	-	1	-	-
4	1	-	-	-	-	-	1	-	-
5	1	-	-	-	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE104	MIMO SYSTEMS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To learn channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems
- To learn precoding and equalization techniques
- Learn about the Beamforming techniques
- To know about cooperative and coordinated multi-cell MIMO, introduction to MIMO in 4G (LTE, LTE Advanced, WiMAX)
- Perform Mathematical modelling and analysis of MIMO systems

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Understand channel modelling and propagation, MIMO Capacity, space-time coding, MIMO receivers, MIMO for multi-carrier systems (**K2)**
CO2 - Understand the precoding and equalization techniques **(K2)**
CO3 - Learn about the Beamforming techniques **(K2)**
CO4 - Understand cooperative and coordinated multi-cell MIMO, Introduction to MIMO in 4G **(K2)**
CO5 - Perform Mathematical modelling and analysis of MIMO systems **(K4)**

UNIT IINTRODUCTION TO MIMO (9Hrs)

Introduction to Multi-antenna Systems, Motivation, Types of multi-antenna systems, MIMO vs. multi-antenna systems. Diversity, exploiting multipath diversity, Transmit diversity, Space-time codes, The Alamouti scheme, Delay diversity, Cyclic delay diversity, Space-frequency codes, Receive diversity, Combining techniques, Spatial Multiplexing, Spectral efficiency and capacity

UNIT II EQUALIZATION AND PRECODING (9Hrs)

The generic MIMO problem, Singular Value Decomposition, Eigenvalues and eigenvectors, Equalizing MIMO systems, Disadvantages of equalising MIMO systems, Predistortion in MIMO systems, Disadvantages of pre-distortion in MIMO systems, Pre-coding and combining in MIMO systems, Advantages of pre-coding and combining, Disadvantages of precoding and combining, Channel state information.

UNIT III BEAMFORMING (9Hrs)

Codebooks for MIMO, Beamforming, Beamforming principles, Increased spectrum efficiency, Interference cancellation, Switched beamformer, Adaptive beamformer, Narrowband beamformer, Wideband beamformer. MIMO in LTE, Codewords to layers mapping, Pre-coding for spatial multiplexing, Pre-coding for transmit diversity, Beamforming in LTE, Cyclic delay diversity-based pre-coding, Pre-coding codebooks,

UNIT IVCASE STUDY (9Hrs)

Case study: Propagation Channels, Time & frequency channel dispersion, AWGN and multipath propagation channels, Delay spread values and time variations, Fast and slow fading environments.

UNIT V INSTRUCTIONAL ACTIVITY (9Hrs)

Simulation: Channel estimation with different techniques, Training based channel estimation, Blind channel estimation, Iterative channel estimation, MMSE channel estimation, Correlative channel sounding, Channel estimation in single carrier systems, Channel estimation for CDMA, Channel estimation for OFDM.

Text Books

1. Claude Oestges, Bruno Clerckx, "MIMO Wireless Communications: From Real-world Propagation to Space-time Code Design", Academic Press, 1st edition, 2010.
2. Mohinder Janakiraman, "Space - Time Codes and MIMO Systems", Artech House Publishers, 2004.
3. Aydin Sezgin , "Transceivers for MIMO Systems: Design, Analysis and Iterative Decoding: Space-Time Diversity and Multiplexing Schemes", VDM Verlag Dr. Müller e.K. , 2013.

Reference Books

1. E. Biglieri, R. Calderbank, A. Constantinides, A. Goldsmith, A. Paulraj, H. V. Poor, MIMO Wireless Communications, Cambridge Press, 2007.
2. T. M. Duman, A. Ghrayeb, Coding for MIMO Communication Systems, Wiley, 2007.
3. A. Paulraj, R. Nabar, D. Gore, Introduction to Space-Time Wireless Communications, Cambridge Press, 2003.
4. D. Tse, P. Viswanath, Fundamentals of Wireless Communications, Cambridge Press, 2005.
5. Antonis Kalis , Athanasios G. Kanatas ," Parasitic Antenna Arrays for Wireless MIMO Systems", Springer-Verlag New York Inc., 2014 edition, 2013.

Web References

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2. https://onlinecourses.nptel.ac.in/noc20_ee33/preview
3. http://www.iitg.ac.in/engfac/krs/public_html/lectures/ee634/
4. http://www.iitg.ac.in/engfac/krs/public_html/mimo.pdf
5. https://www.csie.ntu.edu.tw/~hsinmu/courses/_media/wn_11fall/mimo.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	2	-	3	3	-	-	1	1	2
2	2	-	3	3	-	-	1	1	2
3	2	-	3	3	-	-	1	1	2
4	2	-	3	3	-	-	1	1	2
5	2	-	3	3	3	-	1	1	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE105	OPTICAL COMMUNICATION AND NETWORKING	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To understand the concept of propagation in fibre
- To analyze the concept of optical transmitter and receiver
- To know about optical networks
- To understand the various concept of WDM networks
- To analyze the concept of digital receiver performance

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Understand the behaviour of optical communication network components including optical transmitter, fibers, receiver, amplifier, add drop multiplexer and optical cross connects **(K2)**

CO2 - Analyze the performance of analog and digital optical communication system **(K3)**

CO3 - Solve the problems of wavelength assignment and routing in WDM networks **(K3)**

CO4 - Perform protection in SONET/SDH network and optical layer protection **(K2)**

CO5 - Architect an optical communication network to meet a given set of specification **(K4)**

UNIT IOPTICAL COMMUNICATION AND NETWORKING OVERVIEW (9Hrs)

Motivation optical communication and network - application in Telecom Networks, CATV Networks, Under Sea Network Transmission Characteristics: light propagation in fiber, loss and bandwidth, dispersion, nonlinear effect functions

UNIT II OPTICAL TRANSMITTER AND RECEIVER (9Hrs)

Optical Transmitter: Light Emitting Diode – Laser, Optical Receiver: photo detector, Avalanche photodiode Optical Amplifier: EDFA, SOA Enabling Technologies: Modulation – Demodulation

UNIT III FIRST GENERATION OPTICAL NETWORK (9Hrs)

Introduction to First generation Optical Network: SONET/SDH –FDDI – protection Second generation optical network: layered architecture – protection High speed light wave Links-OADM configuration-Optical ETHERNET-Soliton

UNIT IV BROADCAST AND SELECT NETWORK (9Hrs)

WDM networks: Wavelength assignment and routing-WDM network design, Access Network: HFC- FTTC - Photonic Packet switching network: Interleaving - Synchronization, Header Processing - buffering

UNIT V INSTRUCTIONAL ACTIVITY (9Hrs)

Case study on -Digital receiver performance: Probability of error receiver sensitivity, The Quantum Unit. Eye Diagram: Eye Pattern, Point to point – mesh network, power penalties.

Text Books

1. Gerd Kaiser, “Optical fiber communications”, 4th ed. McGraw Hill Int., 2008.
2. David Greenfield, “The Essential Guide to Optical Networks” Prentice Hall PTR 2001.
3. Swagat Karve , Akshay Jadhav , Amol Kadam,” Optical Communication & Networking “,LAP Lambert Academic Publishing,2020.

Reference Books

1. John M.Senior, Optical fiber communication, Pearson Education, second edition.2007.
2. Rajiv Ramaswami, Optical Networks, Second Edition, Elsevier, 2004.
3. J.Gower, Optical Communication System, Prentice Hall of India, 2001.
4. Govind P. Agrawal, Fiber-optic communication systems, third edition, John Wiley and sons, 2004.
5. Zhongqi Pan, Qiang Wang , Yang Yue," Optical Communications and Networking : Prospects in Industrial Applications", MDPI AG,2020.

Web References

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2. www.zapmeta.co.in/fiber+optic+link
3. https://lecturenotes.in/subject/877/optical-communication-and-network-ocn
4. https://learnengineering.in/ec6702-optical-communication-and-networks/
5. http://www.brainkart.com/subject/Optical-Communication-and-Networks_224/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	-	3
2	1	-	2	2	-	-	1	-	3
3	1	-	2	2	-	-	1	-	3
4	1	-	2	2	-	-	1	-	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE206	ADVANCED SATELLITE COMMUNICATION	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To understand the basics of multiple Access techniques
- To know about telemetry and tracking subsystem
- To acquire knowledge on link calculation
- To acquire knowledge on VSAT systems
- To learn about satellite system design using simulation tool

Course Outcomes

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

CO1-Analyze various elements of satellite orbits **(K1)**
CO2-Remember about Space and Earth segment **(K2)**
CO3-Design Satellite link budget **(K3)**
CO4-Understand VSAT Network architectures **(K1)**
CO5 -Design and implement satellite system design using relevant simulation tool **(K4)**

UNIT I INTRODUCTION AND SATELLITE ACCESS (9 Hrs)

Orbits of Satellite: Low - medium - geo synchronous - angle period - returning period - orbital spacing - delay transponder - earth stations - antennas and earth coverage - altitude and eclipses; Multiple Access: Demand assigned FDMA - spade system - TDMA - satellite switched TDMA - CDMA.

UNIT II SPACE SEGMENT AND EARTH SEGMENT (9 Hrs)

Space Segment: Power supply - altitude control - station keeping - thermal control - TT and C subsystem - transponders; Earth Segment: Receive only home TV system - outdoor unit -indoor unit - master antenna TV system - community antenna TV system.

UNIT III SATELLITE LINK DESIGN (9 Hrs)

Link Design: System noise temperature and G/T ratio - C/N design of uplink and downlink - error control for digital satellite link.

UNIT IV VSAT SYSTEMS (9 Hrs)

VSAT Systems: Network architectures - access control protocols - earth station engineering - antennas - link margins - system design procedure.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation of link budget for two satellite systems - simulation of transponders and antenna system using related tools.

Text Books

1. Timothy Pratt and Charles W. Bostain, “Satellite Communications”, 2nd Edition, Wiley,2012.
2. D. Roddy, “Satellite Communication”, 4th Edition (Reprint), McGraw Hill, 2009.
3. Masoumeh Karimi , “Advances in Satellite Communications”, IntechOpen, 2011

Reference Books

1. Wilbur L. Pritchard, Hendri G. Suyderhoud and Robert A. Nelson, “Satellite Communication Systems Engineering”, Prentice Hall/ Pearson, 2007.
2. Tri T. Ha, “Digital Satellite Communication”, 2nd Edition, McGraw Hill, 1990.
3. Brian Ackroyd, “World Satellite Communication and Earth Station Design”, BSP Professional Books, 1990.
4. Gerard Maral , Michel Bousquet , Zhili Sun,” Satellite Communications Systems : Systems, Techniques and Technology”, John Wiley and Sons Ltd, Wiley-Blackwell ,2020
5. Bruce R. Elbert ,” Introduction to Satellite Communications”, Artech House Publishers , third edition, 2008.

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3. http://advancedengineering.umd.edu/node/2320
4. http://personal.stevens.edu/~yyao/syllabus-674.html
5. http://staff.um.edu.mt/carl.debono/lectures.html

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	3	3	-	-	1	3	3
2	1	-	3	3	-	-	1	3	3
3	1	-	3	3	-	-	1	3	3
4	1	-	3	3	-	-	1	3	3
5	1	-	3	3	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE207	ADVANCED COMMUNICATION NETWORK	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To learn the advanced concepts in Communication Networking.
- Able to design and develop protocols for Communication Networks.
- To acquire the knowledge of Quality of Service in networking.
- Optimize the Network Design.
- To learn about network system design using simulation tool

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Understand advanced concepts in Communication Networking**. (K2)**
CO2 - Design and develop protocols for Communication Networks. **(K4)**
CO3 - Understand the mechanisms in Quality of Service in networking. **(K2)**
CO4 - Optimize the Network Design(K4)
CO5 - Design and develop a Network system using simulation tool **(K4)**

UNIT I NETWORK SERVICE AND ARCHITECTURE (9 Hrs)

Overview of Internet- Overview of ATM. TCP/IP Congestion and Flow Control in Internet-Throughput analysis of TCP congestion control. High bandwidth delay networks. Fairness issues in TCP. Real Time Communications over Internet. Adaptive applications. Latency and throughput issues. Integrated Services Model. Resource reservation in Internet. Characterization of Traffic by Linearly Bounded Arrival Processes (LBAP).

UNIT II SCHEDULING (9 Hrs)

Packet Scheduling Algorithms - requirements and choices. Scheduling guaranteed service connections. GPS, WFQ and Rate proportional algorithms. High speed scheduler design. Theory of Latency Rate servers and delay bounds in packet switched networks for LBAP traffic.; Active Queue Management - RED, WRED and Virtual clock. Control theoretic analysis of active queue management.

UNIT III ROUTINGS (9 Hrs)

IP address lookup-challenges. Packet classification algorithms and Flow Identification- Grid of Tries, Cross producing and controlled prefix expansion algorithms. Admission control in Internet. Concept of Effective bandwidth. Measurement based admission control. Differentiated Services in Internet (DiffServ). DiffServ architecture and framework.

UNIT IV IP FUNCTIONS (9 Hrs)

IPV4, IPV6, IP tunneling, IP switching and MPLS. Overview of IP over ATM and its evolution to IP switching. MPLS architecture and framework. MPLS Protocols. Traffic Engineering issues in MPLS.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulations: analysis the network delays, throughput calculations, error rate analysis

Text Books

1. Jean Wairand and PravinVaraiya, “High Performance Communications Networks”, 2nd edition, 2000.
2. Jean Le Boudec and Patrick Thiran, “Network Calculus A Theory of Deterministic Queueing Systems for the Internet”, Springer Veriag, 2001.
3. Curt White,” Data Communications and Computer Networks: A Business User's Approach”, Cengage Learning, Inc, CENGAGE Learning Custom Publishing, 8th edition, 2015.

Reference Books

1. Zhang Wang, “Internet QoS”, Morgan Kaufman, 2001.
2. Anurag Kumar, D. Manjunath and Joy Kuri, “Communication Networking: An Analytical Approach” , Morgan Kaufman Publishers, 2004.
3. George Kesidis, “ATM Network Performance”, Kluwer Academic, Research Papers, 2005
4. Ricarda Koch , Ralph Luftner ,” Communication Networks in Automation : Bus Systems. Components. Configuration and Management. Protocols. Security “,Publicis MCD Verlag, Germany, 2019
5. R. Srikant , Lei Ying,” Communication Networks : An Optimization, Control, and Stochastic Networks Perspective “, CAMBRIDGE UNIVERSITY PRESS , 2014

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2. https://nptel.ac.in/courses/106/105/106105183/
3. https://nptel.ac.in/courses/117/101/117101050/
4. http://www.alphace.ac.in/downloads/notes/ece/10EC71_NOTES.pdf
5. https://www.vssut.ac.in/lecture_notes/lecture1428550521.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	2	2
2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	3	-	1	2	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE208	STATISTICAL INFORMATION PROCESSING	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Learn the characteristic and apply probabilistic techniques in systems,
- Study about the information systems, receivers, filtering and statistical operations.
- Learn the mathematical modelling and problem solving using such models.
- To know the various systems involving functionalities in decision making, statistical inference, estimation and detection.
- Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Characterize and apply probabilistic techniques in modern decision systems, such as information systems, receivers, filtering and statistical operations **(K3).**

CO2 - Demonstrate mathematical modelling and problem solving using such models**. (K2)**

CO3 - Comparatively evolve key results developed in this course for applications to signal processing, communications systems. **(K3)**

CO4 - Analysis the probabilistic and stochastic themes for modelling and analysis of various systems involving functionalities in decision making, statistical inference, estimation and detection. **(K4)**

CO5 - Develop frameworks based in probabilistic and stochastic themes for modelling and analysis of various systems **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Review of random variables: Probability Concepts, distribution and density functions, moments, independent, uncorrelated and orthogonal random variables; Vector-space representation of Random variables, Vector quantization, Chebyshev's inequality theorem, Central Limit theorem, Discrete &Continuous Random Variables. Random process: Expectations, Moments, Ergodicity, Discrete-Time Random Processes Stationary process, autocorrelation and auto covariance functions.

UNIT II CHANNEL MODELING (9 Hrs)

Random signal modelling: MA(q), AR(p), ARMA(p,q) models, Hidden Markov Model & its applications, Linear System with random input , Forward and Backward Predictions, Levinson Durbin Algorithm. Statistical Decision Theory: Bayes' Criterion, Binary Hypothesis Testing, M-ary Hypothesis Testing, Minimax Criterion, Neyman-Pearson Criterion, Composite Hypothesis Testing.

UNIT III CHANNEL ESTIMATIONS (9 Hrs)

Parameter Estimation Theory: Maximum Likelihood Estimation, Generalized Likelihood Ratio Test, Some Criteria for Good Estimators, Bayes' Estimation Minimum Mean-Square Error Estimate, Minimum, Mean Absolute Value of Error Estimate Maximum A Posteriori Estimate, Multiple Parameter Estimation Best Linear Unbiased Estimator ,Least-Square Estimation Recursive Least-Square Estimator.

UNIT IV CHANNEL CODING (9 Hrs)

Information Theory and Source Coding: Introduction, Uncertainty, Information and Entropy, Source coding theorem, Huffman, ShanonFano, Arithmetic, Adaptive coding. Discrete Memory less channels, Mutual information, channel capacity, Channel coding theorem.

UNIT VINSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation: examples of BCH codes, & Decoder, Reed- Solomon codes & Decoder, Implementation of Reed Solomon encoders and decoders.

Text Books

1. Papoulis and S.U. Pillai, “Probability, Random Variables and Stochastic Processes”, 4th Edition, McGraw-Hill, 2002.
2. D.G. Manolakis, V.K. Ingle and S.M. Kogon, “Statistical and Adaptive Signal Processing”, McGraw Hill, 2000.
3. Sergei V. Chekanov , “Numeric Computation and Statistical Data Analysis on the Java Platform”, Springer International Publishing AG , first edition, 2016.

Reference Books

1. MouradBarkat, “Signal Detection and Estimation”, Artech House, 2nd Edition, 2005.
2. R G. Gallager, “Information theory and reliable communication”, Wiley, 1st edition, 1968.
3. F. J. MacWilliams and N. J. A. Sloane, “The Theory of Error-Correcting Codes”, New York, North-Holland, 1977.
4. Rosen K.H, “Elementary Number Theory”, Addison-Wesley, 6th edition, 2010.
5. Ali Grami , “Probability, Random Variables, Statistics, and Random Processes: Fundamentals & Applications “,John Wiley and Sons Ltd, Wiley-Blackwell , 2019.

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2. https://nptel.ac.in/content/storage2/courses/117103067/module_01_introduction_to_probability/lect_01/slides/slide14.htm
3. https://people.eecs.berkeley.edu/~wlr/126notes.pdf
4. https://web.math.princeton.edu/~rvan/ORF309.pdf
5. https://www.math.kth.se/matstat/gru/sf2940/lectnotemat5.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	1	1
2	1	-	2	2	-	-	1	1	1
3	1	-	2	2	-	-	1	1	1
4	1	-	2	2	-	-	1	1	1
5	1	-	2	2	3	-	1	1	1

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE209	ARTIFICIAL INTELLIGENCE	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To know the underlying structure behind intelligence mathematically.
- Know the logical implications in computational intelligence.
- To know the automated learning techniques.
- To study the techniques of Knowledge Representation.
- To explore Artificial Intelligence techniques in real–time scenarios

Course Outcomes

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

CO1- Understand the search techniques **(K1)**
CO2- Apply the search techniques to real–time problems **(K2)**
CO3-Apply the reasoning techniques to real world problems **(K2)**
CO4- Understand the representation of knowledge **(K2)**
CO5-Apply AI techniques in developing real world applications. **(K4)**

UNIT I INTELLIGENT AGENTS AND KNOWLEDGE REPRESENTATION (9 Hrs)

Agents and Environments – Good Behavior: The concepts of Rationality – The Nature of Environments – The Structure of Agents – Knowledge Representation – Object Oriented Approach – Semantic Nets – Frames – Semantic Web – Ontology.

UNIT II SEARCH TECHNIQUES (9 Hrs)

Problem Solving by Search – Uninformed Search – Searching with Costs – Informed State Space Search – Heuristic Search: – Problem Reduction Search – Game Search – Constraint Satisfaction Problems.

UNIT III REASONING WITH LOWER ORDER LOGICS (9 Hrs)

Logical Agent – Proposition Logic – Syntax and Semantics – Theorem Proving – Model Checking – Inference in First Order Logic.

UNIT IV ARTIFICIAL INTELLIGENCE PLANNING (9 Hrs)

Classical Planning – Partial Order Planning – Graph Plan and SAT Plan – Hierarchical Planning – Planning and Acting in Nondeterministic Domains – Multiagent Planning

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Logical Formulation of Learning – Knowledge in Learning – Explanation–Based Learning – Learning using Relevance Information – Inductive Logic Programming – Statistical Learning – Learning with Complete Data – Learning with Hidden Data – Applications, Flipped classroom on theoretical study of learning methods , Assignment on solving problem in statistical learning , Practical – Programming exercises using Python/ other programming languages

Text Books

1. Stuart J. Russell, Peter Norvig, “Artificial Intelligence – A Modern Approach”, Third Edition, Pearson Education, 2015
2. Stuart Russell , Peter Norvig,” Artificial Intelligence: A Modern Approach, Global Edition”, Pearson Education Limited, 3rd edition, 2018
3. Kevin Warwick ,” Artificial Intelligence: The Basics”, Taylor & Francis Ltd, Routledge, 20

Reference Books

1. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, Tata McGraw-Hill, 2008.
2. DheepakKhermani, “A First Course in Artificial Intelligence”, McGraw-Hill, 2013.
3. Flasinski M,”Introduction To Artificial Intelligence”, Springer, 2017
4. Charniak ,“Introduction to Artificial Intelligence” Pearson Education India, 1st edition, 2002
5. Ertel Wolfgang,” Introduction to Artificial Intelligence”, springer, Prism books pvt ltd, 2013.

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3. https://nptel.ac.in/courses/106/105/106105078/
4. https://nptel.ac.in/courses/106/105/106105079/
5. https://nptel.ac.in/courses/112/103/112103280/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE210	MOBILE COMMUNICATION SYSTEM	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To study about the Evolution of mobile radio communication
- To learn about different generation in mobile standards
- To understand various diversity schemes in MIMO
- To know about mobile IP in detail
- To simulate different parameters of mobile communication standards

Course Outcomes

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

CO1-Explain trends in cellular communication **(K2)**
CO2-Able to distinguish between different standards. **(K2)**
CO3-Apply diversity schemes in MIMO. **(K2)**
CO4-Able to demonstrate various routing protocols **(K2)**
CO5-Case study of mobile communication standards using tools **(K4)**

UNIT IINTRODUCTION TO CELLULAR CONCEPTS (9 Hrs)

Evolution of mobile radio communication - trends in cellular radio and personal communication; Basics of cellular concepts - types and components of mobile communication - operation of cellular system - handoff - radio channel characterization - multiple access schemes.

UNIT II MOBILE STANDARDS (9 Hrs)

System architecture and working principle: GSM - SCSD - GPRS - EDGE - CDMA digital cellular standard - 3G CDMA 2000 - 3G W-CDMA - IMT-2000 - 4G LTE- 5G.

UNIT III DIVERSITY SCHEMES (9 Hrs)

Realization of independent fading paths - Receiver diversity - selection combing -Threshold combing - maximal - ratio combing - equal - gain combing; Transmitter Diversity - channel known at transmitter - channel unknown at transmitter - transmit and receive diversity for MIMO systems.

UNIT IV MOBILE IP NETWORK AND TRANSPORT LAYER (9 Hrs)

Introduction to Mobile IP: Requirements - IP packet delivery- agent discovery- registration, networks - routing - destination sequence distance vector - dynamic source routing and alternative metrics; Traditional TCP - congestion control- slow start- fast retransmit - fast recovery- implications of mobility; Classical TCP improvements - methods of mobile TCP: Indirect TCP - snooping TCP - mobile TCP - fast retransmit.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation study of any (five) mobile communication standards using related tools.

Text Books

1. Mullett, “Introduction to Wireless Telecommunication Systems & Networks”, Cengage Learning, 2008.
2. Theodore S. Rappaport, “Wireless Communications Principles & Practice”, PHI, 2007.
3. Man Young Rhee, “Mobile Communication Systems and Security”, John Wiley & Sons, 2009.

Reference Books

1. Mullett, “Introduction to Wireless Telecommunication Systems& Networks”, Cengage Learning, 2008.
2. Theodore S. Rappaport, “Wireless Communications Principles & Practice”, PHI, 2007
3. Schiller J, “Mobile Communications”, Pearson Education, 2007.
4. Mark J W, Jhuang W, “Wireless Communications & Networking”, PHI, 2006.
5. Krzysztof Wesolowski, “Mobile Communication Systems”, Wiley, 2002.

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3. https://nptel.ac.in/courses/117/104/117104099/
4. https://www.digitaltrends.com/mobile/4g-vs-lte
5. http://www.etsi.org/technologies-clusters/technologies/mobile/umts

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE211 ADVANCED RADIATION SYSTEMS

L	T	P	C	Hours
3	0	0	3	45

Course Objectives

- To understand antenna radiation and its parameters.
- To enhance the student knowledge in the area of various antenna design.
- To design mono pole, dipole and patch antenna and to impart the knowledge about modern antennas.
- To understand radiation mechanism in microstrip antennas
- To analyse antennas for wireless applications using related simulation tools.

Course Outcomes

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

CO1 - Ability to understand antenna concepts **(K2)**
CO2 - Knowledge of modern antenna design **(K2)**
CO3 - Ability to understand about frequency independent antennas **(K4)**
CO4 - Acquire knowledge in impedance matching and tuning of microstrip antennas **(K4)**
CO5 - Ability to design antenna for various applications **(K4)**

UNIT I CONCEPTS OF RADIATION AND ANTENNA FUNDAMENTALS (9 Hrs)

Physical concept of Radiation: Radiation from surface and line current distributions - fundamental parameters of antennas - Friss Transmission Equation - radiation integrals and auxiliary potential functions - Near and Far Field regions - Reciprocity and reaction theorems - radiation hazards and solutions

UNIT II APERTURE AND REFLECTOR ANTENNAS (9 Hrs)

Huygens's principle - radiation from rectangular and circular apertures - design considerations - Babinets principle - radiation from sectoral - pyramidal - conical and corrugated Horns - design concepts of parabolic reflectors and case grain antennas.

UNIT III BROADBAND ANTENNAS (9 Hrs)

Principles - frequency independent antennas - design and properties of log periodic - Yagi-Uda antennas - loop antennas - helical antennas - biconical antennas - broadcast antenna - spiral antenna and slot antennas.

UNIT IV MICROSTRIP ANTENNAS (9 Hrs)

Microstrip Antennas: Radiation mechanism - parameters and applications - feeding methods - design of rectangular and circular patch - impedance matching of microstrip antennas - broadband- compact and tuneable microstrip antennas.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Design, simulation and analysis of different antennas for wireless applications using related simulation tools.

Text Books

1. Jordan E C and Balmain K G, "Electromagnetic Waves and Radiating Systems", 2nd Edition, Pearson Education, 2015.
2. Balanis C A, "Antenna Theory: Analysis and Design", 4th Edition, John Wiley and Sons, New Jersey, 2016.
3. K.D.Prasad, "Antenna and Wave Propagation" 2nd edition, Sathya Prakasam, New Delhi, 2005

Reference Books

1. Jordan E C and Balmain K G, “Electromagnetic Waves and Radiating Systems”, 2nd Edition, Pearson Education, 2015.
2. Balanis C A, “Antenna Theory: Analysis and Design”, 4th Edition, John Wiley and Sons, New Jersey, 2016.
3. Kraus J D and Marhefka R J, “Antennas for All Applications”, 3rd Edition, Tata McGraw Hill, 2002.
4. Elliot R S, “Antenna Theory and Design”, Revised Edition, John Wiley and Sons, India, 2006.
5. Girish Kumar and Ray K P, “Broadband Microstrip Antennas”, Artech House, 2003.

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2. http://www.nptel.ac.in/courses/108101092/
3. http://www.nptel.ac.in/courses/108104099/
4. http://www.nptel.ac.in/courses/108104087/
5. https://www.pulseelectronics.com/docs/library/Antenna%20Basic%20Concepts%2007%2012.pdf

COs/ POs/ PSOs Mapping

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	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	3	3	-	-	1	3	3
2	1	-	3	3	-	-	1	3	3
3	1	-	3	3	-	-	1	3	3
4	1	-	3	3	-	-	1	3	3
5	1	-	3	3	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE212	DESIGN OF ANALOG AND MIXED VLSI CIRCUITS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To study the fundamentals of data converters
- To understand the concepts of D/A conversion methods and their architectures.
- To learn filters for ADC
- To understand the concepts of operational amplifiers
- To simulate various VLSI circuits using CAD tool

Course Outcomes

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

CO1 - Discuss characteristics of different data converters **(K2)**
CO2 - Compare data converters **(K2)**
CO3 - Design filters for ADC **(K4)**
CO4 - Design and analyze switched capacitor circuits **(K4)**
CO5 - Design of PLL using tool **(K4)**

UNIT I DATA CONVERTERS (9 Hrs)

Data converter fundamentals: Analog versus digital discrete time signals - converting analog signals to data signals- sample and hold characteristics - DAC specifications - ADC specifications - mixed-signal layout issues.

UNIT II DATA CONVERTER ARCHITECTURES 9 Hrs)

Data converter architectures: DAC architectures - digital input code - resistors string - R-2R ladder networks - current steering - charge scaling - DACs - cyclic DAC - pipeline DAC - ADC architectures - flash ADC - 2-step flash ADC - pipeline ADC - integrating ADC - successive approximation ADC.

UNIT III SNR IN DATA CONVERTERS (9 Hrs)

Data Converter SNR: Improving SNR using averaging (Excluding Jitter & averaging onwards) - decimating filters for ADCs (Excluding Decimating without averaging onwards) - interpolating filters for DAC - band pass and high pass sync. Filters.

UNIT IV OPERATIONAL AMPLIFIERS AND MIXED SIGNAL CIRCUITS (9 Hrs)

Differential amplifier- basic differential pair - Gilbert Cell; Op-Amp: Performance parameters - one stage and two stage Op-Amp - design of two stage Op-Amps - gain boosting - common mode feedback - slew rate - offset effects - PSRR- noise - stability and frequency compensation - two stage open loop comparators - high speed comparators - sample and hold circuit- switched capacitor circuits - oscillators - VCO - PLL.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Design and simulation of different VLSI Circuits using CAD Tools: Current mirrors - Differential Amplifier - PLL - ADC/DAC

Text Books

1. Razavi B, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill Edition, 2008.
2. Baker R J, “CMOS: Circuit Design, Layout and Simulation”, 3rd Edition, John Wiley and Sons, NJ, 2010.
3. Carusone, Johns, and Martin, Analog Integrated Circuit Design, 2nd edition, Wiley, 2012

Reference Books

1. Allen P E and Holberg D R, “CMOS Analog Circuit Design”, 3rd Edition, Oxford University Press, USA, 2012.
2. Baker R J, “CMOS: Mixed-Signal Circuit Design”, John Wiley India Edition, 2009
3. Leblebici and Leblebici, Fundamentals of High-Frequency CMOS Analog Integrated Circuits, Cambridge, 2009
4. T. H. Lee, The Design of CMOS Radio-Frequency Integrated Circuits, 2nd edition, Cambridge, 2004
5. P. R. Gray, Hurst, Lewis and R. G. Meyer. Analysis and Design of Analog Integrated Circuits. John Wiley, 4th Ed. 2001.

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5. https://doc.xdevs.com/docs/_Books/ASIC_Design/analog%20and%20mixed%20signal%20vlsi%20circuit%20design%20%28bath-2003%29.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	3	3	-	-	1	3	3
2	1	-	3	3	-	-	1	3	3
3	1	-	3	3	-	-	1	3	3
4	1	-	3	3	-	-	1	3	3
5	1	-	3	3	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE213	MACHINE LEARNING TECHNIQUES	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To introduce students to the basic concepts and techniques of Machine learning
- To have an understanding of supervised and unsupervised learning
- To study the various probability-based learning techniques
- To understand graphical models of Machine learning
- To know various simulation models

Course Outcomes

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

CO1 - Distinguish between different types of learning **(K2)**
CO2 - Apply the opt machine learning strategy based on given problem. **(K5)**
CO3 - Suggest type of machine learning algorithm based on given problem**(K3)**
CO4 - Modify. Machine learning algorithm to improve classification efficiency **(K4)**
CO5 - Appropriate graph model simulation. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT II LINEAR MODEL (9 Hrs)

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines

UNIT IIITREE AND PROBABILISTIC MODELS (9 Hrs)

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS (9 Hrs)

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT V INSTRUCTIONAL ACTIVITY (9 Hrs)

Simulation of different models Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

Text Books

1. Ethem Alpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, Third Edition, MIT Press, 2014
2. Steven Alex, “Machine Learning: The Complete Guide for Beginners and Understand Machine Learning Techniques from Beginners “(Big Data with Practical Examples, To Expert Concepts), 2019
3. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective” MIT Press Ltd, 2012

Reference Books

1. Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014
2. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
3. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012
4. Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013
5. John Paul Mueller, “Machine Learning For Dummies” John Wiley & Sons Inc, 2016

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3. http://research.microsoft.com/en-us/um/people/cmbishop/prml/
4. http://www.cs.cmu.edu/~tom/mlbook.html
5. http://mitpress.mit.edu/catalog/item/default.asp?ttype=2&tid=12012

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE214	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To enable the student to understand the basics of Communication Networks
- To understand about MANET
- To familiarize the internet protocol
- To understand the concept of WI-FI and WIMAX
- To simulate the parameters of LTE-A network

Course Outcomes

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

CO1 - The student would be in a position to apply his knowledge of QoS in Communication Networks **(K2)**
CO2 - Able to demonstrate entire MANET architecture **(K2)**
CO3 - The student would be in a position to apply his knowledge of switching technologies, architectures and buffering strategies for designing high speed communication networks and analyse their performance **(K4)**
CO4 - Compare broad band technologies **(K2)**
CO5 - Case study of LTE-A **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Communication Networks: Telephone and computer networks - cable television networks - wireless networks - networking principles - digitalization - network externalities - service integration; Layered architecture: - network bottlenecks - network elements - network mechanisms- traffic characterization and QoS.

UNIT II MANET (9 Hrs)

Multihop wireless broadband networks - mesh networks; MANET architecture - classification of routing protocols in MANET -routing metrics; packet scheduling algorithms - power control mechanism.

UNIT III INTERNET AND TCP / IP NETWORKS (9 Hrs)

Internet Protocol (IP): Technology trends in IP networks - IP packet communications in mobile communication networks; TCP and UDP - performance of TCP/ IP networks; Circuit switched networks: SONET- DWDM - fiber to the home - DSL; Intelligent Network (IN) scheme - comparison with conventional systems - merits of the IN scheme; CATV and layered network - services over CATV.

UNIT IV ENABLING NETWORKS (9 Hrs)

WiFi: overview - architecture - PHY an d MAC layer; WiMAX overview - system architecture - frame structure - PMP mode - mesh mode - multihop relay mode; UWB overview - time hopping UWB - direct sequence UWB - multiband UWB; LTE and LTE- A overview - system model - frame structure - comparison with broadband technologies.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation study: Wifi network - WiMAX network in mesh mode and multihop relay mode - integration of LTE - A and WiMAX network with single IP network.

Text Books

1. Jean Warland and PravinVaraiya, “High Performance Communication Networks”, 2nd Edition, Harcourt and Morgan Kanffman Publishers, London, 2008.
2. Leon Gracia and Widjaja, “Communication Networks”, Tata McGraw Hill, 2008.
3. Dimitris N. Chorafas, “High-Performance Networks, Personal Communications and Mobile Computing”, Springer, 2016.

Reference Books

1. LumitKasera and PankajSethi, “ATM Networks: Concepts and Protocols”, Tata McGraw Hill, 2007.
2. Jeffrey G. Andrews, ArunabhaGhosh and RiasMuhamed, “Fundamentals of WiMAX Understanding Broadband Wireless Networking”, Prentice Hall of India, 2008.
3. AmitabhaGhosh and RapeepatRatasuk, “Essentials of LTE and LTE-A”, Cambridge University, 2011.
4. David Tung Chong Wong, Peng-Yong Kong, Ying-Chang Liang, KeeChaing Chuaand JonW. Mark, “Wireless Broadband Networks”, John Wiley and Sons, 2009.
5. Ada Gavrilovska, “Attaining High Performance Communications: A Vertical Approach”, CRC Press, 2016.

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1. http:// www.ece.gmu.edu/.../high performance communication networks_1.pdf
2. http://www.amazon.com/dp/1558605746/ref=rdr_ext_tmb
3. https://www.geeksforgeeks.org/tcp-ip-model/
4. https://tools.ietf.org/html/rfc1180
5. https://www.javatpoint.com/mobile-adhoc-network

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	2	2
2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	3	-	1	2	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE215	INDUSTRIAL ELECTRONICS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Understand the need and concept of Semiconductor devices
- Learn about rectifiers and inverters
- To study the concept in basic about DC-DC converters
- To understand the concept of Microprocessor
- To know about PLC in Automation

Course Outcomes

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

CO1 - Discuss concept of Semiconductor devices **(K2)**
CO2 – Able to distinguish between rectifiers and inverters **(K2)**
CO3 - Demonstrate on DC-DC converters **(K2)**
CO4 - Able to discuss application on microprocessor **(K3)**
CO5 - Case study of industrial automation using PLC programming. **(K4)**

UNIT I SEMICONDUCTOR DEVICES (9 Hrs)

Semiconductor devices: Diode - application of diode as switch - Zener diode as regulator - Light Emitting Diode - photo diode; Thyristors: Operation and characteristics of SCR; TRIAC - DIAC - UJT - BJT - MOSFET - Insulated Gate Bipolar Junction Transistor (IGBT) - Operational Amplifiers (IC 741) - IC 555 Timer - Operational modes of IC 555- piezoelectric devices- transducers.

UNIT II PHASE CONTROLLED RECTIFIERS AND BRIDGES (9 Hrs)

Single phase bridge rectifier with R - RL and RLE load - three phase semi converter - three phase full converter - dual converter - harmonic issues in controlled rectifiers; Inverters: Single phase bridge inverter - three phase bridge inverter - 120 and 180 degree mode of operation - voltage and frequency control in inverters.

UNIT III DC-DC CONVERTERS (9 Hrs)

DC - DC conversion - Buck Boost converters - circuit configuration and analysis with different types of loads - Resonant DC – DC converters; Switched Mode Power Supply (SMPS) - Concept of PWM in converters - unity power factor converters - Voltage Source Inverters (VSI) - Current Source Inverters (CSI) - Application of VSI and CSI in induction motor control - Uninterrupted Power Supply (UPS).

UNIT IV DIGITAL DESIGN (9 Hrs)

Logic gates and related IC's - combinational and sequential circuits and their IC's - 8086 Microprocessor - 8051 Microcontroller - interfacing of microprocessor and microcontroller with ADC and DAC - display modules - stepper motors and serial ports - application of microprocessors , microcontrollers and DSP in machine drives.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Case study in Programmable Logic Controllers (PLC) - PLC programming methodologies - PLC functions - industrial automation using PLC programming.

Text Books

1. Kassakian John G, Schlecht Martin F and Verghese George C “Principle of Power Electronics”, 1st Edition, Pearson Education Ltd., 2010.
2. Gopal K D, “Power Semiconductor Controlled Drives”, Prentice Hall, 1989.
3. Singh M D and Khanchandani K B, “Power Electronics”, 2nd Edition, Tata McGraw Hill, 2006.

Reference Books

1. Bhattacharya S K, Chatterjee S, “Industrial Electronics and Control”, Tata McGraw Hill, 2006.
2. Ned Mohan T, M. Undeland and William, P Robbins; “Power Electronics: Converters, Applications and Design”, 3rd Edition, John Wiley and Sons, 2009.
3. John W W and Ronald A R, “Programmable Logic Controllers Principles & applications”, 5th Edition, Prentice Hall India, 2002.
4. Douglas V Hall, “Microprocessor and Interfacing”, Revised 2nd Edition, Tata McGraw Hill, 2006.
5. Keneth J Ayala, “The 8051 Microcontroller Architecture, Programming and Applications”, 2nd Edition, Delmar Cengage Learning, 1996.

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3. https://www.lbwcc.edu/academics/careertechnical-division/programs/industrial-electronics-technology
4. https://pinoybix.org/2013/11/industrial-electronics-lecture-1.html
5. https://www.vssut.ac.in/lecture_notes/lecture1424354515.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE316	INFORMATION AND NETWORK SECURITY	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Learn about OSI security architecture
- To understand different security algorithm
- To learn about IP security architecture
- To know about intruders
- To simulate cryptographic algorithms

Course Outcomes

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

CO1 - Able to give outline on security issues **(K2)**
CO2 - Discuss on different security and authentication algorithms **(K2)**
CO3 - Discuss on security in 3G and 4G **(K2)**
CO4 - Able to comprehend on firewall design principle **(K2)**
CO5 - Able to simulate public key and private key cryptography algorithms **(K4)**

UNIT I INTRODUCTION TO CRYPTOGRAPHY (9 Hrs)

Security issues: Security problems in computing - attacks - security services - security mechanism- OSI security architecture - standard setting organizations; Need for cryptographic techniques- substitution - transposition - block ciphers

UNIT II DATA SECURITY AND AUTHENTICATION (9 Hrs)

Triple DES with two keys - stream cipher - RC4 - RSA algorithm - elliptical curve cryptography algorithm; MD5 - HASH algorithm - SHA 512 logic - Digital Signatures standards.

UNIT III NETWORK SECURITY (9 Hrs)

Network Security: IP security overview - IP security architecture - authentication header - encapsulating security payload - combining security association - key management- web security considerations - secure socket layer and transport layer security - secure electronic transaction - security in GSM - security in 3G and 4G.

UNIT IVSYSTEM SECURITY (9 Hrs)

Intruders and intrusion detection: Malicious software - viruses and related threats - virus counter measures - distributed denial of service attack - firewalls design principles- trusted systems.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation of minimum of (three) public key and private key cryptography algorithms using related tools.

Text Books

1. Bernard S and Pabitra K R, “Digital Communications: Fundamentals and Applications”, 2nd Edition, Pearson Edition, 2009.
2. Stallings W, “Cryptography and Network Security”, 4th Edition, Prentice Hall, 2006.
3. Information Security: Principles and Practice, 2nd Edition by Mark Stamp Wiley

Reference Books

1. Thomas S, Cover M and Joy A T, “Elements of Information Theory”, 2nd Edition, John Wiley & Sons, 2006.
2. MacKay J C D, “Information Theory, Inference and Learning Algorithms”, 2nd Edition, Cambridge University Press, 2003.
3. McEliece J R, “The Theory of Information and Coding”, 2nd Edition, Cambridge University Press, 2002.
4. Everyday Cryptography: Fundamental Principles and Applications Keith M. Martin Oxford Scholarship Online: 2013
5. Bruce Schneier,” Applied Cryptography Protocols, Algorithms, and Source Code” in C”

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2. https://www.vssut.ac.in/lecture_notes/lecture1423183198
3. http://gva.noekeon.org/QCandSKD/QCandSKD-introduction.html
4. https://www.vssut.ac.in/lecture_notes/lecture1428550736
5. win.tue.nl/~tozceleb/2IC60/lecture_notes

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	2	2
2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	3	-	1	2	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE317	MARKOV CHAINS AND QUEUEING SYSTEMS	L	T	P	C	HOURS
		3	0	0	3	45

Course Objectives

- To know the mathematical preliminaries required for the performance modeling of telecommunication networks
- Learn the knowledge in the domain of discrete event stochastic processes including renewal and regenerative processes, Markov processes and Semi-Markov processes.
- Understand the theory of discrete and continuous time Markov chains and their characterization
- Acquire the expertise to analyse a given queueing model and evaluate some key performance measures such as blocking probability, average queue length and delay statistics using first principles
- Develop an understanding of the various queueing models and their applications in telecommunications and networking

Course Outcomes

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

CO1 - Understand the mathematical preliminaries required for the performance modeling of telecommunication networks **(K2)**

CO2 - Demonstrate knowledge in the domain of discrete event stochastic processes including renewal and regenerative processes, Markov processes and Semi-Markov processes. **(K2)**

CO3 - Understand the theory of discrete and continuous time Markov chains and their characterization **(K2)**

CO4 - Acquire the expertise to analyse a given queueing model and evaluate some key performance measures such as blocking probability, average queue length and delay statistics using first principles **(K3)**

CO5 - Develop an understanding of the various queueing models and their applications in telecommunications and networking **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Stochastic Processes: Renewal Processes - Reward and Cost Models, Poisson Process; Point Processes; Regenerative Processes; Renewal Theorems.

UNIT II MODELS (9 Hrs)

Markov Models: Discrete Time Markov Chain - Transition Probabilities, Communication Classes, Irreducible Chains; Continuous Time Markov Chain - Pure-Jump Continuous-Time Chains, Regular Chains, Birth and Death Process, Semi-Markov Processes.

UNIT III QUEUING TECHNIQUES (9 Hrs)

Single Class & Multi-class Queuing Networks: Simple Markovian queues; M/G/1 queue; G/G/1 queue; Open queuing networks; Closed queuing networks; Mean value analysis; Multi-class traffic model; Service time distributions; BCMP networks; Priority systems.

UNIT IV QUEUING NETWORKS (9 Hrs)

Time Delays and Blocking in Queuing Networks: Time delays in single server queue; Time delays in networks of queues; Types of Blocking; Two finite queues in a closed network; Aggregating Markovian states.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation: Little's theorem, invariance of the mean delay, Conservation law. Markovian queues: Jackson and BCMP networks, numerical Algorithms. M/G/1 & G/M/1 queues and G/G/1 queues.

Text Books

1. Ronald W. Wolff, Stochastic Modeling and The Theory of Queues, Prentice-Hall International, Inc, 1989.
2. Peter G. Harrison and Naresh M. Patel, Performance Modeling of Communication Networks and Computer Architectures, Addison-Wesley, 1992.
3. Gary N. Higginbottom, Performance Evaluation of Communication Networks, Artech House, 1998.

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1. Anurag Kumar, D. Manjunath, and Joy Kuri, Communication Networking: An Analytical Approach, Morgan Kaufman Publ. 2004.
2. D. Bertsekas and R. Gallager, Data Networks, Prentice Hall of India, 2001.
3. Ross, K.W., Multiservice Loss Models for Broadband Telecommunication Networks, Springer-Verlag, 1995.
4. Walrand, J., An Introduction to Queueing Networks, Prentice Hall, 1988.
5. Cinlar, E., Introduction to Stochastic processes, Prentice Hall, 1975.

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2. http://dspace.mit.edu/handle/1721.1/38950
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5. https://nptel.ac.in/courses/110/104/110104024/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE318	RF AND MICROWAVE CIRCUIT DESIGN	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Understand the behaviour of RF passive components and model active components.
- Perform transmission line analysis.
- Demonstrate use of Smith Chart for high frequency circuit design.
- Justify the choice/selection of components from the design aspects.
- Contribute in the areas of RF circuit design.

Course Outcomes

Upon completion of the course, students will be able to

CO1 - Understand the behaviour of RF passive components and model active components. **(K2)**

CO2 - Perform transmission line analysis. **(K2)**

CO3 - Demonstrate use of Smith Chart for high frequency circuit design. **(K2)**

CO4 - Justify the choice/selection of components from the design aspects. **(K3)**

CO5 - Contribute in the areas of RF circuit design **(K4).**

UNIT I TRANSMISSION LINE THEORY (9 Hrs)

Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.

UNIT IIMICROWAVE NETWORK ANALYSIS (9 Hrs)

Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.

UNIT III MICROWAVE COMPONENTS (9 Hrs)

Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.

UNIT IV MICROWAVE SEMICONDUCTOR DEVICES AND MODELING (9 Hrs)

PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.

UNIT V INSTRUCTIONAL ACTIVITY (9 Hrs)

Simulation: Microwave filters, power dividers and directional couplers, using microwave components

Text Books

1. Matthew M. Radmanesh, “Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design”, AuthorHouse, 2009.
2. D.M.Pozar, “Microwave engineering” ,Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, “R. F. Circuit Design”, Pearson Education Inc, 2009.

Reference Books

1. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
2. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress , 2017.
3. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
4. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
5. Joshua F. Wiley, “R Deep Learning Essentials”, Packt Publications, 2016.

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5. https://nptel.ac.in/courses/117/101/117101119/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE319	VOICE AND DATA NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Protocol, algorithms, trade-offs rationale.
- Routing, transport, DNS resolutions
- Network extensions and next generation architectures.
- Study the networking protocol
- Simulation analysis for different network

Course Outcomes

After completion of the course, the students are able to

CO1 - Protocol, algorithms, trade-offs rationale. (K2)
CO2 - Routing, transport, DNS resolutions (K2)
CO3 - Network extensions and next generation architectures. (K2)
CO4 - Study the networking protocol (K2)
CO5 - Simulation analysis for different network(K4)

UNIT I INTRODUCTION TO NETWORK (9 Hrs)

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

UNIT II TYPES OF NETWORKS (9 Hrs)

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

UNIT III DATA NETWORKS DESIGN (9 Hrs)

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

UNIT IV INTER-NETWORKING (9 Hrs)

Inter-networking, Bridging, Global Internet, IP protocol and addressing, Sub netting, Classless Inter domain Routing (CIDR), IP address lookup, Routing in Internet. End to End Protocols, TCP and UDP. Congestion Control, Additive Increase/Multiplicative Decrease, Slow Start, Fast Retransmit/ Fast Recovery,

UNIT VINSTRUCTIONAL ACTIVITY (9 Hrs)

Case studies on Congestion avoidance, RED TCP Throughput Analysis, Quality of Service in Packet Networks. Network Calculus, Packet Scheduling Algorithms.

Text Books

1. D. Bertsekas and R. Gallager, “Data Networks”, 2nd Edition, Prentice Hall, 1992.
2. L. Peterson and B. S. Davie, “Computer Networks: A Systems Approach”,5th Edition, Morgan Kaufman, 2011.
3. Kumar, D. Manjunath and J. Kuri, “Communication Networking: An analytical approach”, 1st Edition, Morgan Kaufman, 2004.

Reference Books

1 Walrand, “Communications Network: A First Course”, 2nd Edition, McGraw Hill, 2002.
2 Leonard Kleinrock, “Queueing Systems, Volume I: Theory”, 1st Edition, John Wiley and Sons, 1975.
3 Aaron Kershenbaum, “Telecommunication Network Design Algorithms”, McGraw Hill, 1993.
4 Vijay Ahuja, “Design and Analysis of Computer Communication Networks”, McGraw Hill, 1987
5 William Stallings, ‘Data and Computer Communication’, 8th Edition, Pearson Education, 2003 / PHI.

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4. https://nptel.ac.in/content/storage2/courses/106108098//Learning%20Material%20-%20DataCommunication.pdf
5. https://www.youtube.com/playlist?list=PL8BF3052396E05930

COs/ POs/PSOs Mapping

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2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	3	-	1	2	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE320	MODELING AND SIMULATION OF WIRELESS COMMUNICATION SYSTEMS	L	T	P	C	HOURS
		3	0	0	3	45

Course Objectives

- To know about different types of simulation
- To establish a deep knowledge on processing of Random signals
- To understand in detail about Monte Carlo simulation
- To study about different time varying system models
- To simulate distributions using tools

Course Outcomes

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

CO1 - Discuss fundamental concept of communication systems **(K1)**
CO2 - Establish Stationary and Ergodic Processes **(K3)**
CO3 - Case study of methodologies involved in simulation of wireless system **(K3)**
CO4 - Distinguish different time varying system models **(K3)**
CO5 - Design of linear and non-linear system using simulation tools **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Role of Simulation: Examples of complexity - multidisciplinary aspects of simulation - models - deterministic and stochastic simulations; Simulation methodology - aspects of methodology - performance estimation; Fundamental Concepts: Sampling - quantizing - reconstruction and interpolation - simulation sampling frequency - complex envelope techniques.

UNIT II GENERATING AND PROCESSING RANDOM SIGNALS (9 Hrs)

Stationary and Ergodic Processes: Uniform random number generators - mapping uniform random variables to an arbitrary PDF - generating uncorrelated and correlated Gaussian random numbers - PN sequence generators; Establishing a PDF and PSD Post Processing: Basic graphical techniques - estimation – coding.

UNIT III METHODOLOGY FOR SIMULATING A WIRELESS SYSTEM (9 Hrs)

Fundamental Concepts of Monte Carlo Simulation - applications and integration - two Monte Carlo examples; Semi Analytic Techniques System: Level simplifications and sampling rate considerations - overall methodology; Modeling and simulation of nonlinearities: Modeling and simulation of memory less nonlinearities - modeling and simulation of nonlinearities with memory - techniques for solving nonlinear differential equations.

UNIT IV MODELING AND SIMULATION OF TIME-VARYING SYSTEMS (9 Hrs)

Introduction: Models for LTV systems - random process models - simulation models for LTV systems; Wired and guided wave - radio channels - multipath fading channels - random process models - simulation methodology; Discrete channel models: Discrete memory less channel models - Markov models for discrete channels with memory- HMMs - Gilbert and Fritchman models - estimation of Markov model parameters.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation study of generating PDF for the Gaussian and non-Gaussian distributions - linear andnon-linear systems using different techniques with the help of simulation tools

Text Books

1. William H T, Samshanmugan K, Rappaport T S and Kosbar K L, “Principles of Communication Systems Simulation with Wireless Applications”, Pearson Education, 1st Edition, 2011.
2. Jeruchim M C, Philip B and Samshanmugam K, “Simulation of Communication Systems: Modeling Methodology and Techniques”, 2nd Edition, Kluwer Academic Publisher, 2002
3. Jack L. Burbank, William Kasch and Jon Ward, “An Introduction to Network Modeling and Simulation for the Practicing Engineer”, Wiley publication, 2011.

Reference Books

1. Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol, ''Discrete-Event System Simulation'', Pearson Education, 4th Edition, 2007.
2. Lawrence M. Leemis and Stephen K. Park, ''Discrete – Event Simulation A First Course'', Pearson Education/PHI, 2006
3. Averill M L, "Simulation Modelling and Analysis", 5th Edition, McGraw Hill, 2014.
4. Hayes F J, "Modelling and Analysis of Computer Communication Networks", Springer, Plenum Press, 1984.
5. Banks J, Carson J S, Nelson L B and Nicol D M, "Discrete Event System Simulation", 4th Edition, Pearson Education, 2009.

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2. https://nptel.ac.in/courses/106/106/106106167/
3. https://nptel.ac.in/courses/112/107/112107220/
4. https://nptel.ac.in/courses/117/105/117105132/
5. https://nptel.ac.in/courses/117/102/117102062/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE321	ADVANCED TECHNOLOGIES IN WIRELESS NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To study about different Wireless Area Networks and its standards
- To study about the classification and design challenges in wireless sensor network
- To know about internet protocol
- To learn about wideband technologies
- To simulate wireless networks standards

Course Outcomes

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

CO1 - Distinguish different standards in WAN **(K4)**
CO2 - Discuss about wireless sensor networks **(K2)**
CO3 - Evaluate wireless security standards **(K5)**
CO4 - Develop the ability to understand the concepts of UWB and LTE **(K4)**
CO5 - Case study of recent wireless networks standards **(K4)**

UNIT I WIRELESS AREA NETWORKS (9 Hrs)

WPAN: System model - protocol stack of IEEE 802.15; Bluetooth: Network architecture - operation-specification; Radio Frequency Identification (RFID): Types and specifications; ZIGBEE and WBAN: section and architecture; WLAN: Network architecture - protocol stack of IEEE 802.11 - physical layer and MAC layer mechanism; WiMAX: BWA - issues and challenges of WiMAX - network architecture - protocol stack of IEEE 802.16 - differences between IEEE 802.11 and IEEE 802.16

UNIT II WIRELESS SENSOR NETWORK (9 Hrs)

Issues - design challenges - characteristics and architecture of wireless sensor network - classification - MAC protocols - routing schemes - security - enabling technologies for sensor network.

UNIT IIIWIRELESS INTERNET (9 Hrs)

IP for wireless domain - mobile IP - IPv6 advancements - mobility management functions - location management - registration and handoffs; TCP in wireless domain: TCP over wireless - types - mobile transaction - impact of mobility; Wireless security and standards.

UNIT IVWIDEBAND WIRELESS TECHNOLOGIES (9 Hrs)

UWB Radio Communication: Fundamentals of UWB - major issues - operation of UWB systems - comparisons with other technologies - advantages and disadvantages; LTE: System architecture - frame structure – LTE - FDD vs TDD comparison; LTE Advanced: Network architecture - frame structure and its characteristics; 5G networks: Technical challenges- architecture

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation of minimum of five wireless networks standards using related tools.

Text Books

1. KavehPahlavan and Prashant Krishnamurthy, “Principle of Wireless Networks - A Unified Approach”, Prentice Hall of India, 2006.
2. William Stallings, “Wireless Communication and Networks”, 2nd Edition, Prentice Hall, 2005.
3. H.Nikookar, R.Prasad, “Introduction to Ultra-Wideband for Wireless Communications”, Springer, 2010.

Reference Books

1. Clint Smith and Daniel Collins, “3G Wireless Networks”, 2nd Edition, Tata McGraw Hill, 2007.
2. Vijay Garg K, “Wireless Communications and Networks”, 2nd Edition, Morgan Kaufmann Publishers (Elsevier), 2007.
3. Amitabha Ghosh and Rapeepat Ratasuk, “Essentials of LTE and LTE-A,” Cambridge University Press, 2011.
4. C.S.Raghavendra, Krishna M. Sivalingam, “Wireless Sensor Networks”, Springer, 2006.
5. Yu-Kwong Ricky Kwok, Vincent K.N.Lau, “Wireless Internet and Mobile Computing“, Wiley-Blackwell, 2007

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1. http://doktora.kirbas.com/Kitaplar/Wireless%20Networking%20Complete.pdf
2. www.tutorialspoint.com/wimax/
3. http://www.infotech.monash.edu.au/units/archive/2012/s2/fit5083.html
4. https://www.udemy.com/course/wireless-networking-fundamentals/
5. https://nptel.ac.in/courses/106/105/106105160/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
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Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE322	RF SYSTEM DESIGN	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To understand the basics of Transmission line analysis
- Learn about RF amplifier
- To study about power amplifiers
- To learn about PLL
- Simulate frequency response of amplifier, oscillator and mixer

Course Outcomes

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

CO1 - Outline on High Frequency Components **(K2)**
CO2 - Design amplifiers and oscillators **(K6)**
CO3 - Compare different power amplifiers **(K4)**
CO4 - Distinguish different synchronization techniques **(K4)**
CO5 - Simulation of different applications of amplifier, oscillator and mixer **(K5)**

UNIT I RF PASSIVE COMPONENTS AND TRANSMISSION LINE ANALYSIS (9 Hrs)

High Frequency Components: Resistors- capacitors and inductors; Transmission line analysis - line equation - microstrip line - SWR - voltage reflection co-efficient - propagation constant - phase constant - phase velocity - Smith chart - parallel RL and RC circuits - ABCD parameter and S parameters.

UNIT IIRF DEVICES AND CIRCUITS (9 Hrs)

RF amplifier design- power gain equations - maximum gain design, low noise amplifier design, high power amplifier design- stability considerations; RF oscillator design - one - port and two - port negative resistance oscillators - oscillator design using large - signal measurements; RF Mixer Design: Single ended mixed - double ended mixer.

UNIT III RF FEEDBACK SYSTEMS AND POWER AMPLIFIERS (9 Hrs)

Stability of feedback systems: Gain and phase margin - root - locus techniques - time and frequency domain considerations - compensation ; General model - Class A, AB, B, C, D, E and F amplifiers - power amplifier linearization techniques - efficiency boosting techniques - ACPR metric- design considerations.

UNIT IV PLL AND FREQUENCY SYNTHESIZERS (9 Hrs)

Linearised model - noise properties - phase detectors - loop filters and charge pumps – integer - N frequency synthesizers - direct digital frequency synthesizers.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation of the frequency response of amplifier, oscillator and mixer for different applications using related tools.

Text Books

1. Reinhold Ludwig and Pavel Bretchko, “RF Circuit Design”, Pearson Education, 2007.
2. Josn Rogers and Calvin Plett, “Radio Frequency Integrated Circuit Design”, Artech House, 2002.
3. Qizheng Gu, “RF System Design of Transceivers for Wireless Communications”, 1st edition, Springer, 2005

Reference Books

1. Ferri Losee, “RF systems, Components and Circuits Handbook”, Artech House, 2002.
2. Joseph J. Carr, “Secrets of RF Circuit Design”, Tata McGraw Hill, 2004.
3. Thomas Lee,” The Design of Radio Frequency CMOS Integrated Circuits”, Cambridge University Press, 2nd Edition, Cambridge, 2004
4. William F.Egan, “ Practical RF System Design”, Wiley- IEEE Press, 2003.
5. David M. Pozar, “Microwave and RF Design of Wireless Systems”, Wiley, 2000.

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2. http://www.ece.iisc.ernet.in/~dipanjan/E8_202/E8-202-lecturenotes.html
3. https://www.udemy.com/course/rf-engineeer-design-theory-and-principles-rahrf201/
4. https://nptel.ac.in/courses/117/102/117102012/
5. https://nptel.ac.in/courses/117/105/117105138/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
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Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE323 COGNITIVE RADIO TECHNOLOGY

L	T	P	C	Hours
3	0	0	3	45

Course Objectives

- To understand the basic concept of Fundamentals of communication networks
- To know the concept of Software Defined Radio
- To study the concepts of Cognitive radio network architectures
- To introduce the concepts of security threats
- To simulate the concept of spectrum allocation in CR

Course Outcomes

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

CO1 - Apply the Fundamentals of communication networks **(K3)**
CO2 - Able to discuss the architecture goals of SDR **(K2)**
CO3 - Discuss different architecture of Cognitive radio network **(K2)**
CO4 - Discuss security threats to the radio software **(K2)**
CO5 - Able to simulate spectrum allocation algorithms in CR **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Fundamentals of communication networks: New challenges - multiple access schemes - cross layer design and optimization; Multicarrier modulation and equalization - ISI; RF spectrum and regulation: Regulatory issues of cognitive access.

UNIT II SDR ARCHITECTURE (9 Hrs)

Software Defined Radio: Evolution - essential functions of the Software Defined Radio - architecture goals - quantifying degrees of programmability - top level component topology - computational properties of functional components - interface topologies among plug and play modules - architecture partitions - merits and demerits of SDR - problems faced by SDR.

UNIT III CR ARCHITECTURE (9 Hrs)

Cognitive radio network architectures: Architectures for spectrum sharing - network optimization - topology aware CRN architectures - Haykin dynamic spectrum architecture

UNIT IV CR NETWORK SECURITY (9 Hrs)

Primary user emulation attacks - security vulnerabilities in IEEE 802.22 - security threats to the radio software.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation of CR & SDC network using related tools.

Text Books

1. Alexander M. Wyglinski, MaziarNekovee, and Thomas Hou Y, “Cognitive Radio Communications and Networks - Principles and Practice”, Elsevier Inc., 2010.
2. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons Ltd, 2009.
3. Alexander M. Wyglinski, MaziarNekovee, and Thomas Hou Y, “Cognitive Radio Communications and Networks - Principles and Practice”, Elsevier Inc., 2010.

Reference Books

1. Kwang-Cheng Chen and Ramjee Prasad, “Cognitive Radio Networks”, John Wiley & Sons Ltd, 2009.
2. Khattab, Ahmed, Perkins, Dmitri, Bayoumi, Magdy, “Cognitive Radio Networks - From Theory to Practice”, Springer Series: Analog Circuits and Signal Processing, 2009.
3. Mitola J, “Cognitive Radio: An Integrated Agent Architecture for software defined radio”, Doctor of Technology thesis, Royal Inst. Technology, Sweden 2000.
4. Peyman Setoodeh, Simon Haykin,“Fundamentals of Cognitive Radios “Simon Haykin, Wiley, 2017
5. Ekram Hossain, Dusit Niyato, Zhu Han “Dynamic Spectrum Access and Management in Cognitive Radio networks”, Cambridge University Press,2009

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2. http://www.sciencedirect.com/science/book/9780123747150
3. http://www.xgtechnology.com/innovations/cognitive-radio-networks/
4. https://nptel.ac.in/courses/108/107/108107107/
5. https://www.tonex.com/training-courses/sdr-training/

COs/ POs/ PSOs Mapping

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4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE324	ADVANCED HIGH-SPEED NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols.
- Design, implement, and analyze computer networks.
- Identify, formulate, and solve network engineering problems.
- Show knowledge of contemporary issues in high performance computer networks.
- Study the techniques, skills, and modern networking tools necessary for engineering practice.

Course Outcomes

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

CO1 - Apply knowledge of mathematics, probability, and statistics to model and analyze some networking protocols. **(K2)**
CO2 - Design, implement, and analyze computer networks. **(K4)**
CO3 - Identify, formulate, and solve network engineering problems. **(K2)**
CO4 - Show knowledge of contemporary issues in high performance computer networks. **(K2)**
CO5 - Use techniques, skills, and modern networking tools necessary for engineering practice. **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Types of Networks, Network design issues, Data in support of network design. Network design tools, protocols and architecture. Streaming stored Audio and Video, Best effort service, protocols for real time interactive applications, Beyond best effort, scheduling and policing mechanism, integrated services, and RSVP-differentiated services.

UNIT II VOIP (9 Hrs)

VoIP system architecture, protocol hierarchy, Structure of a voice endpoint, Protocols for the transport of voice media over IP networks. Providing IP quality of service for voice, signalling protocols for VoIP, PSTN gateways, VoIP applications.

UNIT III PROTOCOLS FOR QUALITY OF SERVICE (9 Hrs)

VPN – Remote - Access VPN, site-to-site VPN, Tunneling to PPP, Security in VPN. MPLS operation, Routing, Tunneling and use of FEC, Traffic Engineering, MPLS based VPN, overlay networks-P2P connections

UNIT IV SECURITY (9 Hrs)

Network Security and Management: Principles of cryptography, Authentication, integrity, key distribution and certification, Access control and fire walls, attacks and counter measures, security in many layers.

UNIT V INSTRUCTIONAL ACTIVITY (9 Hrs)

Simulation: Infrastructure for network management, internet standard management framework – SMI, MIB, SNMP, Security

Text Books

1. William Stallings, “High Speed Networks and Internet”, Pearson Education, Second Edition, 2002
2. Kershenbaum A., “Telecommunications Network Design Algorithms”, Tata McGraw Hill, 1993.
3. Larry Peterson & Bruce David, “Computer Networks: A System Approach”, Morgan Kaufmann, 2003.

Reference Books

1. Irvan Pepelnjk, Jim Guichard and Jeff Apcar, “MPLS and VPN architecture”, Cisco Press, Volume 1 and 2, 2003
2. Douskalis B., “IP Telephony: The Integration of Robust VoIP Services”, Pearson Ed. Asia, 2000.
3. Warland J., Varaiya P., “High-Performance Communication Networks”, Morgan Kaufmann, 1996.
4. William Stallings,” ISDN and Broadban ISDN with Frame Relay and ATM”, 4th edition, Pearson Education, 2002
5. James P.G. Sternbenz, Joseph D.Touch, “ High Speed Networking”, Wiley, 2001

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3. https://www.youtube.com/watch?v=oSQrL4x-YiM
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5. https://www.nap.edu/read/5769/chapter/1

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
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3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE325	EMBEDDED REAL TIME SYSTEM	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Learn about Embedded Automatic Systems
- To have glimpse on Introduction to Arduino
- To study the basics of python
- To understand the basics of RTOS programming
- To illustrate the concept of Raspberry Pi/ Arduino /any other SOC

Course Outcomes

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

CO1 - Describe various Embedded Automatic Systems **(K2)**
CO2 - Demonstrate about Arduino **(K3)**
CO3 - Discuss on communication interfaces **(K2)**
CO4 - Discuss task management in RTOS **(K2)**
CO5 - Design and implement home automation applications **(K4)**

UNIT I INTRODUCTION TO EMBEDDED AUTOMATIC SYSTEMS (9 Hrs)

Embedded Automatic Systems (EAC): Overview - architecture; Components of the system: Processors-memories and interconnects - processor architectures - memory and addressing: SOC memory examples - addressing.

UNIT IISOC (9 Hrs)

Introduction to Arduino: Types of Arduino devices - common Arduino shields - Beagle Bone; Introduction to Raspberry Pi

UNIT III COMMUNICATION INTERFACES AND PYTHON BASICS (9 Hrs)

Communication interfaces: I2C- SPI Bus- UART- RS-232- RS-485- USB- IEEE 139.4 (Fire wire) - Infrared (IRDA) - Bluetooth - Wi-Fi - ZigBee – GPRS; Python basics: Introduction - variables - displaying output - reading user input - arithmetic - operations on strings - running commands conditionally - comparing values - logical operators- loops.

UNIT IV RTOS PROGRAMMING (9 Hrs)

Tasks and Task states - semaphores - shared data - message queues - mail boxes and pipes - memory management - interrupt routines - encapsulating semaphore and queues - task management - inter task communication - process input/ output.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

RFID based attendance management system - embedded video processing - home automation systems using Raspberry Pi/ Arduino /any other SOC.

Text Books

1. Michael J F and Wayne L. “Computer System Design: System-on-Chip”, John Wiley and Sons, 2011.
2. Hughes M J, “Arduino: A Technical Reference”, 1st Edition, O’REILY, 2016.
3. David E S, “An Embedded software premier”, Pearson Education, 1999.

Reference Books

1. Shibu, “Introduction to Embedded Systems”, 1st Edition, Tata McGraw Hill, 2009.
2. Simon M, “Raspberry Pi Cookbook”, 2nd Edition, O’REILY, 2014.
3. Richardson M and Shawn W, “Make: Getting Started with Raspberry Pi”, 3rd Edition, O’REILY, 2016.
4. Prasad K V K K, “Embedded/ Real-Time Systems”, Dream Tech Press, 2003.
5. Hermann K, “Real–Time systems – Design Principles for Distributed Embedded Applications”, 2nd Edition, Springer, 2011.

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3. https://www.coursera.org/learn/real-time-systems
4. https://www.coursera.org/lecture/real-time-systems/rtos-overview-RIAFe
5. https://www.edx.org/learn/embedded-systems

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
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3	1	-	1	1	-	-	1	1	1
4	1	-	1	1	-	-	1	1	1
5	1	-	1	1	3	-	1	1	1

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE326	FREE SPACE OPTICAL NETWORKS	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- To learn about Free space optics
- To know about FSO sources and detectors
- To understand about different topologies in FSO
- To familiarize about WDM
- To simulate performance comparison of FSO networks

Course Outcomes

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

CO1 - Demonstrate Overview of FSO **(K3)**
CO2 - Apply Security issues in FSO **(K3)**
CO3 - Design simple PP design **(K6)**
CO4 - Discuss Mesh topology in FSO **(K2)**
CO5 - Compare performances of FSO networks **(K4)**

UNIT I INTRODUCTION (9 Hrs)

Propagation of light in unguided media - laser beam characteristics - atmospheric effects on optical signals - coding for atmospheric optical propagation - factors affecting FSO - LOS - LIDAR; Overview of FSO optical transmitters - receivers - subsystems.

UNIT II FSO TRANSCEIVER DESIGN AND SECURITY (9 Hrs)

Light sources: Modulators - photo detectors and receivers - optical amplification - optical signal to noise ratio - acquisition, pointing and tracking - adaptive and active optics - laser safety - node housing and mounting; FSO inherent security levels and layers.

UNIT III POINT TO POINT FSO SYSTEMS (9 Hrs)

Simple PP design: Transponder nodes - hybrid FSO and RF - FSO point to multipoint - FSO point to mobile; Ring FSO systems: Ring topologies and service protection - ring nodes with add drop - concatenated rings - ring to network connectivity.

UNIT IV MESH FSO SYSTEMS (9 Hrs)

FSO Nodes for mesh topology: Hybrid mesh FSO with RF - hybrid FSO fiber networks; WDM Mesh FSO: DWDM and CWDM optical channels - WDM FSO links - WDM mesh FSO networks - service protection in mesh FSO networks.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Simulation of PP FSO system using ring topology / WDM Mesh FSO network with service protection enabled scenario - performance comparison of FSO networks in ring and mesh topology using related tools.

Text Books

1. Stamatios V. Kartalopoulos, “Free Space Optical Networks for Ultra-Broad Band Services”, IEEE Press, 2011.
2. Olivier Bouchet, HerveSizun, Christian Boisrobert and Frederique De Fornel, “Free-Space Optics: Propagation and Communication”, John Wiley and Sons, 2010
3. Arun K. Majumdar and Jennifer C. Ricklin, “Free-Space Laser Communications: Principles and Advances”, Springer, 2008.

Reference Books

1. Heinz Willebrand and Baksheesh S. Ghuman, “Free Space Optics: Enabling Optical Connectivity in Today's Networks”, Sams Publishing, 2002.
2. In Keun Son, “Design and Optimization of Free Space Optical Networks”, Auburn University, Dissertations, Electrical Engineering and Computer Engineering, 2010.
3. Fang Liu, “Bootstrapping Free-space Optical Networks”, University of Maryland, 2004.
4. HemaniKaushal, Jain V K, SubratKar, “Free Space Optical Communication”, Optical Networks, Springer, 2017

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2. http://ee.stanford.edu/~jmk/research/fsocom.html
3. http://www.rp-photonics.com/free_space_optical_communications.html
4. https://mrcet.com/downloads/digital_notes/ECE/III%20Year/FIBER%20OPTICAL%20COMMUNICATIONS.pdf
5. https://www.youtube.com/watch?v=VhM2zsHVXS0

COs/ POs/ PSOs Mapping

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5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE327	WIRELESS SENSOR NETWORK AND IOT	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Learn about Wireless sensor nodes
- To understand sensing node architecture
- To learn about routing protocols
- To know about IoT challenges
- Application in various areas

Course Outcomes

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

CO1 - Explain the concepts of sensors and conversion to digitally formatted signal for transmission. **(K2)**

CO2 - Evaluate the capacity and degradation in performance of various wireless MAC protocols in a transmission environment. **(K4)**

CO3 - Analyze schemes to transport sensor data to a server in a power efficient and time efficient

CO4 - Manner through IoT gateway. **(K4)**

CO5 - Case study on Architectural Approaches for IoT **(K4)**

UNIT I MOTIVATION FOR A NETWORK OF WIRELESS SENSOR NODES (9 Hrs)

Sensing and Sensors, Wireless Sensor Networks, Challenges and Constraints Applications: Structural Health Monitoring, Traffic Control, Health Care, Pipeline Monitoring, Precision Agriculture.

UNIT II SENSING NODE ARCHITECTURE (9 Hrs)

The Sensing Subsystem, the Processor Subsystem Communication Interfaces, Prototypes. Medium Access Control: Overview - Contention-Free Medium Access, Contention - Based Medium Access, Wireless MAC Protocols – CSMA, MACA and MACAW, MACA By Invitation, IEEE 802.11, IEEE 802.15.4 and ZigBee, Characteristics of MAC Protocols; Contention-Free, Contention-Based and Hybrid MAC Protocols.

UNIT III NETWORK LAYER (9 Hrs)

Overview, Routing Metrics, Flooding and Gossiping, Data-Centric Routing, Proactive Routing On-Demand Routing, Location-Based Routing, QoS-Based Routing Protocols. Power management in WSN.

UNIT IV NETWORKING PROTOCOLS AND STANDARDS FOR IoT (9 Hrs)

Introduction, IoT Data Link Protocols, Network Layer Routing Protocols, Network Layer Encapsulation Protocols, 6LoWPAN and RPL, Session Layer Protocols, IoT Management Protocols, IoT Challenges.

UNIT V INSTRUCTIONAL ACTIVITY (9 Hrs)

Case studies on: Architectural Approaches for IoT, Business Architecture, Functional Architecture, Application Architecture, Data and Analytics Architecture, Technology Architecture, Security and Governance, Suitable Case Studies / Assignment

Text Books

1. Fundamentals of Wireless Sensor Networks Theory and Practice, Waltenegus Dargie and Christian Poellabauer, 1st edition, John Wiley & Sons Ltd, 2010.
2. Internet of Things and Data Analytics Handbook, Hwaaiyu Geng,1st edition, John Wiley & Sons Ltd, 2017.
3. Feng Zhao & Leonidas J. Guibas, Wireless Sensor Networks- An Information Processing Approach", Elsevier, 2007.

Reference Books

1. Ian F. Akyildiz and Mehmet Can Vuran, “Wireless Sensor Networks” 1st edition, John Wiley & Sons Ltd, 2010
2. C.Siva Ram Murthy and B.S.Manoj “Ad Hoc Wireless Networks,” Pearson Edition 2005.
3. Raj Kamal, Internet of Things-Architecture and design principles, McGraw Hill Education.
4. Holger Karl & Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks”, John Wiley, 2005.
5. Kazem Sohraby, Daniel Minoli, & Taieb Znati, “Wireless Sensor Networks Technology, Protocols, and Applications”, John Wiley, 2007.

Web References

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://www.electronicshub.org/wireless-sensor-networks-wsn
3. https://www.class-central.com/tag/IoT
4. https://nptel.ac.in/courses/106/105/106105160/
5. https://onlinecourses.nptel.ac.in/noc20_cs66/preview

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	2	2
2	1	-	2	2	-	-	1	2	2
3	1	-	2	2	-	-	1	2	2
4	1	-	2	2	-	-	1	2	2
5	1	-	2	2	3	-	1	2	2

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE328	MULTICARRIER WIRELESS COMMUNICATION	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Getting insights about OFDM principles
- To get a Knowledge of how synchronization in OFDM
- To know about Adaptive modulation for OFDM
- To learn about Pilot Based OFDM channel estimation
- To simulate performance comparison of OFDM

Course Outcomes

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

CO1 - Comprehends the basic principles of OFDM concepts **(K2)**
CO2 - Analysis of synchronization in frequency and time domain **(K4)**
CO3 - Outline the Adaptive modulation for multiuser environment **(K2)**
CO4 - Illustrate the functions of ODFM channel estimation techniques. **(K3)**
CO5 - Illustrate the functions of ODFM channel equalization techniques. **(K4)**

UNIT I OFDM PRINCIPLES (9 Hrs)

System Model: Block diagram of OFDM system - generation of sub carrier using IFFT - guard time-cyclic extensions - windowing - choice of OFDM parameters - signal processing - bandwidth efficiency - peak to average power ratio - peak power problem - PAPR properties of OFDM signals; PAPR reduction techniques: Signal distortion techniques - multiple signalling and probabilistic techniques - coding techniques

UNIT II OFDM TIME AND FREQUENCY DOMAIN SYNCHRONIZATION (9 Hrs)

System performance with frequency and timing errors; Synchronization algorithms -comparison of frequency acquisition algorithms - BER performance with frequency synchronization.

UNIT III ADAPTIVE SINGLE AND MULTIUSER OFDM TECHNIQUES (9 Hrs)

Adaptive modulation for OFDM: Adaptive OFDM speech system - pre-equalization; Comparison of adaptive techniques - near optimum power and bit allocation in OFDM - multiuser AOFDM - Multiuser systems - Maximum likelihood enhanced sphere decoding of MIMO OFDM.

UNIT IV CHANNEL ESTIMATION IN OFDM SYSTEMS (9 Hrs)

Pilot Based OFDM channel estimation-example; Comb Type Pilot (CTP) Transmission - example; Channel estimation in time/ frequency domain; Frequency Domain Equalization (FDE).

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

BER Vs Eb/N0 for OFDM in AWGN channel- OFDM channel estimation using LS, LMMSE, and lower complexity LMMSE methods.

Text Books

1. Ramjee P, “OFDM for Wireless Communication Systems”, Artech House, 2004.
2. Lie-Liang Yang “Multicarrier Communications” John Wiley & Sons, Ltd, 2009
3. Carl R. Nassar, Bala Natarajan, Zhiqiang Wu, David A. Wiegandt Multi-Carrier Technologies for Wireless Communication, 2010.

Reference Books

1. Hanzo L and Keller T, “OFDM and MC-CDMA: A Primer”, John Wiley & Sons, 2006.
2. Henrik S and Christian L, “Theory and Applications of OFDM and CDMA: Wideband Wireless Communications”, John Wiley & Sons, 2005.
3. Bahai Ahmad R S, Burton R S and Mustafa E, “Multi-Carrier Digital Communications: Theory and Applications of OFDM”, 2nd Edition, Springer, 2004.
4. RahmatallahY and Mohan S, “Peak-to-Average Power Ratio Reduction in OFDM System: A Survey and Taxonomy”, IEEE Communication Surveys and Tutorials, vol. 15, no. 5, pp. 1567-1592, 2013.
5. Steven M K, "Fundamentals of Statistical Signal Processing: Estimation Theory ", Volume I, Prentice Hall, 1993.

Web References

1. http://www.nari.ee.ethz.ch/commth/pubs/p/commag06
2. http://www.morganclaypool.com/doi/abs/10.2200/S00255ED1V01Y201002ASE005
3. http://ethesis.nitrkl.ac.in/4380/
4. http://wncg.org/interference-mitigation-in-wireless-ofdm-communication-systems.html
5. https://nptel.ac.in/courses/117/104/117104115/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	2	2	-	-	1	3	3
2	1	-	2	2	-	-	1	3	3
3	1	-	2	2	-	-	1	3	3
4	1	-	2	2	-	-	1	3	3
5	1	-	2	2	3	-	1	3	3

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE329	CLOUD COMPUTING	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- Learn about Cloud Infrastructure
- To understand challenges of cloud computing
- To learn about cloud resource virtualization
- To know about resource management and scheduling
- To know about various security levels

Course Outcomes

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

CO1 - Present and document current trends and issues in Cloud Computing technology. **(K1)**
CO2 - Apply the knowledge of cloud technology to demonstrate the working principles of cloud for different application. **(K3)**
CO3 - Analyse concept of cloud computing technology in usage of various application. **(K4)**
CO4 - Conduct practical experiments for demonstrating cloud computing technology. **(K4)**
CO5 - Understand the concepts of cloud computing technology for different application. **(K5)**

UNIT I INTRODUCTION, CLOUD INFRASTRUCTURE (9 Hrs)

Cloud computing, Cloud computing delivery models and services, Ethical issues, Cloud vulnerabilities, Cloud computing at Amazon, Cloud computing the Google perspective, Microsoft Windows Azure and online services, Open-source software platforms for private clouds, Cloud storage diversity and vendor lock-in, Energy use and ecological impact, Service level agreements, User experience and software licensing. Exercises and problems.

UNIT II CLOUD COMPUTING: APPLICATION PARADIGMS (9 Hrs)

Challenges of cloud computing, Architectural styles of cloud computing, Workflows: Coordination of multiple activities, Coordination based on a state machine model: The Zookeeper, The Map Reduce programming model, A case study: The Gre The Web application, Cloud for science and engineering, High-performance computing on a cloud, Cloud computing for Biology research, Social computing, digital content and cloud computing.

UNIT III CLOUD RESOURCE VIRTUALIZATION (9 Hrs)

Virtualization, Layering and virtualization, Virtual machine monitors, Virtual Machines, Performance and Security Isolation, Full virtualization and paravirtualization, Hardware support for virtualization, Case Study: Xen a VMM based paravirtualization, Optimization of network virtualization, vBlades, Performance comparison of virtual machines, The dark side of virtualization, Exercises and problems

UNIT IV CLOUD RESOURCE MANAGEMENT AND SCHEDULING (9 Hrs)

Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Case study on: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images

Text Books

1. Dan C Marinescu: Cloud Computing Theory and Practice. Elsevier (MK) 2013.
2. Cloud Computing by Miller, Pearson,2008
3. Building applications in cloud: Concept, Patterns and Projects by Moyer, Pearson,2011

Reference Book

1. Rajkumar Buyya, James Broberg, AndrzejGoscinski: Cloud Computing Principles and Paradigms, Willey 2014
2. John W Rittinghouse, James F Ransome: Cloud Computing Implementation, Management and Security, CRC Press 2013.
3. Cloud Computing Bible by B. Sosinsky, Wiley India, 2011
4. Mastering Cloud Computing by R. Buyya, C. Vecchiola and S. T. Selvi, McGraw Hill,2013
5. Cloud computing: A practical approach by A. T. Velte, TMH, 2009

Web References

1. https://nptel.ac.in/courses/106/104/106104182/
2. https://nptel.ac.in/courses/106/105/106105223/
3. https://onlinecourses.nptel.ac.in/noc19_cs64/preview
4. https://nptel.ac.in/courses/106/105/106105223/
5. https://nptel.ac.in/courses/106/105/106105167/

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECE330	REMOTE SENSING	L	T	P	C	Hours
		3	0	0	3	45

Course Objectives

- learn the basic concepts, principles and applications of remote sensing,
- Learn about particularly to data collection, radiation.
- To study about RADAR system and characteristics
- To study the applications of principles to a variety of topics in remote sensing,
- Analysis the SNR w.r.t. spatial and spectral value

Course Outcomes

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

CO1 - Understand the basic concepts, principles and applications of remote sensing **(K2)**
CO2 - Understand about particularly to data collection, radiation. **(K2)**
CO3 - Understand about RADAR system and characteristics **(K2)**
CO4 - Apply the principles to a variety of topics in remote sensing, **(K3)**
CO5 - Analysis the SNR w.r.t. spatial and spectral value**(K4)**

UNIT I PHYSICS OF REMOTE SENSING (9 Hrs)

Electro Magnetic Spectrum, Physics of Remote Sensing - Effects of Atmosphere - Scattering – Different types – Absorption - Atmospheric window - Energy interaction with surface features – Spectral reflectance of vegetation, soil and water atmospheric influence on spectral response patterns - multi concept in remote sensing.

UNIT II DATA ACQUISITION (9 Hrs)

Types of Platforms – different types of aircrafts - Manned and Unmanned spacecrafts – sun synchronous and geo synchronous satellites – Types and characteristics of different platforms – LANDSAT, SPOT, IRS, INSAT, IKONOS, QUICKBIRD

UNIT III SCATTERING SYSTEM (9 Hrs)

Microwave scatterometry, types of RADAR – SLAR – resolution – range and azimuth – real aperture and synthetic aperture RADAR. Characteristics of Microwave images topographic effect - different types of Remote Sensing platforms – airborne and space borne sensors - ERS, JERS, RADARSAT, RISAT - Scatterometer, Altimeter - LiDAR remote sensing, principles, applications.

UNIT IV THERMAL AND HYPER SPECTRAL REMOTE SENSING (9 Hrs)

Sensors characteristics - principle of spectroscopy - imaging spectroscopy – field conditions, compound spectral curve, Spectral library, radiative models, processing procedures, derivative spectrometry, thermal remote sensing – thermal sensors, principles, thermal data processing, applications.

UNIT V INSTRUCTIONAL ACTIVITIES (9 Hrs)

Spatial, Spectral, Radiometric and temporal resolution - signal to noise ratio - data products and their characteristics - visual and digital interpretation

Text Books

1. Lillesand T.M., and Kiefer,R.W. Remote Sensing and Image interpretation, John Wiley & Sons-2000, 6thEdition
2. John R. Jensen, Introductory Digital Image Processing: A Remote Sensing Perspective, 2nd Edition, 1995.
3. Aronoff, Stan. Remote Sensing for GIS Managers, ESRI Press, 2005

Reference Books

1. John A.Richards, Springer – Verlag, Remote Sensing Digital Image Analysis, 1999.
2. Joseph, George and Jeganathan, C. (2017). “Fundamentals of Remote Sensing”, 3rd Edition, Universities press (India) Pvt. Ltd., Hyderabad.
3. Jensen, J.R. (2006). “Remote Sensing of the Environment – An Earth Resources Perspective”, Pearson Education, Inc. (Singapore) Pvt. Ltd., Indian edition, Delhi.
4. Jensen, J.R. (1996). Introductory Digital Image Processing A remote sensing perspective. Prentice Hall Seies in GIS, USA
5. Lillesand, Thomas M. and Kiefer, Ralph, W. (2007). “Remote Sensing and Image Interpretation”, 4th Edition, John Wiley and Sons, New York

Web References

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2. https://nptel.ac.in/noc/courses/noc19/SEM1/noc19-ce08/
3. https://www.digimat.in/nptel/courses/video/121107009/L01.html
4. https://nptel.ac.in/courses/105/108/105108077/
5. http://files.metrowestmodelun.com/uploads/1/3/1/4/131411596/kaperalori.pdf

COs/ POs/ PSOs Mapping

COs	Program Outcomes (POs)						Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PSO1	PSO2	PSO3
1	1	-	1	1	-	-	1	-	-
2	1	-	1	1	-	-	1	-	-
3	1	-	1	1	-	-	1	-	-
4	1	-	1	1	-	-	1	-	-
5	1	-	1	1	3	-	1	-	-

Correlation Level: 1-Low, 2-Medium, 3-High

P20ECC2XX	EMPLOYABILITY ENHANCEMENT COURSES	L	T	P	C	Hrs
		0	0	4	-	50

Students shall choose an International certification course offered by the reputed organizations like Google, Microsoft, IBM, Texas Instruments, Bentley, Autodesk, Eplan and CISCO, etc. The duration of the course is 40-50 hours specified in the curriculum, which will be offered through Centre of Excellence.

Pass /Fail will be determined on the basis of participation, attendance, performance and completion of the course. If a candidate fails, he/she has to repeat the course in the subsequent years. Pass in this course is mandatory for the award of degree.

AUDIT COURSES

Sl. No.	Course Code	Course Title
1	P20ACTX01	English for Research Paper Writing
2	P20ACTX02	Disaster Management
3	P20ACTX03	Sanskrit for Technical Knowledge
4	P20ACTX04	Value Education
5	P20ACTX05	Constitution of India
6	P20ACTX06	Pedagogy Studies
7	P20ACTX07	Stress Management by Yoga
8	P20ACTX08	Personality Development Through Life Enlightenment Skills
9	P20ACTX09	Unnat Bharat Abhiyan

P20ACTX01	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C	Hrs
		2	-	-	-	30

Course Objectives

- Teach improve writing skills and level of readability.
- Tell about what to write in each section.
- Summarize the skills needed when writing a Title.
- Infer the skills needed when writing the Conclusion.
- Ensure the quality of paper at very first-time submission.

Course Outcomes

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

CO1- Understand that how to improve your writing skills and level of readability.
CO2- Learn about what to write in each section.
CO3- Understand the skills needed when writing a Title.
CO4- Understand the skills needed when writing the Conclusion.
CO5- Ensure the good quality of paper at very first-time submission.

UNIT I INTRODUCTION TO RESEARCH PAPER WRITING (6 Hrs)

Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.

UNIT II PRESENTATION SKILLS (6 Hrs)

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticizing, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction.

UNIT III TITLE WRITING SKILLS (6 Hrs)

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

UNIT IV RESULT WRITING SKILLS (6 Hrs)

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

UNIT V VERIFICATION SKILLS (6 Hrs)

Useful phrases, checking Plagiarism, how to ensure paper is as good as it could possibly be the first- time submission

Reference Books

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

P20ACTX02 **DISASTER MANAGEMENT**

L	T	P	C	Hrs
2	-	-	-	30

Course Objectives

- Summarize basics of disaster explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Develop the strengths and weaknesses of disaster management approaches.

Course Outcomes

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

CO1 - Ability to summarize basics of disaster.
CO2 - Ability to explain a critical understanding of key concepts in disaster risk reduction and humanitarian response.
CO3 - Ability to illustrate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
CO4 - Ability to describe an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
CO5- Ability to develop the strengths and weaknesses of disaster management approaches.

UNIT I INTRODUCTION (6 Hrs)

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

UNIT II REPERCUSSIONS OF DISASTERS AND HAZARDS (6 Hrs)

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

UNIT III DISASTER PRONE AREAS IN INDIA (6 Hrs)

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

UNIT IV DISASTER PREPAREDNESS AND MANAGEMENT (6 Hrs)

Preparedness: Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

UNIT V RISK ASSESSMENT (6 Hrs)

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

Reference Books

1. Goel S. L., Disaster Administration and Management Text and Case Studies", Deep& Deep Publication Pvt. Ltd., New Delhi,2009.
2. NishithaRai, Singh AK, "Disaster Management in India: Perspectives, issues and strategies 'New Royal book Company,2007.
3. Sahni, Pardeep Et.Al., "Disaster Mitigation Experiences and Reflections", Prentice Hall of India, New Delhi,2001.

P20ACTX03	SANSKRIT FOR TECNICAL KNOWLEDGE	L	T	P	C	Hrs
		2	-	-	-	30

Course Objectives

- Illustrate the basic Sanskrit language
- Recognize Sanskrit, the scientific language in the world
- Appraise learning of Sanskrit to improve brain functioning
- Relate Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
- Extract huge knowledge from ancient literature

Course Outcomes

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

CO1- Understanding basic Sanskrit language.
CO2- Write sentences.
CO3- Know the order and roots of Sanskrit.
CO4- Know about technical information about Sanskrit literature.
CO5- Understand the technical concepts of Engineering.

UNIT I ALPHABETS (6 Hrs)

Alphabets in Sanskrit.

UNIT II TENSES AND SENTENCES (6 Hrs)

Past/Present/Future Tense - Simple Sentences.

UNIT III ORDER AND ROOTS (6 Hrs)

Order - Introduction of roots of Engineering-Electrical, Mechanical, Architecture, Mathematics.

UNIT IV SANSKRIT LITERATURE (6 Hrs)

Technical information about Sanskrit Literature.

UNIT V TECHNICAL CONCEPTS OF ENGINEERING (6 Hrs)

Technical concepts.

Reference Books

1. "Abhyaspustakam" – Dr. Vishwas, Samskrita-Bharti Publication, New Delhi.
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication.
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

P20ACTX04	VALUE EDUCATION	L	T	P	C	Hrs
		2	-	-	-	30

Course Objectives

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

Course Outcomes

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

CO1-Knowledge of self-development.
CO2-Learn the importance of Human values.
CO3-Developing the overall personality.

UNIT I (7 Hrs)

Alphabets in Sanskrit.

Values and self-development–Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non-moral valuation. Standards and principles. Value judgements of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

UNIT II (7 Hrs)

Alphabets in Sanskrit.

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

UNIT III (8 Hrs)

Alphabets in Sanskrit.

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

UNIT IV (8 Hrs)

Alphabets in Sanskrit.

Character and Competence–Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role.

Reference Books

1. Chakroborty, S.K.“Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

P20ACTX05 **CONSTITUTION OF INDIA**

L	T	P	C	Hrs
2	-	-	-	30

Course Objectives

- Understand the premises informing the twin themes of liberty and freedom from a civil rights Perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional.
- Role and entitlement to civil and economic rights as well as the emergence nation hood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolutionin1917and its impact on the initial drafting of the Indian Constitution.

Course Outcomes

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

CO1 - Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

CO2 - Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.

CO3 - Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections.

CO4 - Discuss the passage of the Hindu Code Bill of 1956.

UNIT I HISTORY OF MAKING OF THE INDIAN CONSTITUTION (5 Hrs)

History, Drafting Committee, (Composition & Working).

UNIT II PHILOSOPHY OF THE INDIAN CONSTITUTION (5 Hrs)

Preamble, Salient Features.

UNIT III CONTOURS OF CONSTITUTIONAL RIGHTS AND DUTIES (5 Hrs)

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT IV ORGANS OF GOVERNANCE (5 Hrs)

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

UNIT V LOCAL ADMINISTRATION (5 Hrs)

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

UNIT VI ELECTION COMMISSION (5 Hrs)

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

Reference Books

1. "The Constitution of India,1950(Bare Act), Government Publication.
2. Dr.S.N.Busi, Dr.B. R.Ambedkar framing of Indian Constitution,1st Edition, 2015.
3. M.P. Jain, Indian Constitution Law, 7th Edition, Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015 "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi, 2017.

P20ACTX06 **PEDAGOGY STUDIES**

L	T	P	C	Hrs
2	-	-	-	30

Course Objectives

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

Course Outcomes

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

CO1 - What pedagogical practices are being used by teachers informal and informal classrooms in developing countries?

CO2- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?

CO3- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT I INTRODUCTION AND METHODOLOGY: **(6 Hrs)**

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

UNIT II THEMATIC OVERVIEW **(6 Hrs)**

Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education.

UNIT III EVIDENCE ON THE EFFECTIVENESS OF PEDAGOGICAL PRACTICES (6 Hrs)

Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches - Teachers' attitudes and beliefs and Pedagogic strategies.

UNIT IV PROFESSIONAL DEVELOPMENT **(6 Hrs)**

Professional development: alignment with classroom practices and follows up support – Peer support - Support from the head teacher and the community - Curriculum and assessment - Barriers to learning limited resources and large class sizes.

UNIT V RESEARCH GAPS AND FUTURE DIRECTIONS **(6 Hrs)**

Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment - Dissemination and research impact.

Reference Books

1. Ackers J, HardmanF (2001) Classroom interaction in Kenyan primary schools, Compare, 31(2): 245- 261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36(3):361-379.
3. Akyeampong K (2003) Teacher training in Ghana-does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33(3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.

P20ACTX07	STRESS MANAGEMENT BY YOGA	L	T	P	C	Hrs
		2	-	-	-	30

Course Objectives

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

Course Outcomes

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

CO1 - Develop healthy mind in a healthy body thus improving social health also

CO2 - Improve efficiency.

UNIT I **(10 Hrs)**

Definitions of Eight parts of yoga. (Ashtanga).

UNIT II **(10 Hrs)**

Yam and Niyam - Do`s and Don't's in life - i) Ahinsa, satya, astheya, bramhacharya and aparigraha, ii) Ahinsa, satya, astheya, bramhacharya and aparigraha.

UNIT III **(10 Hrs)**

Asan and Pranayam - Various yog poses and their benefits for mind & body - Regularization of breathing techniques and its effects-Types of pranayam.

Reference Books

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

P20ACTX08	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C	Hrs
		2	-	-	-	30

Course Objectives

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

Course Outcomes

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

CO1 - Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life.

CO2 - The person who has studied Geeta will lead the nation and mankind to peace and prosperity.

CO3 - Study of Neet is hatakam will help in developing versatile personality of students.

UNIT I **(10 Hrs)**

Neetisatakam-holistic development of personality - Verses- 19,20,21,22 (wisdom) - Verses- 29,31,32 (pride & heroism) – Verses- 26,28,63,65 (virtue) - Verses- 52,53,59 (dont's) - Verses- 71,73,75,78 (do's) 4-Verses 18, 38,39 Chapter18 – Verses37,38,63.

UNIT II **(10 Hrs)**

Approach to day to day work and duties - Shrimad Bhagwad Geeta: Chapter 2-Verses 41, 47,48 - Chapter 3-Verses 13, 21, 27, 35 Chapter 6-Verses 5,13,17,23, 35 - Chapter 18-Verses 45, 46, 48.model – shrimad bhagwad geeta - Chapter2- Verses 17, Chapter 3-Verses 36,37,42 – Chapter.

UNIT III **(10 Hrs)**

Statements of basic knowledge – Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 Chapter12 -Verses 13, 14, 15, 16,17, 18 - Personality of role.

Reference Books

1. Gopinath, Rashtriya Sanskrit Sansthanam P, Bhartrihari's Three Satakam, Niti-sringar- vairagya, New Delhi,2010.
2. Swami Swarupananda ,Srimad Bhagavad Gita, Advaita Ashram, Publication Department, Kolkata, 2016.

P20ACTX09 UNNAT BHARATH ABHIYAN

L	T	P	C	Hrs
2	0	0	0	30

Course Objectives

- To develop an appreciation of rural culture, lifestyle and wisdom among students
- To learn about the status of various agricultural and rural development programmes
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and there by improve quality of learning.

Course Outcomes

After completion of the course, the students will be able to
CO1- Gain an understanding of rural life, culture and social realities
CO2- Develop a sense of empathy and bonds of mutuality with local community
CO3- Appreciate significant contribution so local communities to Indian society and economy
CO4- Learn to value the local knowledge and wisdom of the community
CO5- Identify opportunities for contributing to community's socio-economic improvements.

UNIT I APPRECIATION OF RURAL SOCIETY (4 Hrs)
Rurallife style, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of soul of India lies in villages'(Gandhi), rural infrastructure.

UNIT II UNDERSTANDINGRURALECONOMY&LIVELIHOOD (4 Hrs)
Agriculture, farming, landownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets

UNIT III RURALINSTITUTIONS (4 Hrs)
Traditional rural organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), local civil society, local administration.

UNIT IV RURALDEVELOPMENTPROGRAMMES (4 Hrs)
History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, BetiBachao, BetiPadhao, Ayushman Bharat, Swatchh Bharat, PMAwaas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA, etc.

UNIT V FIELD BASED PRACTICL ACTIVITIES (4 Hrs)
Visit MGNREGS project sites. Swachh Bharat project sites, Conduct Mission Antigo day a surveys, Interactive community exercise with local leaders, panchayat functionaries, Visit Rural Schools / mid-day meal centres, study Academic and infrastructural resources and gaps, Participate in Gram Sabha meetings, Visit local Anganwadi Centre, Conduct soil health test, drinking water analysis.

Reference Books:

1.Singh, Katar, Rural Development: Principles, Policiesand Management, Sage Publications, NewDelhi, 2015.
2.A Handbook on Village Panchayat Administration, RajivGandhi Chair for Panchayat I Raj Studies, 2002.
3.UnitedNations, Sustainable Development Goals, 2015 un.org/sdgs/
4.M.P. Boraian, Bes tPractices in Rural Development, Shanlax Publishers, 2016.