SEMESTER III

S.No	Category	Course Code	Course Title	L	T	P	C
Theory							
1	PC	PCS19301	High Performance Communication Networks	3	0	0	3
2	PE	PCS1955*	Professional Elective V	3	0	0	3
3	OE	********	Open Elective	3	0	0	3
Practical							
4	PC	PCS19302	Dissertation Phase I	0	0	20	10

SEMESTER IV

S.No	Category	Course Code	Course Title	L	T	P	C
Practical							
1	PC	PCS19401	Dissertation Phase II	0	0	24	16

PROFESSIONAL ELECTIVE V

S.No	Category	Course Code	Course Title	L	T	P	C
1	PE	PCS19551	Simulation of Communication Systems and Networks	3	0	0	3
2	PE	PCS19552	Neural Network and Applications	3	0	0	3
3	PE	PCS19553	Cognitive Radio Networks	3	0	0	3
4	PE	PCS19554	Digital Communication Techniques	3	0	0	3

OPEN ELECTIVE

S.No	Category	Course Code	Course Title	L	T	P	C
1	OE	PMA19901	Operations Research	3	0	0	3
2	OE	PSE19901	Cost Management of Engineering Projects	3	0	0	3
3	OE	PCE19901	Business Analytics	3	0	0	3
4	OE	PED19901	Industrial safety	3	0	0	3
5	OE	PED19902	Composite Materials	3	0	0	3
6	OE	PED19903	Waste to Energy	3	0	0	3

SEMESTER III

PCS19301 HIGH PERFORMANCE COMMUNICATION NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- develop a sound knowledge on high performance networks.
- inculcate a comprehensive understanding of multimedia networking.
- study the wireless and mobile networks
- learn about network performance evaluation
- understand various network security in computer networks

UNIT I INTRODUCTION 9

History of Communication Networks- Networking Principles-Future Networks-High Performance Networks- The Internet and TCP/IP Networks,-Packet Switched Networks- Circuit Switched Networks- Asynchronous Transfer mode.

UNIT II MULTIMEDIA NETWORKING 9

Multimedia Networking Applications- Streaming stored Audio and Video,-Best effort service-Protocols for real time interactive applications-Distributing Multimedia: Content Distribution Networks- Beyond Best Effort-Scheduling.

UNIT III WIRELESS AND MOBILE NETWORKS 9

Introduction- Wireless links and network characteristics- Wi-Fi: IEEE 802.11 Wireless LANs-Cellular Internet Access, Mobility management: Principle- Mobile IP- Managing Mobility in cellular Networks- Wireless and Mobility: Impact on Higher-layer protocols.

UNIT IV COMPRESSION AND NETWORK PERFORMANCE EVALUATION 9

Foundations of Compression, Audio Compression, Video Compression, Network Performance Evaluation- Monitoring, SNMP-CMOT and RMON- Models and Analysis- Simulation.

UNIT V SECURITY IN COMPUTER NETWORKS 9

Principles of Cryptography – Authentication – Integrity – Key distribution and certification – Access control: Fire.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- explain the concept of introduction of various network Topology
- discuss about the knowledge about the use of network in multimedia field
- execute the various advanced techniques used in networking
- work on compression techniques and evaluation of networks
- exercise network security concepts in computer networks

REFERENCES

1. Jean Walrand, PravinVaraiya, "High Performance Communication Network", Morgan Kaufmann Publishers Inc., Second edition, 2000
2. James F Kurose & Keith W Ross, "Computer Networking- A top down approach featuring the internet", Pearson, Third edition, 2006.
3. Jean Walrand, "Communication networks", McGraw Hill, second edition 2002.
4. Leom-Garcia, Widjaja, "Communication Networks", TMH, Seventh reprint 2002.
5. HersentGurle& petit, "IP Telephony, Packet Pored Multimedia communication Systems", Pearson education, 2003.
6. Nader F.Mir, "Computer and Communication Networks", First edition, 2010.
7. Larryl.Peterson& Bruce S.David, "Computer Networks: A System Approach", 1996.

CO/PO Mapping (1-Low; 2-Medium ; 3-High)														
COs	**Programme Outcomes (Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3

PCS19302 **DISSERTATON PHASE I** **0 0 20 10**

COURSE OBJECTIVES

To enable the students to

- apply the fundamental knowledge for understanding state of the art information about any topic relevant tocurriculum
- identify a specific problem for the current need of the society and collectinginformation related to the same through detailed review of literatures.
- develop the methodology to solve the identifiedproblems.
- prepare the project reports and face reviews and viva-voceexamination.

SYLLABUS

The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL PERIODS: 300

COURSE OUTCOMES

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

- review Communication engineering problems available inliterature
- select appropriate techniques to analyse the complex Communication engineeringproblems
- apply engineering and management principles through efficient handling of project and have a clear idea of his/her area of work and they are in a position to carry out the work in a systematic way.
- write a detailed report about the topic in the prescribedformat

Co-Po Mapping:

Mapping of Course Objectives with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	-	2	1	2	3	2	1	3	3	3
CO2	3	3	1	3	-	-	1	-	3	-	1	3	3	3
CO3	2	2	2	-	-	2	1	2	2	2	1	3	3	3
CO4	3	3	3	3	-	2	2	3	3	2	1	3	3	3

SEMESTER IV

PCS19401 **DISSERTATION PHASE II** **0 0 24 16**

COURSE OBJECTIVES

To enable the students to

- carry out analytical and/or experimental research oriented work in the field of Communication Engineering
- formulate / define the problem fordissertation.
- solve the identified problem based on the formulatedmethodology
- improve the skills to analyse and discuss the test results and makeconclusions
- develop the skills to write conference paper and to write project report

SYLLABUS

The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

TOTAL PERIODS: 480

COURSE OUTCOMES

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

- take up any challenging practical problem the field of Communication and find bettersolutions.
- implement concepts, tools and techniques to do qualityprojects
- interpret, discuss, compare the work and to give conclusions
- analyse and prepare the report for a given project
- write and present technical paper based on the researchwork.

Co-Po Mapping:

Mapping of Course Objectives with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	3	-	2	1	2	3	2	1	3	3	3
CO2	3	3	1	3	-	-	1	-	3	-	1	3	3	3
CO3	2	2	2	-	-	2	1	2	2	2	1	3	3	3
CO4	3	3	1	3	-	-	1	-	3	-	1	3	3	3
CO5	3	3	2				1	2	2	2	1	3	3	3

PROFESSIONAL ELECTIVE V

PCS19551	SIMULATION OF COMMUNICATION SYSTEMS AND NETWORKS	3	0	0	3

COURSE OBJECTIVES

To enable students to

- analyse the mathematical models for sources and channels
- understand the simulation of Random variables and random process
- develop and the performance measure of analog and digital communication systems
- analyse various queuing models
- analyse the congestion and flow control in communication networks.

UNIT I MODELLING OF COMMUNICATION SYSTEM 9

Model of speech and picture signals, Pseudo noise sequences, Non-linear sequences, Analog channel model- Noise and fading, Digital channel model-Gilbert model of bursty channels, HF, Tropo-scatter and satellite channels, Switched telephone channels, Analog and Digital communication system models, Light wave system models.

UNIT II SIMULATION OF RANDOM VARIABLES AND RANDOM PROCESS 9

Univariate and multivariate models, Transformation of random variables, Bounds and approximation, Random process models - Markov and ARMA Sequences, Sampling rate for simulation, Computer generation and testing of random numbers.

UNIT III ESTIMATION OF PERFORMANCE MEASURES 9

Quality of an estimator, Estimator for SNR, Probability density functions of Analog Communication System, BER of digital communication systems, Monte-Carlo method and Importance of sampling method, Estimation of power spectral density.

UNIT IV COMMUNICATION NETWORKS 9

Queuing models, M/M/I and M/M/I/N queues, Little formula, Burke's theorem , M/G/I queue, Embedded Markov chain analysis of TDM systems, Polling, Random access systems.

UNIT V NETWORK OF QUEUES 9

Queues in tandem, Store and Forward communication networks, Capacity allocation, Congestion and flow chart, Routing model, Network layout and Reliability.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- Interpret and analyse mathematical models for sources and channels
- Apply random number generation algorithms and analyse the properties using simulation tools.
- Develop simulation models for digital communication systems and analyse suitable parameters
- Analyse various queuing models

- Analyse the networking problems by conducting suitable simulation experiments using appropriate tools.

REFERENCES

1.M.C.Jeruchim, Philip Balaban and K.SamShanmugam, "Simulation of CommunicationSystems",Plenum Press, New York, 1992.

2.A.M.Law and W.DavidKelton, "Simulation Modelling and Analysis",McGraw Hill Inc., New York, 1991.

3. J.F.Hayes, "Modelling and Analysis of Computer Communication networks", Plenum Press, New York, 1984.

4.Jerry Banks and John S.Carson, "Discrete-event System Simulation", Prentice Hall Inc., New Jersey,1984.

CO/PO Mapping (1-Low; 2-Medium ; 3-High)														
COs	**Programme Outcomes (Pos)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	-	-	-	-	-	-	-	-	2	3	3
CO4	3	2	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	2	3	2	-	-	-	-	-	-	-	3	3	3

PCS19552 NEURAL NETWORK AND APPLICATIONS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- study the concepts of biological and artificial neurons
- know the concept of radial basis function networks
- explore the fundamentals of various algorithms related to supervised neural network and their applications
- understand the concept of adaptive resonance
- explore the applications of various algorithms related to Genetic algorithms and SVM

UNIT I LEARNING ALGORITHMS **9**

Biological Neuron - Artificial Neural Model - Types of activation functions - Architecture: Feed forward and Feedback - Learning Process: Error Correction Learning -Memory Based Learning - Hebbian Learning Competitive Learning - Boltzmann Learning - Supervised and Unsupervised Learning -Learning Tasks: Pattern Space - Weight Space - Pattern Association - Pattern Recognition - Function Approximation -Control - Filtering

UNIT II RADIAL BASIS FUNCTION NETWORKS AND SUPPORT VECTOR MACHINES RADIAL BASIS FUNCTION NETWORKS **9**

Exact Interpolator – Regularization Theory – Generalized Radial Basis Function Networks - Learning in Radial Basis Function Networks - Applications: XOR Problem – Image Classification Support Vector Machines: Optimal Hyper plane for Linearly Separable Patterns and Non separable Patterns Support Vector Machine for Pattern Recognition – XOR Problem - -insensitive Loss Function – Support Vector Machines for Nonlinear Regression

UNIT III ATTRACTOR NEURAL NETWORKS **9**

Associative Learning – Attractor Neural Network Associative Memory – Linear Associative Memory – Hopfield Network – Content Addressable Memory – Strange Attractors and Chaos - Error Performance of Hopfield Networks- Applications of Hopfield Networks – Simulated Annealing – Boltzmann Machine – Bidirectional Associative Memory – BAM Stability Analysis – Error Correction in BAMs - Memory Annihilation of Structured Maps in BAMS – Continuous BAMs – Adaptive BAMs – Applications.

UNIT IV ADAPTIVE RESONANCE THEORY **9**

Noise-Saturation Dilemma - Solving Noise-Saturation Dilemma – Recurrent On-center –Off-surround Networks Building Blocks of Adaptive Resonance – Substrate of Resonance Structural Details of Resonance Model –Adaptive Resonance Theory – Applications.

UNIT V SELF ORGANIZING MAPS AND NEOCOGNITRON **9**

Self-organizing Map - Maximal Eigenvector Filtering - Sanger's Rule - Generalized Learning Law – -Competitive Learning - Vector Quantization – Mexican Hat Networks - Self-organizing Feature

Maps – Applications. Architecture of Neocognitron - Data processing and performance ofNeocognitron - Architecture of spatio–temporal networks for speech recognition.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- evaluate the basics of neural networks.
- identify the concepts of radial basis functions.
- gain knowledge about bidirectional associative memory.
- trace the principles of resonance theory.
- gain in-depth knowledge about self-organizing maps.

REFERENCES

1. Satish Kumar, "Neural Networks: A Classroom Approach", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2004
2. Simon Haykin, "Neural Networks: A Comprehensive Foundation", Addison Wesley Longman (Singapore) Private Limited, Delhi, second edition, 2001.
3 James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and Programming Techniques", Pearson Education 2003.
4 SimonHaykin, "Neural Networks: A Comprehensive Foundation", second edition, Prentice Hall India, 2002.
5 MartinT.Hagan, Howard B. Demuth, and Mark Beale, "Neural Network Design", Thomson Learning, New Delhi, 2003.

CO/PO Mapping (1-Low; 2-Medium ; 3-High)														
COs	Programme Outcomes (Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO3	3	3	2	-	-	-	-	-	-	-	-	2	3	3
CO4	3	1	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3

PCS19553 COGNITIVE RADIO NETWORKS 3 0 0 3

COURSE OBJECTIVES

To enable students to

- know the evolution of Software Defined Radio and Cognitive Radio
- understand the concepts of cognitiveradio and its architecture.
- learn spectrum sensing and dynamic spectrumaccess
- know the design concept of MAC and network layer
- learn about technologies adopted for cognitive radio

UNIT I INTRODUCTION TO SOFTWARE-DEFINED RADIO AND COGNITIVE RADIO 9

Evolution of Software Defined Radio and Cognitive radio: goals, benefits, definitions, architectures, relations with other radios, issues, enabling technologies, radio frequency spectrum and regulations.

UNIT II COGNITIVE RADIO ARCHITECTURE 9

Cognitive Radio – functions, components and design rules, Cognition cycle – orient, plan, decide and act phases, Inference Hierarchy, Architecture maps, Building the Cognitive Radio Architecture on Software defined Radio Architecture, Overview of IEEE 802.22 standard for broadband wireless access in TVbands.

UNIT III SPECTRUM SENSING AND DYNAMIC SPECTRUM ACCESS 9

Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection , Bayesian Approach, Neyman Pearson fusion rule for spectrum sensing, Optimum spectrum sensing - KullbackLeibler Divergence and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio.

UNIT IV MAC AND NETWORK LAYER DESIGN FOR COGNITIVE RADIO 9

MAC for cognitive radios – Multichannel MAC - slotted ALOHA – CSMA, Network layer design – routing in cognitive radios, flow control and error control techniques.

UNIT V ADVANCED TOPICS IN COGNITIVE RADIO 9

Cognitive radio for Internet of Things - Features and applications – Enabling technologies and protocols – M2M technologies - Data storage and analysis techniques - Requirement and challenges of IoT – Energy efficiency– MIMO Cognitive Radio – Power allocation algorithms.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- know the evolution and concepts of cognitiveradio
- design the cognitive radio architecture
- gain knowledge on spectrum sensing and dynamic spectrum access
- design MAC layer and Network layer for cognitive radio
- apply the cognitive radio concepts and future scope of cognitive radio

REFERENCES

- Alexander M.Wyglinski,MaziarNekovee,ThomasHou,"Cognitive Radio Communications and Networks", Academic Press, Elsevier,2010.
- Bruce Fette, "Cognitive Radio Technology", Newnes, 2006.
- Kwang-Cheng Chen, Ramjee Prasad, "Cognitive Radio Networks", John Wiley and Sons, 2009.
- HuseyinArslan (Ed.), "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007.
- S.Shanmugavel, M.A.Bhagyaveni, R.Kalidoss, "Cognitive Radio-An Enabler for Internet of things", River Publishers, 2017.

CO/PO Mapping (1-Low; 2-Medium ; 3-High)														
COs	Programme Outcomes (Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	2	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3

PCS19554 DIGITAL COMMUNICATION TECHNIQUES 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the envelope modulation techniques
- acquire knowledge about filtering coding and scrambling
- know the various modulation algorithm
- gain knowledge in gain modulation
- design space time coding

UNIT I DIGITAL MODULATION SCHEMES 9

Representation of Digitally Modulated signals, Memory less Modulation Methods, Signalling Schemes with Memory –CPFSK, CPM, Power Spectrum of Digitally Modulated Signals-PSD of a digitally modulated signal with memory, PSD of a linear modulated signal, PSD of a digitally modulated signal with Finite memory, PSD of a digitally modulation scheme with a Markov Structure.

UNIT II OFDM 9

Generation of sub-carriers using the IFFT; Guard Time and Cyclic Extension Windowing; OFDM signal processing; Peak Power Problem: PAP reduction schemes-Clipping, Filtering, Coding and Scrambling.

UNIT III TRELLIS CODED MODULATION 9

Coded modulation for bandwidth-constrained channels-Trellis coded modulation; Set Partitioning, Four –state Trellis-coded modulation with 8-PSK signal constellation, Eight-state Trellis code for coded 8-PSK modulation, Eight-state Trellis for rectangular QAM signal constellations.

UNIT IV TURBO CODING 9

Introduction-Turbo Encoder, Turbo Decoder, Iterative Turbo Decoding Principles; Modifications of the MAP Algorithm- The Soft-Output Viterbi Algorithm(SOVA); Turbo Coded BPSK Performance over Gaussian channels, Turbo Coding Performance over Rayleigh Channels.

UNIT V SPACE-TIME CODING 9

Maximum Ratio combining; Space-time Block codes; Space-time Trellis codes- The 4-state, 4-PSK Space-time Trellis Encoder, The 4-state,4-PSK Space-time Trellis Decoder, MIMO-OFDM Systems.

TOTAL PERIODS 45

COURSE OUTCOMES

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

- know the envelope modulation techniques
- explain about filtering coding and scrambling
- acquire knowledge in gain modulation
- apply various algorithm for digital communication
- design space time coding

REFERENCES

1. Bernard Seklar., "Digital Communications", second edition, Pearson Education, 2001.
2. Theodore S.Rappaport., "Wireless Communications", 2nd edition, Pearson Education, 2002.
3. Stephen G. Wilson., "Digital Modulation and Coding", First Indian Reprint, Pearson Education, 2003.
4. Richard Van Nee &Ramjee Prasad., "OFDM for Multimedia Communications" Artech HousePublication, 2001
5. Simon Haykins, "Communication System", John Wiley and Sons, 2008.

CO/PO Mapping (1-Low; 2-Medium ; 3-High)														
Cos	Programme Outcomes (Pos)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	2	3	-	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	3	3	3

OPEN ELECTIVE

PMA19901	OPERATIONS RESEARCH	3	0	0	3

COURSE OBJECTIVES

To enable the students to

- understandthemathematicalformulationofreal-worldproblemsasalinearprogrammingmodelandapply the theoretical workings of the graphical and simplex method.
- develop various constructive techniques of Transportation and Assignment models to makeeffectivebusiness decisions.
- introduce the concepts of nonlinear programming problem to develop the quantitative toolsfor identifying, analyzing and practicing strategic decisions.
- develop various constructive techniques for the field of inventory and productionmanagement.
- impart knowledgeto manage the projectanalysisby network models and organize the tools and techniques of CPM andPERT.

UNIT-I LINEAR PROGRAMMING 9

Principal components of decision problem, modeling phases, LP Formulation and graphic solution, Resourceallocation problems, Simplex method.

UNIT-II TRANSPORTATION AND ASSIGNMENT MODELS 9

Mathematical formulation of transportation problem; Methods for finding initial basic feasible solution, optimum solution, degeneracy; Mathematical formulation of assignment models - Hungarian Algorithm,variantsof the Assignment problem.

UNIT-III CLASSICAL OPTIMISATION THEORY 9

Nonlinear programming problem, Kuhn-Tucker conditions min cost flow problem, max flow problem.

UNIT-IV INVENTORY MODELS 9

Inventory models, Economic order quantity models, Quantity discount models, Stochastic inventory models,Multi product models, Inventory control models in practice.

UNIT-V NETWORKINGMODELS 9

Network diagram representation, Critical path method, Time charts and resource leveling, PERT.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- demonstrate the mathematical formulation of real-world problems as a linear programming modelandapply the theoretical workings of the graphical and simplex method.
- determine the optimal solution of maximizing the profit and minimizing the cost of bothtransportation and assignment problems.

- develop mathematical skills to analyse and solve Nonlinear programmingproblem.
- determine the optimization concepts in inventory controlmodels.
- use CPM and PERT techniques to plan, schedule and Control projectactivities.

REFERENCE BOOKS

1. Taha H.A., "Operations Research: An Introduction " 10th Edition, Pearson Education, 2017.
2. A.M.Natarajan, P.Balasubramani, A.Tamilarasi, "Operations Research", Pearson Education, Asia, 2013.
3. Prem Kumar Gupta, D.S. Hira, "Operations Research", S.Chand& Company Ltd, New Delhi, 3rd Edition,2013.
4. John W. Chinneck "Feasibility and Infeasibility in Optimization Algorithms and Computational Methods", Springer, 2013.
5. Ravindran, Phillips, Solberg, "Operations Research: Principles and Practice", 2nd Edition, JohnWiley& Sons, 2012.

Co-Po Mapping:

Mapping of Course Objectives with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak

COs	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO2	2	3	2	2	-	-	-	-	-	-	-	2	3	3
CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	3
CO4	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	-	-	-	-	-	-	-	3	3	3

PSE19901 COST MANAGEMENT OF ENGINEERING PROJECTS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- understand the costing concepts and their role in decision making
- apply project management concepts while selecting various projects
- interpret costing concepts with project execution
- analyze costing techniques and various budgetary control techniques which used in service sector
- compute solution for quantitative techniques in cost management

Prerequisite: Nil

UNIT I INTRODUCTION 9

Costing System- Objectives of a Costing System, Cost concepts in decision-making, Relevant cost, Differential cost, Incremental cost and Opportunity cost; Creation of a Database for operational control.

UNIT II PROJECT MANAGEMENT 9

Project - meaning, Different types, why to manage, cost overruns centres, various stages of project execution, conception to commissioning; Project execution as conglomeration of technical and nontechnical activities, Detailed Engineering activities, Pre project execution main clearances and documents; Project team- Role of each member; Importance Project site- Data required with significance, Project contracts.

UNIT III PROJECT EXECUTION AND COSTING CONCEPT 9

Project execution - Project cost control, Bar charts and Network diagram, Project commissioning; mechanical and process, Cost Behavior and Profit Planning - Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis, Various decision-making problems; Pricing strategies- Pareto Analysis, Target costing, Life Cycle Costing.

UNIT IV COSTING OF SERVICE SECTOR AND BUDGETERY CONTROL 9

Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Activity- Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis; Budgetary Control- Flexible Budgets; Performance budgets; Zero-based budgets.

UNIT V QUANTITATIVE TECHNIQUES FOR COST MANAGEMENT 9

Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the costing concepts in decision making
- select various projects based on project management concepts

- execute the project with optimum costing concept
- use costing techniques and various budgetary control techniques in service sector
- solve quantitative techniques CPM/PERT in cost management.

REFERENCES

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi, 2018.
2. Charles T. Horngren and George Foster, Advanced Management Accounting, Prentice Hall of India, 2011.
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting, e-book.
4. Vohra N.D., Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd, 2007.
5. Cost management by Dr. J. Made Gowda, Himalaya Publishing House, 2013.

Co-Po Mapping:

Mapping of Course Objectives with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak**														
Cos	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1	2	-	2	-	-	2	3	-	3	2	1	-
CO2	2	2	2	-	2	-	-	-	2	-	3	3	-	2
CO3	3	1	3	-	3	1	-	-	-	-	3	3	-	1
CO4	3	2	3	-	3	-	3	-	-	-	3	2	1	2
CO5	3	2	2	-	3	1	2	-	-	-	3	3	1	2

PCE19901 BUSINESS ANALYTICS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- analyze data using statistical and data mining techniques and understand relationships betweenthe underlying business processes of an organization.
- gain an understanding of how managers use business analyticsto formulate and solve business problems and to support managerial decision making.
- become familiar with processes needed to develop, report, and model business data.
- analyze and solve problems from different industries such as manufacturing, service, retail,banking and finance, sports, pharmaceutical, aerospace etc.
- use decision-making tools/operations researchtechniques.

Prerequisite: Nil

UNIT I INTRODUCTION 9

Business analytics- Overview of business analytics, scope of business analytics, business analytics process, relationship of business analytics process and organization, competitive advantages of business analytics; Statistical Tools- Statistical notation, descriptive statistical methods- data mining introduction.

UNIT II ANALYSIS 9

Trendiness and Regression Analysis- Modeling relationships and trends in data, business analytics personnel, data and models for business analytics, problem solving, visualizing and exploring data, business analytics technology.

UNIT III MODELLING 9

Organization Structures of Business analytics; Team management; Management Issues; DesigningInformation Policy; Outsourcing; Ensuring Data Quality; Measuring contribution of Business analytics; ManagingChanges.

UNIT IV FORECASTING 9

Forecasting Techniques- Qualitative and Judgmental Forecasting, statistical forecasting models, forecasting models for stationary time series, forecasting time series with seasonality, regression forecasting with casual variables. Monte Carlo Simulation - Monte carlo simulation using analytic solver platform, new-product development model, newsvendor model, overbooking model, cash budget model

UNIT V DECISION MAKING 9

Decision Analysis- Formulating decision problems, decision strategies with the without outcome probabilities, decision trees, value of information, utility and decision making.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- understand the knowledge of dataanalytics.
- demonstrate the ability of think critically in making decisions based on data and deepanalytics.
- demonstrate the ability to use technical skills in predicative and prescriptive modeling tosupport business decision-making.
- demonstrate the ability to translate data into clear, actionableinsights.
- understand the concept of decisionmaking.

REFERENCES

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dar G.Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.
3. The PMI guide to Business Analysis
4. Business Analysis for Practitioners: Practice Guide
5. Agile and Business Analysis Practical guidance for IT Professionals

Co-Po Mapping:

Mapping of Course Objectives with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3–Strong, 2–Medium, 1–Weak

Cos	Programme Outcomes(POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	1	1	-	1	2	-	1	2	1	-
CO2	2	2	2	1	1	1	-	1	2	-	-	2	2	-
CO3	2	2	2	3	1	1	-	1	2	-	-	2	2	2
CO4	2	2	2	3	1	1	-	1	2	-	-	2	2	1
CO5	2	2	2	2	1	1	-	1	2	-	-	2	2	1

PED19901 **INDUSTRIAL SAFETY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- give exposure to various industrial safety equipment's and methods.
- understand tools used for maintenance cost and services life of equipment.
- analyze the types, causes, effects of wear reduction methods.
- enhance awareness of fault tracing concept and maintenance and types of faults in machine tools and their general causes.
- develop rudimentary ability on periodic inspection concept and needs of various mechanical and electrical equipment's.

UNIT I INDUSTRIAL SAFETY **9**

Accident- causes, types, results and control; mechanical and electrical hazards- types, causes and preventive steps/procedure; describe salient points of factories act 1948 for health and safety- wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes; Fire prevention and firefighting equipment and methods.

UNIT II FUNDAMENTALS OF MAINTENANCE ENGINEERING **9**

Definition and aim of maintenance engineering; Primary and secondary functions and responsibility of maintenance department; Types of maintenance; Types and applications of tools used for maintenance; Maintenance cost & its relation with replacement economy; Service life of equipment.

UNIT III WEAR AND CORROSION AND THEIR PREVENTION **9**

Wear- types, causes, effects, wear reduction methods; lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication; Definition, principle and factors affecting the corrosion- Types of corrosion, corrosion prevention methods.

UNIT IV FAULT TRACING **9**

Fault tracing-concept and importance, decision tree concept, need and applications; sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, i. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors; Types of faults in machine tools and their general causes.

UNIT V PERIODIC AND PREVENTIVE MAINTENANCE 9

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes; overhauling of mechanical components; overhauling of electrical motor- common troubles and remedies of electric motor, repair complexities and its use; definition, need, steps and advantages of preventive maintenance; Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets; Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance; Repair cycle concept and importance.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- differentiate the types of accident causes and preventive steps of industrial safety.
- assess the various types and applications of tools used for maintenance and its relation with economy.
- analyze the factors affect the corrosion and its prevention methods.
- identify the types of faults in machine tools and their general causes.
- analyze the various preventive maintenance of mechanical and electrical equipment's and repair cycle concepts.

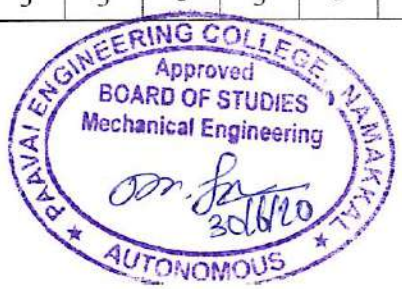
REFERENCES

1. Foundation Engineering Handbook, Hans F.Winterkorn, Hsai-yang fang, Chapman & Hall publishers London 2010.
2. Pump-hydraulic Compressors, Audels, Tata MC Graw hill Publication 2003.
3. Industrial Maintenance , H. P. Garg, S. Chand Ltd., 1987.
4. Maintenance Engineering Handbook, Higgins & Morrow, Tata MC Graw hill 1977.

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	-	2	-	-	3	-	3	2	-	-	-	2	-
CO2	3	-	2	3	-	2	-	3	3	-	-	-	2	-
CO3	3	-	2	3	3	3	-	3	-	-	-	-	2	-
CO4	3	-	2	3	-	3	-	3	-	-	-	-	2	-
CO5	3	-	2	3	3	3	-	3	-	3	-	-	2	-



PED19902 **COMPOSITE MATERIALS** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- give exposure on composite materials and functional requirements of reinforcement matrix.
- understand the mechanical behavior of composites and its preparation methods.
- understand various manufacturing methods of metal matrix composites.
- develop the different preparation of moulding methods.
- enhance the awareness of laminar failure criteria

UNIT I INTRODUCTION **9**

Definition – Classification and characteristics of Composite materials, advantages and application of composites; Functional requirements of reinforcement and matrix; Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT II REINFORCEMENTS **9**

Preparation-layup, curing; properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers; Properties and applications of whiskers, particle reinforcements; Mechanical Behavior of composites- Rule of mixtures, Inverse rule of mixtures; Isostrain and Isostress conditions.

UNIT III MANUFACTURING OF METAL MATRIX COMPOSITES **9**

Casting – Solid State diffusion technique, Cladding; Hot isostatic pressing- Properties and applications; Manufacturing of Ceramic Matrix Composites- Liquid Metal Infiltration , Liquid phase sintering; Manufacturing of Carbon – Carbon composites- Knitting, Braiding, Weaving, Properties and applications.

UNIT IV MANUFACTURING OF POLYMER MATRIX COMPOSITES **9**

Preparation of Moulding compounds and prepregs – hand layup method, autoclave method, filament winding method, compression moulding, reaction injection moulding, properties and applications.

UNIT V STRENGTH **9**

Laminar Failure Criteria- strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure; Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- apply the effect of reinforcement on overall composite performance.
- assess the mechanical behavior of composites, reinforcement properties and its applications.

- analyze the properties and applications of different metal matrix composites manufacturing.
- implement various manufacturing methods of polymer matrix composites and its applications.
- identify the various failure appeared in the composite laminate.

REFERENCES

1. Composite Materials Design and Applications – Danial Gay, 3rd edition, CRC press, taylor and francise grove 2014.
2. Composite Materials Science and Applications – Deborah D.L. Chung, 2nd edition, springer 2010.
3. Composite Materials – Science and Engineering K.K.Chawla, 2nd edition, springer, 1998
4. Hand Book of Composite Materials-edited by George Lubin , 1st edition , van Nostrand reinhold company inc 1982.

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak**														
COs	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	1	-	-	-	-	-	-	-	-	1	2	-
CO2	3	2	3	-	-	2	-	-	-	-	-	1	3	-
CO3	3	2	2	-	2	-	-	-	-	-	-	1	3	-
CO4	3	2	2	-	2	-	-	-	-	-	-	1	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	1	3	-

PED19903 **WASTE TO ENERGY** **3 0 0 3**

COURSE OBJECTIVES

To enable the students to

- give exposure on energy from industrial waste.
- understand the manufacture of charcoal and pyrolytic oil and gases.
- develop biomass gasification design, construction and operation.
- enhance the knowledge in fluidized bed combustors and operation of biomass combustors.
- impart the knowledge on biogas plant technology and biomass conversion processes.

UNIT I INTRODUCTION TO ENERGY FROM WASTE **9**

Classification of waste as fuel – Agro based, Forest residue, Industrial waste, MSW; Conversion devices – Incinerators, gasifiers, digestors.

UNIT II BIOMASS PYROLYSIS **9**

Pyrolysis – Types slow fast; Manufacture of charcoal – Methods, Yields and application; manufacture of pyrolytic oils and gases; yields and applications.

UNIT III BIOMASS GASIFICATION **9**

Gasifiers – Fixed bed system ,downdraft and updraft gasifiers; Fluidized bed gasifiers – Design, construction and operation; Gasifier burner arrangement for thermal heating; Gasifier engine arrangement and electrical power; Equilibrium and kinetic consideration in gasifier operation.

UNIT IV BIOMASS **9**

Biomass stoves – Improved chullahs, types, some exotic designs; Fixed bed combustors- Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation; Operation of all the above biomass combustors.

UNIT V BIOGAS **9**

Properties of biogas (Calorific value and composition); Biogas plant technology and status; Bio energy system - Design and constructional features; Biomass resources and their classification; Biomass conversion processes - Thermo chemical conversion, Direct combustion, biomass gasification, pyrolysis and liquefaction; biochemical conversion - anaerobic digestion, Types of biogas Plants, Applications; Alcohol production from biomass; Bio diesel production; Urban waste to energy conversion; Biomass energy programme in India.

TOTAL PERIODS: 45

COURSE OUTCOMES

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

- differentiate the types of conversion devices and energy from waste.

- assess the various methods of manufacturing of pyrolytic oils and its applications.
- analyze the different biomass gasifier and factor considered in gasifier operations.
- identify the operations, types and design consideration of fluidized bed combustor.
- analyze the different bio gas plant, application and urban waste energy conversion.

REFERENCES

1. Non Conventional Energy, Ashok V., Desai, New age international, 1990.
2. Biogas Technology - A Practical Hand Book – K.C. Khandelwal, and S.S.Mahdi, Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1989.
3. Food, Feed and Fuel from Biomass, Devinder singh.Chahal, IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, Charles. Y. WereKo-Brobby and Essel. B. Hagan, John Wiley & Sons, Newyork 1996.

CO - PO Mapping

Mapping of Course Outcomes with Programme Outcomes:

(1/2/3 indicates strength of correlation) 3-Strong, 2-Medium, 1-Weak

COs	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	3	3	-	-	-	-	2	3	-
CO2	-	-	3	3	-	3	3	-	-	-	-	2	3	-
CO3	-	-	3	2	-	3	3	-	-	-	-	2	3	-
CO4	-	-	3	2	-	3	3	-	-	-	-	2	3	-
CO5	-	-	3	2	-	3	3	-	-	-	-	2	3	-