K.L.N. COLLEGE OF ENGINEERING

Pottapalayam - 630612, Sivagangai District

(An Autonomous Institution, Affiliated to Anna University, Chennai)

Estd: 1994

CURRICULA & SYLLABI

I to IV Semesters

CHOICE BASED CREDIT SYSTEM

REGULATIONS 2020

For Post Graduate Program

M.E. COMPUTER SCIENCE AND ENGINEERING

(With Specialization in Networks)

(For the students admitted from the academic year 2020-2021 onwards)

K.L.N. COLLEGE OF ENGINEERING,POTTAPALAYAM

(An Autonomous Institution, Affiliated to Anna University, Chennai)

VISION OF THE INSTITUTION

To become a Centre of Excellence in Technical Education and Research in producing Competent and Ethical professionals to the society.

MISSION OF THE INSTITUTION

To impart Value and Need based curriculum to the students with enriched skill development in the field of Engineering, Technology, Management and Entrepreneurship and to nurture their character with social concern and to pursue their career in the areas of Research and Industry**.**

VISION OF THE DEPARTMENT

To emerge as a center of excellence through innovative technical education and research in Information Technology.

MISSION OF THE DEPARTMENT

To produce competent Information Technology professionals to face the industrial and societal challenges by imparting quality education with ethical values.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

PEO1 To excel in industrial or graduate work in Information Technology and multi-disciplinary Environments.

PEO2 To adapt to ever changing technologies by applying Engineering Principles.

PEO3 To practice professionalism conforming to ethical values, team work and Leadership.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1 To create better learning environment in line with technological updation and research progress.

PSO2 To give industry exposure through research and consultancy in Information and Communication Technologies.

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PROGRAM OUTCOMES (POs):

The Graduate Attributes of PG programmes of the NBA are as following:

1. 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.

2. Critical Thinking

Analyze complex engineering problems critically, apply independent judgment for synthesizing information to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context.

3. Problem Solving

Think laterally and originally, conceptualize and solve engineering problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors in the core areas of expertise.

4. Research Skill

Extract information pertinent to unfamiliar problems through literature survey and experiments, apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in one or more domains of engineering.

5. Usage of modern tools

Create, select, learn and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities with an understanding of the limitations.

6. Collaborative and Multidisciplinary work

Possess knowledge and understanding of group dynamics, recognize opportunities and contribute positively to collaborative-multidisciplinary scientific research, demonstrate a capacity for self- management and teamwork, decision-making based on open-mindedness, objectivity and rational analysis in order to achieve common goals and further the learning of themselves as well as others.

7. Project Management and Finance

Demonstrate knowledge and understanding of engineering and management principles and apply the same to one's own work, as a member and leader in a team, manage projects efficiently in respective disciplines and multidisciplinary environments after consideration of economical and financial factors.

8. Communication

Communicate with the engineering community, and with society at large, regarding complex engineering activities confidently and effectively, such as, being able to comprehend and write effective reports and design documentation by adhering to appropriate standards, make effective presentations, and give and receive clear instructions.

9. Life-long Learning

Recognize the need for, and have the preparation and ability to engage in life-long learning independently, with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

10. 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.

11. Independent and Reflective Learning

Observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

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REGULATIONS 2020

CHOICE BASED CREDIT SYSTEM

M.E. COMPUTER SCIENCE AND ENGINEERING
(With Specialization in Networks)

CATEGORY OF COURSES

i. **FOUNDATION COURSES (FC)** may include Mathematics or other basic courses

ii. **PROFESSIONAL CORE (PC)** courses include the core courses relevant to the chosen specialization/branch.

iii. **PROFESSIONAL ELECTIVES (PE)** courses include the elective courses relevant to the chosen specialization/ branch.

iv. **EMPLOYABILITY ENHANCEMENT COURSES (EEC)** includes Term paper writing and seminar, Project work Phase – I and II.

v. **AUDIT COURSES (AC)** include courses which develop desired attitude.

vi. **OPEN ELECTIVE COURSES (OE**) include skill development Courses.

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M.E. COMPUTER SCIENCE AND ENGINEERING
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REGULATIONS – 2020

CHOICE BASED CREDIT SYSTEM

CURRICULA AND SYLLABI

I to IV SEMESTERS

SEMESTER – I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	20MA101	Applied Probability and Statistics	FC	4	4	0	0	4
2	20NE101	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
3	20NE102	Advanced Computer Architecture	PC	3	3	0	0	3
4	20NE103	Wireless Technologies	PC	3	3	0	0	3
5	20NE104	Machine Learning Techniques	PC	3	3	0	0	3
6	20RM101	Research Methodology and IPR	PC	2	2	0	0	2
7		Audit Course – 1	AC	2	2	0	0	0
PRACTICAL								
8	20NE1L1	Advanced Data Structures and Algorithms Laboratory	PC	4	0	0	4	2
			TOTAL	25	21	0	4	21

SEMESTER II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1	20NE201	Network Design and Programming	PC	4	4	0	0	4
2	20NE202	Network Security	PC	3	3	0	0	3
3	20NE203	IOT Architecture and Programming	PC	3	3	0	0	3
4	20NE204	Advanced Software Engineering	PC	3	3	0	0	3
5		Professional Elective I	PE	3	3	0	0	3
6		Professional Elective II	PE	3	3	0	0	3
7		Audit Course – 2	AC	2	2	0	0	0
PRACTICAL								
8	20NE2L1	Network Design and Programming Laboratory	PC	4	0	0	4	2
9	20NE2L2	Term Paper Writing and Seminar	EEC	2	0	0	2	1
			TOTAL	27	21	0	6	22

SEMESTER III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1		Professional Elective III	PE	3	3	0	0	3
2		Professional Elective IV	PE	3	3	0	0	3
3		Open Elective	OE	3	3	0	0	3
PRACTICAL								
4	20NE3L1	Project Work Phase – I	EEC	12	0	0	12	6
			TOTAL	21	9	0	12	15

SEMESTER IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICAL								
1	20NE4L1	Project Work Phase – II	EEC	24	0	0	24	12
			TOTAL	24	0	0	24	12

TOTAL NO. OF CREDITS: 70

FOUNDATION COURSES (FC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20MA101	Applied Probability and Statistics	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20NE101	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
2	20NE102	Advanced Computer Architecture	PC	3	3	0	0	3
3	20NE103	Wireless Technologies	PC	3	3	0	0	3
4	20NE104	Machine Learning Techniques	PC	3	3	0	0	3
5	20RM101	Research Methodology and IPR	PC	2	2	0	0	2
6	20NE1L1	Advanced Data Structures and Algorithms Laboratory	PC	4	0	0	4	2
7	20NE201	Network Design and Programming	PC	4	4	0	0	4
8	20NE202	Network Security	PC	3	3	0	0	3
9	20NE203	IOT Architecture and Programming	PC	3	3	0	0	3
10	20NE204	Advanced Software Engineering	PC	3	3	0	0	3
11	20NE2L1	Network Design and Programming Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSES (EEC)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20NE2L2	Term Paper Writing and Seminar	EEC	2	0	0	2	1
2	20NE3L1	Project Work Phase - I	EEC	12	0	0	12	6
3	20NE4L1	Project Work Phase - II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)

PROFESSIONAL ELECTIVE I

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20NE2A1	Software Architectures and Design	PE	3	3	0	0	3
2	20NE2A2	Image Processing and Analysis	PE	3	3	0	0	3
3	20NE2A3	Mobile Application Development	PE	3	3	0	0	3
4	20NE2A4	Cloud Computing Technologies	PE	3	3	0	0	3
5	20NE2A5	Operating System Internals	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE II

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1	20NE2B1	Multimedia Communication Networks	PE	3	3	0	0	3
2	20NE2B2	Mobile and Pervasive Computing	PE	3	3	0	0	3
3	20NE2B3	Simulation of Computer Systems and Networks	PE	3	3	0	0	3
4	20NE2B4	High Speed Switching Architectures	PE	3	3	0	0	3
5	20NE2B5	Data Science and Big Data Analytics	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE III

S. No	COURSE CODE	COURSE TITLE	CATEGOR Y	CONTACT PERIODS	L	T	P	C
1	20NE3A1	Network Management	PE	3	3	0	0	3
2	20NE3A2	Network Performance Analysis	PE	3	3	0	0	3
3	20NE3A3	Next Generation Networks	PE	3	3	0	0	3
4	20NE3A4	Software Defined Networks and Network Function Virtualization (SDN and NFV)	PE	3	3	0	0	3

PROFESSIONAL ELECTIVE IV

S. No	COURS E CODE	COURSE TITLE	CATEGOR Y	CONTACT PERIODS	L	T	P	C
1	20NE3B1	Embedded Software Development	PE	3	3	0	0	3
2	20NE3B2	Protocols and Architectures for Wireless Sensor Networks	PE	3	3	0	0	3
3	20NE3B3	Data Storage and Information Management	PE	3	3	0	0	3
4	20NE3B4	Deep Learning	PE	3	3	0	0	3

AUDIT COURSE (AC)

S. No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20AC101	English for Research Paper Writing	AC	2	2	0	0	0
2.	20AC102	Disaster Management	AC	2	2	0	0	0
3.	20AC103	Sanskrit for Technical Knowledge	AC	2	2	0	0	0
4.	20AC104	Value Education	AC	2	2	0	0	0
5.	20AC105	Constitution of India	AC	2	2	0	0	0
6.	20AC106	Pedagogy Studies	AC	2	2	0	0	0
7.	20AC107	Stress Management by Yoga	AC	2	2	0	0	0
8.	20AC108	Personality Development through Life Enlightenment Skills	AC	2	2	0	0	0

OPEN ELECTIVE (OE)

S.No	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	20OE301	Business Analytics	OE	3	3	0	0	3
2.	20OE302	Industrial Safety	OE	3	3	0	0	3
3.	20OE303	Operations Research	OE	3	3	0	0	3
4.	20OE304	Cost Management of Engineering Projects	OE	3	3	0	0	3
5.	20OE305	Composite Materials	OE	3	3	0	0	3
6.	20OE306	Waste to Energy	OE	3	3	0	0	3

SUMMARY

S.No	Category	Credits as per Semester				Total Credits
		I	II	III	IV	
1	**FC**	4	-	-	-	4
2	**PC**	17	15	-	-	32
3	**PE**	-	6	6	-	12
4	**OE**	-	-	3	-	3
5	**EEC**	-	1	6	12	19
6	**AC**	0	0	-	-	0
Total		**21**	**22**	**15**	**12**	**70**

20MA101	APPLIED PROBABILITY AND STATISTICS	L	T	P	C
		4	0	0	4

OBJECTIVES:

This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

UNIT I PROBABILITY AND RANDOM VARIABLES **12**

Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES **12**

Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III ESTIMATION THEORY **12**

Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT IV TESTING OF HYPOTHESIS **12**

Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

UNIT V MULTIVARIATE ANALYSIS **12**

Random vectors and matrices – Mean vectors and covariance matrices – Multivariate normal density and its properties – Principal components - Population principal components – Principal components from standardized variables

TOTAL : 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the basic probability axioms, rules and to find the moments of discrete and continuous random variables.
- Determine Marginal and Conditional distributions of two dimensional random variables.
- Find Correlation and Regression between the two dimensional random variables.
- Apply the concept of unbiased estimators to check the consistency, efficiency and to calculate the maximum likelihood estimates.
- Apply statistical tests in testing the hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

REFERENCES:

1. Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
2. Devore, J. L., "Probability and Statistics for Engineering and the Sciences", 8th Edition, Cengage Learning, 2015.
3. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistic", Sultan and Sons, 11th Edition,New Delhi, 2007.
4. Dallas E. Johnson, "Applied Multivariate Methods for Data Analysis", Thomson and Duxbury press, 1998.
5. Richard A. Johnson and Dean W. Wichern, "Applied Multivariate Statistical Analysis", 6th Edition, Pearson Education, Asia, 2007.

20NE101	ADVANCED DATA STRUCTURES AND ALGORITHMS	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To understand the usage of algorithms in computing.
- To learn and use hierarchical data structures and its operations
- To learn the usage of graphs and its applications.
- To select and design data structures and algorithms that is appropriate for problems.
- To study about NP Completeness of problems.

UNIT I INTRODUCTION TO ALGORITHM ANALYSIS 12

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT II HIERARCHICAL DATA STRUCTURES 12

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable- heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT III GRAPHS 12

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra's Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm.

UNIT IV ALGORITHM DESIGN TECHNIQUES 12

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming –Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements ofthe Greedy Strategy- Huffman Codes.

UNIT V NP COMPLETE AND NP HARD **12**

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducibility – NP-Completeness Proofs – NP-Complete Problems

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Measure the efficiency of the algorithm by applying appropriate methodology.
- Design the various trees and apply its applications.
- Solve the geometrical application by using various graph algorithms.
- Design optimization algorithm and find the solutions to the problems associated with it.
- Apply suitable design strategy for problem solving.
- Design an Analyze the problems related to P & NP type of problems.

REFERENCES:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, “Data Structures and Algorithms”, PearsonEducation, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, “ALGORITHMS”, Fourth Edition, Pearson Education.
3. S.Sridhar,“Design and Analysis of Algorithms”, First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, “Introduction to Algorithms”, Third Edition, Prentice-Hall, 2011.
5. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, 4thEdition, Pearson, 2014.

20NE102	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- To understand the design of the memory hierarchy.

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading

UNIT II MEMORY HIERARCHY DESIGN 9

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines- Design of Memory Hierarchies- Case Studies.

UNIT III MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers-Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

TOTAL : 45PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions.
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Discuss the various techniques used for optimizing the cache performance.
- Design hierarchal memory system.
- Point out how data level parallelism is exploited in architectures.

REFERENCES:

1. Darryl Gove, “Multicore Application Programming: For Windows”, Linux, and Oracle Solaris,Pearson, 2011.
2. David B. Kirk, Wen-mei W. Hwu, “Programming Massively Parallel Processors”, Morgan Kauffman, 2010.
3. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture : A hardware/software approach” , Morgan Kaufmann, Elsevier Publishers, 1999.
4. John L. Hennessey and David A. Patterson, “Computer Architecture – A Quantitative Approach”,Morgan Kaufmann , Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.WeiXu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 2003.
6. John L Hennessy and David A. Patterson, Computer Architecture, “A Quantitative Approach”, Morgan Kauffman publishers, Fifth Edition, 2011.

20NE103	WIRELESS TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of various wireless technologies
- To review the concepts of wireless networks
- To explore the emerging wireless technologies and their potential impact

UNIT I WIRELESS LAN and PAN **9**

Introduction, fundamentals of WLAN –technical issues, network architecture, IEEE 802.11-physical layer, Mac layer mechanism, CSMA/CA,RTS/CTS, Polling, Bluetooth- User scenarios, Architecture, Radio layer, Baseband layer, Link manager protocol, L2CAP, Security, SDP, IEEE 802.15.3. 19.

UNIT II WIRELESS INTERNET **9**

Introduction –wireless internet, address mobility, inefficiency of transport layer and Application layer protocol, mobile IP – simultaneous binding, route optimization, mobile IP variations, handoffs, IPv6 advancements, IP for wireless domain, security in mobile IP, TCP in wireless domain – TCP over wireless , TCPs -traditional, snoop, indirect, mobile, transaction- oriented, impact of mobility.

UNIT III AD-HOC SENSOR NETWORK **9**

Wireless Sensor Network – Applications, design Challenges, Protocol stack, comparisons with MANET node architecture, network architecture, MAC protocols-requirements, IEEE 802.15.4 MAC protocol, Routing Protocol –energy aware routing, Location based routing, clustering, aggregation, QoS, security protocol, Zigbee standard.

UNIT IV 3G NETWORKS **9**

Evolution from GSM, 3G Services and Applications - UMTS network structure - Core network - UMTS Radio access - HSPA – HSUPA- HSDPA- CDMA 1X - EVDO Rev -0, Rev-A, Rev-B, Rev-C

Architecture- Protocol stack, Cognitive Radio network, Spectrum Sensing.

UNIT V 4G - LTE **9**

Overview of LTE Networks - Need for LTE- From LTE to LTE-Advanced SAE :- LTE Architecture, Radio Protocol stack , Interfaces, Concept of HetNET, Quality of Service and Bandwidth Reservation - QoS metrics, Signaling for Bandwidth Requests and Grants, Bandwidth Allocation and Traffic Handling, Mobility Management, Security Protocols-An Overview of 5G requirements, Regulations for 5G. Case Study on collaborative mobile edge computing in 5G networks, Case study on Security challenges in 5G networks.

TOTAL :45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To design the various wireless networks.
- To be able to design the 4G and LTE networks
- To design application sensor networks.
- To design Heterogeneous networks
- To Learn emerging wireless technologies and their potential impact
- To analyze the future design challenges of 5G networks and edge computing.

REFERENCES:

1. Abd-Elhamid M. Taha and Hossam S. Hassanein and Najah Abu Ali, “LTE, LTE-Advanced and Wimax towards IMT-advanced networks”, John Wiley &Sons, 2012.
2. HarriHolma and AnttiToskala, “SDPA/HSUPA for UMTS”, John Wiley & Sons, 2006.
3. Holger Karl and Andreas Willing, “Protocols and Architecture for Wireless Sensor Network”, John Wiley & Sons, 2007.
4. Jochen Schiller, “Mobile Communication”, Pearson education”, 2nd edition 2005.
5. JuhaKorhonen, “Introduction to 3G Mobile Communication”, Artech House, 2003.
6. Larry J. Greenstein, Andrea J. Goldsmith, “Principles of Cognitive Radio”, Cambridge University press, 2013.
7. Vijay. K. Garg, “Wireless Communication and Networking”, Morgan Kaufmann Publishers, 2007.
8. https://scholar.google.co.in/scholar?start=10&q=+case+study+on+5g+networks&hl=en&as_sdt=0,5&as_vis=1
9. https://www.gsma.com/futurenetworks/wiki-category/5g-case-studies/

20NE104	MACHINE LEARNING TECHNIQUES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.
- To study the various probabilities based learning techniques.
- To understand graphical models of machine learning algorithms.

UNIT I INTRODUCTION 9

Learning – Types of Machine Learning -Uses of Machine learning- languages for 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.

UNIT II LINEAR MODELS 9

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 III TREE AND PROBABILISTIC MODELS9

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-Case Study - Building an automated category tree.

UNIT IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

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-Case Study - Digitizing information on business cards.

UNIT V GRAPHICALMODELS9

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

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning
- Apply the apt machine learning strategy for any given problem
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem
- Design systems that uses the appropriate graph models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency
- Understand graphical models of machine learning algorithms

REFERENCES:

1. EthemAlpaydin, “Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)”, Third Edition, MIT Press, 2014
2. Jason Bell, “Machine learning – Hands on for Developers and Technical Professionals”, First Edition, Wiley, 2014
3. Peter Flach, “Machine Learning: The Art and Science of Algorithms that Make Sense of Data”, First Edition, Cambridge University Press, 2012.
4. Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Second Edition, Chapman and Hall, CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, “Machine Learning”, First Edition, McGraw Hill Education, 2013.
6. https://tryolabs.com/static/Machine-Learning-Case Studies

20RM101	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

OBJECTIVES:

To give an overview of the research methodology and explain the technique of defining a research problem and to explain the functions of the literature review in research. This course can explain the art of interpretation and the art of writing research reports. Also it explains various forms of the intellectual property, its relevance and business impact in the changing global business environment.

UNIT I INTRODUCTION TO RESEARCH METHODOLOGY 6

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. Effective literature studies, approaches, analysis, Plagiarism, Research ethics.

UNIT II EFFECTIVE TECHNICAL WRITING 6

How to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

UNIT III INTELLECTUAL PROPERTY AND INTERNATIONAL SCENARIO 6

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 IV PATENT RIGHTS 6

Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

UNIT V NEW DEVELOPMENTS IN IPR 6

Administration of Patent System, New developments in IPR, IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.

TOTAL: 30 PERIODS

OUTCOMES:

After completing this course, students should demonstrate competency in the following skills:

- Understand research problem formulation.
- Analyze research related information.
- Follow research ethics.
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

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3. Debora J. Halbert, "Resisting Intellectual Property (RIPE Series in Global Political Economy)", Taylor & Francis Ltd., 2006.
4. W.H.Mayall, "Industrial Design for Engineers", London Iliffe Books Ltd. 1967.
5. Benjamin W. Niebel, "Product Design and Process Engineering", McGraw-Hill Inc., US, 1974.
6. Morris Asimow, "An Introduction To Design", Prentice-Hall, Inc. First Edition, 1962.
7. Robert P. Merges, Peter S. Menell and Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Law & Business, 2012.
8. T. Ramappa, "Intellectual Property Rights Under WTO: Tasks Before India", A H Wheeler Publishing Co. Ltd., 2002.

20NE1L1	ADVANCED DATA STRUCTURES AND ALGORITHMS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To acquire the knowledge of using advanced tree structures.
- To learn the usage of heap structures.
- To understand the usage of graph structures and spanning trees.

LIST OF EXPERIMENTS

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

EXPERIMENTS:

1. Implementation of Merge Sort and Quick Sort-Analysis
2. Implementation of Binary Search and Linear Search
3. Implementation of a Binary Search Tree
4. Implementation of Tree Traversal
5. Red-Black Tree Implementation
6. Heap Implementation
7. Fibonacci Heap Implementation
8. Graph Traversals
9. Spanning Tree Implementation
10. Implementation of Kruskal Algorithm
11. You are supposed to build a Social Cop in your smart phone. Social Cop helps people report crimes in the nearest police station in real time. Use K-d tree to search for the police station nearest to the crime location before attempting to report anything by constructing a 2 dimensional K-d tree from the location of all the police stations in your city querying the K-d tree to find the nearest police to the any given location in the city.

12. Implement Crossword puzzles as Constraint satisfaction problems
13. Develop an approximation algorithm for the problems like graph coloring, vertex color Problem, Maximal flow, shortest path problems, Minimum subsequence generation etc.

TOTAL: 60 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Design and apply iterative and recursive algorithms.
- Design and implement algorithms using the hill climbing and dynamic programming and recursive backtracking techniques.
- Design and implement randomized algorithms.
- Design appropriate shared objects and concurrent objects for applications.
- Implement and apply concurrent linked lists, stacks, and queues.

20NE201	NETWORK DESIGN AND PROGRAMMING	L	T	P	C
		4	0	0	4

OBJECTIVES:

- To understand the basic networking principles
- To explore various networking devices and protocols required for network design and management
- To study two novel networking technologies: SDN and DTN
- To learn network programming in UNIX C

UNIT I NETWORKING PRINCIPLES 12

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Collision detection and collision avoidance, Hidden and Exposed Terminals – Switched networks – Datagrams, Virtual circuits, Cell switching and Label switching – Wireless Networks – Infrastructure based, ad hoc and hybrid – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Comparison of WLAN and UMTS -Quality of Service – End to end level and network level solutions.

UNIT II PHYSICAL NETWORK DESIGN 12

LAN cabling topologies – Ethernet Switches – High speed and Gigabit and 10Gbps – Building cabling topologies and Campus cabling topologies – Routers, Firewalls and L3 switches –Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP - WAN Design and Enterprise Networks – Core networks, distribution networks and access networks-Comparison of WLAN and UMTS.

UNIT III LOGICAL DESIGN AND MANAGEMENT 12

IPv4 and IPv6 Dynamic Addressing –Hierarchical routing – VLSMand CIDR – Transition from IPv4 to IPv6 – NAT and DHCP – Static and Dynamic routes – RIP, OSPF and BGP – VPN –RMON and SNMP

UNIT IV INNOVATIVE NETWORKS 12

Green Wireless Networks -Software Defined Networks – Evolution of switches and control planes – Centralized and distributed data and control planes – OpenFlow and SDN Controllers – Network Function Virtualization – Needsof the Data Centres – SDN solutions for data centres - Delay Tolerant Networks – Overlay architecture – Bundle Protocol – Opportunistic routing and Epidemic routing-4G

Networks and Composite Radio Environment-Green Wireless Networks - 4G Networks and Composite Radio Environment

UNIT V NETWORK PROGRAMMING IN UNIX C 12

Socket address structures – Byte ordering and byte manipulation functions – Elementary TCP sockets– socket, connect, bind, listen, accept and close functions – Stream socket and datagram Socket-TCP client and server – Elementary UDP sockets –recvfrom and sendto functions, connect function with UDP – Raw sockets – Client-server design alternatives – Iterative and Concurrent servers-Stream socket and datagram Socket .

TOTAL: 60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Develop network based applications in UNIX C and Python
- Develop various client server applications using TCP/UDP sockets
- Develop client applications for major APIs
- Develop an application that interacts with various servers like e-mail servers
- Design and implement a multiprotocol server with TCP and UDP
- Develop an application that work with remote servers using SSH, FTP

REFERENCES:

1. Larry Peterson and Bruce Davie, “Computer Networks: A Systems Approach”, 5th edition, Morgan Kauffman, 2011
2. ParitoshPuri, M.P.Singh, “Asurvey paper on routing in delay tolerant networks”, International Conference on Information and Computer Networks (ISCON), 2013, DOI:10.1109/ICISCON 2013.6524206
3. Paul Goransson, Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Morgan Kauffman, 2014
4. W.Richard Stevens, Bill Fenner and Andrew M Rudoff, “Unix Network Programming: The Sockets Networking API: Volume 1”, 3rd Edition, Addison Wesley, 2003
5. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, “Computer Networks: An Open Source Approach”, McGraw Hill, 2011

20NE202 NETWORK SECURITY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To understand the fundamentals of network security
- To acquire knowledge on standard algorithms used to provide confidentiality, integrity and authenticity.
- To understand the various key distribution and management schemes.
- To understand how to deploy encryption techniques to secure data in transit across data networks
- To design security applications in the field of Information technology

UNIT I INTRODUCTION 10

Services, Mechanisms and attacks-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).FINITE FIELDS AND NUMBER THEORY: Groups, Rings, Fields-Modular arithmetic-Euclid's algorithm-Finite fields- Polynomial Arithmetic –Prime numbers-Fermat's and Euler's theorem-Testing for primality -The Chinese remainder theorem- Discrete logarithms.

UNIT II BLOCK CIPHERS & PUBLIC KEY ENCRYPTION 10

Data Encryption Standard-Block cipher design principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES-Blowfish-RC5 algorithm. Public key encryption: Principles of public key cryptosystems-The RSA algorithm – Key Management - Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

UNIT III HASH FUNCTIONS AND DIGITAL SIGNATURES 9

Authentication requirement – Authentication function – MAC – Hash function – Security of hash function and MAC –MD5 - SHA - HMAC – CMAC - Digital signature and authentication protocols – DSS – EIGamal – Schnorr.

UNIT IV E-MAIL, IP & WEB SECURITY 8

E-mail Security: Pretty Good Privacy-S/MIME. IP Security: Overview of IPSec - IP security policy-Encapsulation Security Payload (ESP)-Combining Security Associations-Internet Key Exchange. Web Security: Web Security Considerations-Secure Socket Layer(SSL)-Transport Layer Security(TLS)- -Secure Electronic Transaction (SET).

UNIT V SYSTEM SECURITY **8**

Authentication applications – Kerberos – X.509 Authentication services - Firewalls – Types of Firewalls- Firewall design principles- Trusted System. Intruders – Intrusion detection – Viruses and related threats – Virus Countermeasures.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Compare various Security Techniques Design Secure Applications Inject secure coding in the developed applications
- Analyze the vulnerabilities in any computing system and hence be able to design a security solution.
- Analyze the possible security attacks in complex real time systems and their effective countermeasures
- Identify the security issues in the network and resolve it.
- Evaluate security mechanisms using rigorous approaches, including theoretical derivation, modeling, and simulations
- Formulate research problems in the computer security field

REFERENCES:

1. Behrouz A. Ferouzan, “Cryptography & Network Security”, Tata McGraw Hill, 2007.
2. Bruce Schneier and Neils Ferguson, “Practical Cryptography”, First Edition, Wiley Dream tech India Pvt Ltd, 2003.
3. Charles Pfleeger, “Security in Computing”, 4th Edition, Prentice Hall of India, 2006.
4. Charlie Kaufman and Radia Perlman, Mike Speciner, “Network Security”, Second Edition, Private Communication in Public World, PHI 2002.
5. Douglas R Simson,“Cryptography – Theory and practice”, First Edition, CRC Press,1995.
6. Ulysess Black, “Internet Security Protocols”, Pearson Education Asia, 2000.
7. William Stallings, “Cryptography and Network Security”, 6th Edition, Pearson Education, March 2013.
8. Man Young Rhee, “Internet Security: Cryptographic Principles-Algorithms andProtocols”, Wiley Publications,2003.
9. http://nptel.ac.in/

20NE203	IOT ARCHITECTURE AND PROGRAMMING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the significance of Internet of Things and its applications
- To learn about the basics of IOT Sensors and circuits
- To build a small low cost embedded system using Raspberry Pi.
- To learn about IoT challenges in the real world scenario.

UNIT UNIT I- IOT – MOTIVATION AND APPLICATIONS 9

Importance of IoT. Motivating Applications of IoT: Smart Cities- Smart Waste Management, Smart Street Lights, Smart Street Parking, Security without Surveillance, Connected Vehicles. Healthcare- Baby Monitoring, Elderly Monitoring, Mood Enhancing, Disease Treatment and Progression Monitoring, Enhance Adherence, Challenges. Agriculture- Precision Agriculture, Connected Livestock, Food Safety. Manufacturing and Logistics- Smart Manufacturing- Smart Packaging, Smart Label. Smart Electricity Grid- Managing Supply and Demand. Home Automation.

UNIT II SENSORS AND CIRCUITS 9

Sensor – Introduction, Terminology, Behavior, Selection, Circuits – Overview and Applications, Battery Issue and Energy Management, Wireless Link, Digital and Analog – Digital Computing, Analog to Digital Interfaces

UNIT III EMBEDDED SYSTEMS, CONNECTIVITY AND NETWORKING 9

Embedded Systems – Overview, Technology Drivers, Energy, Microcontrollers, Software Connectivity and Networking – Introduction, Connectivity Challenges in IoT, Energy Harvesting Transmitters, Massive Multiple Access, Computation vs Communication.

UNIT IV ARCHITECTURE AND PROGRAMMING 9

IoT Architectures – embedded System, Gateway and Cloud (MGC) Architecture and other reference models and architectures Arduinovs Raspberry Pi vs Electric Imp – Key features and comparisons – Arduino Interfaces – Arduino IDE – Programming

UNIT V IOT CHALLENGES **9**

Technology Challenges – Security, Connectivity, Compatibility and Longevity, Standards, Intelligent Analysis and Actions Business Challenges – Consumer IoT, Commercial IoT, Industrial IoT Society Challenges – Privacy, Regulatory Standards

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Appreciate the evolution and applications of IoT
- Evaluate the available sensors for an application and understand circuits
- Analyze different options for Embedded systems, connectivity and networking protocol and apply the appropriate one for a given application.
- Understand MGC Architecture and Arduino Programming.
- Analyze technological challenges of IoT and overcome the Business challenges.
- Analyze applications and develop IoT products in real time scenario.

REFERENCES:

1. Pethuru Raj and Anupama C. Raman ,"The Internet of Things: Enabling Technologies, Platforms, and Use Cases", CRC Press, Taylor and Francis Group, 2017.
2. Adrian McEwen and Hakim Cassimally, “Designing the Internet of Things”, John Wiley & Sons Ltd., UK, 2014.
3. ArshdeepBahga and Vijay Madisetti, "Internet of Things: A Hands-on Approach", Universities Press,2014.
4. David Boswarthick, Omar Elloumi and OlivierHersent, “M2M Communications: A Systems Approach”, John Wiley & Sons Ltd, UK, 2012.
5. Dieter Uckelmann, Mark Harrison and Florian Michahelles, “Architecting the Internet of Things”, Springer, NewYork, 2011.
6. Olivier Hersent, David Boswarthick and OmarElloumi, “The Internet of Things: Key Applications and Protocols”, John Wiley & Sons Ltd., UK, 2012.
7. Marco Schwartz, “Internet of Things with the Arduino Yun”, Packt Publishing, 2014.
8. Bernd Scholz-Reiter, Florian Michahelles, “Architecting the Internet of Things”, ISBN 978-3-642- 19156-5 e-ISBN 978-3-642-19157-2, Springer 2011.
9. Dieter Uckelmann, Mark Harrison and Florian Michahelles, “Architecting the Internet of Things”, Springer, NewYork, 2011.

10. https://iot.ieee.org/newsletter/march-2017/three-major-challenges-facing-iot.html

OTHER WEB REFERENCES

1. https://online.stanford.edu/courses/xee100-introduction-internet-things
2. https://onlinecourses.nptel.ac.in/noc17_cs22/course
3. https://www.coursera.org/specializations/internet-of-things
4. https://www.edx.org/micromasters/curtinx-internet-of-things-iot#courses

20NE204	ADVANCED SOFTWARE ENGINEERING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand Software Engineering Lifecycle Models
- To do project management and cost estimation
- To gain knowledge of the System Analysis and Design concepts.
- To understand software testing approaches
- To be familiar with DevOps practices

UNIT I INTRODUCTION **9**

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling.

UNIT II SOFTWARE REQUIREMENT SPECIFICATION **9**

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modeling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams

– State chart diagrams – Functional modeling – Data Flow Diagram-Sequence Diagram.

UNIT III ARCHITECTURE AND DESIGN **9**

Software design – Design process – Design concepts –-Modularity- Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command

– Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter- User interface design

UNIT IV TESTING **9**

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Smoke Testing-Debugging - Program analysis – Symbolic execution – Model Checking

UNIT V DEVOPS **9**

DevOps: Motivation-Cloud as a platform-Operations- Deployment Pipeline: Overall Architecture- Building and Testing-Deployment- Case study: Migrating to Microservices

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the advantages of various Software Development Lifecycle Models
- Gain knowledge on project management approaches as well as cost and schedule estimation strategies
- Perform formal analysis on specifications
- Use UML diagrams for analysis and design
- Architect and design using architectural styles and design patterns
- Understand software testing approaches
- Understand the advantages of DevOps practices

REFERENCES:

1. Bernd Bruegge, Alan H Dutoit, “Object-Oriented Software Engineering”, 2nd edition, Pearson Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, “Fundamentals of Software Engineering”, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, “Applying UML and Patterns”, 3rd edition, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect’s Perspective”, Pearson Education, 2016.
5. Rajib Mall, “Fundamentals of Software Engineering”, 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, Software Engineering 7th edition, McGraw-Hill, 2007.
7. Roger S. Pressman, “Software Engineering A Practitioner's Approach”, sixth Edition, McGraw Hill International Edition, 2007.

20NE2L1	NETWORK DESIGN AND PROGRAMMING LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To practice LAN and WAN design
- To learn network programming in UNIX C and Python
- Establish a LAN with a switch/hub with 3 PCs and check the connectivity and configuration
- Establish a internetwork with 2 routers and two or more LANs using static routes and check the connectivity and configuration
- Establish a dynamic routing based internetwork with 2 routers and two or more LANs using RIP/OSPF and check the connectivity and configuration
- In the internetwork created in experiment number 4, analyze the performance of various TCP variants using an FTP application

NETWORK PROGRAMMING EXERCISES:

1. Develop a C program that demonstrates inter process communication
2. Develop a TCP client/server application
3. Develop a UDP client/server application
4. Develop an Iterative UDP server with 2 or 3 clients
5. Develop a concurrent TCP server with 2 or 3 clients
6. Develop a multiprotocol server with TCP and UDP and 2 clients
7. Develop simple Python programs that use frequently used syntactic constructs
8. Develop a Socket based application in Python
9. Build client applications for major APIs (Amazon S3, Twitter etc) in Python
10. Develop an application that interacts with e-mail servers in python
11. Develop applications that work with remote servers using SSH, FTP etc in Python

TOTAL :60 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Develop network-based applications in UNIX C and Python
- Develop various client server applications using TCP/UDP sockets
- Develop client applications for major APIs
- Develop an application that interacts with various servers like e-mail servers
- Design and implement a multiprotocol server with TCP and UDP
- Develop an application that work with remote servers using SSH, FTP

20NE2L2	TERM PAPER WRITING AND SEMINAR	L	T	P	C
		0	0	4	1

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (atleast 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analyzing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation
10. Presentation and publication of final paper in reputed International Conference / Journals

Please keep a file where the work carried out by you is maintained.

Activities to be carried Out

Activity	Instructions	Submission week	Evaluation
Selection of area of interest and Topic	You are requested to 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			

Activity	Instructions	Submission week	Evaluation
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society 2. List 2 journals 3.List2 conferences, symposia or workshops 4.List1 thesis title 5.List 3 web presences (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area 7. 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	1. You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar 2. 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. 3. Favour —first or —foundational papers in the field (as indicated in other people's survey paper), 4. Favour more recent papers, 5. Pick a recent survey of the field so you can quickly gain an overview, 6. Find relationships with respect to each	4th week	**6%** (the list of standard papers and reason for selection)

Activity	Instructions	Submission week	Evaluation
	other and to your topic area (classification scheme/categorization) 7. 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? • How does the work build on other's work, in the author's opinion? • 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 your survey)	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

Activity	Instructions	Submission week	Evaluation
Reading and notes for next5 papers	Repeat Reading Paper Process	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 final 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)

Activity	Instructions	Submission week	Evaluation
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11th week	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (conclusions–clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	**5%** (formatting, English, Clarity and linking) **4%** (Plagiarism Check Report)
Seminar	A brief 15 slides on your paper	14th week	**5%** (based on presentation and Viva-voce)
Presentation & Publication	Presentation and Publication of the final paper in reputed International Conference/Journal		**10%** **(** Presentation & Publication)

TOTAL : 30 PERIODS

20NE2A1	SOFTWARE ARCHITECTURES AND DESIGN	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
- To learn the design principles and to apply for large scale systems
- To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
- To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services**.**

UNIT I INTRODUCTION TO SOFTWARE ARCHITECTURE DESIGN SPACE 9

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT II DATA CENTERED AND INTERACTION ORIENTED SOFTWARE 9

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC)

UNIT III DISTRIBUTED ARCHITECTURE 9

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM,CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture-Methodology of Architecture Decision, Quality Attributes-WSDL.

UNIT IV USER INTERFACE SOFTWARE ARCHITECTURE 9

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines -Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDA-Model transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT V ASPECT ORIENTED ARCHITECTURES AND CASE STUDIES 9

Aspect Oriented Architectures- AOP in UML,AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the need of software architecture for sustainable dynamic systems.
- Learn the design principles and to apply for large scale systems.
- Design architectures for distributed heterogeneous systems.
- Implement the service oriented architecture in web services, grid and cloud computing.
- Build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
- Develop appropriate architectures for case studies like semantic web services, supply chain cloud services.

REFERENCES :

1. Ion Gorton, "Essentials of software Architecture , Second Edition", Springer- Verlag, 2011.
2. Kai Qian,“Software Architecture Design Illuminated”, first edition, Jones and Bartlett Publishers Canada,2010.
3. Len bass, Paul Clements, Rick Kazman, “Software Architecture in Practice”, Third Edition, AdissonWisley Publications, 2013.

20NE2A2	IMAGE PROCESSING AND ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the image processing concepts and analysis
- To understand the image processing techniques
- To familiarize the image processing environment and their applications,
- To appreciate the use of image processing in various applications

UNIT I IMAGE PROCESSING FUNDAMENTALS **9**

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.'

UNIT II IMAGE ENHANCEMENT AND RESTORATION **9**

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain- Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models -Colour Image Processing: Full color processing - Pseudo-color processing.

UNIT III IMAGE SEGMENTATION AND MORPHOLOGY **9**

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms-Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT IV IMAGE ANALYSIS AND CLASSIFICATION **9**

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

TOTAL :45PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Explain image modalities, sensing, acquisition, sampling, and quantization
- Explain image noise models
- Implement spatial filter operations
- Explain frequency domain transformations
- Explain Image compression techniques
- Explain processing of color Images

REFERENCES:

1. Alasdair McAndrew, “Introduction to Digital Image Processing with Matlab”, Cengage Learning 2011,India
2. Anil J Jain, “Fundamentals of Digital Image Processing”, PHI, 2006.
3. KavyanNajarian and Robert Splerstor, “Biomedical signals and Image Processing”, CRC Taylor and Francis, New York, 2006
4. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2008, New Delhi
5. S.Sridhar, “Digital Image Processing”, Oxford University Press, 2011

20NE2A3	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand system requirements for mobile applications.
- Generate suitable design using specific mobile development frameworks.
- Generate mobile application design.
- Implement the design using specific mobile development frameworks.
- Deploy the mobile applications in marketplace for distribution.

UNIT I INTRODUCTION 5

Introduction to mobile applications – Embedded systems - Market and business drivers for mobile applications – Publishing and delivery of mobile applications – Requirements gathering and validation for mobile applications.

UNIT II BASIC DESIGN 8

Introduction – Basics of embedded systems design – Embedded OS - Design constraints for mobile applications, both hardware and software related – Architecting mobile applications – User interfaces for mobile applications – touch events and gestures – Achieving quality constraints – performance, usability, security, availability and modifiability.

UNIT III ADVANCED DESIGN 8

Designing applications with multimedia and web access capabilities – Integration with GPS and social media networking applications – Accessing applications hosted in a cloud computing environment – Design patterns for mobile applications.

UNIT IV ANDROID 12

Introduction – Establishing the development environment – Android architecture – Activities and views– Interacting with UI – Persisting data using SQLite – Packaging and deployment – Interaction with server side applications – Using Google Maps, GPS and Wifi – Integration with social media applications-Develop a mobile application for a simple needs.

UNIT V IOS **12**

Introduction to Objective C –Swift and Xcode-iOS features – UI implementation – Touch frameworks – Data persistence using Core Data and SQLite – Location aware applications using Core Location and Map Kit – Integrating calendar and address book with social media application – Using Wifi - iPhone marketplace.

TOTAL :45PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To understand the basics and requirements of mobile application.
- Explain the design and quality constraints of mobile application development.
- Develop and design for mobile applications for specific requirements.
- Implement the design using Android SDK for application like location identify, Database and communication with social media.
- Implement the design using Objective C and iOS for location aware applications.
- Deploy mobile application in Android and iPhone marketplace for distribution.

REFERENCES:

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS Development: Exploring the iOS SDK”, Apress, 2013.
3. http://developer.android.com/develop/index.html.
4. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012.
5. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox,2012.
6. Reto Meier, “PProfessional android Developmen”, Wiley-India Edition, 2012.

20NE2A4	CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing and to be able to set up a private cloud
- To understand the security issues in the grid and the cloud environment

UNIT I VIRTUALIZATION **9**

Basics of Virtual Machines - Process Virtual Machines – System Virtual Machines –Emulation – Interpretation – Binary Translation - Taxonomy of Virtual Machines. Virtualization –Management Virtualization –– Hardware Maximization – Architectures – Virtualization Management – Storage Virtualization – Network Virtualization

UNIT II VIRTUALIZATION INFRASTRUCTURE **9**

The anatomy of cloud infrastructures – distributed Management of Virtual Infrastructures – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization -Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT III CLOUD PLATFORM ARCHITECTURE **9**

Cloud deployment models: public, private, hybrid, community – Aneka Cloud Platform- Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design –Workflow Engine for clouds- Layered cloudArchitectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT IV PROGRAMMING MODEL **9**

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications -

Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments - Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT V CLOUD SECURITY **9**

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud –Cloud Security and Trust Management

TOTAL :45PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the concepts of virtualization and virtual machines.
- Employ the concepts of storage virtualization, network virtualization and its management.
- Apply the concept of virtualization in the cloud computing.
- Identify the architecture, infrastructure and delivery models of cloud computing.
- Develop services using Cloud computing.
- Apply the security models in the cloud environment.

REFERENCES:

1. Danielle Ruest, Nelson Ruest, “Virtualization: A Beginner‟s Guide”, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Tim Mather, SubraKumaraswamy, and ShahedLatif ,"Cloud Security and Privacy", O’Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.
8. Thomas Erl, “Cloud Computing : Concepts, Technology and Architecture”, 1e, Pearson publication, Second Edition,2014.

20NE2A5	OPERATING SYSTEM INTERNALS	L	T	P	C
		3	0	0	3

OBJECTIVES :

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in Linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of inter-process communication.
- To understand how program execution happens in Linux.

UNIT I INTRODUCTION 9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes - Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels

- Address Space - Synchronization – Inter-process Communication - Process Management - Memory Management - Device Drivers.

UNIT II PROCESSES 9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes

- -

System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT III FILE SYSTEM 9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process – File system Types - Special File systems - File System Type Registration - File System Handling - Namespaces - Mounting -Unmounting

-Implementation of VFS System Calls.

UNIT IV MEMORY MANAGEMENT 9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

UNIT V PROCESS COMMUNICATION AND PROGRAM EXECUTION 9

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials -Command- Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions

- Execution tracing - Executable Formats - Execution Domains - The exec Functions.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To understand the high-level structure of the Linux kernel both in concept and source code
- To understand and analyse theory and implementation of processes
- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the linux kernel for a different software system.

REFERENCES:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O' Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, —Structure and Interpretation of Computer Programs, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, —The Design of the Unix Operating System‖ 1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, “Linux Kernel Internals”, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, “Linux Kernel Development”, 3rd Edition, Addison-Wesley, 2010.
6. D M Dhamdhere, “Operating Systems A Concept Based Approach”, Tata McGraw-Hill Publishers, 2013, Fourth Reprint.

20NE2B1	MULTIMEDIA COMMUNICATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the multimedia communication models
- To study the multimedia transport in wireless networks
- To explore real-time multimedia network applications

UNIT I MULTIMEDIA COMMUNICATION MODELS 9

Common Multimedia applications - VoIP- Video Conferencing- Military Surveillance- Interactive TV- Video on Demand- Smart Phone - Requirements and Design challenges of multimedia communications- Architecture of Internet Multimedia Communication- Protocol Stack-H.323.

UNIT II BEST EFFORT AND GUARANTEED SERVICE MODEL 9

Best effort service model and its limitations-Resource allocation-Metrics-Max and Min fair sharing Queuing-FIFO-Priority queue-Fair queue- Waited fair queue-Traffic policing-Token bucket-leaky bucket-Admission control-Packet classification and scheduling.

UNIT III MULTIMEDIA ON IP NETWORKS 9

QoS aware routing-RSVP-Integrated and Differentiated services-MPLS-Multicasting-IGMP-PIMDVMRP.

UNIT IV TRANSPORT LAYER SUPPORT FOR MULTIMEDIA 9

Multimedia over TCP-Significance of UDP- Multimedia Streaming- Audio and Video Streaming Interactive and non-Interactive Multimedia-RTP/RTCP-SIP-RTSP.

UNIT VMULTIMEDIA QOS ON WIRELESS NETWORKS 9

IEEE 802.11e, IEEE 802.16, 3G networks-UMTS, 3GPP, 4G networks-LTE-IMS-5G Mobile Networks.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To understand different multimedia communication models and it's real time applications
- To implement various algorithms to provide best effort and quality service
- To understand different IP routing protocols and it's working in multimedia network to provide QoS
- To understand the working of multimedia in transport layer
- To apply QoS on wireless networks using IEEE standards.
- To develop a multimedia network application

REFERENCES:

1. James F. Kurose and Keith W. Ross, “Computer Networking-A Top-Down Approach Featuring the Internet”, Pearson, 2012.
2. Larry L. Peterson and Bruce S. Davie, “Computer Networks- A Systems Approach”, MorganKaufmann Publishers, 2007.
3. Mario Marques da Silva, “Multimedia Communications and Networking”, CRC Press, 2012.
4. Mark Wuthnow, Jerry Shih, Matthew Stafford, “IMS: A New Model for Blending Applications”,Auerbach Publications, 2009.

20NE2B2 MOBILE AND PERVASIVE COMPUTING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To learn the basic architecture and concepts till Third Generation Communication systems.
- To understand the latest 4G Telecommunication System Principles.
- To introduce the broad perspective of pervasive concepts and management
- To Explore the HCI in Pervasive environment
- Apply the pervasive concepts in mobile environment

UNIT I INTRODUCTION 9

History – Wireless communications: GSM – DECT – TETRA – UMTS – IMT – 2000 – Bluetooth, WiFi, WiMAX, 3G ,WATM.- Mobile IP protocols -WAP push architecture-Wml scripts and applications. Data networks – SMS – GPRS – EDGE – Hybrid Wireless100 Networks – ATM – Wireless ATM.

UNIT II OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM 9

Introduction. LTE-A System Architecture. LTE RAN. OFDM Air Interface. Evolved Packet Core. LTE Requirements. LTE-Advanced. LTE-A in Release. OFDMA – Introduction. OFDM Principles. LTE Uplink—SC-FDMA. Summary of OFDMA.

UNIT III PERVASIVE CONCEPTS AND ELEMENTS 9

Technology Trend Overview - Pervasive Computing: Concepts - Challenges - Middleware - Context Awareness - Resource Management - Pervasive Transaction Processing - Infrastructure and Devices - Wireless Networks - Middleware for Pervasive Computing Systems - Resource Management - User Tracking- Context Management -Service Management - Data Management - Security Management
- Pervasive Computing Environments - Smart Car Space - Intelligent Campus-AURA-GAIA

UNIT IV HCI IN PERVASIVE COMPUTING 9

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration - Context-Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware

Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm

UNIT V PERVASIVE MOBILE TRANSACTIONS 9

Pervasive Mobile Transactions - Introduction to Pervasive Transactions – Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing

- Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

TOTAL : 45PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the Basic architecture and concepts of till Third Generation Communication systems.
- Explain the latest 4G Telecommunication System Principles.
- Understand the pervasive concepts.
- Develop applications using Pervasive Computing Environments
- Implement the HCI in Pervasive environment.
- Work on the pervasive concepts in mobile environment.

REFERENCES:

1. Alan Colman, Jun Han, and Muhammad AshadKabir, “Pervasive Social Computing Socially- Aware Pervasive Systems and Mobile Applications”, Springer, 2016.
2. J.Schiller, “Mobile Communication”, Addison Wesley, 2000
3. JuhaKorhonen, “Introduction to 4G Mobile Communications” , Artech House Publishers, 2014
4. Kolomvatsos, “Kostas, Intelligent Technologies and Techniques for Pervasive Computing”, IGI Global, 2013.
5. M. Bala Krishna, Jaime LloretMauri, “Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks”, CRC 2016
6. MinyiGuo, Jingyu Zhou, Feilong Tang, Yao Shen, “Pervasive Computing: Concepts, Technologies and Applications”, CRC Press, 2016.

20NE2B3	SIMULATION OF COMPUTER SYSTEMS AND NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand how simulators are built.
- To understand the statistical models used in simulations.
- To learn different ways of generating random numbers.
- To learn modeling of the data given as input to simulators.
- To understand how computer networks are simulated using case studies.

UNIT I STATISTICAL AND QUEUING MODELS **9**

Statistical models – Discrete, continuous and empirical distributions – Characteristics of Queuing systems – Measures of performance of queuing systems – Markovian models.

UNIT II RANDOM NUMBER AND RANDOM VARIATE GENERATION **9**

Properties of random numbers – Generating uniform random numbers – Generating non-uniform random numbers - Tests for random numbers – Random-variate generation

UNIT III ANALYSIS OF SIMULATION DATA **9**

Input modeling – Identifying the distribution – Parameter estimation – Goodness-of-fit tests – Multivariate and time-series input models – Verification and validation of simulation models

UNIT IV SIMULATION OF COMPUTER NETWORKS **9**

Introduction – Performance modeling – Modeling Techniques – Protocol modeling – Workload modeling – Network Topology modeling – Performance metrics in computer network simulation – Validation and verification – Discrete event simulation – GPU-based simulations – Multi-agent-based simulations –Network simulators.

UNIT V CASE STUDIES OF NETWORK SIMULATORS **9**

NS-3 based Simulative Platform - Evolved packet system – Differentiated services domain – ns-3 simulator – Simulation techniques for next generation wireless heterogeneous networks - Features of common network simulators - OpNet, mininet.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Understand the modeling and development of simulations and simulators
- Differentiate the different ways in which simulators are designed
- Analyze how computer networks are simulated
- Use simulators like ns-3
- Analyze Performance metrics in computer network simulation
- Compare the features of different simulators

REFERENCES:

1. J. B. Sinclair, “Simulation of Computer Systems and Computer Networks: A Process-Oriented Approach”, 2004.
2. Jerry Banks, John S. Carson II, Barry L. Nelson, David M. Nicol, “Discrete-event System Simulation”, Fifth Edition, Pearson, 2010.
3. Law, Averill, “Simulation Modeling and Analysis with Expert Software”, McGraw Hill, 2006.
4. Mohammad S. Obaidat, PetrosNicopolitidis, FaouziZarai, “Modeling and Simulation of Computer Networks and Systems – Methodologies and Applications”, Morgan Kaufmann, 2015.
5. Sheldon M. Ross, “Simulation”, Fifth Edition, Elsevier, 2013.

20NE2B4	HIGH SPEED SWITCHING ARCHITECTURES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the basics of switching
- To explore the various space division switches
- To evaluate the performance of various switching architectures
- To study the architecture of IP routers
- To study about MPLS switches

UNIT ISWITCHINGBASICS **9**

Circuit switching, Message switching and Packet switching – Datagrams and Virtual circuits – Cell switching – Label switching – L2 switching Vs L3 switching – VLANs – Switching and Bridging – Loop resolution, Spanning tree algorithms – Cut through and Store and forward switches – Head of line blocking – Back pressure – Switch design goals

UNIT II SWITCHING ARCHITECTURES **9**

Shared medium switches – Shared memory switches – Space division switches – Cross bar based switching architecture – Input queued, Output queued and Combined input-output queued switches – Non blocking and blocking cross bar switches – Banyan networks – Batcher Banyan networks – Optical switches – Unbuffered and buffered switches – Buffering strategies – Optical packet switches and Optical burst switches – MEMS optical switches

UNIT III PACKET QUEUES AND DELAY ANALYSIS **9**

Littles theorem – Birth and death processes – Queuing disciplines – Markovian FIFO queuing – Non Markovian – Pollaczek Khinchine formula –M/M/1, M/G/1 and M/D/1 models – Self similar models and Batch arrivals models – Network of queues – Burkes theorem and Jackson theorem.

UNIT IV P ROUTER ARCHITECTURE **9**

Bus based router architecture with single processor and multiple processors – Architecture with multiple parallel forwarding engines – Switch based router architecture with multiple processors

– Switch based router architecture with multiple processors – Switch based architecture with fully distributed processors – Critical and non-critical data path processing – fast and slow path.

UNIT V MPLS ROUTERS 9

MPLS – Layer 2.5 - Labels – Switching and Distribution –Label Switched Path – Label Forwarding Instance Base – Label Stacking - IP Lookup vs Label lookup – Label Distribution Protocol – MPLS based VPNs– Label switching – Label switched path – Comparison with ATM technology.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course the students should be able to:

- Apply switching concepts to build networks.
- Deploy the network with appropriate type of switching Architectures.
- Understand the different types of Packet Queues.
- Understand the different types of Delay Analysis.
- Select and configure the appropriate type of IP router.
- Design and implement MPLS networks.

REFERENCES:

1. Damitri P Bertsekas and Gallager, “Data Networks”, 2nd edition, PHI, 1992
2. Elhanany, Itamar, Hamdi and Mounir, “High Performance Packet Switching Architectures”, Springer 2007
3. H.Jonathan Chao and Bin Liu, “High Performance Switches and Routersl, John Wiley and Sons”, 2007
4. Howard C Berkowitz, “Designing Routing and Switching Architectures for Enterprise Networks”,Sams, 1999
5. Luc De Ghein, “MPLS Fundamentals”, Cisco Press 2014.
6. VivekAlwayn, “Advanced MPLS Design and Implementation”, 2001.
7. ItamarElhanany and Mounir Hamdi, “High-performance Packet Switching Architectures”, Springer Kindle Edition. 2007th Edition.

20NE2B5	DATA SCIENCE AND BIG DATA ANALYTICS	L	P	T	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of data science.
- To apply various analytical theory and methods.
- To understand and use the advanced analytics technology and tools
- To explore the Hadoop distributed file system architecture
- To apply the Map-Reduce concepts and learn Hadoop related tools.

UNIT I INTRODUCTION TO DATA SCIENCE 9

Data Science - Evolution of data – Best Practices for Big data Analytics – Big data characteristics – Validating – The Promotion of the Value of Big Data – Big Data Use Cases- Characteristics of Big Data Application-Statistics for Analytics – Data science life cycle – Analysis and reporting – Modern Data Analytics Tools

UNIT II ADVANCED ANALYTICAL THEORY AND METHODS 9

Overview of Clustering, K-means, Use Cases, Overview of the Method, Perform a K-means Analysis using RClassification, Decision Trees, Overview of a Decision Tree, Decision Tree Algorithms, Evaluating a Decision Tree - Decision Tree in R, Bayes' Theorem, Naïve Bayes Classifier, Smoothing, Naive Bayes in R

UNIT III ADVANCED ANALYTICS TECHNOLOGY AND TOOLS 9

Analytics for Unstructured Data, Use Cases, MapReduce, Apache Hadoop, The Hadoop Ecosystem, Pig, Hive, Hbase, Mahouth, NoSQL, SQL Essentials- Joins, Set Operations, Grouping Extensions, In-Database Text Analysis, Advanced SQL, Window Functions, User-defined Functions and Aggregates, Ordered Aggregates, MADlib

UNIT IV HADOOP DISTRIBUTED FILE SYSTEM ARCHITECTURE 9

HDFS Architecture, HDFS Concepts, Blocks- NameNode, Secondary NameNode, DataNode, HDFS Federation, HDFS High Availability, Basic File System Operations- Data Flow, Anatomy of File Read, Anatomy of File Write, Anatomy of a MapReduce Job Run

UNIT V MAPREDUCE APPLICATIONS AND HADOOP RELATED TOOLS 9

MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of Map Reduce job run, classic Map-reduce, YARN: failures in classic Map-reduce and YARN job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats. Hadoop Related Tools Hbase: data model and implementations, Pig: Grunt, pig data model,

Hive: data types and file format, HiveQL data definition, HiveQL data manipulation, HiveQLqueries.

TOTAL: 45 PERIODS

OUTCOMES

Upon completion of this course the students should be able to:

- Understand the basics of data science.
- Apply the advanced analytical theory and methods.
- Understand and use the advanced analytics technology and tools
- Understand the Hadoop distributed file system architecture
- Apply the Map-Reduce concepts and learn hadoop related tools.
- Apply data science concepts to real time applications

REFERENCES:

1. David Dietrich, Barry Heller and Beibei Yang, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, EMC Education Services, Reprint 2015, Wiley,ISBN: 9788126556533.
2. Nathan Marz, James Warren, “Big Data-Principles and best practices of scalable real- time data systems”, Edition 2015, DreamTech Press, ISBN: 9789351198062.
3. Tom White, "Hadoop: The Definitive Guide", 4th Edition, 2015, O'Reilly, ISBN: 9789352130672
4. BirisLublinsky, Kevin T. Smith and Alexey Yakubovich, “Professional Hadoop Solutions”, Reprint 2014, Wiley, ISBN 13:9788126551071
5. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
6. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
7. Alan Gates, "Programming Pig", O'Reilley, 2011.

20NE3A1	NETWORK MANAGEMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To appreciate the need for interoperable network management as a typical distributed application
- To familiarize concepts and terminology associated with SNMP
- To be aware of current trends in network management technologies

UNIT I OSI NETWORK MANAGEMENT 8

OSI Network management model - Organizational model - Information model, Communication model. Abstract Syntax Notation - Encoding Structure, Macros Functional Model CMIP/CMIS.

UNIT II BROADBAND NETWORK MANAGEMENT 9

Broadband networks and services, ATM Technology - VP, VC, ATM Packet, Integrated service, ATM LAN emulation, Virtual LAN, ATM Network Management - ATM Network reference model, Integrated local Management Interface. ATM Management Information base, Role of SNMP and ILMI in ATM Management, M1, M2, M3, M4 interface. ATM Digital Exchange Interface Management.

UNIT III SIMPLE NETWORK MANAGEMENT PROTOCOL 10

SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional model. SNMP Management SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, The SNMPv2 Management Information Base,SNMPv2 Protocol, Compatibility With SNMPv1.Configuration management, Fault management, Performance management, Event Correlation Techniques 168 security management, Accounting management, Report Management, Policy Based Management, Services Level Management.

UNIT IV NETWORK MANAGEMENT SYSTEMS 9

Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Commercial Network management Systems, System Management and Enterprise Management Solutions.

UNIT V WEB-BASED MANAGEMENT 9

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

TOTAL:45PERIODS

OUTCOMES:

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

- Diagnose problems and make minor repairs to computer networks using appropriate diagnostics software
- Demonstrate how to correctly maintain LAN computer systems
- Maintain the network by performing routine maintenance tasks
- Apply network management tools

REFERENCES:

1. Lakshmi G Raman, "Fundamentals of Telecommunication Network Management", Eastern Economy Edition IEEE Press, New Delhi, 1999.
2. Mani Subramanian, "Network Management - Principles and Practice", Pearson Education, Second edition, 2010.
3. Mani Subramanian, "Network Management Principles and Practice", Addison Wesley, Second edition, 2010.
4. Mark Burges, "Principles of Network System Administration", Wiley, 2000.
5. Salah Aiidarons and Thomas Plevayk, "Telecommunications Network Technologies and Implementationsl, Eastern Economy Edition IEEE press, New Delhi, 1998.
6. Stephen Morris, "Network Management, MIBs and MPLS - Principles, Design and Implementation", Pearson Education, 2003.

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1. http://www.apps.ietf.org/rfc/rfc1095.html
2. ycchen.im.ncnu.edu.tw/nm/ch_5x.ppt
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4. www.rivier.edu/faculty/vriabov/NWM_ch_14.ppt 169

20NE3A2	NETWORK PERFORMANCE ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the mathematical basis for analyzing the performance of networks.
- To understand queuing theory and queuing models.
- To analytically model traffic control protocols, and error control protocols using these concepts.
- To model performance of wired and wireless MAC such as 802.3, 802.11 and 802.16.
- To model network traffic and study the performance of different packet scheduling algorithms.

UNIT I MARKOV CHAINS BASICS 9

Overview of Random Processes, Markov Chains – Markov matrices, State transition matrix, Markov chains at equilibrium – steady state distribution vector.

UNIT II REDUCIBLE AND PERIODIC MARKOV CHAINS 9

Reducible Markov chain – Transition matrix, Reducible Composite Markov chain, Transient analysis, Steady state, Periodic Markov chain – Transition matrix, canonical form, Strongly and weakly periodic Markov chains, Queuing Analysis –M/M/1 queues, M/M/1/B queues, D/M/1/B queues, performance, communicating Markov chains

UNIT IIITRAFFIC CONTROL, ERROR CONTROL AND MAC MODELING 9

Modeling traffic control protocols – Modeling leaky bucket and token bucket algorithms, Modeling Error control protocols - Stop and wait and GBN ARQ performance, Modeling media access control protocols – 802.1p, ALOHA, 802.3.

UNIT IV WIFI AND WIMAX PERFORMANCE 9

Modeling 802.11 protocol – Basic DCF modeling, RTS/CTS modeling, Modeling 802.11e, Performance, 802.11e HCCA Performance. Modeling 802.16 protocol – system and user performance.

UNIT V NETWORK TRAFFIC AND SCHEDULING 9

Modeling network traffic – Flow traffic models – Continuous time modeling, Discrete time modeling, Pareto traffic distribution, Destination traffic. Scheduling algorithms – Analysis.

TOTAL :45PERIODS

OUTCOMES :

At the end of the course, the student should be able to:

- Apply markov chain models and analyse the behavior of network systems.
- Perform queuing theory based analysis of various L2 layer functions, such as flow control, error control, and MAC.
- Build network traffic models.
- Analyse QoS functions such as scheduling and traffic control.

REFERENCES:

1. Anurag Kumar, D. Manjunath, Joy Kuri, “Communication Networking: An analytical Approach”, Elsevier, 2004.
2. Bertsekas D and Gallager R, “Data Networks”, 2nd Edition, Prentice-Hall, 1992.
3. Fayez Gebali, “Analysis of computer networks”, 2nd Edition, Springer, 2015.
4. Harrison P G and Patel N M, “Performance Modelling of Communication Networks and Computer Architectures”, Addison-Wesley, 1993.
5. Robertazzi T G, “Computer Networks and Systems: Queuing Theory and Performance Evaluation”, 2nd, Edition, Springer-Verlag, 1994.

20NE3A3	NEXT GENERATION NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the technical, economic and service advantages of next generation networks.
- To learn the evolution of technologies of 4G and beyond.
- To learn Software defined Mobile Network issues and integrating challenges with LTE.
- To explore the NGN framework catering the services of end user with QoS provisioning.
- To learn about the NGM management and standards.

UNIT I INTRODUCTION 9

Evolution of public mobile services -motivations for IP based services, Wireless IP network architecture –3GPP packet data network architecture. Introduction to next generation networks - Changes, Opportunities and Challenges, Technologies, Networks, and Services, Next Generation Society, future Trends.

UNIT II 4G and BEYOND 9

Introduction to LTE-A –Requirements and Challenges, network architectures –EPC, E-UTRAN architecture-mobility management, resource management, services, channel -logical and transport channel mapping, downlink/uplink data transfer, MAC control element, PDU packet formats, scheduling services, random access procedure.

UNIT III SDMN-LTE INTEGRATION 9

SDN paradigm and applications, SDN for wireless-challenges, Leveraging SDN for 5G networks- ubiquitous connectivity-mobile cloud-cooperative cellular network-restructuring mobile networks to SDN-SDN/LTE integration benefits.

UNIT IV NGN ARCHITECTURE 9

Evolution towards NGN-Technology requirements, NGN functional architecture- Transport stratum, service stratum, service/ content layer and customer terminal equipment function. NGN entities, Network and Service evolution -fixed, mobile, cable and internet evolution towards NGN.

UNIT V NGN MANAGEMENT AND STANDARDIZATION 9

NGN requirements on Management-Customer, third party, Configuration, Accounting, performance, device and information management. Service and control management- End-to-End QoS and security. ITU and GSI-NGN releases, ETSI-NGN concept and releases, NGMN alliance and NGMN.

TOTAL: 45 PERIODS

OUTCOMES:

- To be able to understand the issues and challenges of wireless domain in future generation network design.
- To be able to explore the LTE concepts and technologies.
- To be able to understand the integration of SDN with LTE.
- To be able to understand the NGN management and standardizations.

REFERENCES:

1. Jingming Li Salina, Pascal Salina "Next Generation Networks-perspectives and potentials" Wiley, January 2008.
2. Madhusanga Liyanage, Andrei Gurtov, Mika Ylianttila, "Software Defined Mobile Networks beyond LTE Network Architecture", Wiley, June 2015.
3. Martin Sauter,"3G,4G and Beyond bringing networks, devices and web together", Wiley, 2nd edition-2013.
4. Savo G Glisic," Advanced Wireless Networks- Technology and Business models", Wiley, 3rd edition- 2016.
5. Thomas Plavyk, —Next generation Telecommunication Networks, Services and Management, Wiley & IEEE Press Publications, 2010.

20NE3A4	SOFTWARE DEFINED NETWORKS AND NETWORK FUNCTION VIRTUALIZATION (SDN AND NFV)	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of software defined networks
- To learn the interface between networking devices and the software controlling them
- To learn network virtualization and tools
- To explore modern approaches like Vmware, openflow, openstack

UNIT I SOFTWARE DEFINED NETWORK (SDN) 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Architecture-SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework

UNIT II VIRTUALIZATION BASICS 9

Primer on Virtualization, Benefits of virtual machines, Hypervisors, Managing Virtual resources, Virtualized cloud/data center

UNIT III NETWORK FUNCTIONS VIRTUALIZED 9

Virtualize a Network, virtualizing appliances, virtualizing core networking functions, scalability and performance

UNIT IV MODERN NETWORKING APPROACHES 9

Openflow, VMware NSX, OpenDayLight project-ODL architecture & controller platform, control network, Business case for SDN-Fog Computing Concepts

UNIT V SECURITY & VISIBILITY 9

Security-Preventing Data leakage, Logging and auditing, Encryption in Virtual Networks Visibility-Overlay networks, Network management tools, Monitoring Traffic

TOTAL :45 PERIODS

OUTCOMES:

Upon successful completion of this course, a student will be able to:

- To identify/design software defined network for the required application/platform
- To deploy network virtualization tool & design
- To equip in various network security measures and tackle

REFERENCES:

1. Jim Doherty,"SDN and NFV Simplified", Addison Wesley, 2016
2. SiamakAzodoimolky, "Software Defined Networking with OpenFlow", Packt Publishing Limited, 2013
3. Thomas D.Nadeau and Ken Gray, “SDN – Software Defined Networks”, O‟Reilly Publishers,2013

20NE3B1	EMBEDDED SOFTWARE DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the architecture of embedded processor, microcontroller and peripheral devices.
- To interface memory and peripherals with embedded systems.
- To study the embedded network environment.
- To understand challenges in Real time operating systems.
- To study, analyze and design applications on embedded systems.

UNIT I EMBEDDED PROCESSORS 9

Embedded Computers - Characteristics of Embedded Computing Applications - Challenges in Embedded Computing System Design - Embedded System Design Process- Formalism for System Design - Structural Description - Behavioral Description - ARM Processor - Intel ATOM Processor.

UNIT II EMBEDDED COMPUTING PLATFORM 9

CPU Bus Configuration - Memory Devices and Interfacing – Input / Output Devices and Interfacing - System Design - Development and Debugging – Emulator – Simulator - JTAG Design Example – Alarm Clock - Analysis and Optimization of Performance - Power and Program Size.

UNIT III EMBEDDED NETWORK ENIVIRONMENT 9

Distributed Embedded Architecture - Hardware And Software Architectures - Networks for Embedded Systems - I2C - CAN Bus - SHARC Link Supports – Ethernet – Myrinet – Internet - Network-based Design - Communication Analysis - System Performance Analysis - Hardware Platform Design - Allocation and Scheduling - Design Example - Elevator Controller.

UNIT IV REAL-TIME CHARACTERISTICS 9

Clock Driven Approach - Weighted Round Robin Approach - Priority Driven Approach - Dynamic versus Static Systems - Effective Release Times and Deadlines - Optimality of the Earliest Deadline First (EDF) Algorithm - Challenges in Validating Timing Constraints in Priority Driven Systems - Off-Line versus On-Line Scheduling.

UNIT V SYSTEM DESIGN TECHNIQUES 9

Design Methodologies - Requirement Analysis – Specification - System Analysis and Architecture Design - Quality Assurance - Design Examples - Telephone PBX - Ink jet printer - Personal Digital Assistants - Set-Top Boxes.

TOTAL: 45 PERIODS

OUTCOME:

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

- Understand different architectures of embedded processor, microcontroller and peripheral devices. Interface memory and peripherals with embedded systems.
- Work with embedded network environment.
- Understand challenges in Real time operating systems.
- Design and analyze applications on embedded systems.

REFERENCES:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013
2. Andrew N Sloss, D. Symes, C. Wright, “Arm system developers guide”, Morgan Kauffman/Elsevier, 2006.
3. ArshdeepBahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach**"**, VPT First Edition, 2014
4. C. M. Krishna and K. G. Shin, “Real-Time Systems” , McGraw-Hill, 1997
5. Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley & Sons.
6. Jane.W.S. Liu, “Real-Time systems”, Pearson Education Asia.
7. Michael J. Pont, “Embedded C”, Pearson Education , 2007.
8. Muhammad Ali Mazidi, SarmadNaimi, SepehrNaimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, First edition, 2014
9. Steve Heath, “Embedded System Design” , Elsevier, 2005
10. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.

20NE3B2	PROTOCOLS AND ARCHITECTURES FORWIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of wireless sensor networks
- To understand the protocols for WSN
- To get exposure on WSN environment with TinyOS and like
- To understand the layered approach in sensor networks
- To design WSN and analyse performance

UNIT I WIRELESS SENSOR NETWORK ARCHITECTURE 9

Introduction to wireless sensor networks- Challenges, Comparison with ad hoc network, Node architecture and Network architecture, design principles, Service interfaces, Gateway, Short range radio communication standards-IEEE 802.15.4, Zigbee and Bluetooth. Physical layer and transceiver design considerations.

UNIT II DATA LINK LAYER 9

MAC protocols – fundamentals, low duty cycle protocols and wakeup concepts, contention- based protocols, Schedule-based protocols - SMAC, BMAC,TRAMA, Link Layer protocols – fundamentals task and requirements, error control, framing, link management, Naming and addressing – address assignment, unique, Content-based and geographical addressing.

UNIT III NETWORK LAYER 9

Routing protocols – Requirements, Taxonomy - Data-centric routing – SPIN, Directed Diffusion, Energy aware routing, Gradient-based routing – COUGAR, ACQUIRE, Hierarchical Routing – LEACH, PEGASIS, Location Based Routing – GAF, GEAR, Data aggregation – Various aggregation techniques, Localization and positioning – Properties, Approaches, Mathematical basics for single hop and multi-hop environment.

UNIT IV TRANSPORT LAYER 9

Transport Protocol, Coverage and deployments - Sensing models, Coverage measures, Random deployments: Poisson model, Boolean sensing model, general sensing model, Coverage determination, grid deployment, Reliable data transport, Single packet delivery, Block delivery, Congestion control and rate control, Time synchronization – Issues and protocol – Sender/Receiver, Security – protocols and Key Distribution Techniques.

UNIT V TOOLS FOR WSN 9

TinyOS – Introduction, NesC, Interfaces, modules, configuration, Programming in TinyOS using NesC, TOSSIM, Contiki – Structure, Communication Stack, Simulation environment – Cooja simulator, Programming.

TOTAL : 45 PERIODS

OUTCOMES:

Upon successful completion of this course, a student will be able to:

- To be able to design energy efficient WSNs.
- To design and implement protocols in TinyOS and Contiki.
- To design application dependent WSNs.
-

REFERENCES:

1. Anna Hac, “Wireless Sensor Network Design”, John Wiley & Sons, 2003.
2. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, “Wireless Sensor Networks”, Springer Publication, 2004
3. HolgerKarl , Andreas willig, “Protocol and Architecture for Wireless Sensor Networks”, John Wiley Publication, 2006.
4. KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Networks Technology Protocols and Applications”, John Wiley & Sons, 2007.
5. Paolo Santi, “Topology Control in Wireless Adhoc and Sensor Networks”, John Wiley & Sons, 2005.
6. Philip Levis, David Gay,"Tiny OS Programming", Cambridge University Press, 2009 Contiki - Open Source Operating System for IOT - http://www.contiki-os.org/

20NE3B3 DATA STORAGE AND INFORMATION MANAGEMENT

L	T	P	C
3	0	0	3

OBJECTIVES:

- To gain knowledge about information storage system, data protection and intelligent storage system
- To learn various storage networking technologies
- To discuss the various virtualization techniques
- To study the backup and recovery, local and remote replications
- To understand the storage security and management

UNIT I INTRODUCTION TO INFORMATION STORAGE SYSTEM9

Introduction to information storage and management: Information storage – Evolution of storage technology and architecture – Data center infrastructure – Key challenges in managing information – Information lifecycle. Storage system environment: Components of a storage system environment – Disk drive components – Disk drive performance – Data protection: RAID - Implementation of RAID, RAID array components – RAID levels – RAID comparison – RAID impact on disk performance – Applications - Intelligent storage system: Components of an Intelligent Storage System – Intelligent Storage Array.

UNIT II STORAGE NETWORKING TECHNOLOGIES 9

Direct-Attached Storage and Introduction to SCSI: Types of DAS – DAS Benefits and Limitations – Disk Drive Interfaces – Introduction to Parallel SCSI – SCSI Command Model – Storage Area Networks: Fibre Channel – SAN Evolution – Components of SAN – FC Connectivity – Fibre Channel Ports – Fibre Channel Architecture – Zoning – Fibre Channel Login Types – FC Topologies - Network-Attached Storage: Benefits – NAS File I/O – Components of NAS – NAS Implementations – NAS File-Sharing Protocols.

UNIT III NETWORKING TECHNOLOGIES AND VIRTUALIZATION 9

IPSAN: iSCSI – FCIP – Content-Addressed Storage: Fixed Content and Archives – Types – Features – Benefits – CAS Architecture - Storage Virtualization: Forms of Virtualization –

SNIA Storage Virtualization Taxonomy – Storage Virtualization Configurations – Storage Virtualization Challenges – Types of Storage Virtualization.

UNIT IV BACKUP AND RECOVERY, LOCAL AND REMOTE REPLICATION 9

Information availability and Business Continuity -terminologies - Business Continuity Planning – Solutions - Clustering and Multipathing architecture - Single Points of Failure - Backup and Recovery - Methods, targets and topologies - Data Deduplication and backup in virtualized environment - Fixed Content and Data Archive – Replication - Local Replication - Remote Replication - Three-Site Remote Replication - Continuous Data Protection

UNIT V STORAGE SECURITY AND MANAGEMENT 9

Securing the Storage Infrastructure: Framework – Risk Triad – Storage Security Domains – Security Implementations in Storage Networking – Managing the Storage Infrastructure: Monitoring the Storage Infrastructure – Storage Management Activities – Storage Infrastructure Management Challenges – Developing an Ideal Solution.

TOTAL : 45PERIODS

OUTCOMES:

Upon successful completion of this course, a student will be able to:

- Analyze the information and intelligent storage system
- Work with various storage networking technologies
- Choose the right networking technology and virtualization method
- Devise the backup and recovery procedure and do local and remote replication
- Propose a solution using storage security and management

REFERENCES:

1. G. Somasundaram, Alok Shrivastava, “Information Storage and Management: Storing, Managing and Protecting Digital Information”, EMC Corporation, Wiley Publication, 2009.

2. Gerald J. Kowalski, Mark T. Maybury, “Information Storage and Retrieval Systems”, Kluwer Academic Publishers, 2002.
3. C. Manning, P. Raghavan and H.Schutze, “Information Retrieval”, Cambridge University Press, 2008.
4. Ricardo Baeza, Yates and Berthier Ribeiro Neto, “Modern Information Retrieval: The concepts and technology behind search”, Second Edition, ACM Press Books, 2011.
5. https://www.itracs.com
6. https://developer.mozilla.org/en/docs/Web/Guide/API/DOM/ Storage
7. http://www.snia.org/sites/default/education/tutorials/2010/spring/executive/RaymondClar ke_An_Introduction_to_Storage_Management

20NE3B4 DEEP LEARNING

L	T	P	C
3	0	0	3

OBJECTIVES:

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

UNIT I INTRODUCTION 9

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II DEEP NETWORKS 9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Back propagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

UNIT III DIMENTIONALITY REDUCTION 9

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyper parameter optimization **UNIT IV OPTIMIZATION AND GENERALIZATION 9**

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V CASE STUDY AND APPLICATIONS 9

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection Bio-Informatics- Face Recognition- Scene Understanding- Gathering Image Captions

TOTAL: 45 PERIODS

OUTCOMES:

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

- Understand basics of deep learning
- Implement various deep learning models
- Realign high dimensional data using reduction techniques
- Analyze optimization and generalization in deep learning
- Explore the deep learning applications

REFERENCES:

1. CosmaRohillaShalizi, “Advanced Data Analysis from an Elementary Point of View”, 2015.
2. Deng & Yu, “Deep Learning: Methods and Applications”, Now Publishers, 2013.
3. Ian Goodfellow, YoshuaBengio, Aaron Courville, “Deep Learning”, MIT Press, 2016.
4. Michael Nielsen, “Neural Networks and Deep Learning”, Determination Press, 2015.

20AC101	ENGLISH FOR RESEARCH PAPER WRITING	L	T	P	C
		2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

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

UNIT I	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.	**4**
UNIT II	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts and Introduction.	**4**
UNIT III	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	**4**
UNIT IV	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.	**4**
UNIT V	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.	**4**
UNIT VI	Useful phrases, How to ensure paper is as good as it could possibly be the first-time submission.	**4**

TOTAL: 24 PERIODS

REFERENCES:

1. Robert Goldbort, “Writing for Science”, Yale University Press, 2006.
2. Robert A Day and Barbara Gastel, “How to Write and Publish a Scientific Paper”, Seventh Edition, Greenwood Press, 2011.
3. Nicholas J Higham, “Handbook of Writing for the Mathematical Sciences”, Society for Industrial and Applied Mathematics, 1998.
4. Adrian Wallwork, “English for Writing Research Papers”, Springer, 2011.

20AC102 **DISASTER MANAGEMENT**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

UNIT I	**Disaster:** Definition, Factors and Significance, Difference between Hazard and Disaster.**Natural and Manmade Disasters:** Difference, Nature, Types and Magnitude.	**4**
UNIT II	**Repercussions of Disasters and Hazards:** Economic Damage, Loss of Human and Animal Life, Destruction Of Ecosystem. **Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches. **Man-made Disaster:** Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.	**4**
UNIT III	**Disaster Prone areas in India:** Study of Seismic Zones, Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics.	**4**
UNIT IV	**Disaster Preparedness and Management Preparedness:** Monitoring of Phenomena Triggering a Disaster or Hazard. **Evaluation of Risk:** Application of Remote Sensing, Data from Meteorological and other Agencies. **Media Reports:** Governmental and Community Preparedness.	**4**
UNIT V	**Risk Assessment Disaster Risk:** Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation In Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.	**4**
UNIT VI	Disaster Mitigation Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.	**4**

TOTAL: 24 PERIODS

REFERENCES:

1. Nishith Rai and A.K.Singh, “Disaster Management in India: Perspectives, Issues and Strategies”, New Royal Book Company, 2007.
2. Pardeep Sahni, Alka Dhameja and Uma Medury, “Disaster Mitigation: Experiences and Reflections”, Prentice Hall India Learning Private Limited, 2001.
3. S.L.Goel, “Disaster Administration and Management: Text and Case Studies”, Deep & Deep Publication Pvt. Ltd., 2007.

20AC103	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
		2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Get a working knowledge in illustrious Sanskrit, the scientific language in the world.
- Learning of Sanskrit to improve brain functioning.
- Learning of Sanskrit to develop the logic in mathematics, science and other subjects enhancing the memory power.
- The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature.

UNIT I	➢ Alphabets in Sanskrit ➢ Past/Present/Future Tense ➢ Simple Sentences	**8**
UNIT II	➢ Order ➢ Introduction of roots ➢ Technical information about Sanskrit Literature	**8**
UNIT III	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	**8**

TOTAL: 24 PERIODS

REFERENCES:

1. H.R.Vishwas and Samskrita Bharati, “Abhyâsapustakam”, Samskrita-Bharti Publication, New Delhi.
2. Vempati Kutumba Shastri, “Teach Yourself Sanskrit: Prathama Diksha (Sanskrit)”, Rashtriya Sanskrit Samsthana, Delhi, 2012.
3. Suresh Soni, “Indias Glorious Scientific Tradition”, Prabhat Prakashan, 2006.

20AC104	VALUE EDUCATION	L	T	P	C
		2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Understand the value of education and self-development.
- Imbibe good values in students.
- Know about the importance of character.
- Learn the importance of Human values.
- Developing the overall personality.

UNIT I **6**

- 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.

UNIT II **6**

- 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 **6**

- Personality and Behaviour Development - Soul and Scientific attitude.
- Positive Thinking.
- Integrity and Discipline.
- Punctuality, Love and Kindness.
- Avoid fault Thinking.
- Free from anger, Dignity of Labour.
- Universal brotherhood 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 **6**

- Character and Competence – Holy books vs. Blind faith.
- Self-Management and Good health.
- Science of reincarnation.
- Equality, Non-violence, Humility, Role of Women.
- All religions and same message.
- Mind your Mind, Self-control.
- Honesty, Studying effectively.

TOTAL: 24 PERIODS

REFERENCES:

1. S.K. Chakraborty, “Values of Ethics for Organization: Theory and Practice”, Oxford University Press, 1999.

20AC105	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- Address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- Address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

UNIT I **History of Making of the Indian Constitution:** History, Drafting Committee (Composition and Working) **4**

UNIT II **Philosophy of the Indian Constitution:** Preamble, Salient Features **4**

UNIT III **Contours of Constitutional Rights and Duties:** **4**

- 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:** **4**

- 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: **4**

- District's Administration head: Role and Importance
- Municipalities: Introduction, Mayor and role of Elected Representative, CEO of 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: **4**

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

TOTAL: 24 PERIODS

REFERENCES:

1. The Constitution of India, January 1950 (Bare Act), Gazette of **India**.
2. S.N.Busi, "Dr. B.R. Ambedkar Framing of Indian Constitution", Vol. 1 to 6, First Edition, 2016.
3. M.P.Jain, Justice Jasti Chelameswar and Justice Dama Seshadri Naidu, "Indian Constitution Law", Lexis Nexis, 2018.
4. D.D.Basu, "Introduction to the Constitution of India", Lexis Nexis, 2011.

20AC106 **PEDAGOGY STUDIES**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the Department for International Development (DFID), other agencies and researchers.
- Identify critical evidence gaps to guide the development.
- What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
- What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
- How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

UNIT I Introduction and Methodology: **5**

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

UNIT II Thematic Overview: **4**

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

UNIT III Evidence on the effectiveness of pedagogical practices: **5**

- 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: **5**

- Alignment with classroom practices and follow-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: **5**

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

TOTAL: 24 PERIODS

REFERENCES:

1. Jim Ackers and Frank Hardman, “Classroom Interaction in Kenyan Primary Schools”, Compare, Vol. 31, No. 2, 2001.pp. 245-261.
2. Mamta Agrawal, “Curricular reform in schools: The importance of evaluation”, Journal of Curriculum Studies, Vol. 36, No. 3, 2004. pp. 361-379.
3. Kwame Akyeampong, “Teacher training in Ghana - does it count? Multi-site teacher educationresearch project (MUSTER),Country Report One, London, DFID, March 2003.
4. Kwame Akyeampong, Kattie Lussier,John Pryor and Jo Westbrook, “Improving teaching and learning ofbasic maths and reading in Africa: Does teacher preparation count?”, International Journal of Educational Development, Vol. 33, No. 3, 2013. pp. 272–282.
5. Robin J Alexander, “Culture and Pedagogy: International Comparisons in Primary Education”, Wiley-Blackwell, 2001.
6. www.pratham.org/images/resource%20working%20paper%202.pdf.

20AC107 **STRESS MANAGEMENT BY YOGA**

L	T	P	C
2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Achieve overall health of body and mind
- Overcome stress
- Develop healthy mind in a healthy body thus improving social health also
- Improve efficiency

UNIT I **Ashtanga:** **8**

Definitions of Eight parts of yoga.

UNIT II **Yam and Niyam:** Do and Not Do in life **8**

- Ahinsa, Satya, Astheya, Bramhacharya and Aparigraha
- Shaucha, Santosh, Tapa, Swadhyay, Ishwarpranidhan

UNIT III **Asan and Pranayam:** **8**

- Various yoga poses and their benefits for mind and body
- Regularization of breathing techniques and its effects - Types of Pranayam

TOTAL: 24 PERIODS

REFERENCES:

1. “Yogic Asanas for Group Training-Part-I”, Janardan Swami Yogabhyasi Mandal, Nagpur.
2. Swami Vivekananda, “Raja-Yoga or Conquering the Internal Nature”, Vedanta Press, 1998.

20AC108	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

OBJECTIVES:

This course is intended to provide an integrated framework for the students can able to:

- Learn to achieve the highest goal happily
- Become a person with stable mind, pleasing personality and determination
- Awaken wisdom in students
- Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
- The person who has studied Geeta will lead the nation and mankind to peace and prosperity
- Study of Neetishatakam will help in developing versatile personality of students.

UNIT I Neetisatakam - Holistic development of personality: 8

- Verses - 19, 20, 21, 22 (Wisdom)
- Verses - 29, 31, 32 (Pride andHeroism)
- Verses - 26, 28, 63, 65 (Virtue)
- Verses - 52, 53, 59 (Dont's)
- Verses - 71, 73, 75, 78 (Do's)

UNIT II Approach to day-to-day work and duties:Shrimad Bhagwad Geeta 8

- 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

UNIT III Statements of basic knowledge: Shrimad Bhagwad Geeta 8

- Chapter 2 - Verses - 56, 62, 68
- Chapter 12 - Verses - 13, 14, 15, 16,17, 18

Personality of role model: Shrimad Bhagwad Geeta

- Chapter 2 -Verses - 17
- Chapter 3 - Verses - 36, 37, 42
- Chapter 4 - Verses - 18, 38, 39
- Chapter18 - Verses - 37, 38, 63

TOTAL: 24 PERIODS

REFERENCES:

1. Swami Swarupananda, "Srimad Bhagavad Gita", by Advaita Ashram, Kolkata.
2. Pt. Gopinath, "Three Satakam of Bharatrhari (Niti, Srngara, Vairagya)", Rashtriya Sanskrit Sansthan, 2010.

20OE301 BUSINESS ANALYTICS

L	T	P	C
3	0	0	3

OBJECTIVES:

- Have an understanding of the fundamental concepts of forensic science.
- Have a basic understanding of the application of forensic science principles to digital Evidence examinations.
- Be able to articulate the steps of the forensic process as applied to digital evidence.
- Be able to draft a Standard Operating Procedure.
- Conduct rudimentary digital forensic examinations.

UNIT I BUSINESS ANALYTICS AND STATISTICAL TOOLS 9

Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organization, Competitive advantages of Business Analytics, Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modeling, sampling and estimation methods overview.

UNITII TRENDINESS AND REGRESSION ANALYSIS 9

Modelling Relationships and Trends in Data, Simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, Problem solving, visualizing and Exploring Data, Business Analytics Technology.

UNIT III BUSINESS ANALYTICS AND DESCRIPTIVE ANALYTICS 9

Organization Structures of Business analytics, Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, Nonlinear Optimization.

UNIT IV FORECASTING TECHNIQUES 9

Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models. Monte Carle Simulation Using Analytic Solver Platform, New - Product Development Model, News vendor Model, Overbooking Model, Cash Budget Model.

UNIT V DECISION ANALYSIS AND RECENT TRENDS IN BUSINESS ANALYTICS 9

Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

TOTAL: 45 PERIODS

OUTCOMES:

Upon successful completion of this course, a student will be able to:

- Understand the role of business analytics within an organization.
- Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
- Understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
- Understanding the processes needed to develop report and analyze business data.
- Use decision-making tools/Operations research techniques.
- Mange business process using analytical and management tools

REFERENCES:

1. Marc J Schniederjans, Dara G Schniederjans and Christopher M Starkey, “Business Analytics Principles, Concepts and Applications: What, Why and How”, Pearson FT Press,2014.
2. James R Evans, “Business Analytics”, Person,2012.

20OE302 INDUSTRIAL SAFETY

L	T	P	C
3	0	0	3

OBJECTIVES:

- To familiarize students with basic safety practices in the Electronics industry and other common industrial settings
- To be aware of signage commonly used for Hazards and Warning in industrial workplace.
- To learn the prevention methodology for wear and corrosion
- To understand fault tracing mechanism.
- To understand the importance of periodic and preventive maintenance.

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: 45 PERIODS

Upon successful completion of this course, a student will be able to:

- Understanding of the documentation used with hazardous materials, such as the MSDS.
- Describe the different levels of danger that exist with electrical shock.
- Describe several appropriate actions to take in the event of an electrical accident.
- Describe the situations under which static electricity may cause damage to electrical components (ESD - electrostatic discharge).
- Apply the methods of prevention of fire and explosions.
- Understand the industrial laws, regulations and source models.

REFERENCES:

1. Keith Mobley, “Maintenance Engineering Handbook”, Eight Edition, McGraw-Hill Education,2014.
2. H.P.Garg, “Industrial Maintenance”, S.Chand (G/L) & Company Ltd.,1987.
3. Frank Graham, “Audels Pumps Hydraulics Air Compressors: A Practical Guide”, Theo Audel& Co., 1949.
4. ManjrikerGunaratne, “The Foundation Engineering Handbook”, Second Edition, CRC Press,2013.

20OE303	OPERATIONS RESEARCH	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the need for optimization techniques
- To learn optimization tool for solving the problems.
- To learn and solve linear programming and non linear programming problems
- To apply the optimization techniques for solving the different types of problems
- To understand the network problems and game theory problems

UNIT I INTRODUCTION TO OPERATIONS RESEARCH 9

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

UNITII LINEAR PROGRAMMING PROBLEM 9

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

UNIT III NON-LINEAR PROGRAMMING PROBLEM 9

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

UNIT IV SCHEDULING AND SEQUENCING 9

Scheduling and sequencing - single server and multiple server models - deterministic inventory models -Probabilistic inventory control models - Geometric Programming.

UNIT V APPLICATIONS OF OPERATIONS RESEARCH 9

CompetitiveModels,SingleandMulti-channelProblems,SequencingModels,Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation.

TOTAL: 45 PERIODS

Upon successful completion of this course, a student will be able to:

- Understand the concepts and tools of Operations Research.
- Understand the mathematical models used in Operations Research.
- Apply these techniques constructively to make effective business decisions.
- Solve the Linear Programming Problems.
- Solve the Non-Linear Programming Problems.
- Understand the usage of game theory and Simulation for Solving Business Problems.

REFERENCES:

1. Hamdy A Taha, “Operations Research: An Introduction”, Tenth Edition, Pearson,2017.
2. Wagner H.M., “Principles of Operations Research, with Applications to Managerial Decisions”, Prentice Hall India Learning Private Limited,1980.
3. J.C.Pant, “Introduction to Optimization Operations Research”, Seventh Edition, Jain Brothers,2008.
4. Hitler Libermann, “Operations Research”, Mc-Graw Hill Pub.,2009.
5. R.Pannerselvam, “Operations Research”, Prentice Hall of India,2010.

20OE304	COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the different types cost estimation and its process
- To learn the methods for controlling the scope of project
- To understand the cost based decision making
- To identify the methods pricing strategy and practical cost management

UNIT I INTRODUCTION TO STRATEGIC COST MANAGEMENT PROCESS 9

Cost concepts in decision-making, Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System, Inventory valuation, Creation of a Database for operational control, Provision of data for Decision-Making.

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. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process.

UNIT III COST BASED DECISION-MAKING 9

Cost Behavior and Profit Planning Marginal Costing, Distinction between Marginal Costing and Absorption Costing, Break-even Analysis, Cost-Volume-Profit Analysis. Various decision- making problems. Standard Costing and Variance Analysis.

UNIT IV PRICING STRATEGIES 9

Pricing: Pareto Analysis, Target costing, Life Cycle Costing. Costing of service sector. Just-in- time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking, Balanced Score Card and Value- Chain Analysis. Budgetary Control, Flexible Budgets, Performance budgets, Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

UNIT V PRACTICAL COST MANAGEMENT 9

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

TOTAL: 45 PERIODS

Upon successful completion of this course, a student will be able to:

- Creating the project requirements document and project scope statement.
- Identify ways to control the scope of the project.
- Create a work breakdown structure and develop work packages.
- Develop a critical path Schedule.
- Perform a cost and schedule analysis.
- Calculate planned and earned values to compare with actual cost.

REFERENCES:

1. Srikant M Datar and Madhav V Rajan, “Horngren's Cost Accounting: A Managerial Emphasis”, Pearson,2017.
2. Robert Kaplan and Anthony A Atkinson, “Advanced Management Accounting”, Pearson Education India,2015.
3. AlnoorBhimani, Charles T Horngren, Srikant M Datar and Madhav V Rajan, “Management & Cost Accounting”, Pearson,2015.
4. Ashish K Bhattacharya, “Principles and Practices of Cost Accounting”, Prentice Hall India Learning Private Limited,2004.
5. N.D.Vohra, “Quantitative Techniques in Management”, McGraw Hill Education,2009.

20OE305	COMPOSITE MATERIALS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basic characteristics of composite material
- To know how to apply the computational techniques to mechanical systems with composite materials
- To design the guidelines and drafting notations for composite components
- To understand manufacturing process of metal matrix
- To learn the manufacturing process polymer matrix components
- To understand occurrence of different failures at composite materials

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.

UNITII 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, hydrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TOTAL: 45 PERIODS

Upon successful completion of this course, a student will be able to:

- Understand the fundamental properties of composite materials.
- Apply the fundamental principles and mechanics of composite materials.
- Apply modern analytical techniques to mechanical systems with composite materials.
- Apply computational techniques to mechanical systems with composite materials.
- Understand the manufacturing processes and cost analysis in composite materials.
- Demonstrate effective communication and teamwork skills through technical presentations and reports in term projects.

REFERENCES:

1. R. W. Cahn, P. Haasen and E. J. Kramer, “Material Science and Technology: A Comprehensive Treatment” – Vol. 13 – “Structure and Properties of Composites” (T. W. Chou), Wiley-VCH Verlag GmbH & Co.,KGoA.
2. William D Callister and David G Rethwisch, “Materials Science and Engineering: An Introduction”, John Wiley & Sons,2010.
3. George Lubin, “Handbook of Composites”, Springer,2013.
4. Krishan K Chawla, “Composite Materials: Science and Engineering”, Springer,2010.
5. Deborah D.L. Chung, “Composite Materials: Science and Applications (Engineering Materials and Processes)”, Springer,2012.
6. Danial Gay and Suong V Hoa, “Composite Materials: Design and Applications”, CRC Press,2007.

20OE306	WASTE TO ENERGY	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To learn the different types of environmental wastages
- To understand the mechanism of generating energy from wastages
- To identify the energy sources from biomass
- To evaluate the cost estimation of bio energy generation
- To identify the challenges and risks involved in the waste disposal and identify appropriate waste management technique to handle and turn waste toenergy.

UNITI INTRODUCTION TO ENERGYFROMWASTE9

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

UNITII 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 BIOMASSGASIFICATION 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 BIOMASSCOMBUSTION 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: 45 PERIODS

Upon successful completion of this course, a student will be able to:

- Understand the technologies for generation of energy from solid waste.
- Identify remedies/potential solutions to the supply and environmental issues associated with biomass based energy resources.
- Identify sources of energy from bio-chemical conversion.
- Understand and assess the biomass resource, appropriate conversion technology for the given biomass resource and end use.
- Evaluate the cost-benefit of various biomass energy conversion processes.
- Describe the challenges/risks involved in the waste disposal and identify appropriate waste management technique to handle and turn waste to energy.

REFERENCES:

1. Ashok V Desai, “Nonconventional Energy”, New Age Publishers,1996.
2. K.C.Khandelwal and S.S.Mahdi, “Biogas Technology: A Practical Handbook”, Tata McGraw-Hill, 1986.
3. Devinder Singh Chahal, “Food, Feed and Fuel from Biomass”, Asia Publishing House,1991.
4. Charles Y Wereko–Brobby and Essel B Hagan, “Biomass Conversion and Technology”, Wiley– Blackwell,1996.