KALASALINGAM
ACADEMY OF RESEARCH & EDUCATION
(DEEMED TO BE UNIVERSITY)
Under sec. 3 of UGC Act 1956. Accredited by NAAC with "A" Grade

SCHOOL OF COMPUTING
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

FOR

M.TECH. DEGREE PROGRAMME IN NETWORK ENGINEERING

[Regulations 2018]

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CURRICULUM
FOR
M.TECH. DEGREE PROGRAMME IN
NETWORK ENGINEERING

Programme Educational Objectives:

1. The post graduates will be proficient in applying contemporary networking theory and practice to problems encountered in real time applications using sustainable and inclusive technology.
2. The post graduates will be contributing effectively as a network administrator and researcher using common modern tools and techniques in networking.
3. The post graduates will possess a solid foundation for engaging in lifelong learning and professional development in network engineering.

Programme Outcomes:

1. Ability to apply the knowledge of mathematics and network engineering fundamentals to deploy, analyze, monitor, test and manage different networks.
2. Ability to investigate complex problems through research and effectively utilize suitable networking tools in tune with state of art of technology to solve network related problems.
3. Ability to design sustainable solutions through use of inclusive technology for considering public health and safety, cultural, societal and environmental factors.
4. Ability to design, conduct experiments, analyze and interpret data by applying appropriate research methodologies, techniques and tools, to solve unfamiliar problems.
5. Ability to create, select, learn and apply modern engineering tools and techniques to solve complex networking activities.

6. Ability to be in a position to communicate effectively in groups involved in collaborative, multidisciplinary research activities.
7. Ability to possess leadership, project management and financial skills with professional ethics.
8. Ability to propose original ideas and design novel solutions and communicate them effectively to the stakeholders verbally as well as in writing.
9. Ability to recognize the need for, and develop confidence in self and life-long learning.
10. Ability to understand the impact of engineering solutions in a contemporary, global, economical, environmental, ethical and societal context for sustainable development.
11. Ability to observe and examine critically to correct themselves without depending on external feedback.

Programme Specific Outcomes

Problem Solving Skills: Ability to apply the knowledge of computing and mathematics to network problems and thereby able to design, develop and analyze the software, hardware systems with cost and environmental considerations.

Professional Skills: Ability to enhance research skills and utilize advanced computing tools for analyze, design and implementation of network systems for resolving real life / social problems to deliver a quality product for business success.

Successful career and Entrepreneurship: Ability to have all round personality skills with multidisciplinary knowledge, leadership, communication, team work and sensitivity towards society in order to become valued and responsible networking professionals for life-long learning.

	PO										
	1	2	3	4	5	6	7	8	9	10	11
PSO1	S	S	S								
PSO2				S	S			M			
PSO3						S	S	S	S	M	M

KALASALINGAM ACADEMY OF RESEARCH AND EDUCATION
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
M.Tech. Networking - CURRICULUM STRUCTURE

S.No	Course Category	Credits
1	Core Theory Courses	14
2	Lab Courses	8
3	Supporting Courses (Research Methodology and IPR)	4
4	Program Specific Elective Courses	15
5	Open Elective (interdisciplinary / General Elective)	3
6	Mini Project	2
7	Project Work	26
8	Audit course (2 courses)	-
Total Credits		72

Core Courses

Code	Name of the Course	Credit
CSE18R5102	Enterprise Network Design	4
CSE18R5103	Data center Networking	3
CSE18R5104	Network Forensics	4
CSE18R5105	Advance Computer Networks	3
Total		14

Lab Courses

Code	Name of the Lab Courses	Credits
CSE18R5182	Network Design Lab	2
CSE18R5082	Machine Learning Lab	2
CSE18R5181	Social Network Analysis Lab	2

CSE18R5183	Network Forensics, Testing and Monitoring Lab	2
Total		8

Supporting Courses

Code	Name of the Courses	Credits
PGM18R5001	Research Methodology	1
MAT18R5001	Applied Mathematics	3
Total		4

List of Programme Specific Electives:

S.No	Code	Name of the Course	Credit
1.	CSE18R5005	Machine Learning	3
2.	CSE18R5106	Network Programming	3
3.	CSE18R5107	Analytical Approach in Networking	3
4.	CSE18R5108	Cloud Computing	3
5.	CSE18R5109	Network Routing Protocols	3
6.	CSE18R5110	Mobile and Pervasive Computing	3
7.	CSE18R5111	Optical Networks	3
8.	CSE18R5112	Multimedia Communication Networks	3
9.	CSE18R5113	Vehicular Ad Hoc Networks (VANETs)	3
10.	CSE18R5114	High speed switching Architecture	3
11.	CSE18R5116	Survivable Networks	3
12.	CSE18R5117	Next Generation Networks	3
13.	CSE18R5118	High Speed Networks	
14.	CSE18R5119	Storage Area Networks	3

15.	CSE18R5120	Virtual Forensics and Security	3
16.	CSE18R5121	Convergent Networking	
17.	CSE18R5122	Network System Design using Network Processors	3
18.	CSE18R5123	Autonomic Networks	3
19.	CSE18R5125	High Performance Communication Networks	3
20.	CSE18R5126	Network Management	3
21.	CSE18R5127	Data Centre Virtualization	3
22.	CSE18R5128	Cyber law	3
23.	CSE18R5129	Simulation of Communicating systems and Networks	3
24.	CSE18R5130	Distributed Computing	3
25.	CSE18R5015	Mobile Application Development	3
26.	CSE18R5020	Social Network Analysis	3
27.	CSE18R5021	Software Defined Networking	
28.	CSE18R5022	Green Computing	

List of Interdisciplinary Electives:

S.No	Code No	Course Title	T	L	P	C
1.	ICE18R5009	Robotics And Automation	3	0	0	3
2.	ECE17R5141	Basics Of VLSI Design	3	0	0	3
3.	ECE17R6042	Data Compression Techniques	3	0	0	3
4.	EEE18R6015	Embedded C	3	0	0	3
5.	EEE18R5007	Smart Grid Technology	3	0	0	3
6.	INT17R6023	Deep Learning Techniques	3	0	0	3

List of General Electives:

List of General Electives:

S.No	Code No	Course Title	T	L	P	C
1.	CSE18R5051	IoT and Applications	3	0	0	3
2.	CSE18R5053	Big Data Analytics	3	0	0	3
3.	CSE18R5052	Cloud Computing	3	0	0	3
4.	EEE18R5020	Soft Computing Techniques	3	0	0	3
5.	EEE18R6013	Evolutionary Computation Techniques	3	0	0	3
6.	EEE18R5021	Optimization techniques	3	0	0	3

Open Elective

Code	Name of the Course	Credits
1	Business Analytics	3
2	Industrial Safety	3
3	Operations Research	3
4	Cost Management of Engineering Projects	3
5	Composite Materials	3
6	Waste to Energy	3

S.No	Content	Credits
1	Mini Project	2
2	Project Work	26
Total		28

Audit Course

1. English for Research Paper Writing
2. Disaster Management
3. Sanskrit for Technical Knowledge
4. Value Education
5. Constitution of India
6. Pedagogy Studies
7. Stress Management by Yoga
8. Personality Development through Life Enlightenment Skills.

SEMESTER I

Code No.	Course Title	L	T	P	C	Course Type
MAT18R5001	Applied Mathematics	3	0	0	3	Supporting Core
CSE18R5102	Enterprise Network Design	3	1	0	4	Core
CSE18R5103	Data center Networking	3	0	0	3	Core
*******	Elective – I	3	0	0	3	Elective
*******	Elective – II	3	0	0	3	Elective
PGM18R5001	Research Methodology and IPR	1	0	0	2	Supporting course
	Audit Course	2	0	0	0	
CSE18R5182	Network Design Lab	0	0	3	2	Practical
CSE18R5082	Machine Learning Lab	0	0	3	2	Practical
				Total	21	

SEMESTER 2

Code No.	Course Title	L	T	P	C	Course Type
CSE18R5104	Network Forensics	3	1	0	4	Core
CSE18R5105	Advanced Computer Network	3	0	0	3	Core
*******	Elective – III	3	0	0	3	Elective
*******	Elective – IV	3	0	0	3	Elective
	Audit Course	2	0	0	0	
CSE18R5181	Social Network Analysis Lab	0	0	3	2	Practical
CSE18R5183	Network Forensics, Testing and Monitoring Lab	0	0	3	2	Practical
	Mini Project with Seminar	2	0	0	2	
				Total	19	

*Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.

SEMESTER 3

Code No.	Course Title	T	L	P	C	Course Type
*******	Elective - V	3	0	0	3	Elective
*******	Open Elective	3	0	0	3	IE
CSE18R5198	Dissertation-I /Industrial Project	0	0	20	10	
				Total	16	

*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

SEMESTER 4

Code No.	Course Title	T	L	P	C	Course Type
CSE18R5199	Project Phase II	0	0	30	16	Project
				Total	16	

Core Courses

CSE18R5102	ENTERPRISE NETWORK DESIGN	L	T	P	Credit
		3	1	0	4
Course Category : Theory		**Course Type** : Core			

PRE-REQUISITE:

- Computer Networks

COURSE OUTCOMES

CO1: Identify the various components of the networking concepts, standards and protocols

CO2: Able to implement the Local and wide area network topologies.

CO3: To become an expert in in-depth TCP/IP networking and enterprise networking with windows 2008.

CO4: Analyze the various the TCP/IP applications

CO5: To analyze the Security and risk issues in Enterprise network design.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	S											S		
CO2			S									S		
CO3		M										M		
CO4				M									M	
CO5		M						M				M	M	

UNIT I INTRODUCTION TO NETWORK CONCEPTS, STANDARDS AND PROTOCOLS

Introduction to Computer Networks - Networking Standards and Reference Models - Transmission Basics and Networking Media – Introduction to TCP/IP Protocols

UNIT II LOCAL AND WIDE AREA NETWORK TOPOLOGIES AND HARDWARE

LAN Topologies and Ethernet Standards - Networking Hardware - Wide Area Networking Technologies -WAN Topologies - WAN Transmission Methods - WAN Implementation and Remote Connectivity – Wireless Networking

UNIT III ENTERPRISE NETWORKING WITH WINDOWS 2008 and UNIX

Characteristics of Network Operating Systems - Networking with Windows Server 2008 - Networking with UNIX

UNIT IV INDEPTH TCP/IP NETWORKING

Designing TCP/IP based networks – TCP/IP mail Services – TCP/IP Utilities – Voice and Video over IP – Signaling and Transport Protocols – QoS Assurance

UNIT V ENTERPRISE NETWORK MANAGEMENT

Security Audits, Risks and Policies – Security in Network Design – Wireless Network Security - Troubleshooting Network Problems - Ensuring Network Integrity and Availability -Maintaining and Upgrading Computer Networks – Network Management Fundamentals – Fault and Performance Management – Change Management

TEXT BOOK

1. Tamara Dean, Network+ Guide to Networks, Course Technology, USA, 7th edition, 2015
2. Glen E. Clarke, CompTIA Network+ Certification Study Guide, Tata McGraw Hill, 2015, 6th edition

CSE18R5103	DATA CENTRE NETWORKING	L	T	P	Credit

		3	0	0	3
Course Category : Theory		**Course Type** : Core			

PRE-REQUISITE:

- Computer Networks

Course Outcomes:

CO1: Understand the fundamentals of Data Centre design
CO2: Identify the various architectures and standards of Data Centre
CO3: Analyze and understand the various features of server architectures involved in data centre network
CO4: Understand the topology structure, applications and technologies involved in Layer 2 Network design
CO5: Understand the topology structure, applications and technologies involved in Layer 3 Network design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	S											S		
CO2				S									S	
CO3		S		S	M							S	S	
CO4	M		S							M		M		M
CO5	M		S							M		M		M

EVOLUTION OF DATA CENTRE DESIGN

Design for flexibility, scalability, environmental control, electrical power, flooring, fire protection, security, network infrastructure. Energy use and greenhouse gas emissions. Requirements for modern data centers, high availability and Service Orientated Infrastructures (SOI). Modern data centre use case studies.

DATA CENTRE ARCHITECTURES

Network connectivity optimization evolution: Top of rack (TOR), end of rack (EOR), scale up vs scale up, solutions that reduce power and cabling. Data Centre standards; TIA/EIA-942. Structured cabling standards, fibre and copper cabling characteristics, cable management, bandwidth requirements, I/O connectivity.

SERVER ARCHITECTURES

Stand-alone, blades, stateless, clustering, scaling, optimization, virtualization. Limitation of traditional server deployments; modern solutions. Applications; database, finance etc. Redundant Layer 2 and Layer 3 designs, Data Center OS, Case studies.

LAYER 2 NETWORKS

Ethernet; IEEE 802.3b/a; 40 Gbps and 100 Gbps Ethernet. IEEE 802.1D Spanning Tree Protocol (STP), RSTP, PVST, MSTP. TRILL (Transparent Interconnection of Lots of Links), R Bridges, IEEE 802.1Qbg Edge Virtual Bridging, 802.1Qbh Bridge Port Extension. Fibre Channel over Ethernet (FCoE) vs Internet Small Computer System Interface (iSCSI). Data Center Bridging (DCB); priority-based flow control, congestion notification, enhanced transmission selection, Data Center Bridging Exchange (DCBX). Layer 2 Multicasting; Case studies.

LAYER 3 AND BEYOND

Layer 3 Data Centre technologies, network virtualization. Protocols; IPv4, Ipv6, MPLS, OSPF, IS-IS, BGP. OTV, VPLS layer 2 extension protocols. Locator Identifier Separation Protocol (LISP). Layer 3 Multicasting. Data centre application services. Data centre networking use case studies and the enabling technologies and protocols in the modern data centre.

REFERENCES

1. Silvano Gai, Claudio DeSanti,"I/O Consolidation in the Data Center" Cisco Press; 1 edition [ISBN: 9781587058882]. 2014.
2. Kevin Corbin, Ron Fuller, David Jansen, "NX-OS and Cisco Nexus Switching: Next-Generation Data Center Architectures" Cisco Press; 1 edition [ISBN: 9781587058929], 2010.
3. SilvanoGai, TommiSalli, Roger Andersson, "Cisco Unified Computing System" Cisco Press; 1 edition, [ISBN: 9781587141935], 2010.
4. Nash Darukhanawalla, Patrice Bellagamba, "Interconnecting Data Centers Using VPLS" Cisco Press; 1 edition, [ISBN: 9781587059926], 2011.
5. Robert W. Kembel, Roger Cummings (Introduction), "The Fibre Channel Consultant" Northwest Learning Assoc; 3rd edition, [ISBN: 0931836840], 2010.

6. Robert W Kembal"Fiber Channel Switched Fabric" Northwest Learning Associates, inc. [ISBN: 0931836719], 2011.
7. John L. Hufferd, "ISCSI", Addison-Wesley Boston [ISBN: 978 - 0201784190], 2011.

CSE18R5104	NETWORK FORENSICS	L	T	P	Credit

		3	1	0	3
Course Category : Theory		**Course Type**	**:** Core		

PRE-REQUISITE:

- Network Security
- Network Routing protocols

COURSE OUTCOMES

CO1: Understand the need of network forensics and analysis.

CO2: Identify traffic analysis tools and measure the packet performances for complex problems.

CO3: Apply the knowledge of networking protocols to identify evidence within traffic captures and intrusion detection alerts.

CO4: Utilize the tools and policies for acquisition and analysis.

CO5: Understand the need for advanced techniques and tools for network forensics.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	S			S							S		
CO2		S		S	S			S					S	
CO3			S					S		S	M			S
CO4		S		S	S						S	S	S	
CO5		S		S	S	S		S	M				S	

UNIT I INTRODUCTION

Practical Investigative Strategies – Real World Class – Footprints – Concepts in Digital Evidence – Challenges relating to Network Evidence – Network Forensics Investigative Methodology – Technical Fundamentals – Sources of Network Based Evidences – Evidence Acquisition – Physical Interception – Traffic Acquisition Software – Active Acquisition.

UNIT II TRAFFIC ANALYSIS

Packet Analysis – Protocol Analysis - Flow Analysis – Higher – Layer Traffic Analysis – Case Study – Statistical Flow Analysis – Sensors – Flow Record Export Protocol – Collection and Aggregation – Analysis – Case Study

UNIT III WIRELESS NETWORK FORENSICS AND IDS

Wireless Access Points – Wireless Traffic Capture and Analysis – Common Attacks – Locating Wireless Devices – Case Study – Network Intrusion Detection and Analysis – Types of NIDS/NIPS – NIDS/NIPS Evidence Acquisition – Comprehensive Packet logging – Snort – Case Study

UNIT IV NETWORK DEVICES AND SERVERS

Event Log Aggregation, Correlation and Analysis – Sources of Logs – Network Log Architecture – Collecting and Analyzing Evidences – Case Study – Switches , Routers and Firewalls – Interfaces – Logging – Case Study - Web Proxies – Web Proxy Functionality – Evidence- Squid – Web Proxy Analysis – Encrypted Web Traffic - Case Study

UNIT V ADVANCED TOPICS

Network Tunneling – Tunneling for Functionality - Tunneling for Confidentiality - Covert Tunneling – Case Study – Malware Forensics – Trends in Malware Evolution – Network Behavior of Malware – The future of Malware and Network Forensics – Case Study

REFERENCES

1. Sheri Davidoff and Jonathan Han, Network Forensics – Tracking Hackers through Cyberspace, Prentics Hall, 2012.
2. William J Buchanan, Introduction to Security and Network Forensics, CRC Press, 2011.
3. Kevin Mandia, Chris Prosise, Incident Response and computer forensics, Tata McGrawHill, 2010.
4. Bill Nelson, Amelia Philips and Christopher Steuart, Guide to computer forensics and investigations, course technology, Cengage Learning; 4thedition, ISBN: 1-435-49883-6, 2011.

CSE18R5105	ADVANCED COMPUTER NETWORKS	L	T	P	Credit
		3	1	0	3
Course Category : Theory		**Course Type** : Core			

PRE-REQUISITE:

Have taken at least an undergraduate-level Computer networks course.

Have programming experience in C++, JAVA and Python.

Experience with virtual machines and other virtual networking environments are added advantages.

COURSE OUTCOMES

1. Student will be able to design a network with appropriate protocols selected according to requirement.
2. Students will be able to analyze different routing protocols and traffic engineering methods deployed in networking.
3. Understand the concept of SDN (i.e. abstracting and centralizing the control plane).
4. Analyze the implications of shifting from traditional network architectures to software defined networks.
5. Apply and analyze network functions virtualization.
6. Implement a network service using the knowledge acquired throughout the lectures.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	S			S							S		
CO2		S		S	S			S					S	
CO3			S					S		S	M			S
CO4		S		S	S						S	S	S	
CO5		S		S	S	S		S	M				S	

UNIT I:

Routing in Packet Networks; Shortest Path Routing; Traffic Management at packet level; Traffic management at flow level;

UNIT II:

Advanced Network Architecture: Integrated Services in Internet, RSVP, Differentiated Services, MPLS, Real-time Transport Protocol.

UNIT III:

Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs, **The Genesis of SDN**: Abstract, The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Open Source Contributions, Legacy Mechanisms Evolve Toward SDN, Network Virtualization, May I Please Call My Network SDN? **How SDN Works**: Abstract, Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods.

Unit IV

SDN in the Data Center, Abstract, Data Center Definition, Data Center Demands, Tunnelling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, Real-World Data Center Implementations **SDN in Other Environments** : Abstract, Consistent Policy Configuration, Global Network View,8.1 Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Hospitality Networks, Mobile Networks, In-Line Network Functions, Optical Networks, SDN vs. P2P/Overlay Networks.

Unit V

Network Function Virtualization: Introduction, Existing Network Virtualization Framework (VMWare and others), Mininet based examples, Virtualization and Data Plane I/O, Services Engineered Path, Service Locations and Chaining, NFV at ETSI, Non-ETSI NFV Work, **Network Topology and Topological Information Abstraction**: Introduction, Network, Topology, Traditional Methods, LLDP, BGP-TE/LS, ALTO, I2RS Topology **Building an SDN Framework**: Introduction, Build Code First; Ask Questions Later...,The Juniper SDN Framework, IETF SDN Framework(s),Open Daylight Controller/Framework, Policy, Conclusions

TextBooks:

1. Communication Network by Alberto Leon Garcia and IndraWidjaja.

2. SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies, By Thomas D. Nadeau, Ken Gray Publisher: O'Reilly Media, August 2013, ISBN: 978-1-4493-4230-2, ISBN 10: 1-4493-4230-2.

3. Software Defined Networks: A Comprehensive Approach, by Paul Goransson and Chuck Black, Morgan Kaufmann, June 2014, Print Book ISBN: 9780124166752, eBook ISBN : 9780124166844(unit 1)

References:

1. SDN and OpenFlow for Beginners by Vivek Tiwari, Sold by: Amazon Digital Services, Inc., ASIN: , 2013.

2. Network Innovation through OpenFlow and SDN: Principles and Design, Edited by Fei Hu, CRC Press, ISBN-10: 1466572094, 2014.

Lab Courses

CSE18R5182	NETWORK DESIGN LAB	L	T	P	Credit
		0	0	3	2
Course Category : Lab		**Course Type** : Practical			

PRE-REQUISITE:

- Computer Networks

COURSE OUTCOMES:

CO1: Design and develop networks to meet varying need of an organization depending on the available resources.

CO2: Implement and verify WAN Links

CO3: To become expertise in monitoring network bandwidth and network hacking.

CO4: Implement, verify and troubleshoot NAT and ACLs in a medium sized office network.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		M	M			M				M		M	M	
CO2					S								S	
CO3										M				M
CO4	S	S										S		

LIST OF EXPERIMENTS

1. Familiarization of various devices and components :

   Study of network cables – Color coding schemes – Crimping procedure – Routers and switches

2. Experiments using routers :

   Configuring routers – Implementing static and dynamic routing – Implementing Border Gateway protocol

3. Experiments using switches :

   Configuring switches – Layer2 switching & spanning tree Protocol – Virtual LAN – VTP – VTP pruning – Implementing inter VLAN routing

4. IPv6 :

Configuring IPv6 – Configuring Routing Information protocol for IPv6 (RIPng) – Configuring Open Shortest Path First (OSPFv3) protocol.

5. Access Control :

Access control List - Network Address Translation – Configuring Client–Server Component – enable SNMP probe using access lists

6. Wide Area networks :

Configuring PPP

7. Experiments on network security :

Network reconnaissance – Network sniffers – address spoofing – network monitoring – Configuring firewalls, IDS and VPN – wireless security tools

CSE18R5082	MACHINE LEARNING LAB	L	T	P	Credit
		0	0	3	2
Course Category : Lab		**Course Type** : Practical			

PREREQUISITE:

- Programming Language Lab

COURSE OBJECTIVES

- To learn the fundamental issues and challenges of machine learning: data, model selection, model complexity, etc.
- To understand the strengths and weaknesses of many popular machine learning approaches.
- To comprehend the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised and un-supervised learning.

COURSE OUTCOMES

- CO1: Analyze and employ the use of regression and classification algorithms.
- CO2: Comprehend the usage of supervised and unsupervised learning for the underlying application.
- CO3: Design and implement appropriate machine learning algorithms in a range of real-world applications.
- CO4: Work with prediction based applications by applying the concepts of learning algorithms.

LIST OF EXPERIMENTS

Programming Language: Python

- Implementation of Nearest Neighbor criterion using various distance measures.
- Implementation of Linear regression algorithm.
- Implementation of Logistic regression algorithm.
- Implementation of naïve-bayes algorithm for word count application.
- Implementation of K-means algorithm with reference to gap analysis.
- Implementation of Dimensionality reduction algorithm with Kernel trick.
- Implementation of Support Vector Machines (SVM) technique.

- Implementation of Random forest learning technique.
- Experiment the use of prediction algorithms with statistical data.
- Develop a prediction application using appropriate learning technique.

CSE18R5181	Social Network Analysis Lab	L	T	P	Credit

		0	0	3	2
Course Category :Lab		Course Type : Practical			

PREREQUISITE:

Programming Languages, Network Analysis tools.

COURSE OBJECTIVEs

Understand the basic concepts associated with social network analysis as a conceptual tool and a methodology.

Think creatively and constructively about network structures of varied kind and form.

Describe economically and analyze networks in order to reveal their key structural features.

COURSE OUTCOMES

CO1: Understanding the various network analysis systems.

CO2: Create the dataset and use the various data in social networks.

CO3: Analysis the various tools for detecting community Social Network Infrastructures and Communities

CO4: Able to identify the Link prediction in various social networks

LIST OF EXPERIMENTS

1. To enter some network data using a variety of formats.

Enter the data in the following ways (note: you can simplify the node labels by removing the numeric suffixes):

2. Create an Excel file, enter the adjacency matrix of the graph, and then cut-and-paste into UCINET. Call the resulting dataset M1.

3. Create a DL text file using Full matrix formatting and import into Ucinet. Call the result M2.

4. Create a DL text file using Nodelist1 formatting and import into Ucinet. Call the result M3.

5. Create a DL text file using Edgelist1 formatting and import into Ucinet. Call the result M4.

6. To implement the epidemics and contagion; modeling and prediction for dynamic processes in networks

7. To determine the centrality of individual nodes in a network.

8. To determine the Community detection of nodes in a network.

9. To determine the Link prediction of the nodes in a network
10. To determine the Model fitting: Fitting a hybrid degree distribution to Data in a network.
11. To determine the Network measures in any one of the social networks

CSE18R5183	NETWORK FORENSICS, TESTING AND MONITORING LAB	L	T	P	Credit
		0	0	3	2
Course Category : Lab		**Course Type** : Practical			

PRE-REQUISITE:

- Network Forensics
- Traffic Management

COURSE OUTCOMES:

CO1: Understand the importance of Network Forensics.

CO2: Analyze the concepts behind the network delay, network traffic engineering and network Protocols.

CO3: To become expertise in monitoring network bandwidth and network hacking.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		M	M			M				M		M	M	
CO2					S								S	
CO3										M				M

LIST OF EXPERIMENTS

Network Forensics

1. Intrusion detection
2. Logging (the best way to track down a hacker is to keep vast records of activity on a network with the help of an intrusion detection system)
3. Correlating intrusion detection and logging

Testing and Monitoring

1. IP Monitoring
2. Network management using Cisco Works
3. Network protocol analysis
4. Network Traffic Engineering
5. Network Delay analysis
6. Troubleshooting basic network problems (IP configuration, NIC)
7. Bandwidth Measuring/Monitoring/Engineering
8. Network Hacker Monitoring
9. Enterprise Management using Tivoli - Net View
10. Use of Network Monitoring/testing Tools

Supporting Course

PGM18R5001	Research Methodology	L	T	P	Credit
		3	0	0	1
Course Category :		**Course Type** : Supporting Course			

COURSE OUTCOMES

CO1 : To understand the basic concepts of research and its methodologies.

CO2 : To select and define appropriate research problems.

CO3 : To solve statistical problems and probability distributions.

CO4 : To process and analysis the methods of data collection.

CO5: To recognize the powerfulness of the soft computing tools and to formulate the optimization problems and write a research report, thesis and proposal.

UNIT I

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

UNIT II

Effective literature studies approaches, analysis Plagiarism, Research ethics

UNIT III

Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee

UNIT IV

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

UNIT V

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

REFERENCES

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for
2. science & engineering students'"
3. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction" Ranjit Kumar, 2 ndEdition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd,2007.
5. Mayall, "Industrial Design", McGraw Hill, 1992.
6. Niebel, "Product Design", McGraw Hill, 1974.
7. Asimov, "Introduction to Design", Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
9. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

MAT18R5001	Applied Mathematics	Credits			
		L	T	P	Total
		3	0	0	3
Pre-requisite: Basic knowledge in Algebra and Calculus at the under graduate level		**Course Category:** Supportive Course **Course Type :** Theory			

Course Objective(s)

The main objective of this course is to demonstrate various analytical skills in applied mathematics and extensive experience with the tactics of problem solving and logical thinking applicable for engineering. This course will also help the students to identify, formulate, abstract and solve problems in engineering using mathematical tools from variety of mathematical areas, including matrix theory, probability, random variables, queueing theory, classical optimization and linear programming.

Course Outcome(s):

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

CO1 : Evaluate norms, generalized eigen vector, Pseudo Inverse and QR decomposition of a Matrix.

CO2 : Understand the concept of probability, random variables, various probability distributions and its applications.

CO3 : Apply the techniques of Queueing models in real life situations.

CO4 : Understand the various concepts of classical optimization techniques.

CO5 : Apply graphical method, Simplex method and Dual Simplex method to solve Linear Programming Problems and also solving Transportation problems.

Unit 1: MATRIX THEORY

Matrix Norms - Jordan Canonical form – Generalized Eigen vectors - Pseudo Inverse – QR-decomposition – QR Algorithm.

Unit 2: PROBABILITY AND RANDOM VARIABLES

Probability – conditional probability - Random variables – Mathematical Expectation – Moments - Moment Generating function - Binomial, Poisson, Geometric, Uniform, Exponential and Normal Distributions – Function of a random variable.

Unit 3: QUEUEING MODELS

Markovian Queues - Single and multi server models – Little's formula - Steady state analysis – Queuing applications.

Unit 4: CLASSICAL OPTIMIZATION TECHNIQUES

Classification – optimization technique - Unconstrained Optimization – Equality constraints – Inequality constraints – Lagrange Multiplier method – Kuhn-Tucker Condition - Indirect search methods – Gradient of a function – Steepest descent method – Conjugate gradient method – Newton's method.

Unit 5: LINEAR PROGRAMMING

Standard form of Linear programming problem – formation – graphical method - Simplex method – Dual simplex method – Transportation problem - Applications.

TEXT BOOK:

1. Bronson.R. Matrix operations, Second Edn., Schaum's Outline series, McGraw Hill Education, 2011.
2. Gupta S.C. and Kapoor V.K. Fundamentals of Mathematical Statistics, Sultan Chand & Sons, New Delhi, 2014.
3. Taha H A, "Operations Research, An Introduction", 9th Edn., Pearson Education, 2016.
4. Singiresu S.Rao ,Engineering Optimization: Theory and Practice, Fourth Edition, New Age International (P) Ltd, 2009.

REFERENCES :

1. S.D.Sharma, Operations Research, Kedar Nath Ram Nath & co, 2008.
2. Sheldon M. Ross, Probability and Statistics for Engineers and Scientists, Fifth Edn., Elsevier India, 2014.

Program Specific Elective Courses

CSE18R5005	MACHINE LEARNING	L	T	P	Credit
		0	3	0	3
Course Category : Theory		**Course Type : Elective**			

PREREQUISITE

Soft computing

COURSE OBJECTIVES

1. To learn the concept of how to learn patterns and concepts from data without being explicitly
   programmed in various IOT nodes.
2. To design and analyse various machine learning algorithms and techniques with a modern
   outlook focusing on recent advances.
3. Explore supervised and unsupervised learning paradigms of machine learning.
4. To explore Deep learning technique and various feature extraction strategies.

COURSE OUTCOMES

CO1: Extract features that can be used for a particular machine learning approach in various IoT applications.

CO2: To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach

CO3: To mathematically analyse various machine learning approaches and paradigms.

PO/PSO	POs											PSOs		
CO'S	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	S			S							S		
CO2		S			S	M		S					S	
CO3			S	M				S		S	M	S		
CO4		S		S	S		M				S	S	S	
CO5		S		S	S	S		S	M				S	

UNIT I Supervised Learning (Regression/Classification)

Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes - Linear models: Linear Regression, Logistic Regression, Generalized Linear Models- Support Vector Machines, Nonlinearity and Kernel Methods -Beyond Binary Classification: Multi-class/Structured Outputs, Ranking

UNIT II: Unsupervised Learning

Clustering: K-means/Kernel K-means - Dimensionality Reduction: PCA and kernel PCA - Matrix Factorization and Matrix Completion -Generative Models (mixture models and latent factor models)

UNIT III

Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests.

UNIT IV

Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning

UNIT V

Scalable Machine Learning (Online and Distributed Learning) - A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference- Reecent trends in various learning techniques of machine learning and classification methods for IOT applications - Various models for IOT applications.

REFERENCES

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

CSE18R5106	NETWORK PROGRAMMING	L	T	P	Credit
		3	1	0	3
Course Category : Theory		**Course Type** : Elective			

UNIT – I

Linux Utilities- File handling utilities, Security by file permissions, Process utilities, Disk utilities, Networking utilities, Filters, Text processing utilities and Backup utilities. Bourne again shell(bash) - Introduction, pipes and redirection, here documents, running a shell script, the shell as a programming language, shell meta characters, file name substitution, shell variables, command substitution, shell commands, the environment, quoting, test command, control structures, arithmetic in shell, shell script examples. Review of C programming concepts-arrays, strings (library functions), pointers, function pointers, structures, unions, libraries in C.

UNIT - II

Files- File Concept, File types File System Structure, Inodes, File Attributes, file I/O in C using system calls, kernel support for files, file status information-stat family, file and record locking-lockf and fcntl functions, file permissions- chmod, fchmod, file ownership-chown, lchown , fchown, linkssoft links and hard links – symlink, link, unlink. File and Directory management – Directory contents, Scanning Directories- Directory file APIs. Process- Process concept, Kernel support for process, process attributes, process control – process creation, replacing a process image, waiting for a process, process termination, zombie process, orphan process.

UNIT - III

Signals- Introduction to signals, Signal generation and handling, Kernel support for signals, Signal function, unreliable signals, reliable signals, kill, raise , alarm, pause, abort, sleep functions. Interprocess Communication - Introduction to IPC mechanisms, Pipes- creation, IPC between related processes using unnamed pipes, FIFOs-creation, IPC between unrelated processes using FIFOs(Named pipes), differences between unnamed and named pipes, popen and pclose library functions, Introduction to message queues, semaphores and shared memory. Message Queues- Kernel support for messages, UNIX system V APIs for messages, client/server example. Semaphores-Kernel support for semaphores, UNIX system V APIs for semaphores.

UNIT – IV

Shared Memory- Kernel support for shared memory, UNIX system V APIs for shared memory, client/server example. Network IPC - Introduction to Unix Sockets, IPC over a network, Client-Server model ,Address formats(Unix domain and Internet domain), Socket system calls for Connection Oriented - Communication, Socket system calls for Connectionless-Communication, Example-Client/Server Programs- Single Server-Client connection, Multiple simultaneous clients, Socket options – setsockopt, getsockopt, fcntl.

UNIT-V

Network Programming in Java-Network basics, TCP sockets, UDP sockets (datagram sockets), All Server programs that can handle one connection at a time and multiple connections (using JNTU WORLD M. TECH. COMPUTER SCIENCE ENGINEERING-R13 Regulations multithreaded server), Remote Method Invocation (Java RMI)-Basic RMI Process, Implementation details-Client-Server Application.

TEXT BOOKS:

1. Unix System Programming using C++, T.Chan, PHI.(Units II,III,IV)
2. Unix Concepts and Applications, 4th Edition, Sumitabha Das, TMH.(Unit I)
3. An Introduction to Network Programming with Java, Jan Graba, Springer, rp 2010.(Unit V)
4. Unix Network Programming ,W.R. Stevens, PHI.(Units II,III,IV)
5. Java Network Programming,3rd edition, E.R. Harold, SPD, O'Reilly.(Unit V)

REFERENCE BOOKS:

1. Linux System Programming, Robert Love, O'Reilly, SPD.
2. Advanced Programming in the UNIX environment, 2nd Edition, W.R.Stevens, Pearson Education. 3. UNIX for programmers and users, 3rd Edition, Graham Glass, King Ables, Pearson Education.
4. Beginning Linux Programming, 4th Edition, N.Matthew, R.Stones, Wrox, Wiley India Edition.
5. Unix Network Programming The Sockets Networking API, Vol.-I,W.R.Stevens, Bill Fenner, A.M.Rudoff, Pearson Education.
6. Unix Internals, U.Vahalia, Pearson Education.
7. Unix shell Programming, S.G.Kochan and P.Wood, 3rd edition, Pearson Education

CSE18R5107	ANALYTICAL APPROACH IN NETWORKING	L	T	P	Credit
		3	1	0	3
Course Category : Theory		**Course Type** : Elective			

Pre-requisites:

Computer Networks

Course Outcomes:

1. Students are able to understand the communication networking and build conceptual tools for networking issues.
2. Students are able to identify the functional elements of networking---multiplexing, switching, routing and management.
3. Students can deterministically analyze packet multiplexed stream traffic, network calculus and packet scheduling.
4. Students are able to design the switching architectures and algorithms for networking issues.
5. Students are able to develop shortest path routing algorithms and protocols for distributed implementation of the routing algorithms.

Unit 1: Overview of networking principles and analytical networking: Networking practice-A brief overview of networking technologies and the development of a functional view-Analysis of packet multiplexed stream traffic-Introduction to Deterministic Network Calculus and packet scheduling algorithms and their analysis.

Unit 2: Stochastic analysis of packet multiplexed stream traffic: Overview of queueing models-Little's theorem-Brumelle's theorem- M/G/1 queue formulae-development of equivalent bandwidth of a stream source-Circuit multiplexing-Blocking probability calculations and the Kaufman Roberts recursion.

Unit 3: Stochastic analysis of packet multiplexing of elastic sources: Window flow/congestion control algorithms-TCP and analysis of the TCP protocol-multiple access channels-Aloha-Ethernet-and CSMA/CA protocols-Packet Switching-Scheduling and Architecture of routers-Queueing issues in packets switches-input and output queueing-virtual-output-queueing-maximum and maximal matching algorithms-stable matching algorithms.

Unit 4: Switching architectures: blocking and non blocking principles in switching networks-Self routing architectures and banyan and Batcher-banyan networks-Algorithms for packet processing in switches and routers.

Unit 5: Introduction to Optimal routing. Bellman-Ford and Dijkstra's shortest path routing algorithms-RIP, OSPF and BGP routing protocols and issues-QoS routing and aggregate routing- overview of Network Management.

Text Book:

1. A Kumar, D Manjunath and J Kuri, Communication Networking: An Analytical Approach, Morgan Kaufman Publishers, 2004. (Also available as an Indian Elsevier paperback edition in India).

References:

1. D Bertsekas and R Gallager. "Data Networks", Prentice Hall (India), Second Edition.

2. L Peterson and B Davie, "Computer Networks: A Systems Approach" Morgan Kaufman Publishers, Third Edition.

CSE18R5108	CLOUD COMPUTING	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Network Security
- Network Routing protocols

COURSE OUTCOMES

CO1: Understanding about basics of cloud, its terminologies, leaders in cloud market
CO2: Able to know virtualization technology and virtual machine management
CO3: Understanding about various PaaS services and open source tools for PaaS
CO4: Concept of SLAs and ensuring QoS through SLAs in Cloud
CO5: Introduction to various security threats and mechanisms to safe guard against threats

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	M										S		
CO2				S	S								S	
CO3		S		S	S								S	
CO4							S	S						S
CO5		M	S	M								M	S	

UNIT – I FOUNDATIONS

Introduction to Cloud Computing – Roots of Cloud Computing – Layers and Types of Clouds – Desired features of a Cloud - Challenges and Risks – Migration into a Cloud – Seven step Model of Migration in to a Cloud – Enriching the "Integrations as a Service" Paradigm for the Cloud Era –The Enterprise Cloud Computing Paradigm.

UNIT – II INFRASTRUCTURE AS A SERVICE

Virtual Machines Provisioning and Migration Services – Management of Virtual Machines for Cloud Infrastructures – The anatomy of cloud infrastructures – distributed Management of Virtual Infrastructures - Scheduling Techniques – Capacity Management to meet SLA Commitments – Enhancing Cloud Computing Environments Using Cluster as a Service – Cloud Storage

UNIT – III PLATFORM AND SOFTWARE AS A SERVICE

Integration of Private and Public Clouds – Aneka Cloud Platform – Hybrid Cloud Implementation – Workflow Engine for clouds – Architecture of workflow management System – The MapReduce Programming Model and Implementations – MapReduce Programming Model – Major MapReduce Implementations for the Cloud – MapReduce Impacts

UNIT – IV MONITORING AND MANAGEMENT

An Architecture for Federated Cloud Computing – SLA Management in Cloud Computing – Traditional Approaches to SLA Management – Types of SLA – Life Cycle of SLA – Automated policy based management – Performance Prediction for HPC on clouds – Grid and Cloud – HPC in the Cloud: Performance –related issues

UNIT – V GOVERNANCE AND SECURITY

Organisational Readiness and Change Management in the cloud age – Basic concept of Organisational Readiness – Common Change Management Models – Data Security in the Cloud – Cloud Computing and Data Security Risk – Cloud Computing and Identity – Content level Security – Technologies for Data Security in Cloud Computing

REFERENCES :

1. Rajkumar Buyya, James Broberg and Andrej Goscinski, Cloud Computing – Principles and Paradigms, Wiley 2014
2. Borko Furht, Armando Escalante, Handbook of Cloud Computing, Springer 2013
3. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2012.
4. Kumar Saurabh, “Cloud Computing – Insights into New Era Infrastructure”, Wiley Indian Edition,2011.

CSE18R5109	NETWORK ROUTING PROTOCOLS	L	T	P	C
		3	0	0	3
Course Category : Theory		**Course Type :** Elective			

PRE-REQUISITE:

- Computer Networks

COURSE OUTCOME

CO1 : To understand the concepts of Network Router Architecture.
CO2 : To be aware of Network routing algorithm foundations and its Framework
CO3 : To implement the abstraction of IP networks using Routing Protocols.
CO4 : To utilize the available protocols for MANET Routing.
CO5 : To understand the technical, economic and services of next generation routing.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	M											M		
CO2					M								M	
CO3			M		S								S	
CO4					S								S	
CO5			M									M		

UNIT I ROUTER ARCHITECTURE

Functions of Router – Types – Elements – Packet Flow – Packet Processing Router Architectures, IP Address Lookup Algorithms- Impact of Addressing on Lookup- Longest Prefix Matching – Naïve algorithms – Binary Tries – Multibit Tries.

UNIT II NETWORK ROUTING: BASICS AND FOUNDATIONS

Networking and Network Routing: An Introduction, Routing algorithms: Shortest path and widest path – Bellman Ford algorithm and distance vector approach – Dijikstra's algorithm-

comparison – widest path algorithm – shortest and widest path computation – k-shortest path algorithms, Routing Protocols: Framework and Principles.

UNIT III ROUTING IN IP NETWORKS

IP Routing and Distance Vector Protocol Family – Routers, Networks, and Routing Information Basics – static Routes - RIP v1, v2 - IGRP – EIGRP – Route Redistribution, OSPF and integrated IS-IS – Features – Packet Format – examples – Integrated IS-IS, similarities and differences between OSPF and IS-IS, IP Traffic Engineering, BGP, Internet Routing Architectures

UNIT IV MANET ROUTING

Internet based mobile ad-hoc networking, communication strategies, classification of MANET routing algorithms Destination sequenced Distance Vector (DSDV), Dynamic source Routing (DSR), Ad-hoc on demand Distance Vector (AODV) & Temporarily Ordered Routing algorithm (TORA).

UNIT V NEXT GENERATION ROUTING

Quality of Service Routing – Attributes – Adapting shortest path and widest path routing – Update Frequency, Information Accuracy and impact on routing Heterogeneous Service, Single-Link case – Source based QoS routing – Routing protocols for QoS Routing, MPLS, Routing and Traffic Engineering with MPLS-Advanced topics: Packet Queuing and Scheduling, Traffic Conditioning,

TEXT BOOK

1. D.Medhi and K.Ramasamy, Network Routing : Algorithms, Protocols and Architectures, Morgan Kaufmann Publishers, 2017.

REFERENCES

1. Steen Strub M, Routing in Communication networks, Prentice Hall International, New York, 2005
2. C.Siva Ram Murthy and B.S.Manoj, Adhoc Wireless Networks, Pearson Education, 2012.
3. Internetworking Technologies Handbook, Inc. Cisco Systems, ILSG Cisco Systems, 4th Edition, 2013.

CSE18R5110	MOBILE AND PERVASIVE COMPUTING	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Mobile Computing

COURSE OUTCOMES

CO1 : To understand the basic concepts behind mobile and pervasive computing.
CO2 : To catch a profound knowledge in 3g and 4g Cellular Technologies.
CO3 : To analyze the architecture for sensor and mesh networks.
CO4 : To fathom the requirement and functionality of context aware computing & wearable computing .
CO5 : To generate a model for application development.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	S											S		
CO2				S				S						S
CO3			S		S						S		S	S
CO4		S					M	S		S		S		S
CO5					S	S							S	

UNIT I INTRODUCTION

Differences between Mobile Communication and Mobile Computing – Contexts and Names – Functions – Applications and Services – New Applications – Making Legacy Applications Mobile Enabled – Design Considerations – Integration of Wireless and Wired Networks – Standards Bodies – Pervasive Computing – Basics and Vision – Principles of Pervasive Computing – Categories of Pervasive Devices.

UNIT II 3G AND 4G CELLULAR NETWORKS

Migration to 3G Networks – IMT 2000 and UMTS – UMTS Architecture – User Equipment – Radio Network Subsystem – UTRAN – Node B – RNC functions – USIM – Protocol Stack – CS and PS Domains – IMS Architecture – Handover – 3.5G and 3.9G a brief discussion – 4G LAN and Cellular Networks – LTE – Control Plane – NAS and RRC – User Plane – PDCP, RLC and MAC – WiMax IEEE 802.16d/e – WiMax Internetworking with 3GPP

UNIT III SENSOR AND MESH NETWORKS

Sensor Networks – Role in Pervasive Computing – In Network Processing and Data Dissemination – Sensor Databases – Data Management in Wireless Mobile Environments – Wireless Mesh Networks – Architecture – Mesh Routers – Mesh Clients – Routing – Cross Layer Approach – Security Aspects of Various Layers in WMN – Applications of Sensor and Mesh networks

UNIT IV CONTEXT AWARE COMPUTING & WEARABLE COMPUTING

Adaptability – Mechanisms for Adaptation - Functionality and Data – Transcoding – Location Aware Computing – Location Representation – Localization Techniques – Triangulation and Scene Analysis – Delaunay Triangulation and Voronoi graphs – Types of Context – Role of Mobile Middleware – Adaptation and Agents – Service Discovery Middleware Health BAN- Medical and Technological Requirements-Wearable Sensors-Intra-BAN communications

UNIT V APPLICATION DEVELOPMENT

Three tier architecture - Model View Controller Architecture - Memory Management – Information Access Devices – PDAs and Smart Phones – Smart Cards and Embedded Controls – J2ME – Programming for CLDC – GUI in MIDP – Application Development ON Android and iPhone

REFERENCES:

1. Asoke K Talukder, Hasan Ahmed, Roopa R Yavagal, Mobile Computing: Technology, Applications and Service Creation, 2nd edition, Tata McGraw Hill, 2014.
2. Reto Meier, Professional Android 2 Application Development, Wrox Wiley,2012.
3. Pei Zheng and Lionel M Li, Smart Phone & Next Generation Mobile Computing, Morgan Kaufmann Publishers, 2011.

4. Frank Adelstein, Fundamentals of Mobile and Pervasive Computing, TMH, 2010
5. Jochen Burthardt et al, Pervasive Computing: Technology and Architecture of Mobile Internet Applications, Pearson Education, 2010
6. Feng Zhao and Leonidas Guibas, Wireless Sensor Networks, Morgan Kaufmann Publishers, 2011
7. Uwe Hansmaan et al, Principles of Mobile Computing, Springer, 2010
8. Reto Meier, Professional Android 2 Application Development, Wrox Wiley,2010.
9. Mohammad s. Obaidat et al, Pervasive Computing and Networking, John wiley
10. Stefan Poslad, Ubiquitous Computing: Smart Devices, Environments and Interactions, Wiley, 2010
11. Frank Adelstein Sandeep K. S. Gupta Golden G. Richard III Loren Schwiebert Fundamentals of Mobile and Pervasive Computing, McGraw-Hill, 2011

CSE18R5111	OPTICAL NETWORKS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Data Communication
- Computer Networks

COURSE OUTCOMES

CO1: To understand the basic concepts of Fundamental optical network elements.

CO2: To become skilled at Optical network architectures ranging from optical access networks to backbone optical transport networks.

CO3: Approaches and methodologies of optical network design optimization, Techniques of optical network survivability.

CO4: To be a expert on Problem solving skills and critical thinking in the discipline of advanced optical networks.

CO5: To be aware of the optical network design and management.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	S	S										S		
CO2			S	S				S						S
CO3			S		S					S	S		S	S
CO4		S		S			M	S		S	S	S		S
CO5														

UNIT I OPTICAL NETWORK TECHNOLOGY AND COMPONENTS

Circuit Switching-Packet Switching-Optical Networks-Optical Layers-Optical Packet Switching-Transmission Basis – Propagation of Signals in Optical Fiber-Modulation and Demodulation formats. Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

UNIT II OPTICAL NETWORKS ARCHITECTURES

SONET/SDH: Multiplexing- Layers-Frame Structure-Elements of SONET/SDH Infrastructure- ATM: Functions-Adaptation Layer-QOS-Flow Control- Signaling and Routing, IP: Routing and Forwarding- QOS- MPLS, SAN: ESCON- Fiber Channel- HIPPI

UNIT III WDM NETWORK DESIGN

WDM Network Elements: Line Terminal- Line Amplifier- OXC and its configuration, WDM Network Design: Cost Trade Offs – LTD and RWA Problem- Dimensioning Wave Length Routing Network- Statistical and Maximum Load Dimensioning Model.

UNIT IV ADVANCED OPTICAL NETWORKS

Access Network: Overview- HFC- FTTC, Photonic Packet Switching: OTDM Synchronization- Buffering-Header processing- Burst Switching- NTT's Optical ATM switches-AON-CORD, Long- Haul Networks- Long- Haul Network Case Study- Long- Haul Undersea Networks- Metro Networks- Metro Ring Case Study.

UNIT V OPTICAL NETWORK DESIGN AND MANAGEMENT

Transmission System Engineering: Power penalty- Gain Saturation and Equalization in EDFA- Power Transient and Automatic Control-Cross Talk- Dispersion- Wave Length Stabilization- Fiber Non linearities- Soliton system- over all design Consideration. Control and Management – Network management functions, Configuration management, Performance management, Fault management, Optical safety, Service interface.

TEXT BOOK

1. Ramaswami .R and Sivarajan .K, Optical Networks: A Practical Perspective, Morgan Kaufmann, 3rd Edition, 2013.

REFERENCES:

1. Stern T.E and Bala K, Multiwave length Optical Networks: A Layered Approach, Addison-Wesley, 2010.
2. Agarwal G.P, Fiber-Optic Communication Systems, John Wiley and Sons, 2012.

CSE18R5112	MULTIMEDIA COMMUNICATION NETWORKS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Computer Networks
- Multimedia Systems

COURSE OUTCOMES

CO1 : Understanding about the architecture and models of multimedia communication.
CO2 : Build the multicast routing and guaranteed service models.
CO3 : Provide the end to end solutions for multimedia transport.
CO4: Understand End to end QoS Provisioning for multimedia over wireless networks.
CO5 : To analyze the Security threats in Multimedia Communication.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		S		S			S		M	M	S	S	M
CO2			S	S	S			S					S	
CO3								S			S		S	
CO4					S		S		S	S			S	S
CO5				S	S	S				S	S		S	S

UNIT I MULTIMEDIA COMMUNICATION MODELS

Architecture of Internet Multimedia Communication- Protocol Stack-Requirements and Design challenges of multimedia communications- Multimedia distribution models Unicasting, Broadcasting and Multicasting.

UNIT II GUARANTEED SERVICE MODEL

Multicast routing-PIM- Best effort service model and its limitations- QoS and its Metrics-Queuing techniques-WFQ and its variants-RED-QoS aware routing -Call Admission Control-RSVP- Policing and Traffic Shaping algorithms- QoS architectures.

UNIT III MULTIMEDIA TRANSPORT

End to end Solutions-Multimedia over TCP-Significance of UDP- Multimedia Streaming-Audio and Video Streaming-Interactive and non-Interactive Multimedia- RTSP- RTP/RTCP – SIP-H.263.

UNIT IV MULTIMEDIA OVER WIRELESS NETWORKS

End to end QoS Provisioning-QoS Enhancements-Call Admission Control-QoS Management-Multimedia support in 3G & 4G networks- Location Based Multimedia Service System.

UNIT V MULTIMEDIA NETWORK SECURITY AND APPLICATIONS 9 hours

Security threats in Multimedia Communication- Digital Rights Management Architecture-DRM for Mobile Multimedia- Architectures, Requirements and Design Challenges of real time Multimedia Network Applications- Case Study-VoIP- Video Conferencing- Military Surveillance- Interactive TV Video on Demand- Smart Phone.

REFERENCES:

1. K. R. Rao, Zoran S. Bojkovic, Dragorad A. Milovanovic, Introduction to Multimedia Communications Applications, Middleware, Networking, John Wiley and Sons, 2014.
2. Jean Warland, Pravin Vareya, High Performance Networks, Morgan Kauffman Publishers, 2012.
3. William Stallings, High Speed Networks and Internets Performance and Quality of Service, 2nd Edition, Pearson Education, 2012.
4. Aura Ganz, Zvi Ganz, Kitti Wongthawaravat, Multimedia Wireless Networks Technologies, Standards and QoS, Prentice Hall, 2011.
5. Mahbub Hassan and Raj Jain, High Performance TCP/IP Networking, Pearson Education, 2004
6. Shiguo Lian, Multimedia Communication Security Recent Advances, Nova Science Publishers, 2010.

CSE18R5113	VEHICULAR ADHOC NETWORKS (VANETS)	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type**	**:** Elective		

PRE-REQUISITE:

- Knowledge of Engineering mathematics, fundamentals of Statistics & Probability.

COURSE OUTCOME

CO1: To expose the students to the globe of VANET infrastructure.

CO2 : Design various models and structures of VANET.

CO3: Understand the concepts behind Communication and propagation models of VANET.

CO4: To be an expert in Message coding, Architecture, safety features of VANET and Violations.

CO5 : To analyze the model for Privacy, Security related Standards in VANET.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S									S		S		
CO2		S	S	S								S	S	
CO3	S				S	M					S		M	S
CO4			S	S			M			S			S	S
CO5			S	S			S	S					S	

UNIT I INTRODUCTION TO VANETS

Infrastructure in Vehicular Communications: Status, Challenges and Perspectives – Architecture of Vehicular Ad Hoc Networks – Traffic Engineering – Traffic Monitoring Models for Traffic Flow and Vehicle Motion – Co-operative Vehicular Safety Applications – Enabling Technologies – Co-operative System Architectures – Mapping for Safety Applications- VANET – enabled Active Safety Applications

UNIT II INFORMATION DISSEMINATION AND MOBILITY MODELING IN VANETS

Introduction – Obtaining Local Measurements – Information Transport – Protocols for Information Transport – Improving Network Connectivity – What to Transport – Summarising Measurements – Geographical Data Aggregation – VANET Convenience and Efficiency Applications Vehicular Mobility Modeling for VANET – Flow Models – Traffic Models – Behavioral Models – Trace or Survey based Models – Integration with Network Simulators

UNIT III PHYSICAL LAYER AND MAC LAYER FOR VEHICULAR COMMUNICATIONS

Wireless Propagation Theory – Channel Metrics – Measurement Theory – Empirical Channel Characterization at 5.9 GHz – MAC Layer and Scalability Aspects of Vehicular Communication Networks – Communication based on IEEE 802.11 p – Performance Evaluation and Modeling – Aspects of Congestion Control

UNIT IV APPLICATION LEVEL MESSAGE CODING AND COMPOSITIONS

Introduction to Application Environment – Safety Applications and data requirements – Desirable Architectural features – Broadcast Characteristics – Message Dispatcher – Data element dictionary – Message Construction – Example Applications – Emergency brake warning – Intersection violation warning - Data sets – Predictive coding – Architecture Analysis

UNIT V DATA SECURITY AND STANDARDS IN VEHICULAR COMMUNICATION NETWORKS

Challenges of Data Security in Vehicular Networks – Network, Applications, and Adversarial Model – Network Model – Application Model – Attacker Model – Security Infrastructure – Cryptographic Protocols – Privacy Protection Mechanisms – Implementation Aspects – Standards and Regulations – Layered architecture for VANETs – DSRC Regulations – DSRC Physical Layer and Middle Layers – DSRC Message Sub layer.

REFERENCES:

1. Hannes Hartenstein and Kenneth P Laberteaux, VANET Vehicular Applications and Inter-Networking Technologies, Wiley 2012

2. Mohamed Watfa, Advances in Vehicular Ad-Hoc Networks: Developments and Challenges, Information Science Reference, 2011
3. Stephan Olariu, Michele C. Weigle Vehicular Networks: From Theory to Practice, Chapman and Hall/CRC, 2011.

CSE18R5114	HIGH SPEED SWITCHING ARCHITECTURE	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Computer Architecture & Organization
- Network Management

COURSE OUTCOMES

CO1 : To understand the basic concepts of High Speed Networks.

CO2 : Apply the various switching techniques in ATM and LAN networks

CO3 : Analyze various queuing techniques in ATM switches.

CO4 : Design and develop the IP switching networks

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	S										S		
CO2			S	S				S					S	S
CO3			S	S	S					S	S		S	S
CO4		S		S			M	S		S	S	S		S

UNIT I HIGH SPEED NETWORK

LAN and WAN network evolution through ISDN to BISDN - Transfer mode and control of BISDN - SDH multiplexing structure - ATM standard, ATM adaptation layers.

UNIT II LAN SWITCHING TECHNOLOGY

Switching concepts; Switch forwarding techniques; switch path control - LAN switching; cut through forwarding; store and forward - virtual LANs.

UNIT III ATM SWITCHING ARCHITECTURE

Switch models - Blocking networks – basic and enhanced banyan networks - sorting networks – merge sorting - rearrange able networks - full and partial connection networks - nonblocking networks – recursive network – construction and comparison of non-blocking network - switches with deflection routing – shuffle switch - tandem banyan.

UNIT IV QUEUES IN ATM SWITCHES

Internal queuing – Input, output and shared queuing - multiple queuing networks – combined input, output and shared queuing – performance analysis of queued switches.

UNIT V IP SWITCHING

Addressing mode - IP switching types-flow driven and topology driven solutions - IP Over ATM address and next hop resolution – multicasting - IPv6 over ATM.

TEXT BOOK

1. Ranier Handel, Manfred Huber N, Stefan Schrodder, ATM Networks-concepts, protocols, applications, Adisson Wesley, New York, 3rd Edition, 2011.

REFERENCES

1. John Chiong A, Internetworking ATM for the internet and enterprise networks, McGraw Hill, New York, 2010.
2. Achille Patavina, Switching Theory: Architectures and performance in Broadband ATM Networks, John Wiley and Sons Ltd., New York.2012.

CSE18R5116	SURVIVABLE NETWORKS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Network Security
- Network Routing protocols

COURSE OUTCOMES:

CO1 : Understand the concepts of different network attacks.

CO2 : Skilled to discuss the facts of different Operating system vulnerabilities.

CO3 : Capable to derive a plan for survivable networks and Preparations for disasters.

CO4 : Identify and analyze the threat, operational resources to fix the data disaster.

CO5: Analyze the forensic procedures and recover the data with cost effectively.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		S					S				S		M
CO2		S		S									S	
CO3					S					S	S			S
CO4		S	S	S	M					S	M	S	S	
CO5		S			S	M	S	M	M				S	S

UNIT I INTRODUCTION

Network Continuity – Define Survival – In defense of Paranoia – By the Numbers – Plan to Survive – Choice Versus Chance - Tactics of Mistakes – TCP/IP – Probes –Viruses – Worms – Trojan Horses – Denial of Service /Distributed DoS – Sample Attack

UNIT II VULNERABILITIES

System Complexity – Top General Vulnerabilities – Top Windows Vulnerabilities – Top Unix Vulnerabilities – Common Threads – Design your Way out of Trouble – Defense in

depth – Olive –Drab Networks – Converged Networks – Operator Error - Lessons from Failure – Lessons from Success

UNIT III PLAN FOR SURVIVABLE NETWORKS AND DISASTERS

Three main points – Operational Continuity – Getting the People out – Data Services Example – Topology – Facilities – Configuration Control – Unnatural Disasters – Physical Attacks – Cyber Attacks – Combine Attacks – unnatural disasters (Un-intentional) – Unfortunate Opportunities – Unfortunate Planning – Unfortunate Implementation

UNIT IV PREPARING FOR DISASTER

Survival requirements – Network Continuity Requirements – Threat Analysis – Operational Analysis – Survival Planning – Fixes – Remedies – Procedures – Survivability Today – Data Currency – Trade – Offs

UNIT V RECOVERY AND BUSINESS CASE

Cyber Recovery – Operational Procedures – Forensic Procedures – Physical Discovery – Restoration – Rehearsal –Evolution - Business Case – Understanding the Cost – Understanding the Revenues – Expected values – Presenting your case – CDG Example – Necessity – Catastrophes happen – Your Recovery – Trade Offs

REFERENCES

1. Annlee Hines, Plansning for Survivable Networks: Ensuring Business Continuity, Wiley Publishing, 2012.
2. Mechthild Stoer, Design of Survivable Networks, Springer –Verlag, 2014.
3. R. Bhandari, Survivable Networks – Algorithms for Diverse Routing, Springer, 2009.

Ibrahima Diarrassouba, Survivable Network Design Problems with High Connectivity Requirement: Optimization Models and Exact Algorithms, Lambert

CSE18R5117	NEXT GENERATION NETWORKS	L	T	P	Credit
		3	1	0	3
Course Category : Theory		**Course Type** : Core			

PRE-REQUISITE:

- Network Security
- Network Routing protocols

COURSE OUTCOME

CO1: To understand the technical, economic and service advantages of next generation networks

CO2: To become skilled at the NGN Functional Architecture of a next generation network (NGN) with reference

CO3: To analyze the various key development areas of next generation networks.

CO4: To be able to compare various NGN Standards in the vein of TMF, NGOSS, 3GPP and LTE/SAE.

CO5: To be able to evaluate various NGN Wireless LANs with respect to OFDM device - High Throughput and Robust Performance.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S						S			S		S	S	
CO2	S		M		M	M						S	M	
CO3		S		S								S		
CO4										S	S			S
CO5					S			S		S	S		S	S

UNIT I INTRODUCTION

Next Generation Networks (NGN) Vision, Scenarios and Advances – NGN Networks: Perspectives and Advances – Some Possible Scenarios – Virtual International Congress – Virtual Class Rooms – e-Education and Experimental Laboratory – Virtual Home – Home

Networks – Automatic Traffic and Car Driving – NGN Requirements on Technology and Management.

UNIT II NGN FUNCTIONAL ARCHITECTURE

ITU NGN Functional Architecture – Proposed NGN Functional Architecture – NGN Network Operator – NGN Network Service Provider – NGN Customer and CTE – Network and Service Evaluation towards NGN- Fixed Network Evaluation – Mobile Network Evaluation – Internet Evaluation

UNIT III NGN KEY DEVELOPMENT AREAS

Terminal Area – Access Network Area – Backhaul Network Area – Core Transport Network Area – Service Creation Area – Network Control and Managerial Area – Service Control and Management – Advanced Technologies for Network and Service Management.

UNIT IV NGN STANDARDIZATION

ITU and GSI NGN – ETSI and TISPAN - NGN – ATIS and NGN – CJA and NGN - TMF and NGOSS, NGMN Alliance and NGMN - 3GPP and LTE/SAE – NGMN Alliance and NGMN, 3GPP and LTE/SAE

UNIT V NEXT GENERATION WIRELESS LANS

An overview of IEEE 802.11 – History of high throughput and 802.11 n- Environments and applications of 802.11 n – Major features of 802.11 n – Orthogonal Frequency Division Multiplexing – MIMO/SDM Basics – Physical Interoperability with 11 a/g legacy OFDM device – High Throughput and Robust Performance

REFERENCES:

1. Jingming Li Salina and Pascal Salina, Next Generation Networks, Prospective and Potentials, John Wiley and Sons, 2008.
2. Thomas Plavyk, Next generation Telecommunication Networks, Services and Management, Wiley & IEEE Press Publications, 2011.
3. Eldad Perahia and Robert Stacey, Next Generation Wireless LANs, Cambridge University Press, 2013.
4. Monique J. Morrow, Next Generation Networks, CISCO Press, 2007.

CSE18R5118	HIGH SPEED NETWORKS	L	T	P	Credit
		3	1	0	3
Course Category : Theory		**Course Type** : Elective			

Pre-requisites:

Computer Networks

Course Outcomes:

1. Student will be able to design a high speed networks with appropriate protocols.
2. Student will be able to analyze traffic and congestion management
3. Apply the knowledge of networking protocols to identify resource allocation and service management approaches
4. Identify traffic analysis and measure the packet performances for real time problems.

UNIT-I - HIGH SPEED NETWORKS

Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL. High Speed LAN's: Fast Ethernet, Gigabit Ethernet, Fibre Channel – Wireless LAN's.

UNIT-II - CONGESTION AND TRAFFIC MANAGEMENT

Queuing Analysis- Queuing Models – Single Server Queues – Effects of Congestion – Congestion Control – Traffic Management – Congestion Control in Packet Switching Networks – Frame Relay Congestion Control.

UNIT-III - TCP AND ATM CONGESTION CONTROL

TCP Flow control – TCP Congestion Control – Retransmission – Timer Management – Exponential RTO backoff – KARN's Algorithm – Window management – Performance of TCP over ATM. Traffic and Congestion control in ATM – Requirements – Attributes – Traffic Management Frame work, Traffic Control – ABR traffic Management – ABR rate control, RM cell formats, ABR Capacity allocations – GFR traffic management.

UNIT-IV - INTEGRATED AND DIFFERENTIATED SERVICES

Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS,WFQ – Random Early Detection, Differentiated Services.

NIT V - PROTOCOLS FOR QoS SUPPORT

RSVP – Goals & Characteristics, Data Flow, RSVP operations, Protocol Mechanisms – Multiprotocol Label Switching – Operations, Label Stacking, Protocol details – RTP – Protocol Architecture, Data Transfer Protocol, RTCP.

Text Books:

1. William Stallings, "HIGH SPEED NETWORKS AND INTERNET", Pearson Education, Second Edition, 2002.

References:

1. Warland & Pravin Varaiya, "HIGH PERFORMANCE COMMUNICATION NETWORKS", Jean Harcourt Asia Pvt. Ltd., II Edition, 2001.
2. Irvan Pepelnjk, Jim Guichard and Jeff Apcar, "MPLS and VPN architecture", Cisco Press, Volume 1 and 2, 2003.

CSE18R5119	STORAGE AREA NETWORKS	L	T	P	C
		3	0	0	3
Course Category : Theory		**Course Type : Elective**			

PRE-REQUISITE:

- Computer Organization and Architecture
- Network Management

Course Outcome(s):

CO1: Understand the basics of management and storage systems.

CO2: Identify the need for performance evaluation and the metrics used for it

CO3: Apply the techniques used for data maintenance.

CO4: understand the business continuity life cycle.

CO5: Develop techniques for security policies for management systems

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1			S									S		
CO2			M							M		M		M
CO3					S								S	
CO4	S			M								S	M	
CO5		M						M				M	M	

UNIT I STORAGE SYSTEMS

Introduction to Information Storage and Management: Information Storage, Data Center Infrastructure, Information Lifecycle. Storage System Environment: Components of a Storage System, Disk Drive Architecture and Performance, Logical Components of the Host. Data Protection: Concept of RAID and different RAID levels. Intelligent Storage System (ISS) and its components, Implementation of ISS as high-end and midrange storage arrays

UNIT II STORAGE NETWORK TECHNOLOGIES

Direct Attached Storage and SCSI, Storage Area Networks: Fibre Channel. Network Attached Storage, IPSAN: iSCSI, FCIP. Network Attached Storage, Content Addressed Storage.

UNIT III STORAGE VIRTUALIZATION

Forms of Virtualization, Storage Virtualization Challenges, File and Block level Virtualization, Concepts in Practice. Cloud Computing: Cloud Services (SaaS, PaaS, and IAAS), Cloud concerns and implementations

UNIT IV BUSINESS CONTINUITY

Business Continuity Life Cycle, Failure Analysis, Backup and Recovery: Architecture and different Backup/Recovery topologies, Local Replication technologies and their operation, Remote replication technologies and their operation. Overview of emerging technologies like Duplication, Offsite Backup, Continuous Data Protection (CDP) technology

UNIT V STORAGE SECURITY AND MANAGEMENT

Storage Security framework, Storage Security domains, Security implementations in Storage Networking, Monitoring the Storage Infrastructure, Storage Management Activities, Storage Management Standards and Initiatives, Concepts in Practice.

REFERENCES

1. EMC Corporation, Information Storage and Management, 1st edition, Wiley India, ISBN: 978-81-265-2147-0, 2013.
2. Additional resource material on www.emc.com/resource-library/resource-library.esp
3. Marc Farley, Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems, Cisco Press, 2010, ISBN: 1-58705-162-1
4. Tom Clark, Designing Storage Area Networks, 2nd edition, ISBN: 0-321-13650-0, 2011

CSE18R5120	VIRTUAL FORENSICS AND SECURITY	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Operating Systems

Course Outcomes, Cos:

CO1: Understand the fundamentals of data centre and need for virtualization

CO2: Understand the protocols, interfaces involved in storage and network level virtualization

CO3: Familiar with the various operations of Virtual Machine

CO4: Deploy Virtual Machine and handle involved with resource provisioning, monitoring and migration

CO5: Analyze and understand the need for security and available techniques to ensure security to VMs

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		M									S		
CO2	S	M										S		
CO3	S				S					S			S	
CO4			S	S						S	S		S	S
CO5			S	S		S	M	M			S		S	S

DATA CENTER CHALLENGES

Requirement of virtualization, How virtualization works- virtualizing operating systems, hardware platforms and servers, hypervisors- baremetal, embedded, hosted, Categories of virtualization- full virtualization, Para virtualization, hardware-assisted virtualization , operating system virtualization, application server virtualization , application virtualization , network virtualization , storage virtualization , service virtualization , Benefits of virtualization, cost of virtualization, Purpose of server virtualization, server virtualization the bigger picture, differences between desktop and server virtualization, common virtual servers

ENTERPRISE-LEVEL VIRTUALIZATION

What is desktop virtualization, common virtual desktops, virtual appliances and forensics, virtual desktops as a forensic platform, portable virtualization-MajoPac, MokaFive, preconfigured virtual Environments, virtual appliance providers, Jumpbox virtual appliances, virtual Box, virtualization hardware devices, virtual privacy machine, virtual emulators. Investigating dead Virtual environments – Install files, Remnants, registry, Microsoft disk image format.

VIRTUAL MACHINES & ACCESS CONTROL

Fundamentals of investigating live virtual environments, artifacts, processes and ports, log files, VM memory usage, memory analysis, Microsoft analysis tools, trace collection for a virtual machine, separate swap files for different virtual machines in a host computer. Profile based creation of virtual machine in a virtualization 20 environment, system and methods for enforcing software license compliance with virtual machine as well as for improving memory locality of virtual machines, mechanisms for providing virtual machines for multiple users.

RESOURCE MONITORING

Detecting Rogue virtual machines, alternate data streams and Rogue virtual machines, virtual machine traces- prefetch file, link files, registry files, imaging virtual machines, snapshots and snapshot files, VMotion, Identification and conversion tools, Environment to environment conversion. - Virtual environment and compliance- standards, compliance, regulatory requirements, discoverability of virtual environment, legal and protocol document language, organizational chain of custody, data retention policies, backup and data recovery.

VIRTUAL MACHINE DATA PROTECTION

Virtualization System- Specific Attacks : Guest hopping, attacks on the VM (delete the VM, attack on the control of the VM, code or file injection into the virtualized file structure), VM migration attack, hyperjacking Technologies For Virtualization-Based Security

Enhancement: IBM security virtual server protection, virtualization-based sandboxing; Storage Security- HIDPS, log management, Data Loss Prevention. Location of the Perimeter.

References:

1. Virtualization and Forensics: A Digital Forensic Investigator's Guide to Virtual Environments, Diane Barrett, Greg Kipper, Elsevier Science & Technology, 2012

2. Cloud Computing : Insights into new- era infra structure- Dr Kumar Saurabh, Wiley Publishers, April 2011

3. Evelyn Brown NIST —Guide to Security for Full Virtualization Technologies‖, 2011.

CSE18R5121	CONVERGENT NETWORKING	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type : Elective**			

PRE-REQUISITE:

- High Speed Networks

COURSE OUTCOMES

CO1: To understand the traditional concepts of voice communication and networks.

CO2: Able to design WAN Protocols for pocket voice and data networks

CO3: To be an expert on Voice over IP.

CO4: To design a model and architecture for voice gateways and gate keepers.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S											S		
CO2		S	S	S	M								S	
CO3			S	S				S	M			S	M	
CO4			S	S			M		S	S			S	S

UNIT I TRADITIONAL VOICE NETWORKS:

The state of voice communications – Enterprise telephony signaling – Signaling system 7 – Call routing and dial plans – defining and measuring voice quality – voice digitization and coding.

UNIT II PACKET VOICE AND DATA NETWORKS:

Quality of Service criteria for packet telephony – WAN protocols for integrated voice and data services – Design considerations for WAN protocols – Review of IP features for voice/Data integration.

UNIT III VOICE OVER IP:

VOIP fundamental – VOIP gateways – VOIP design elements – Routing calls over analog voice posts – Performing call signaling over digital voice parts.

UNIT IV VOICE GATEWAYS AND GATE KEEPERS:

Gateways and gate keepers – Media gateway control protocol – H.323 –Session Initiation protocol – Connecting to PSTN - Connecting to PBX – Connecting to IP WAN – Dial plans – Digit manipulation – Configuring class of restrictions.

UNIT V GATE KEEPERS & UNIFIED COMMUNICATION MANAGER:

Deploying gate keepers – Gate keeper configuration – IP to IP gateways - Cisco unified communication manager – Architecture – Deployment models – End points – Media resources – User features – Voice mail integration.

REFERENCES:

1. Scott Keagy, Integrating voice and data networks, Cisco press, 2013.
2. Kevin Wallace, Cisco Voice Over IP (CVoice), 3rd edition 2012.
3. Denise Dano hue, David Mellory and Ken Salhoff, Cisco Voice Gateways and Gate Keepers, Pearson education 2010.
4. Dennis Hartmann, Implementing Cisco Unified Communications Manager – Part I, Pearson Education, 2011.

CSE18R5122	NETWORK SYSTEM DESIGN USING NETWORK PROCESSORS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Computer Architecture

COURSE OUTCOMES

CO1: To understand the basic concepts of Traditional protocol, packets and processing systems.

CO2 : Motivation to design an architecture for Network processor technology.

CO3 : Analyze the recent network processor architectures.

CO4 : Able to gain knowledge to discuss about network processors and programming.

CO5: Talented to analyze and design an alternative architecture for network processors.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S				M							S		
CO2			S	S	S								S	
CO3								S		S	S			S
CO4	S	S										S		
CO5			S	S	S	S				S			S	S

UNIT I INTRODUCTION

Introduction and Overview-Basic Terminology and Example Systems -Review of Protocols and Packet Formats.

UNIT II TRADITIONAL PROTOCOL PROCESSING SYSTEMS

Conventional computer hardware and its use in low-end network systems- Algorithms for protocol processing-packet processing Functionality-Software architectures for protocol processing on conventional hardware-advanced hardware architectures

UNIT III NETWORK PROCESSOR TECHNOLOGY

Motivation for network Processors-Complexity of network processor design-network processor Architectures - Scaling a network processor-a review of commercial network processor architectures-languages

UNIT IV NETWORK PROCESSORS AND PROGRAMMING

Discussion of Intel IXP2XXX network processor-Intel: reference platform; embedded RISC processor-Intel: programmable packet processor hardware and programming- Intel: more on programming the packet processors- a programming example- Programming example; switching fabrics

UNIT V ALTERNATIVE ARCHITECTURES

Network processor design tradeoffs-Active and programmable networks-Active network Applications - Commercial network processors - Benchmarks for Network Processors

TEXT BOOK

1. Comer D, Network Systems Design Using Network Processors, Intel® IXP1200Version, Prentice Hall, 2012.

REFERENCE BOOK

1. Network Systems Design Using Network Processors 1st Edition , Prentice Hall; 1 edition (February 9, 2003)

CSE18R5123	AUTONOMIC NETWORKS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Network Security
- Network Routing protocols

COURSE OUTCOMES

CO1: To understand the basic concepts of autonomic networks.

CO2: Capable to design a bizarre architecture for autonomic and self- organizing networks.

CO3: Analyze the evaluation methodologies for various autonomic networks.

CO4: Impulse to apprehend the autonomics in radio access networks.

CO5: Evaluate the various policy management systems

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S			S								S		
CO2			S	S									S	
CO3		S		S							M	S	S	
CO4						S	M		S	S			S	
CO5							S		S	S	S			S

UNIT I INTRODUCTION

Introduction to Autonomic Concepts Applied to Future Self-Managed Networks – The need for Autonomic Systems – Application of Autonomics to Computers – Autonomics Computing - From Autonomics Computing to Autonomics Networking – Autonomic Networking Design Principles – From Autonomic Networking to Autonomic Network Management.

UNIT II AUTONOMIC NETWORK ARCHITECTURE

Autonomic Overlay Network Architecture – Smart Media Routing and Transport – An Autonomic Service Architecture - ANA : Autonomic Network Architecture – Core Architectural Abstractions – The Compartment API – Implementation of a Functional Block for Inter-Compartment Connectivity – A utility-Based Autonomic Architecture to Support QoE Quantification in IP Networks

UNIT III AUTONOMIC NETWORK MANAGEMENT, SELF ORGANISING ARCHITECTURE

Autonomic Network Management: Avoiding New Management Silos – Federation of Networks – Federation of Management Systems – End to End management of IPTV Services - Principles of Self- Organisation – Self Organising Modules –Inter-/Intra- Layer Interactions – Evaluation Methodologies

UNIT IV AUTONOMICS IN RADIO ACCESS NETWORKS

Radio Resource Management – Self-Organizing Network – Self Optimization – SON in Radio Access Networks – SON in GSM- SON in UMTS – SON in LTE – SON in Heterogeneous Networks – SON in IEEE 1900 Standard – Control and Learning Techniques in SON – SON Use Case in LTE Network: Intercell Interference Co-ordination

UNIT V AUTOMATED POLICY MANAGEMENT

Security Risk Evaluation Framework – Service Risk Analysis – Network Risk Analysis - Quality of Protection Metric – ROCONA Tool Implementation – Deployment and Case Study – Experimentation and Evaluation – Vulnerability Database Used in the Experiments – Validation of HVM – Validation of Expected Risk (ER) – Validation of QoPM- Running Time Evaluation of the Attack Propagation Metric.

REFERENCES:

1. Nazim Agoulmine, Autonomic Network Management Principles, Academic Press 2011
2. Monique Calisti, John C. Strassner, Advanced Autonomic Networking and Communication, Springer 2013.
3. Mieso Denko, Laurence Tianruo Yang, Yan Zhang, Autonomic Computing and Networking, Springer 2010

CSE18R5125	HIGH PERFORMANCE COMMUNICATION NETWORKS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Network Security
- Network Routing protocols

OUTCOMES:

CO1: Understand the fundamental concept of High speed as well as high performance networks
CO2: Understand the various topologies, services
CO3: To design and implement CAC protocols in multimedia networks.
CO4: Design and implement network protocols in HPCN.
CO5: Analyze performance of network related issues using mathematical models.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	M			M							S		
CO2	S				M					S		S		
CO3			S	S	M			S					S	S
CO4			S	S				S					S	S
CO5	S	S		S							M	S		

UNIT I BASICS OF NETWORKS

Telephone, computer, cable television and wireless networks, networking principles, digitization: service integration, network services and layered architecture, traffic characterization and QOS, network services: network elements and network mechanisms.

UNIT II PACKET SWTCHED NETWORKS

OSI and IP models: Ethernet (IEEE 802.3); token ring (IEEE 802.5), FDDI, DQDB, frame relay : SMDS : internet working with SMDS.

UNIT III INTERNET AND TCP/IP NETWORKS

Overview; Internet protocol; TCP and VDP, performance of TCP/IP networks circuit-switched networks: SONET; DWDM, Fiber to home, DSL. Intelligent networks, CATV.

UNIT IV ATM AND WIRELESS NETWORKS

Main features - addressing, signaling and routing; ATM header structure - adaptation layer, management and control; BISDN; interworking with ATM, Wireless channel, link level design, channel access; Network design and wireless networks.

UNIT V OPTICAL NETWORKS AND SWITCHING

Optical Links – WDM systems – optical cross connects – Optical LANs – Optical paths and networks – Time and space Divisions Switching – modular switch designs – Packet switching – Distributed buffer – Shared buffer – Input Buffer.

REFERENCE BOOKS:

1. Jean Warland and Pravin Varaiya, "High Performance Communication Networks", 2nd Edition, Harcourt and Morgan Kauffman, London,2011.
2. Leon Garcia, Widjaja, "Communication Networks", Tata McGraw Hill, New Delhi, 2006.
3. Sumit Kasera, Pankaj Sethi, "ATM Networks", Tata McGraw Hill, New Delhi, 2010.
4. Behrouz.A. Forouzan, "Data communication and Networking", Tata McGraw Hill, New Delhi, 5th edition, 2012.

CSE18R5126	NETWORK MANAGEMENT	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Computer Networks

COURSE OUTCOMES

CO1: Understand Network types and technology services.
CO2: Understand Network Management Architecture
CO3: Analyze SNMP protocol
CO4: Analyze RMON tools for Network Management
CO5: Implement Network management plan for large enterprise.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		S					M				S		
CO2	S	S		S		M					S	S	S	
CO3		S	S	M	S			S			S	S	S	
CO4		S	S	S	S			M				S	S	
CO5						S	M	S	M	S	S		M	S

UNIT I TECHNOLOGY SERVICES AND COMPUTER NETWORK TECHNOLOGY

Introduction to Network Management-IT Services, Challenges, and Opportunities - Economics of IT Services-Network Management Systems and Organization-Network Components – Topologies - Internet Architecture - Bridged and Router Networks-Ring Networks, Virtual LANs, and Broadband Services

UNIT II NETWORK MANAGEMENT

Network Management Basics-Network Management Architectures & Applications Management Standards and Models – Network Management Functions-Configuration Management & Auto discovery-Configuration Database & Reports-Abstract Syntax Notation One (ASN.1)

UNIT III SNMP PROTOCOL

SNMP v1: Structure of Management Information-Std. Management Information Base (MIBs), Network Management Functions: Fault Management-Fault Identification and Isolation-Event Correlation Techniques. SNMP v2: Version 2 Protocol Specification-Version 2 MIB Enhancements-MIB-II, Case Diagrams - Security Management - Protecting Sensitive Information - Host and User Authentication-Key Management. SNMP v3: Version 3 Protocol & MIB - SNMP v3 User Based Security Model – View Based Access Model - Network Management Functions: Accounting Management - Performance Management-Network Usage, Metrics and Quotas.

UNIT IV REMOTE NETWORK MONITORING RMON

RMON1: Statistics Collection- Alarms and Filters-Remote Network Monitoring RMON 2-Monitoring Network Protocol Traffic-Application-Layer Visibility-Management Tools, Systems and Applications-Test and Monitoring Tools-Integrating Tools-Development Tools-Web-based Enterprise Management-Enterprise Network Management: Network Management System Requirements- Network Management Applications and Systems.

UNIT V TELECOMMUNICATIONS MANAGEMENT FOR SERVICE PROVIDERS

Telecommunications Network Management- ATM Management-Management of broadband Networks- Real-time OSs for Next-Generation Service Management-The Operations Systems Implications of Managing Next-Generation Networks Managing a Portfolio of Broadband Access Technologies-Next-Generation Network Design-Experiences in Establishing a Nationwide Broadband Network -Quality of Service in Heterogeneous Networks-Customer-Empowered Networking.

TEXT BOOK

1. Subramanian, M., Network Management: Principles and Practice, Addison-Wesley, 2014

REFERENCE BOOKS

1. Mauro, D.R. and Schmidt K.J., Essential SNMP, O'Reilly & Associates, Sabastopol, CA. 2011.
2. Peterson L. and Davie B, Computer Networks: A Systems Approach, Morgan Kaufmann Publishers Inc., 3rd edition, 2012.
3. Mahbub Hassan and Raj Jain, High Performance TCP/IP Networking, Prentice Hall, 1st Edition, 2011.

CSE18R5127	DATA CENTER VIRTUALIZATION	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Operating Systems

Course Outcomes, Cos:

CO1: Understand the fundamentals of data centre and need for virtualization

CO2: Understand the protocols, interfaces involved in storage and network level virtualization

CO3: Familiar with the various operations of Virtual Machine

CO4: Deploy Virtual Machine and handle involved with resource provisioning, monitoring and migration

CO5: Analyze and understand the need for security and available techniques to ensure security to VMs

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		M									S		
CO2	S	M										S		
CO3	S				S					S			S	
CO4			S	S						S	S		S	S
CO5			S	S		S	M	M			S		S	S

DATA CENTER CHALLENGES

How server, desktop, network Virtualization and cloud computing reduce data center footprint, environmental impact and power requirements by driving server consolidation; Evolution of Data Centers: The evolution of computing infrastructures and architectures from standalone servers to rack optimized blade servers and unified computing systems (UCS).

ENTERPRISE-LEVEL VIRTUALIZATION

Provision, monitoring and management of a virtual datacenter and multiple enterprise-level virtual servers and virtual machines through software management interfaces; Networking and Storage in Enterprise Virtualized Environments: Connectivity to storage area and IP networks from within virtualized environments using industry standard protocols.

VIRTUAL MACHINES & ACCESS CONTROL

Virtual machine deployment, modification, management; monitoring and migration methodologies.

RESOURCE MONITORING

Physical and virtual machine memory, CPU management and abstraction techniques using a hypervisor.

VIRTUAL MACHINE DATA PROTECTION

Backup and recovery of virtual machines using data recovery techniques; Scalability: Scalability features within Enterprise virtualized environments using advanced management applications that enable clustering, distributed network switches for clustering, network and storage expansion; High Availability **:** Virtualization high availability and redundancy techniques.

References:

1. Mickey Iqbal 2014, IT Virtualization Best Practices: A Lean, Green Virtualized Data Center Approach, MC Press [ISBN: 978-1583473542]
2. Mike Laverick, VMware vSphere 4 Implementation, Tata McGraw Hill, 2014 [ISBN: 978-0071664523]
3. Jason W. McCarty, Scott Lowe, Matthew K. Johnson, VMware vSphere 4 Administration Instant Reference, Wiley, 2012 [ISBN: 978-0470520727]
4. Brian Perry, Chris Huss, Jeantet Fields, VCP VMware Certified Professional on vSphere 4 Study Guide, Wiley, 2010 [ISBN: 978-0470569610]
5. Jason Kappel, Anthony Velte, Toby Velte, Microsoft Virtualization with Hyper-V: Manage Your Datacenter with Hyper-V, Virtual PC, Virtual Server, and Application Virtualization, 2013, Tata Mcgraw hill, [ISBN: 978-0071614030]

CSE18R5128	CYBER LAW	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Operating Systems

Course Outcomes, Cos:

CO1: explain the basic information on cyber security.

CO2: understand the issues those are specific to amendment rights.

CO3: have knowledge on copy right issues of software's

CO4: understand ethical laws of computer for different countries

CO5: Understand the protocols, interfaces involved in storage and network level virtualization

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		M									S		
CO2	S	M										S		
CO3	S				S					S			S	
CO4			S	S						S	S		S	S
CO5			S	S		S	M	M			S		S	S

UNIT I - FUNDAMENTALS OF CYBER SECURITY

Introduction-Cyber Security and its problem-Intervention Strategies: Redundancy, Diversity and Autarchy.

UNIT II - ISSUES IN CYBER SECURITY

Private ordering solutions, Regulation and Jurisdiction for global Cyber security, Copy Right-source of risks, Pirates, Internet Infringement, Fair Use, postings, criminal liability, First Amendments, Data Loss.

UNIT III - INTELLECTUAL PROPERTY RIGHTS

Copy Right-Source of risks, Pirates, Internet Infringement, Fair Use, postings, Criminal Liability, First Amendments, Losing Data, Trademarks, Defamation, Privacy Common Law Privacy, Constitutional law, Federal Statutes, Anonymity, Technology expanding privacy rights.

UNIT IV - PROCEDURAL ISSUES

Duty of Care, Criminal Liability, Procedural issues, Electronic Contracts & Digital Signatures, Misappropriation of information, Civil Rights, Tax, Evidence.

UNIT V - LEGAL ASPECTS OF CYBER SECURITY

Ethics, Legal Developments, Late 1990 to 2000, Cyber security in Society, Security in cyber laws case. studies, General law and Cyber Law-a Swift Analysis.

REFERENCES

1. Jonathan Rosenoer,"Cyber Law: The law of the Internet", Springer-Verlag, 2012.

2. Mark F Grady, Fransesco Parisi, "The Law and Economics of Cyber Security", Cambridge University Press, 2006.

CSE18R5129	SIMULATION OF COMMUNICATING SYSTEMS AND NETWORKS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Knowledge of Engineering mathematics,
- Fundamentals of Graphs &Network Algorithms

COURSE OUTCOMES

CO1: To understand the concepts of Network Simulation.

CO2: To obtain a deep knowledge in Implementation of network configuration in NS2.

CO3: Understand and Implement Various Protocols in NS2.

CO4: Capable to discuss the Module development of NS2.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1				S	M								S	
CO2		S			S							S	S	
CO3				M									M	
CO4					S			M		M			S	M

UNIT I INTRODUCTION TO NETWORK SIMULATION

Simulation of Computer Networks - Introduction to Network Simulator Linkage between OTcl and C++ in NS2

UNIT II SIMULATION CONCEPTS OF NS2

Implementation of Discrete-Event Simulation Network Objects: Creation, Configuration, and Packet Forwarding

UNIT III NS2 MODULES

Nodes as Routers or Computer Hosts - Link and Buffer Management - Packets, Packet Headers, and Header Format - Transport Control Protocols, TCP, UDP - Application: User Demand Indicator

UNIT IV HELPER MODULES

Related Helper Classes, Timers, Random numbers, Built-in error models, bit operations of NS2 - Processing an NS2 Simulation: Debugging, Tracing, and Result Compilation

UNIT V MODULE DEVELOPMENT

Developing New Modules for NS2, ARQ, Packet Scheduling for Multi-Flow Data Transmission - AWK Programming – Trace file analysis using awk scripts

TEXT BOOK

1. Teerawat Issariyakul, Ekram Hossain, Introduction to Network Simulator NS2, Springer, 3rd edition, 2015.

REFERENCES

1. Jeruchim M.C,Philip Balabanand Sam Shanmugam S, Simulation of communications systems, PlenumPress, New York, 2008
2 Law A.M and David Kelton W, Simulation Modelling and analysis, Mc GrawHill Inc., New York , 5th Edition,2014
3. Hayes J.F, Modelling and Analysis of Computer Communication networks, Plenum Press, New York, 2012

CSE18R5130	DISTRIBUTED COMPUTING	L	T	P	Credit
		3	1	0	3
Course Category : Theory		**Course Type** : Elective			

Pre-requisites:

Student needs basic knowledge of operating system

Course Outcomes:

1. Students will be able to recognize various architectural models, resource sharing and inter process communication techniques
2. Students will be able to demonstrate client server communication and describe remote procedure call events
3. Students will be able to identify synchronization of deadlocks, distributed mutual exclusion and deadlocks
4. Students will be able to describe design and implementation issues of distributed transactions and shared memory.

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1		S			S							S		
CO2		S			S			S					S	
CO3			S					S		S	M			S
CO4		S			S						S		S	
CO5		S		S		S		S	M				S	

UNIT I CHARACTERIZATION OF DISTRIBUTED SYSTEMS: Introduction-Examples of distributed systems-Trends in distributed systems-Focus on resource sharing-Challenges-Case study: The World Wide Web.

SYSTEM MODELS: Introduction-Physical models-Architectural models-Fundamental models.

UNIT II REMOTE INVOCATION: Introduction-Request-reply protocols-Remote procedure call-Remote method invocation, Case study: Java RMI.

DISTRIBUTED OBJECTS AND COMPONENTS: Introduction-Distributed objects-Case study: CORBA, from objects to components, Case studies: Enterprise JavaBeans and Fractal.

UNIT III

DISTRIBUTED FILE SYSTEMS: Introduction-File service architecture-Case study: Sun Network File System-Case study: The Andrew File System.

NAME SERVICES: Introduction-Name services and the Domain Name System-Directory services.

TIME AND GLOBAL STATES: Introduction-Clocks, events and process states-Synchronizing physical clocks-Logical time and logical clocks-Global states- distributed debugging.

UNIT IV

COORDINATION AND AGREEMENT: Introduction-Distributed mutual exclusion-Elections- Coordination and agreement in group communication-Consensus and related problems.

TRANSACTIONS AND CONCURRENCY CONTROL: Introduction-Transactions-Nested transactions-Locks-Optimistic concurrency control-Timestamp ordering-Comparison of methods for concurrency control.

UNIT V

DISTRIBUTED TRANSACTIONS: Introduction-Flat and nested distributed transactions-Atomic commit protocols-Concurrency control in distributed transactions-Distributed deadlocks-Transaction recovery.

REPLICATION: Introduction-System model and the role of group communication-Fault-tolerant services-Case studies of highly available services: The gossip architecture-Bayou and Coda-Transactions with replicated data.

Text Book:

1. Distributed Systems Concepts and Design: George Coulouris, Jean Dollimore, Tim Kindberg, Gordon Blair, Fifth Edition, Pearson, M.Addison Wesley Co1987.

CSE18R5015	MOBILE APPLICATION DEVELOPMENT	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Java Programming
- Object Oriented Programming

COURSE OUTCOMES

CO1: Understand mobile application market and web services for various mobile devices

CO2: Develop the various Mobile Information Design and Mobile Platforms

CO3: Design User interface with various features of Android SDK like displaying pictures, menus etc.

CO4: Utilize the messaging, networking and location based service in Android application

CO5: Debug and build the apps for the latest Windows and IOS systems

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S		S				S	M		M		S	M	
CO2		S	S	S	S							S	S	
CO3			S	S			S			S	S	S		S
CO4			S		S			S		M	M		S	M
CO5				S	S	S		S					S	

UNIT I - INTRODUCTION

Preliminary Considerations – Cost of Development – Importance of Mobile Strategies in Business World – Mobile Web Presence – Mobile Applications – Marketing – Web Services for Mobile Devices – Creating Example Web Service _ Debugging Web Sevice

UNIT II - MOBILE USER INTERFACE DESIGN

Effective Use of Screen Real Estate – Understanding Mobile Application Users – Understanding Mobile Information Design – Understanding Mobile Platforms – Using the

Tools for Mobile Interface Design – Choosing a Mobile Web Option – Adaptive Mobile Website – Mobile Web Applications with HTML 5

UNIT III - ANDROID APPLICATION DEVELOPMENT

Getting to know the Android User Interfaces – Designing Your User interface using Views – Displaying Pictures and Menus with Views – Using Image views to Display pictures – Using menus with views – Data Persistence – Saving and loading user performances - Persisting data to files – Creating and using Data bases – Content Providers.

UNIT IV ANDROID MESSAGING, NETWORKING, LOCATION BASED SERVICES

SMS Messaging, Sending E-mail – Networking – Downloading Binary Data, Text Files-Accessing Web Services – Performing Asynchronous Calls – Location Based Services – Displaying Maps – Getting Location Data – Creating your own services – Communicating between a service and an activity – Binding activities to Services

UNIT V IOS AND WINDOWS PHONE

Getting started with iOS – iOS Project – Debugging iOS Apps – Objective C Basics – Hello Word App – Building the derby app in iOS – Windows Phone 7 Project – Building Derby App in Windows Phone 7.

REFERENCES

1. Jeff McWherter and Scott Gowell, Professional Mobile Application Development, Wrox 2014.
2. Wei – Meng Lee, Beginning Android Application Development, Wiley 2011
3. Charlie Collins, Michael Galpin and Matthias Kappler, Android in Practice, Dream Tech. 2012
4. James Dovey and Ash Furrow, Beginning Objective C, Apress, 2012
5. David Mark, Jack Nutting, Jeff LaMouche, and Fredric Olsson, beginning iOS6 Development: Exploring the iOS SDK, Apress, 2013.

CSE18R5020	SOCIAL NETWORK ANALYSIS	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

PRE-REQUISITE:

- Network Analysis

Course Outcomes, Cos:

CO1: Understand the basic notation and terminology used in network science

CO2: visualize, summarize and compare networks

CO3: Understand basic principles behind network analysis algorithms

CO4: Develop practical skills of network analysis

CO5: Capable of analyzing real work networks

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	S										S		
CO2	S			S	S							S	S	
CO3				S	S					M	S		S	S
CO4			S					S		S	S			S
CO5		S	M	S	S			S		M	S		S	S

INTRODUCTION TO SOCIAL NETWORK ANALYSIS

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web - Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Electronic sources for network analysis - Electronic discussion networks, Blogs and online communities, Web-based networks - Applications of Social Network Analysis.

MODELLING, AGGREGATING AND KNOWLEDGE REPRESENTATION

Ontology and their role in the Semantic Web - Ontology-based Knowledge Representation – Ontology languages for the Semantic Web – RDF and OWL - Modelling and aggregating social network data - State-of-the-art in network data representation, Ontological

representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with social network data, Advanced Representations.

EXTRACTION AND MINING COMMUNITITES IN WEB SOCIAL NETWROKS

Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Definition of Community - Evaluating Communities - Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Tools for Detecting community Social Network Infrastructures and Communities - Decentralized Online Social Networks- Multi- Relational Characterization of Dynamic Social Network Communities.

PREDICTING HUMAN BEHAVIOR AND PRIVACY ISSUES

Understanding and Predicting Human Behaviour for Social Communities - User Data Management, Inference and Distribution - Enabling New Human Experiences - Reality Mining - Context-Awareness - Privacy in Online Social Networks - Trust in Online Environment - Trust Models Based on Subjective Logic - Trust Network Analysis - Trust Transitivity Analysis - Combining Trust and Reputation – Trust Derivation Based on Trust Comparisons - Attack Spectrum and Countermeasures.

VISUALIZATION AND APPLICATIONS OF SOCIAL NETWORKS

Graph Theory- Centrality- Clustering - Node-Edge Diagrams, Matrix representation, Visualizing Online Social Networks, Visualizing Social Networks with Matrix-Based Representations- Matrix + Node-Link Diagrams, Hybrid Representations - Applications - Covert Networks - Community Welfare - Collaboration Networks - Co-Citation Networks.

REFERENCES

1. Peter Mika, “Social networks and the Semantic Web”, Springer, 1st edition 2011.
2. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer,2nd edition, 2014.
3. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking Techniques and applications”, Springer, 1st edition, 2011.
4. Dion Goh and Schubert Foo, “Social information retrieval systems: emerging technologies and applications for searching the Web effectively”, IGI Global snippet, 2010.

5. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, "Collaborative and social information retrieval and access: techniques for improved user modelling", IGI Global snippet, 2011.
6. John G. Breslin, Alexandre Passant and Stefan Decker, "The Social Semantic Web", Springer, 2014.

CSE18R5021	SOFTWARE DEFINED NETWORKING	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Core			

PRE-REQUISITE:

- Computer Networks

Course Outcomes:

CO1: Understand the Control Planes and Data Planes in Software Defined Networking
CO2: Understand the operations of SDN Controllers
CO3: Compare the SDN Solutions for the Data Centre Network
CO4: Analyze the Use cases of Software Defined Networking
CO5: Implement an Open Flow Switch

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1		M	S			M						S	M	
CO2	M				M							M	M	
CO3		S	S			S						S	S	
CO4				S									S	
CO5								S			M		S	M

UNIT – I INTRODUCTION

Introduction – Centralized and Distributed Control and Data Planes – Evolution versus Revolution – The Control Plane – Data Plane – Moving Information between Planes – Distributed Control Planes – IP and MPLS – Creating IP Underlay – Convergence Time – Load Balancing – High availability – creating the MPLS overlay – Replication – Centralized Control Planes – ATM/LANE – Route Servers

UNIT – II SDN CONTROLLERS

Introduction – General Concepts – Layer 3 Centric – Plexxi – Cisco OnePK – Network Programmability – The Management Interface – The Application – Network Divide – The

Command line Interface – NETCONF and NETMOD- SNMP- Modern Programmatic Interfaces- I2RS – Modern Orchestration – OpenStack- CloudStack- Puppet.

UNIT III NETWORK FUNCTION VIRTUALIZATION

The Multitenant Data Centre – The virtualized Multitenant Data Centre – SDN Solutions for the Data Centre Network – VLANs- EVPN – VxLAN – NVGRE – Network Function Virtualizations – Virtualization and Data Plane I/O – Services Engineered Path – Service Locations and Chaining – NFV at ETSI – Non- ETSI NFV Work

UNIT IV OPEN FLOW

Introduction to OpenFlow – Building Blocks – OpenFlow Messages – Northbound Interface- Implementing OpenFlow Switch – OpenFlow Reference Switch – Hardware Implementations – Software based Switches – Openflow in Cloud Computing. – Use cases for Bandwidth Scheduling, Manipulation, and Calendaring – Bandwidth Calendaring, - Use case for Input Traffic Monitoring, Classification, and Triggered Actions.- Virtualization tools - Neutron Architecture - Neutron Plug-Ins and Extensions - Managing Networks - Troubleshooting Methodology and Tools

UNIT – V SDN WAN

SDN Evolution Introduction, SDN and Enterprise Networks, SDN and Transport Networks, SDN and Optical Transport Networks, Increasing WAN Utilization with SDN, SDN Scalability Issues, Controller Designs for Scalability, Potential SDN Scalability Issues, Network Types, SDN Management, Load Adaptation, Google and SDN, Google's G-Scale Network, Google's G-Scale Network Hardware, Google SDN Deployment, Implementation Challenges

REFERENCES:

1. Thomas D.Nadeau and Ken Gray, Software Defined Networks, O'reilly, 2013
2. Siamak Azodolmolky, Software Defined Networking with OpenFlow, PACKT Publishing, 2013
3. Rajesh Kumar Sundarrajan, Software Defined Networking(SDN)- a definitive guide, e-book, March 2014.

CSE18R5022	GREEN COMPUTING	L	T	P	Credit
		3	0	0	3
Course Category : Theory		**Course Type** : Elective			

COURSE OBJECTIVES

At the end of the course, delegates will have adequate knowledge and skills to implement, operate and optimize green computing technologies for small, medium and large IT infrastructures.

COURSE OUTCOMES

CO1: Understand the fundamentals of green computing
CO2: Design green assets and modeling
CO3: Applying the grid frame work
CO4: Creating green compliance protocols, standards and audits
CO5: Applying green IT strategies and application to real time environment

	POs											PSOs		
	1	2	3	4	5	6	7	8	9	10	11	1	2	3
CO1	S	S			S		S					S		
CO2		S		S	S			S					S	
CO3			S					S		S	M			S
CO4		S		S	S						S	S	S	
CO5		S		S	S	S		S	M				S	

UNIT I FUNDAMENTALS

Green IT Fundamentals: Business, IT, and the Environment – Green computing: carbon foot print, scoop on power – Green IT Strategies: Drivers, Dimensions, and Goals – Environmentally Responsible Business: Policies, Practices, and Metrics.

UNIT II GREEN ASSETS AND MODELING

Green Assets: Buildings, Data Centers, Networks, and Devices - Green Business Process Management: Modeling, Optimization, and Collaboration – Green Enterprise Architecture –

Environmental Intelligence Green Supply Chains – Green Information Systems: Design and Development Models.

UNIT III GRID FRAMEWORK

Virtualizing of IT systems – Role of electric utilities, Telecommuting, teleconferencing and teleporting –Materials recycling –Best ways for Green PC –Green Data center –Green Grid framework.

UNIT IV GREEN COMPLIANCE

Socio-cultural aspects of Green IT –Green Enterprise Transformation Roadmap –Green Compliance: Protocols, Standards, and Audits –Emergent Carbon Issues: Technologies and Future.

UNIT V CASE STUDIES

The Environmentally Responsible Business Strategies (ERBS) –Case Study Scenarios for Trial Runs –CASE STUDIES –Applying Green IT Strategies and Applications to a Home, Hospital, Packaging Industry and Telecom Sector.

TEXT BOOKS

1. Bhuvan Unhelkar, Green IT Strategies andApplications-Using Environmental Intelligence, CRC Press, June 2016
2. Woody Leonhard, Katherrine Murray, Green Home computing for dummies, August 2009.

REFERENCES

1. Alin Gales, Michael Schaefer, Mike Ebbers, Green Data Center: steps for the Journey, Shoff/IBM rebook, 2011.
2. John Lamb, The Greening of IT, Pearson Education,2011
3. Jason Harris, Green Computing and Green IT-Best Practices on regulations & industry, Lulu.com, 2008.
4. Carl Speshocky, Empowering Green Initiatives with IT, John Wiley & Sons, 2010.
5. Wu Chun Feng (editor), Green computing: Large Scale energy efficiency, CRC Press, 2012

Inter Disciplinary Courses:

Unit 1: INTRODUCTION **09 Hours**

ICE18R5009	ROBOTICS AND AUTOMATION	L	T	P	C
		3	0	0	3

Geometric configuration of robots – Manipulators – Drive systems – Internal and external sensors – End effectors – Control systems – Robot programming languages and applications – Introduction to robotic vision

Unit 2: ROBOT ARM KINEMATICS **09 Hours**

Direct and inverse kinematics – Rotation matrices – Composite rotation matrices – Euler angle representation – Homogenous transformation – Denavit Hattenberg representation and various arm configuration

Unit 3: ROBOT ARM DYNAMICS **09 Hours**

Lagrange – Euler formulation, joint velocities – Kinetic energy – Potential energy and motion equations – Generalised D'Alembert equations of motion

Unit 4:PLANNING OF MANIPULATOR TRAJECTORIES **09 Hours**

General consideration on trajectory planning joint interpolation & Cartesian path trajectories

Unit 5: CONTROL OF ROBOT MANIPULATORS **09 Hours**

PID control computed, torque technique – Near minimum time control – Variable structure control – Non-linear decoupled feedback control – Resolved motion control and adaptive control

TEXT BOOKS

1. Wesley, E. Sryda, Industrial Robots: Computer interfacing and Control PHI, 1985
2. Saeed B. Niku, Introduction to Robotics, Analysis, systems and Applications, Pearson Education, 2002

REFERENCE BOOKS

1. Lee, C. S. G., et al ,Robotics (Control, Sensing, Vision and Intelligence), McGraw-Hill, 1968
2. Asada, Slotine, Robot Analysis and Control, John Wiley and Sons, 1986 Groover M. P. Mitchell Wesis., Industrial Robotics Technology Programming and Applications, Tata McGraw-Hill, 1986

ECE17R5141	BASICS OF VLSI DESIGN	L	T	P	Credit
		3	1	0	3
Course Category : Interdisciplinary Elective		Course Type: Theory			

COURSE OBJECTIVE(S):

This course describes about the present and possible near future processing technologies, delays, power and interconnects engineering of CMOS, combinational and sequential circuit design, array sub systems and special purpose systems

COURSE OUTCOME(S):

After completing this course, the student will be able to:

1. Explain the characteristics of CMOS transistors
2. To learn the MOS process technology
3. To learn the basic CMOS circuit design and system design

COURSE TOPICS:

UNIT I: MOS TRANSISTOR THEORY 9 Hours

CMOS logic, CMOS fabrication layout, Design partitioning, Logic design, circuit design, physical design, MOS transistor theory, CV characteristics, Non-ideal IV effects, DC transfer characteristics, pitfalls and fallacies

UNIT II: CMOS PROCESSING TECHNOLOGY 9 Hours

CMOS design rules, CMOS process enhancement, and technology related CAD issues, manufacturing issues. Delay –Transient response, RC delay model and linear delay model, logical efforts of path, Timing analysis and delay fault models.

UNIT III: POWER AND INTERCONNECT 9 Hours

Dynamic power, static power, energy delay optimization, Low power optimization, Interconnect – Wire geometry, Interconnect modelling, Interconnect Engineering, Logical effort with wires, Robustness – variability, Reliability, Scaling, statistical Analysis of variability, variation in tolerant design

UNIT IV: CIRCUIT DESIGN USING CMOS 9 Hours

Combinational circuit design – circuit families, circuit pitfalls, SOI circuit design, threshold circuit design, Sequential circuit design- sequential static circuits, circuit design of latches and flip flops, static sequential element methodology, sequencing dynamic circuits.

UNIT V: SYSTEM DESIGN USING CMOS 9 Hours

Array sub systems – SRAM, DRAM, Read only memory, Serial access memory, CAM, PLA, Robust memory design, Special purpose systems- Overview, packages and cooling, Power distribution, clocks, PLLs and DLLs, I/Os, High speed links, random circuits

REFERENCE(S):

1. Neil H.E. Weste and David Mani Harris CMOS VLSI Design, A circuit and system perceptive, PEARSON publication, 2017.
2. Douglas A. Pucknell and Kamran Eshraghian, BASIC VLSI Design., PHI publication, 2012.
3. Kiran V. G. and Nagesh H.R. Fundamentals of CMOS VLSI Design., Pearson, 2011.

ECE17R6042- DATA COMPRESSION TECHNIQUES	Credits			
	L	T	P	Total
	3	0	0	3
Pre-requisite: --	Course Category: Interdisciplinary Elective Course Type: Theory			

COURSE OBJECTIVE(S):

The course aims at providing students with theoretical and technical understanding on multimedia components and systems. The course covers contemporary, interactive multimedia technology systems, focusing on types, applications, and theories of operation. Basic technologies such as multimedia data representation, compression, retrieval and communication will be covered in an integrated manner. On the completion of the course, students should be able to understand the fundamental concepts and make critique to the technologies associated with various multimedia data types such as image, video, audio, graphics and animation.

COURSE OUTCOME(S):

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

1. explain approaches to represent multimedia data in digital format and identify their properties;
2. derive the rational of the multimedia representation format and compression algorithms based on the human visual and auditory perception;
3. analyse image, video and audio in the frequency domain to identify important components to be encoded;
4. explain the major steps in some of the image, video and audio compression standards;
5. apply lossless and lossy compression techniques on multimedia data.

COURSE TOPICS:

UNIT I: INTRODUCTION 9 Hours

Special features of Multimedia – Graphics and Image Data Representations –Fundamental Concepts in Video and Digital Audio – Storage requirements for multimedia applications - Need for Compression - Taxonomy of compression techniques – Overview of source coding, source models, scalar and vector quantization theory – Evaluation techniques – Error analysis and methodologies

UNIT II: TEXT COMPRESSION 9 Hours

Compaction techniques – Huffman coding – Adaptive Huffman Coding – Arithmetic coding – Shannon-Fano coding – Dictionary techniques – LZW family algorithms.

UNIT III: AUDIO COMPRESSION 9 Hours

Audio compression techniques - μ- Law and A- Law Companding. Speech compression-waveform codecs-source codecs- hybrid codecs-Shorten compressor, Frequency domain and filtering –Basic sub-band coding – Application to speech coding – G.722 –Application to audio coding –MPEG audio, progressive encoding for audio – Silence compression, speech compression techniques – Formant and CELP Vocoders.

UNIT IV: IMAGE COMPRESSION 9 Hours

Predictive techniques – DM, PCM, DPCM: Optimal Predictors and Optimal Quantization– Contour based compression – Transform Coding – JPEG Standard – Sub-band coding algorithms: Design of Filter banks – Wavelet based compression: Implementation using filters – EZW, SPIHT coders –JPEG 2000 standards – JBIG, JBIG2 Standards

UNIT V: VIDEO COMPRESSION 9 Hours

Video compression techniques and standards – MPEG Video Coding I: MPEG – 1 and 2 MPEG Video Coding II: MPEG – 4 and 7 – Motion estimation and compensation techniques – H.261 Standard – DVI technology – PLV performance – DVI real time compression – Packet Video.

REFERENCE(S)

1. Khalid Sayood: Introduction to Data Compression, Morgan Kauffman Harcourt India, 2nd Edition, 2000.
2. David Salomon: Data Compression – The Complete Reference, Springer Verlag New York Inc., 2nd Edition, 2001.
3. Yun Q. Shi, Huifang Sun: Image and Video Compression for Multimedia Engineering - Fundamentals, Algorithms & Standards, CRC press, 2003.
4. Peter Symes: Digital Video Compression, McGraw Hill Pub., 2004.
5. Mark Nelson: Data compression, BPB Publishers, New Delhi, 1998.
6. Mark S. Drew, Ze-Nian Li: Fundamentals of Multimedia, PHI, 1st Edition, 2003.
7. Watkinson, J: Compression in Video and Audio, Focal press, London. 1995.

EEE18R6015 EMBEDDED C	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Interdisciplinary Elective Courses - Theory				

Course Outcome(s):

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

CO1	:	Describe the basic Embedded C concepts
CO2	:	Understand knowledge of Embedded hardware and its peripherals Programming
CO3	:	Design real time embedded systems using IDE tool
CO4	:	Analyze basic serial communication devices of embedded systems
CO5	:	Analyze advanced examples of embedded systems for Power Electronics application

Course Topics:

UNIT 1: INTRODUCTION

C concepts and programming- data types, C and Assembly - Programming Style - Declarations and Expressions - Arrays, Qualifiers and Reading Numbers - Decision and Control Statements - Programming Process - More Control Statements - Variable Scope and Functions - C Preprocessor - Advanced Types - Simple Pointers - Debugging and Optimization – In-line Assembly.

UNIT 2: INPUT AND OUTPUT DEVICE PROGRAMMING

I/O ports, I/O bit manipulation programming, timers/counters, programming to generate delay and wave form generation, I/O programming, LEDs, 7segment led's,- Keyboard basics – Keyboard scanning algorithm – Multiplexed LED displays – Character LCD modules – LCD module display – Configuration – Time-of-day clock – Timer manager - Interrupts - Interrupt service routines – IRQ - ISR - Interrupt vector or dispatch table multiple-point - Interrupt- driven pulse width modulation, Device Driver, Timer Driver, Watchdog Timers.

UNIT 3: EMBEDDED C PROGRAMMING TOOLS

Real-Time Characteristics, Selection Process. Design and Development : Embedded System development environment - IDE, Types of file generated on cross compilation, disassemble / decompile, simulator, emulator and debugging, embedded product development life-

cycle, trends in embedded industry

UNIT 4: SERIAL COMMUNICATION PROGRAMMING

Asynchronous serial communication – RS-232 – RS-485 –I2C-USB-XIGBEE-WiFi Sending and receiving data – Serial ports on PC – Low level PC serial I/O module - Buffered serial I/O.

UNIT 5: CASE STUDIES :ADVANCED PROGRAMMING

Multiple closure problems – Controlling motors – Bi-directional control of motors – H bridge — Stepper control – Inventory control systems. Serial port communication, interrupts ,ADC,DAC and sensor interfacing, interfacing external memory, interfacing slave IC,RTC interfacing , Relay, PWM, AC and DC Grid integration.

Text Book(s):

1. Programming Embedded Systems in C and C++, First Edition January, Michael Barr, O' Reilly ,2006
2. Introduction to embedded systems, Shibu K V Tata McGraw-Hill,2016
3. The 8051 Microcontroller and Embedded systems using Assembly and C ,second edition ,Muhammad Ali Mazidi,JaniceGillispieMazidi,RolinD.McKinlaym,2008

Reference(s):

1. Embedded Systems, Rajkamal, TataMcGraw-Hill,2008
2. Jean J. Labrosse, "Embedded Systems Building Blocks: Complete and Ready To Use Modules in C", CMP Books 2000.
3. Daniel W. Lewis, "Fundamentals of Embedded Software where C and Assembly meet", PHI, 2002.

EEE18R5007 SMART GRID TECHNOLOGY	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Interdisciplinary Elective Courses - Theory				

COURSE OUTCOMES:

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

CO1 - To understand the challenges and the benefits of the smart grid system.

CO2 - To apply the knowledge of PMU and WAMS in the power system operation.

CO3 - To understand the benefits, standards and initiatives of AMI, IoT in smart grid system.

CO4 - To apply the high performance computing techniques in the smart grid environment.

CO5 – To acquire knowledge in the communications and measurement technologies, from the power-line communications to wireless.

Unit 1: INTRODUCTION TO SMART GRID

Evolution of Electric Grid - Concept, Definitions and Need for Smart Grid - Smart grid drivers, functions, opportunities, challenges and benefits - Difference between conventional & Smart Grid- Microgrid and Smart Grid Comparison - Concept of Resilient &Self-Healing Grid - Present development & International policies in Smart Grid - Smart Grid Roadmap for India.

Unit 2: PMU, SAS, DAS and WIDE AREA MONITORING

Phasor Measurement Unit (PMU): Requirements, RTU limitations, GPS Time Synchronization, Location & Placement, Features - Wide Area Monitoring Systems (WAMS) - Sub-station Automation Systems (SAS) - Distribution Automation Systems (DAS)

Unit 3: SMART METERS AND ADVANCED METERING INFRASTRUCTURE

Introduction to Smart Meters - Advanced Metering infrastructure (AMI) drivers and benefits - AMI protocols - standards and initiatives - AMI needs in the smart grid –smart meter data analytics, Big Data, IoT

Unit 4: HIGH PERFORMANCE COMPUTING FOR SMART GRID APPLICATIONS

Local Area Network (LAN) - House Area Network (HAN) - Wide Area Network (WAN) - Broadband over Power line (BPL) - IP based Protocols - Basics of Web Service and CLOUD Computing to make Smart Grids smarter - Cyber Security for Smart Grid.

Unit 5: SMART GRID COMMUNICATIONS AND MEASUREMENT TECHNOLOGY

Communication and Measurement - Monitoring, PMU, Smart Meters, and Measurements Technologies - GIS and Google Mapping Tools - Multiagent Systems (MAS) Technology

REFERENCE BOOKS

1. Smart Grid: Fundamentals of design and analysis, James Momoh, John Wiley & sons Inc, IEEE press 2012.
2. Smart Grid: Technology and Applications, Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, John Wiley & Sons, 2012
3. Smart Grid: Technology and Applications, Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, John Wiley & sons inc, 2012.

INT18R6023 DEEP LEARNING TECHNIQUES	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: Interdisciplinary Elective Courses - Theory				

COURSE OBJECTIVE(S):

- 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

COURSE OUTCOMES:

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

CO1 - Understand basics of deep learning.

CO2 - Implement various deep learning models.

CO3 - Realign high dimensional data using reduction techniques.

CO4 - Analyze optimization and generalization in deep learning.

CO5 – Explore the deep learning applications.

UNIT I INTRODUCTION

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

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation 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

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, hyperparameter

optimization

UNIT IV OPTIMIZATION AND GENERALIZATION

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

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

REFERENCES:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
   Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

General Electives

CSE18R5051	IOT AND APPLICATIONS	L	T	P	Credit
		3	0	1	3
	Course Type : General Elective				

UNIT I

IoT & Web Technology The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.

UNIT II

M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.

UNIT III

IoT Architecture -State of the Art – Introduction, State of the art, Architecture Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views

UNIT IV

IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and Gas Industry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.

UNIT V

Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

REFERENCE BOOKS:

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-Approach)", 1 st Edition, VPT, 2014

2. Francis daCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1 st Edition, Apress Publications, 2013

3. Cuno Pfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978-1-4493- 9357-1

CSE18R5053	BIG DATA ANALYTICS	L	T	P	Credit
		3	0	1	3
Course Type : General Elective					

UNIT I – INTRODUCTION TO DATA ANALYTICS

Data analytics process – roles, stages in data science project – working with data from files – working - with relational databases – exploring data – managing data – cleaning and sampling for modeling and validation – introduction to NoSQL.

UNIT II – MODELING METHODS

Choosing and evaluating models – mapping problems to machine learning, evaluating clustering models, validating models – cluster analysis – K-means algorithm, Naïve Bayes – Memorization Methods – Linear and logistic regression – unsupervised methods.

UNIT III – INTRODUCTION TO R

Reading and getting data into R – ordered and unordered factors – arrays and matrices – lists and data frames – reading data from files – probability distributions – statistical models in R - manipulating objects – data distribution.

UNIT IV – MAP REDUCE

Introduction – distributed file system – algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

UNIT V- DELIVERING RESULTS

Documentation and deployment – producing effective presentations – Introduction to graphical analysis – plot() function – displaying multivariate data – matrix plots – multiple plots in one window - exporting graph - using graphics parameters. Case studies.

REFERENCES

1. Nina Zumel, John Mount, “Practical Data Science with R”, Manning Publications, 2014.
2. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
3. 3. Mark Gardener, “Beginning R - The Statistical Pr ogramming Language”, John Wiley & Sons, Inc., 2012.
4. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
6. Nathan Yau, “Visualize This: The FlowingData Guide to Design, Visualization, and Statistics”, Wiley, 2011.
7. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, ISBN: 9788126551071, 2015.
8. http://www.johndcook.com/R_language_for_programmers.html
9. http://bigdatauniversity.com/
10. http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction

CSE18R5052	CLOUD COMPUTING	L	T	P	Credit
		3	0	1	3
Course Type : General Elective					

UNIT I

Introduction Cloud Computing: Nutshell of cloud computing, Enabling Technology, Historical development, Vision, feature Characteristics and components of Cloud Computing. Challenges, Risks and Approaches of Migration into Cloud. Ethical Issue in Cloud Computing, Evaluating the Cloud's Business Impact and economics, Future of the cloud. Networking Support for Cloud Computing. Ubiquitous Cloud and the Internet of Things

UNIT II

Cloud Computing Architecture: Cloud Reference Model, Layer and Types of Clouds, Services models, Data center Design and interconnection Network, Architectural design of Compute and Storage Clouds. Cloud Programming and Software: Fractures of cloud programming, Parallel and distributed programming paradigms-MapReduce, Hadoop , High level Language for Cloud. Programming of Google App engine,

UNIT III

Virtualization Technology: Definition, Understanding and Benefits of Virtualization. Implementation Level of Virtualization, Virtualization Structure/Tools and Mechanisms, Hypervisor VMware, KVM, Xen. Virtualization: of CPU, Memory, I/O Devices, Virtual Cluster and Resources Management, Virtualization of Server, Desktop, Network, and Virtualization of data-center

UNIT IV

Securing the Cloud : Cloud Information security fundamentals, Cloud security services, Design principles, Policy Implementation, Cloud Computing Security Challenges, Cloud Computing Security Architecture . Legal issues in cloud Computing. Data Security in Cloud: Business Continuity and Disaster Recovery , Risk Mitigation , Understanding and Identification of Threats in Cloud, SLA-Service Level Agreements, Trust Management

UNIT V

Cloud Platforms in Industry: Amazon web services Google AppEngine, Microsoft Azure Design, Aneka Cloud Application Platform -Integration of Private and Public Clouds Cloud applications: Protein structure prediction, Data Analysis, Satellite Image Processing, CRM and E ,Social networking . Cloud Application- Scientific Application, Business Application. Advance Topic in Cloud Computing: Federated Cloud/InterCloud, Third Party Cloud Services.

TEXT/REFERENCE BOOKS :

1. "Distributed and Cloud Computing " By Kai Hawang , Geofrey C.Fox, Jack Dongarra Pub: Elservier
2. Cloud Computing ,Principal and Paradigms, Edited By Rajkumar Buyya, Jemes Broberg, Goscinski, Pub.- Wiley
3. Kumar Saurabh, "Cloud Computing" , Wiley Pub
4. Krutz , Vines, "Cloud Security " , Wiley Pub
5. Velte, "Cloud Computing- A Practical Approach" ,TMH Pub

EEE18R5020 SOFT COMPUTING TECHNIQUES	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: General Elective - Theory				

Course Outcome(s):

After completing this course, the student will be able to:

CO1: To understand the basic concepts of soft computing techniques

CO2: To solve real world problems using neural network

CO3: To analyse the functioning of recurrent neural network

CO4: To apply genetic algorithm to solve the optimization problem

CO5: To develop fuzzy logic controller and ANN for the given system

Course Topics:

Unit 1: INTRODUCTION AND FEEDFORWARD NEURAL NETWORK

Introduction to soft computing -soft computing vs hard computing-various types of soft computing techniques-applications of soft computing-Neuron-Nerve structure and synapse-Artificial Neuron and its model-activation functions-Neural network architecture-single layer and multilayer feed forward networks-McCullochPitts neuron model-perceptron model -Adaline and Madaline-multilayer perception model-back propagation learning algorithm- Implement back propagation learning algorithm using Matlab Toolbox.

Unit 2: RECURRENT NEURAL NETWORKS

Counter propagation network-architecture-functioning & characteristics of counter-Propagation network-Hopfield/ Recurrent network-configuration-stability constraints-associative memory- and characteristics-limitations and applications-Hopfield v/s Boltzman machine-Adaptive Resonance Theory-Architecture-classifications-Implementation and training-Associative Memory- Design of multilayer feed forward network using MATLAB Toolbox..

Unit 3: FUZZY LOGIC SYSTEM

Introduction to crisp sets and fuzzy sets-basic fuzzy set operation and approximate reasoning. Introduction to fuzzy logic modeling and control-Fuzzification-inferencing and defuzzification- Fuzzy knowledge and rule bases-Fuzzy modeling and control schemes for nonlinear systems. Self-organizing fuzzy logic control-Fuzzy logic control for nonlinear time delay system- Development of Neuro fuzzy system using MATLAB tool box.

Unit 4: GENETIC ALGORITHM

Basic concept of Genetic algorithm and detail algorithmic steps-adjustment of free Parameters-Solution of typical control problems using genetic algorithm-Concept on some other search techniques like tabu search and ant colony search techniques for solving optimization problems- Implementation of optimization problem using MATLAB Toolbox.

Unit 5: APPLICATIONS

GA application to power system optimization problem-Case studies: Identification and control of linear and nonlinear dynamic systems using Matlab-Neural Network toolbox. Stability analysis of Neural Network interconnection systems-Implementation of fuzzy logic controller using Matlab fuzzy logic toolbox-Stability analysis of fuzzy control systems.

Text Book(s):

1. S.N. Sivanandam, S.N.Deepa, “Principles of Soft Computing” 2nd Edition, Wiley, 2011.
2. Fakhreddine O. Karray and Clarence De Silva, “Soft Computing & Intelligent System: Theory, Tools and Applications”, First edition, Pearson Education, 2009.

Reference(s):

1. Laurene V. Fausett, Fundamentals of Neural Networks: Architectures, Algorithms And Applications, Pearson Education. 2004
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications” Wiley India., 2010.

EEE18R6013 EVOLUTIONARY COMPUTATION TECHNIQUES	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: General Elective - Theory				

Course Outcome(s):

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

CO1 - To understand the working principle of evolutionary computation.

CO2 - To apply Genetic Algorithm to solve optimization problems.

CO3 - To recognize the powerfulness of EC Techniques and the ability to apply EC algorithms to solve optimization problem.

CO4 - To understand the principle of PSO and to solve optimization problems.

CO5 - To understand the principle of ACO and to solve optimization problems.

Course Topics:

Unit 1: EVOLUTIONARY COMPUTATION (EC): THE BACKGROUND

Outline of Evolutionary Algorithms (EA) – EA Terminologies – Robust adaptation and Machine Intelligence – Principles of Evolutionary Processes – Principles of Genetics – No-free Lunch theorem for EA – Advantages of EA over other approaches.

Unit 2: GENETIC ALGORITHM (GA)

Binary GA – genetic operators – Tournament, Proportionate and Ranking Selection – Single point, two-point and uniform crossover – Elitism – Real Parameter GA – Linear, naïve, blend and Simulated Binary Crossover – Random, Non-uniform, Normally distributed and Polynomial Mutation – Constraint Handling Techniques in GA.

Unit 3: EVOLUTIONARY STRATEGIES (ES) & EVOLUTIONARY PROGRAMMING (EP)

Non-Re combinative ES – Re combinative ES – Self Adaptive ES – Connection between RGA and Self adaptive ES – Evolutionary Programming(EP) – EP and ES: Similarities and Differences – Genetic Programming (GP) – Population size and Dynamics – Convergence and Stopping Criteria – Exploration and Exploitation.

Unit 4: PARTICLE SWARM OPTIMIZATION (PSO)

Concepts and formulation – Simulating the Social behavior – PSO algorithm – Topology – Parameter Selection and Improvements for Convergence – Maximum Velocity – Acceleration Constants - Constriction factor - Inertia weight – Advantages of PSO.

Unit 5: ANT COLONY OPTIMIZATION (ACO)

Ants' ForagingBehavior – Stigmergy – Double Bridge Experiment – Real Ants to Artificial Ants – Behavioral Differences – Properties of Artificial Ants – ACO Algorithms – Ant System - MAX–MIN Ant System – Ant Colony System (ACS) – Advances of ACO.

Text Book(s):

1. S.N. Sivanandam, S.N.Deepa, "Principles of Soft Computing" 2nd Edition, Wiley, 2011.
2. Fakhreddine O. Karray and Clarence De Silva, "Soft Computing & Intelligent System: Theory, Tools and Applications", First edition, Pearson Education, 2009.

Reference(s):

1. Kalyanmoy Deb, "Multi-Objective Optimization using Evolutionary Algorithms", 3rd Edition, John Wiley & Sons, 2008.
2. Thomas Back, David BFogel and ZbigniewMichalewicz, "Evolutionary Computation 1 &2 : Basic/advanced Algorithms and Operators", Institute of Physics Publishing, 2000.
3. Marco Dorigo and Thomas Stutzle, "Ant Colony Optimization", MIT Press, 2004.
4. JurgenBranke, Kalyanmoy Deb, KaisaMiettinen and Roman Slowinski (Eds.), "MultiObjective Optimization: Interactive and Evolutionary Approaches", Springer-Verlag, 2008.

EEE18R5021 OPTIMIZATIONTECHNIQUES	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category: General Elective - Theory				

Course Outcome(s):

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

CO1- To understand the importance of optimization for solving engineering applications.

CO2 - To solve the linear optimization problems using conventional mathematical methods.

CO3 - To understand the NewtonsMethod, Sequential quadratic programming and Penalty function method for solving the nonlinear optimization problems.

CO4 - To solve optimality problems using dynamic programming methods.

CO5 - To formulate genetic algorithm to solve optimization problems.

Course Topics:

Unit 1: INTRODUCTION

Definition, Classification of optimization problems, Classical Optimization Techniques, Single and Multiple Optimization with and without inequality constraints.

Unit 2: LINEAR PROGRAMMING (LP)

Simplex method of solving LPP, revised simplex method, duality, constrained optimization, Theorems and procedure, Linear programming, mathematical model, solution technique, duality.

Unit 3: NON LINEARPROGRAMMING

Steepest descent method, conjugates gradient method, Newtons Method, Sequential quadratic programming, Penalty function method, augmented Lagrange multiplier method.,

Unit 4: DYNAMIC PROGRAMMING (DP)

Multistage decision processes, concept of sub-optimization and principle of optimality, Recursive relations, Integer Linear programming, Branch and bound algorithm

Unit 5: GENETIC ALGORITHM

Introduction to genetic Algorithm, working principle, coding of variables, fitness function, GA operators; Similarities and differences between Gas and traditional methods; Unconstrained and constrained optimization using genetic Algorithm, real coded gas, Advanced Gas, global optimization using GA, Applications to power system.

Reference(s):

1. Computational methods in Optimization, Polak, Academic Press, 1971.
2. Optimization Theory with applications, Pierre D.A.,WileyPublications, 1969.
3. Taha, H. A., Operations Research: An Introduction, Seventh Edition, Pearson Education Edition, Asia, New Delhi ,2002.
4. S.S.Rao,"Optimization–Theoryand Applications",Wiley-Eastern Limited, 1984.
5. G.Luenberger," Introduction of Linear and Non-Linear Programming",Wesley Publishing Company, 2011

Open Elective

Business Analytics	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category:				

Course objective

1. Understand the role of business analytics within an organization.
2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization.
3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making.
4. To become familiar with processes needed to develop, report, and analyze business data.
5. Use decision-making tools/Operations research techniques.
6. Mange business process using analytical and management tools.
7. Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

Course Outcomes

1. Students will demonstrate knowledge of data analytics.
2. Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3. Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4. Students will demonstrate the ability to translate data into clear, actionable insights.

Course Topics:

Unit 1: Business analytics: Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview.

Unit 2: Trendiness and Regression Analysis: 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 3: 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 4: Forecasting Techniques: 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 Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.

Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.

Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G.
Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

Industrial Safety	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category:				

Unit-I: Industrial safety: 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, pressur vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: 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: 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: 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: 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.

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

Operations Research	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category:				

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

1. Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
2. Students should able to apply the concept of non-linear programming
3. Students should able to carry out sensitivity analysis
4. Student should able to model the real world problem and simulate it.

Course Topics:

Unit 1: Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models.

Unit 2: Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming.

Unit 3: Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT.

Unit 4: Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5: Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation

References:

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008.
2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008.
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009.
5. Pannerselvam, Operations Research: Prentice Hall of India 2010.

Cost Management of Engineering Projects	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category:				

Introduction and Overview of the Strategic Cost Management Process 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.

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.

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. Pricing strategies: 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.

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

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi

2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Composite Materials	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category:				

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

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

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.

2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

Waste to Energy	*Credits*			
	L	*T*	*P*	*Total*
	3	*0*	*0*	*3*
Course Category:				

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: 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: 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.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.

4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

Audit Course

ENGLISH FOR RESEARCH PAPER WRITING	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course objectives:

Students will be able to:

1. Understand that how to improve your writing skills and level of readability

2. Learn about what to write in each section

3. Understand the skills needed when writing a Title

Ensure the good quality of paper at very first-time submission

Course Topics:

Unit 1: Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing, Redundancy, Avoiding Ambiguity and Vagueness.

Unit 2: Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction

Unit 3: Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Unit 4: 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.

Unit 5: Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions.

Unit 6: Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission

Suggested Studies:

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

DISASTER MANAGEMENT	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course Objectives: -Students will be able to:

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

Course Topics:

Unit 1: Introduction

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

Unit 2: 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.

Unit 3: 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.

Unit 4: 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.

Unit 5: 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.

Unit 6: 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.

SUGGESTED READINGS:

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, Pardeep Et.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep
Publication Pvt. Ltd., New Delhi.

SANSKRIT FOR TECHNICAL KNOWLEDGE	*Credits*			
	L	*T*	*P*	*Total*
Course Category:				

Course Objectives

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

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students.

Course Topics:

Unit 1: Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences.

Unit 2: Order, Introduction of roots, Technical information about Sanskrit Literature.

Unit 3: Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics.

Suggested reading

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

VALUE EDUCATION	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course Objectives

Students will be able to

1.Understand value of education and self- development

2. Imbibe good values in students

3. Let the should know about the importance of character

Course outcomes

Students will be able to

1. Knowledge of self-development

2. Learn the importance of Human values

3. Developing the overall personality.

Course Topics:

Unit 1: 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 2: 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 3: Personality and Behavior Development - Soul and Scientific, attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal 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 4: Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively.

Suggested reading

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

CONSTITUTION OF INDIA	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To 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.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

Course Topics:

Unit 1: History of Making of the Indian Constitution:

History Drafting Committee, (Composition & Working)

Unit 2: Philosophy of the Indian Constitution:

Preamble, Salient Features

Unit 3: Contours of Constitutional Rights & Duties:

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 4: Organs of Governance:

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 5: Local Administration:

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 6: Election Commission:

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.

Suggested reading

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

PEDAGOGY STUDIES	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course Objectives:

Students will be able to:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in
developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

Course Topics:

Unit 1: Introduction and Methodology:

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

Unit 2: Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Unit 3: Evidence on the effectiveness of pedagogical practices, 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 4: Professional development: 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 5: Research gaps and future directions

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

Suggested reading

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.

2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.

3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.

5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education.
Oxford and Boston: Blackwell.

6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.

7. www.pratham.org/images/resource%20working%20paper%202.pdf.

STRESS MANAGEMENT BY YOGA	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

Course Topics:

Unit 1: Definitions of Eight parts of yog. (Ashtanga)

Unit 2: Yam and Niyam.

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan.

Unit 3: Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam.

Suggested reading

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

PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	*Credits*			
	L	*T*	*P*	*Total*
				-
Course Category:				

Course Objectives

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

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve
the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

Course Topics:

Unit 1: Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Unit 2:

- Approach to day to day work and duties.
- Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,

- Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17,23, 35,
- Chapter 18-Verses 45, 46, 48

Unit 3:

- Statements of basic knowledge.
- Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18
- Personality of Role model. Shrimad Bhagwad Geeta:
- Chapter2-Verses 17, Chapter 3-Verses 36,37,42,
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63.

Suggested reading

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