RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2020 – 2021

(Batch of 2020 – 2022)

COMPUTER SCIENCE AND ENGINEERING

I - IV Semester M. Tech (CNE)

COMPUTER NETWORKS AND ENGINEERING

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 13 UG programs and 15 PG programs. All these programs are approved by AICTE. All the UG programs & 09 PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with 'A' grade by NAAC in 2014. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs till the year 2029. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility to all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology & Schneider Centre of Excellence. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

The Centre for Advanced Training and Continuing Education (CATCE), and Entrepreneurship Development Cell (EDC) have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), an initiative of Ministry of Human Resource Development (MHRD), Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. It has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association. **As per the National Institutional Ranking Framework, MHRD, Government of India, M S Ramaiah Institute of Technology has achieved 59th rank among 1071 top Engineering institutions of India for the year 2020 and 1st rank amongst Engineering colleges (VTU) in Karnataka.**

About the Department:

Year of Establishment	1984
Names of the Programmes offered	1. UG: B.E. in Computer Science and Engineering 2. PG: M.Tech. in Computer Science and Engineering 3. PG: M.Tech. in Computer Networks and Engineering 4. Ph.D 5. M.Sc(Engg.) by Research

The Department of Computer Science and Engineering (CSE) has eminent emeritus professors, 15 faculty with the doctorate degree and 15pursuing the doctoral studies. The faculty has been publishing research papers in refereed journals and in conference proceedings. The department also conducts vocational courses and proficiency courses on fundamental and new programming languages and computer science concepts. These courses are conducted beyond college hours/summer semester by the faculty of the department. Some of the faculty are involved in institutional level activities and actively involved in interdisciplinary research activities. The department has state of the art laboratories like SAP, IBM Centre of Excellence and CUDA learning center. Technical seminars, workshops and hackathons are conducted regularly for UG & PG students. The department encourages the students to conduct and participate in extra-curricular/sports activities. The alumni network is very active and regular meeting are conducted by the department. The department is accredited by Nation Board of Accreditation (NBA). The department has MoUs with leading IT Industries like NVIDIA, SAP, IBM and HP. The department conducts subjects with more of hands-on sessions and encourages students to take up MOOC based online courses in NPTEL, IITBombayX, Coursera, Udacity and edX.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through
1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M. S. Ramaiah Institute of Technologystrive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To build a strong learning and research environment in the field of Computer Science and Engineering that promotes innovation towards betterment of the society

MISSION OF THE DEPARTMENT

1. To produce Computer Science post graduates who, trained in design and implementation of computational systems through competitive curriculum and research in collaboration with industry and research organizations.

2. To educate students in technology competencies by providing professionally committed faculty and staff.

3. To inculcate strong ethical values, leadership abilities and research capabilities in the minds of students so as to work towards the progress of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

An M.Tech (Computer Science & Engineering) graduate of M S Ramaiah Institute of Technology should, within three to five years of graduation

PEO1 Pursue a successful career in the field of Computer Science & Engineering or a related field utilizing his/her education and contribute to the profession as an excellent employee, or as an entrepreneur

PEO2 Be aware of the developments in the field of Computer Science & Engineering, continuously enhance their knowledge informally or by pursuing doctoral studies and engage in research and inquiry leading to new innovations and products

PEO3 Be able to work effectively in multidisciplinary and multicultural environments and Be responsible members and leaders of their communities

PEO4 Understand the human, social and environmental context of their profession and contribute positively to the needs of individuals and society at large

PROGRAM OUTCOMES (POs):

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

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

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

PO4: Acquire professional and intellectual integrity to stress upon the impact of computer engineering applications with respect to economic and environmental aspects

PO5: Acquire methods of engaging in life-long learning not only to predict and plan the projects of the future but also to groom others in the group.

Curriculum Course Credits Distribution

Semester	Professional Core- PCC	Professional Electives -PEC	Internship	Project	Total Credits in a Semester
First	12	12	0	0	24
Second	12	12	0	0	24
Third	4	4	4	6	18
Fourth	0	0	0	22	22
				Total	**88**

SCHEME OF TEACHING
I SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	MCN11	Advanced Engineering Mathematics	PCC	4	0	0	4	56
2.	MCN12	Advances in Computer Networks	PCC	3	1	0	4	42
3.	MCNE13x	Elective-I	PEC	*	*	*	4	*
4.	MCNE14x	Elective-II	PEC	*	*	*	4	*
5.	MCNE15x	Elective-III	PEC	*	*	*	4	*
6.	MCNL16	Computer Networks Laboratory	PCC	0	0	1	1	28
7.	MCNL17	Network Programming Laboratory using Python	PCC	0	0	1	1	28
8.	MCN18	Technical Seminar-I	PCC	0	0	2	2	--
		Total					24	

II SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	MCN21	Cyber Security	PCC	3	1	0	4	42+28
2.	MCN22	Software Defined Networks	PCC	4	0	0	4	56
3.	MCNE23x	Elective-IV	PEC	*	*	*	4	*
4.	MCNE24x	Elective-V	PEC	*	*	*	4	*
5.	MCNE25x	Elective-VI	PEC	*	*	*	4	*
6.	MCNL26	Cyber Security Laboratory	PCC	0	0	1	1	28
7.	MCNL27	Software Defined Networks Laboratory	PCC	0	0	1	1	28
8.	MCN28	Technical Seminar-II	PCC	0	0	2	2	--
			Total				24	

III SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	MCN31	Research Methoddology and IPR	PCC	3	1	0	4	42+28
2	MCNE32x	Elective -VII	PEC	*	*	*	4	*
3	MCN33	Internship/Industrial Training	Internship	0	0	4	4	*
4	MCN34	Project Work-I	Project	0	0	6	6	*
			Total				18	

Internship: The department should prepare Gantt chart with milestones, deliverables, evaluation and maintain weekly dairy signed by both Internal and External Guide.

Project Work-I: Seminar on: problem definition, literature survey and methodology to be used.

IV SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	MCN41	Project Work-II	Project	0	0	22	22	*
			Total				22	

Electives

Course Code	Course Name
List of Elective-I	
MCNE131	Protocol Engineering
MCNE132	Distributed Systems
MCNE133	Multimedia Communications
MCNE134	Network Security and Ethical Hacking
MCNE135	Client Server Programming
List of Elective-II	
MCNE141	Wireless Adhoc Networks
MCNE142	Network Routing Algorithms
MCNE143	Computer System Performace Analysis
MCNE144	Future Skills
MCNE145	Blockchain Technology
List of Elective-III	
MCNE151	Artificial Intelligence
MCNE152	IoT Technology and Applications
MCNE153	Data Storage Technology and Networks
MCNE154	Advances in Opearting Systems
MCNE155	Software Testing
List of Elective-IV	
MCNE231	Cloud Infrastructure and Services
MCNE232	High Speed Networks
MCNE233	Software Engineering and Modelling
MCNE234	Enterprise Devices and Networking

MCNE235	Software Project Management and Professional Ethics
List of Elective-V	
MCNE241	Information and Network Security
MCNE242	Deep Learning
MCNE243	Web Technologies
MCNE244	Privacy and Security in Online Social Media
MCNE245	Semantic Web and Social Networks
List of Elective-VI	
MCNE251	Network Management
MCNE252	Security Engineering
MCNE253	Mobile Computing
MCNE254	Softwware Oriented Architecture
MCNE255	Applied Cryptography
List of Elective-VII	
MCNE321	Startup Engineering
MCNE322	Malware Analysis
MCNE323	Cyber Physical Systems
MCNE324	Storage Area Networks
MCNE325	Digital Forensic and Cyber Crime

Note:

The total number of credits for all the elective courses is 4. The Faculty coordinator can choose to conduct a 1 credit integrated lab or 1 credit Tutorial for the course offered. The lab exercises and tutorial exercises will be formulated during delivery of the Elective Course.

Advanced Engineering Mathematics

Course Code: MCN11   Credits: 4:0:0
Prerequisites:Engineering Mathematics I- IV Course   Contact Hours: 56
Coordinator/s: Dr. Govindaraju M V

Course Contents:

Unit I

Numerical Methods: Numerical Solution of Algebraic and Transcendental equations:Horner's method and Graffe root method.Numerical Solution of system of non-linear equations:Newton-Raphson method.Solution of Higher Order ODE with initial conditions: Runge – Kutta Method and Milne's Predictor and Corrector method.

Unit II

Linear Transformations: Introduction to Linear transformations, Composition of matrix transformations, Rotation about the origin, Dilation, Contraction and Reflection, Kernel and Range, Change of basis.

Unit III

Random Variables: Random Variables (Discrete and Continuous), Probability density function, Cumulative distribution function, Mean, Variance, Moment generating function.Probability Distributions**:** Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution and Uniform distribution.Joint probability distribution:Joint probability distribution (both discrete and continuous), Conditional expectation.

Unit IV

Markov Process: Introduction, Markov chain and Transition probabilities, Continuous Parameter Markov Chain, Pure Birth and Pure Death Process, Birth and Death Process, Renewal Process.

Unit V

Introduction to Queuing and Applications: Single server with infinite system capacity queuing models.M/M/1: ∞/FIFO, K/FIFO, M/M/s:∞/FIFO, K/FIFO, M/G/1 Queuing system characteristics, Case studies.

Text Books:
1. Erwin Kreyszig – Advanced Engineering Mathematics-Wiley-India publishers-10^{th}edition-2015.

2. B.S.Grewal – Higher Engineering Mathematics – Khanna Publishers – 40th edition – 2007.
3. R.E. Walpole, R. H. Myers, R. S. L. Myers and K. Ye – Probability and Statistics for Engineers and Scientists – Pearson Education – Delhi – 8th edition – 2007.
4. Garreth Williams – Linear Algebra with Applications – Jones and Bartlett Press – 4th edition – 2001.

Reference Books:
1. Sheldon M. Ross – Probability models for Computer Science – Academic Press – 2009.
2. Murray R Spiegel, John Schiller & R. Alu Srinivasan – Probability and Statistics – Schaum"s outlines -2nd edition.
3. Kishor S. Trivedi – Probability & Statistics with reliability, Queuing and Computer Science Applications – PHI – 2nd edition – 2002.

Course Outcomes (COs):
At the end of the course, students should be able to:
1. Solve the problems of algebraic, transcendental and ordinary differential equations using numerical methods. (PO1,3,4)
2. Find the Kernel and Range of Linear transformations. (PO1,3)
3. Express the probability distribution arising in the study of engineering problems and their applications. (PO1,3,4)
4. Apply the Markov Chain in prediction of future events. (PO1,3)
5. Apply and calculate the various parameters of the queuing models. (PO1,3)

Advances in Computer Networks

Course Code:MCN12
Prerequisites: Computer Networks
Course Coordinator: Dr. Monica R Mundada

Credits: 3:1:0
Contact Hours: 4 2 + 2 8

Course Contents:

Unit I

Foundation: Building a Network, Requirements, Perspectives, Scalable Connectivity, Cost-Effective Resource sharing, Support for Common Services, Manageability, Protocol layering, Performance, Bandwidth and Latency, Delay X Bandwidth Product, Perspectives on Connecting, Classes of Links, Reliable Transmission, Stop-and-Wait, Sliding Window, Concurrent Logical Channels.

Unit II

Internetworking I: Switching and Bridging, Datagram"s, Virtual Circuit Switching, Source Routing, Bridges and LAN Switches, Basic Internetworking (IP), What is an Internetwork?, Service Model, Global Addresses, Datagram Forwarding in IP, sub netting and classless addressing, Address Translation (ARP), Host Configuration (DHCP), Error Reporting (ICMP), Virtual Networks and Tunnels.

Unit III

Internetworking- II: Network as a Graph, Distance Vector (RIP), Link State (OSPF), Metrics, The Global Internet, Routing Areas, Routing among Autonomous systems (BGP), IP Version 6 (IPv6), Mobility and Mobile IP

Unit IV

End-to-End Protocols: Simple Demultiplexer (UDP), Reliable Byte Stream(TCP), Endto-End Issues, Segment Format, Connecting Establishment and Termination, Sliding Window Revisited, Triggering Transmission, Adaptive Retransmission, Record Boundaries, TCP Extensions, Queuing Disciplines, FIFO, Fair Queuing, TCP Congestion Control, Additive Increase/ Multiplicative Decrease, Slow Start, Fast Retransmit and Fast Recovery.

Unit V

Congestion Control and Resource Allocation Congestion-Avoidance Mechanisms, DEC bit, Random Early Detection (RED), Source-Based Congestion Avoidance. The Domain Name System (DNS), Electronic Mail (SMTP,POP,IMAP,MIME), World Wide Web (HTTP), Network Management (SNMP)

Reference Books:

1. Larry Peterson and Bruce S Davis "Computer Networks: A System Approach" 5th Edition, Elsevier -2014.
2. Douglas E Comer, "Internetworking with TCP/IP, Principles, Protocols and Architecture" 6th Edition, PHI –2014.
3. Uyless Black, "Computer Networks, Protocols, Standards and Inte rfaces" 2nd Edition – PHI.
4. Behrouz A Forouzan, "TCP /IP Protocol Suite" 4th Edition – Tata McGraw-Hill.

Course Outcomes (COs):

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

1. Explain basic computer network technology. (PO1,3,4)
2. Explain Data Communications System and its components. (PO1,3,4)
3. Identify the different types of network topologies and protocols. (PO1,3,4)
4. Identify the different types of network devices and their functions within a network. (PO1,3,4)
5. Illustrate the skills of subnet and routing mechanisms. (PO1,3,4)

Computer Networks Laboratory

Course Code: MCNL16
Prerequisites: Nil
Course Coordinator: Sanjeetha R

Credits: 0:0:1:0
Contact Hours: 28

Course Contents:

The Practical work will be conducted using QualNet Packet Tracer (any other open source tool can also be used). This provides a visual representation of packet trace files generated during the simulation of a network scenario.

The following concepts will be explored in the laboratory:

- Exercises on Computer Networks and the Internet
- Exercises on Application Layer
- Exercises on Transport Layer
- Exercises on Network Layer
- Exercises on Link Layer and Local Area Networks
- Exercises on Wired and Wireless VOIP application
- Exercises on mobility in wireless networks.

Reference Books:

1. Larry L. Peterson and Bruce S. Davie: Computer Networks – A Systems Approach, 5th Edition, Elsevier, 2011.
2. Behrouz A. Forouzan: Data Communications and Networking, 4th Edition, Tata McGraw Hill, 2012.
3. William Stallings: Data and Computer Communication, 8th Edition, Pearson Education, 2012.
4. Alberto Leon-Garcia and Indra Widjaja: Communication Networks -Fundamental Concepts and Key Architectures, 2nd Edition Tata McGraw-Hill, 2011.

CourseOutcomes(COs):

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

1. Explain basic computer network technology.(PO1,3,4)
2. Explain Data Communications System and functions of all the layers.(PO1,3,4)
3. .Illustrate the skills of wired and wireless VOIP applications and mobility.(PO1,3,4)

Network Programming Laboratory Using Python

Course Code:MCSL17
Prerequisites:Nil
Course Coordinator/s: Dr. Rajarajeswari S

Credits: 0:0:1
Contact Hours: 28

Course Contents:

1. Python Basics
2. Control Structures
3. Functions
4. Strings, lists, list comprehensions
5. Tuples and dictionaries
6. Modules and packages
7. Object Oriented Concepts
8. Regular Expression
9. Programs on File I/O
10. Exceptions
11. Network Programming
12. GUI Programming
13. Design a simple game application using pygame
14. Game application Demo.

Text Books:

1. Python Programming: Using Problem Solving Approach, Reema Thareja.
2. Problem Solving and Python Programming, E Balagurusamy

Reference Books:

1. Introduction to computer science using Python: A computational Problem solving focus, Charles dierbagh.
2. Practical programming: An Introduction To Computer science using Python,Campbell, J., Gries, P., Montojo, J., & Wilson, G. (2013), Pragmatic Bookshelf,2ndEdition.
3. Learn Python the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Shaw, Z. A. (2013), Addison-Wesley.

Course Outcomes (COs):
After the course, students should be able to:

1. Adapt and combine standard algorithms to solve a given problem (includes numericalas well as non-numerical algorithms)(PO1,3,4)
2. Adequately use standard programming constructs: repetition, selection, functions,Composition, modules, aggregated data (arrays, lists, etc.)(PO1,3,4)
3. Create, debug and test a software application using the Python programming language.(PO1,3,4)

Cyber Security

Course Code: MCN21 **Credits: 3:1:0**
Prerequisites: Computer Networks **Contact Hours: 42+28**

Course Coordinator: Dr. Mohana Kumara S

Course Contents:

Unit I

Introduction to Cyber Security: Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats:- Cyber Warfare-Cyber Crime-Cyber terrorism-Cyber Espionage, Need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace. Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

Unit II

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges. Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

Unit III

Cryptography and Network Security Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

Unit IV

Cyberspace and the Law: Introduction, Cyber Security Regulations, Roles of International Law, the state and Private Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013.

Unit V

Cyber Forensics: Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

Text Book:
1. Nina Godbole, Sunit Belapure, Cyber Security, Wiley Publishers-2011

Reference Book:
1. Mayank Bhushan, Fundamentals of Cyber Security, BPB Publications

Course Outcomes (COs):

After the course, students should be able to:
1. Evaluate the computer network and information security needs of an organization (PO 1,3,4,5)

2. Assess cybersecurity risk management policies in order to adequately protect an organization's critical information and assets (PO 1,3,4,5)

3. Measure the performance of security systems within an enterprise-level information system (PO 1,3,4,5)

4. Implement continuous network monitoring and provide real-time security solutions (PO 1,3,4,5)

5. Formulate, update and communicate short- and long-term organizational cyber security strategies and policies (PO 1,3,4,5)

Software Defined Networks

Course Code : MCN22   Credits: 4:0:0
Prerequisites: Data Communications and Networks   Contact Hours: 56
Course Coordinator: Sanjeetha R

Course Contents:

Unit I

Introduction – Traditional Switch Architecture.

Why SDN-Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs.

The Genesis of SDN: Forerunners of SDN: Early efforts, Network Access Control, Orchestration, Virtualization manager network plugins, FORCES, 4D Centralized Network Control, Ethane, Software Defined Networking is Born, Network Virtualization.

How SDN Works - Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods. Data Center Needs, Network Virtualization.

Unit II

How SDN Works Contd. -SDN Controller- SDN controller core modules, SDN controller interfaces, Existing controller implementations, potential issues with the SDN Controller, SDN Applications, Alternate SDN Methods – SDN via APIs, Benefits and Limitations of SDN via APIs, SDN via hypervisor based overlay networks.

The OpenFlow Specification– OpenFlow Overview – The OpenFlow switch, The OpenFlow Controller, The OpenFlow protocol, The Controller- switch secure channel, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, OpenFlow Limitations.
Benefits and Limitations of SDN via APIs, OpenFlow Limitations.

Unit III

The OpenFlow SpecificationContd. Openflow 1.4 additions – Bundles, Eviction and vacancy events, enhanced support for multiple controller, optical port support, and flow table synchronization.

Alternative Definitions of SDN – Potential Drawbacks of Open SDN, SDN via APIs – Legacy APIs in Network Devices, NETCONF/YANG, BGP- LS/PCE-P, REST, Examples of SDN via APIs, Ranking SDN via APIs, SDN via Hypervisor-Based Overlays – Overlay Controller, Overlay Operation, Examples of SDN via Hypervisor-Based Overlays, Ranking SDN via Hypervisor-Based Overlays, SDN via Opening Up the Device, Network Functions Virtualization, Alternatives Overlap and Ranking. flow table synchronization, Alternatives Overlap and Ranking.

Unit IV

Emerging Protocol, Controller - Additional SDN Protocol Models, Using Existing Protocols to Create SDN Solutions, Using the Netconf Protocol, BGP Protocol, BGP-LS Protocol, PCE-P Protocol MPLS Protocol For SDN. Additional SDN Controller Models – Controllers with Multiple Southbound Plugins, Controllers Targeting Service Provider Solutions, Controllers Built For Scalability, Intents-Based Applications.

SDN in the Data Center-Data Center Demands – Overcoming Current Network Limitations, MAC address explosion, Number of VLANs, Spanning tree, adding, moving and deleting resources, Failure recovery, multitenancy, Tunneling Technologies for the Data Center.

Intents-Based Applications, Tunneling Technologies for the Data Center.

Unit V

SDN in the Data Center- Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Comparison Of Open SDN, Overlays, and APIs.

SDN in Other Environments - Wide Area Networks, Service Provider and Carrier Networks, Campus Networks, Mobile Networks, Optical Networks. **Network Functions Virtualization -** Definition Of NFV, What Can We Virtualize? SDN Vs NFV, When Should NFV Be Used With SDN?, In-Line Network Functions, SDN Applied To Server Load-Balancing, Firewalls and Intrusion Detection.

SDN Applications- Application Types, a Simple Reactive Java Application – Blacklisting Hostnames and IP Addresses, Offloading Flows in the Data Center. Optical Networks, Firewalls and Intrusion Detection, Offloading Flows in the Data Center.

Text Book:

1. Paul Goransson, Chuck Black, and Timothy Culver: Software Defined Networks A Comprehensive Approach, Second Edition, Elsevier, 2014.

Reference Book:

1. Thomas D.Nadeau & Ken Gray: SDN Software Defined Networks O'Reilly publishers, Second edition, 2017.

Course Outcomes(COs):

At the end of the course, students should be able to:
1. Describe the fundamental characteristics of SDN. (PO1,3,4)
2. Differentiate between various Open Flow specifications. (PO1,3,4)

Identify different ways of implementing SDN. (PO1,3,4)

3. Compare and contrast different types of controller models in SDN. (PO1,3,4)
4. Illustrate use of SDN in Data Centers and other environments (PO1,3,4)
5. Explore the various aplications of SDN (PO1,3,4,5)

Cyber Security Laboratory

Course Code : MCNL26   **Credits: 0:0:1**
Prerequisites: Computer Security   **Contact Hours: 28**
Course Coordinator: Dr. Mohana Kumara S

Course Contents:

Network Cyber Security Lab Exercises

1. Study of different wireless network components and features of any one of the Mobile Security Apps.
2. Study of the features of firewall in providing network security and to set Firewall Security in windows.
3. Steps to ensure Security of any one web browser (Mozilla Firefox/Google Chrome)
4. Study of different types of vulnerabilities for hacking a websites / Web Applications.
5. Analysis the Security Vulnerabilities of E-commerce services.
6. Analysis the security vulnerabilities of E-Mail Application

Applications:

1. Study of steps to protect your personal computer system by creating User Accounts with Passwords and types of User Accounts for safety and security.
2. Study the steps to protect a Microsoft Word Document of different version with different operating system.
3. Study the steps to remove Passwords from Microsoft Word
4. Study various methods of protecting and securing databases.
5. Study "How to make strong passwords" and "passwords cracking techniques".
6. Study the steps to hack a strong password.

Reference Book:

1. Roberta Bragg, Mark Rhodes Ousley, Keith Strassberg, The Complete Reference –Network Security, TMH 2014

Course Outcomes (COs):

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

1. Understand relevant legislation and codes of ethics (PO1,3,4,5)
2. Computer forensics and digital detective and various processes, policies and procedures (PO1,3,4,5)
3. Learn E-discovery, guidelines and standards, E-evidence, tools and environment, email, web and network forensics and develop cyber threat intelligence requirements(PO1,3,4,5)

Software Defined Networks Laboratory

Course Code : MCNL27   **Credits: 0:0:1**
Prerequisites: Computer Networks   **Contact Hours: 28**
Course Coordinator: Sanjeetha R

Course Contents:

Experiments based on the topics:

1. Installing Mininet on Ubuntu and windows
2. Creating topologies in mininet
3. Using wireshark to see the contents of the open flow packets
4. Using MiniEdit, Mininet's graphical user interface
5. Executing hub behaviour using pox controller
6. Running a webserver in mininet
7. Introduction to RYU Controller
8. Implementing REST APIs
9. Group Table implementation to perform specific actions on packets
10. Collecting packet Statistics from OpenFlow switch
11. Using Meter Tables to implement QoS
12. Adding multiple actions for a flow using Flow Manager
13. Discovering underlying Network Topology
14. Identifying different roles of Multicontrollers

Reference Books:

1. Paul Goransson, Chuck Black, Timothy Culver: Software Defined Networks A Comprehensive Approach, Second Edition, Elsevier, 2014.
2. Chayapathi, Rajendra, Syed F. Hassan, and Paresh Shah. Network Functions Virtualization (NFV) with a Touch of SDN: Netw Fun Vir (NFV ePub_1. Addison-Wesley Professional, 2016. Reference Books:
3. Thomas D.Nadeau & Ken Gray: SDN Software Defined Networks O'Reilly publishers, First edition, 2013.

Course Outcomes (COs):

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

1. Demonstrate the use of mininet emulator for implementing SDN concepts.(PO1,3,4)
2. Illustrate use of basic and openflow commands and implementation of REST APIs. (PO1,3,4)
3. Demonstrate the use of Ryu controller and concepts of multiple controllers for real time applications (PO1,3,4)

Research Methodology and IPR

Course Code: MCN31　　　　　　　　　　**Credits: 4:0:0**
Prerequisites: Nil　　　　　　　　　　　**Contact Hours: 56**
Course Coordinator: Dr Jagadish S Kallimani

Course Contents:

Unit I

Research Methodology: Introduction, Meaning of Research, Objectives of Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India. Defining the Research Problem: Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, an Illustration.

Unit II

Reviewing the literature: Place of the literature review in research, Bringing clarity and focus to research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, Review of the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. Research Design: Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs

Unit III

Design of Sample Surveys: Design of Sampling: Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. Measurement and Scaling: Qualitative and Quantitative Data, Classifications of Measurement Scales, Goodness of Measurement Scales, Sources of Error in Measurement, Techniques of Developing Measurement Tools, Scaling, Scale Classification Bases, Scaling Technics, Multidimensional Scaling, Deciding the Scale. Data Collection: Introduction, Experimental and Surveys, Collection of Primary Data, Collection of Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method

Unit IV

Testing of Hypotheses: Hypothesis, Basic Concepts Concerning Testing of Hypotheses, Testing of Hypothesis, Test Statistics and Critical Region, Critical Value and Decision Rule, Procedure for Hypothesis Testing, Hypothesis Testing for Mean, Proportion, Variance, for Difference of Two Mean, for Difference of Two Proportions, for Difference of Two Variances, P-Value approach, Power of Test, Limitations of the Tests of Hypothesis. Chi-

square Test: Test of Difference of more than Two Proportions, Test of Independence of Attributes, Test of Goodness of Fit, Cautions in Using Chi Square Tests.

Unit V

Interpretation and Report Writing: Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Intellectual Property: The Concept, Intellectual Property System in India, Development of TRIPS Complied Regime in India, Patents Act, 1970, Trade Mark Act, 1999,The Designs Act, 2000, The Geographical Indications of Goods (Registration and Protection) Act1999, Copyright Act,1957,The Protection of Plant Varieties and Farmers' Rights Act, 2001,The Semi-Conductor Integrated Circuits Layout Design Act, 2000, Trade Secrets, Utility Models, IPR and Biodiversity, The Convention on Biological Diversity (CBD) 1992, Competing Rationales for Protection of IPRs, Leading International Instruments Concerning IPR, World Intellectual Property Organisation (WIPO),WIPO and WTO, Paris Convention for the Protection of Industrial Property, National Treatment, Right of Priority, Common Rules, Patents, Marks, Industrial Designs, Trade Names, Indications of Source, Unfair Competition, Patent Cooperation Treaty (PCT), Advantages of PCT Filing, Berne Convention for the Protection of Literary and Artistic Works, Basic Principles, Duration of Protection, Trade Related Aspects of Intellectual Property Rights(TRIPS) Agreement, Covered under TRIPS Agreement, Features of the Agreement, Protection of Intellectual Property under TRIPS, Copyright and Related Rights, Trademarks, Geographical indications, Industrial Designs, Patents, Patentable Subject Matter, Rights Conferred, Exceptions, Term of protection, Conditions on Patent Applicants, Process Patents, Other Use without Authorization of the Right Holder, Layout-Designs of Integrated ndisclosed Information, Enforcement of Intellectual Property Rights, UNSECO.

Reference Books:

1. C.R. Kothari,Gaurav Garg, "Research Methodology Methods and techniques" , New Age International Publishers, 4th edition, 2018.
2. Ranjit Kumar,"Research Methodology a step-by-step guide for beginners", SAGE Publications, 3rd Edition, 2011
3. Trochim "Research Methods: the concise knowledge base", Atomic Dog Publishing, 2005.
4. Fink A "Conducting Research Literature Reviews: From the Internet to Paper " Sage Publications, 2009.

Course Outcomes(COs):

At the end of the course,students should be able to:
1. Understand the objectives of research methodology (PO1,3,4,5)
2. Review literature and develop design frame work (PO1,2,3,4,5)
3. Develop and use different data collection techniques (PO 1,3,4,5)
4. Apply hypothesis theory (PO1,3,4,5)
5. Develop technical reports and understand IPR (PO 1,2,3,4,5)

Protocol Engineering

Course Code: MCNE131   **Credits: 3:1:0**
Prerequisites: Networks   **Contact Hours: 42+28**
Course Coordinator: Dr. Mohana Kumara S

Course Contents:

Unit I

Network Reference Model: Layered Architecture, Network Services and Interfaces, Protocol Functions: Encapsulation, Segmentation and Reassembly of messages, Error Control, Flow control and Multiplexing, Addressing, OSI Model, Functions of layers in OSI model, TCP/IP Protocol Suite, MAC protocols, LLC protocols, Network protocols, Routing, RIP, OSPF, BGP, Multicast protocols, BOOTP, DHCP, Mobile IP, ICMP, CIDR, ARP, RARP, transport protocols, UDP, RTP, Wireless protocol challenges, Application Protocols: FTP, TFTP, Telnet, E-mail, POP, IMAP, SNMP, DNS, HTTP, RTSP.

Unit II

Introduction:
Communication Communication model, Communication Software, Protocol Subsystems, Communication Definition/Representation, Formal and Informal Protocol Development Methods,Protocol Engineering Phases. **Protocol Specification:** Components of specification, Service specification, Communication Service Specification Protocol entity specification: Sender, Receiver and Channel specification, Interface specifications, Interactions, Multimedia specifications, Alternating Bit Protocol Specification, RSVP specification.

Unit III

Protocol Specification Language (SDL): Salient Features. Communication System Description using SDL, Structure of SDL. Data types and communication paths, Examples of SDL based Protocol Specifications: Question and answer protocol, X-on-X-off protocol, Alternating bit protocol, Sliding window protocol specification, TCP protocol specification, SDL based platform for network, OSPF, BGP Multi Protocol Label Switching SDL components. Protocol Verification / Validation: Protocol Verification using FSM, ABP Verification, Protocol Design Errors, Deadlocks, Unspecified Reception, Non-executable Interactions, State Ambiguities, Protocol Validation Approaches: Perturbation Technique, Reachability Analysis, Fair Reachability Graphs, Process Algebra based Validation, SDL Based Protocol Verification: ABP Verification, Liveness Properties, SDL Based Protocol Validation: ABP Validation.

Unit IV

Protocol Conformance and Performance Testing: Conformance Testing Methodology and Framework, Local and Distributed Conformance Test Architectures, Test Sequence Generation Methods: T, U, D and W methods, Distributed Architecture by Local Methods, Synchronizable Test Sequence, Conformance testing with Tree and Tabular Combined

Notation (TTCN), Conformance Testing of RIP, Testing Multimedia Systems, quality of service test architecture(QOS), Performance Test methods, SDL Based Performance Testing of TCP, OSPF, Interoperability testing, Scalability testing protocol synthesis problem.

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Unit V

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Protocol Synthesis and Implementation: Synthesis methods, Interactive Synthesis Algorithm, Automatic Synthesis Algorithm, Automatic Synthesis of SDL from MSC, Protocol Re-synthesis, Requirements of Protocol Implementation, Objects Based Approach to Protocol Implementation, Protocol Compilers, Code generation from Estelle, LOTOS, SDL and CVOPS.

Text Book:

1. Pallapa Venkataram and Sunilkumar S. Manvi: Communication Protocol Engineering, PHI, 2004.

Reference Book:

1. Mohammed G. Gouda: Elements of Protocol Design, Wiley Student Edition, 2004.

Course Outcomes (COs):

At the end of the course, students should be able to:
1. Recall the structure of TCP/IP protocol suite. (PO1,3,4)
2. Identify different phases of protocol engineering. (PO1,3,4)
3. Design SDL based protocol specifications for various protocols. (PO1,3,4)
4. Design and generate test sequences using different methods. (PO1,3,4)
5. Demonstrate different ways of protocol synthesis. (PO1,3,4)

Distributed Systems

Course Code: MCNE132
Prerequisites: OS
Course Coordinator/s: Sini Anna Alex

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Introduction: Definition, Relation to computer system components, Motivation, Relation to parallel multiprocessor/multicomputer systems, Message-passing systems versus shared memory systems, Primitives for distributed communication, Synchronous versus asynchronous executions, Design issues and challenges.

A model of distributed computations: A distributed program, A model of distributed executions, Models of communication networks, Global state of a distributed system, Cuts of a distributed computation, Past and future cones of an event, Models of process communications

Logical time: Introduction, A framework for a system of logical clocks, Scalar time, Vector time, Efficient implementations of vector clocks, Jard– Jourdan"s adaptive technique, Matrix time, Virtual time, Physical clock synchronization: NTP.

Unit II

Global state and snapshot recording algorithms: Introduction, System model and definitions, Snapshot algorithms for FIFO channels, Variations of the Chandy–Lamport algorithm, Snapshot algorithms for non-FIFO channels, Snapshots in a causal delivery system, Monitoring global state, Necessary and sufficient conditions for consistent global snapshots, Finding consistent global snapshots in a distributed computation.

Terminology and basic algorithms: Topology abstraction and overlays, Classifications and basic concepts, Complexity measures and metrics, Program structure, Elementary graph algorithms, Synchronizers, Maximal independent set (MIS), Connected dominating set, Compact routing tables, Leader election, Challenges in designing distributed graph algorithms, Object replication problems.

Unit III

Synchronous program order on an asynchronous system, Group communication, Causal order (CO), Total order, A nomenclature for **Message ordering and group communication:** Message ordering paradigms, Asynchronous execution with synchronous communication, multicast, Propagation trees for multicast, Classification of application-level multicast algorithms, Semantics of fault-tolerant group communication, Distributed multicast algorithms at the network

layer, **Termination detection**: Introduction, System model of a distributed computation, Termination detection using distributed snapshots, Termination detection by weight throwing, A spanning-tree-based termination detection algorithm, Message-optimal termination detection, Termination detection in a very general distributed computing model, Termination detection in the atomic computation model, Termination detection in a faulty distributed system.

Unit IV

Distributed mutual exclusion algorithms: Introduction, Preliminaries, Lamport"s algorithm, Ricart–Agrawala algorithm, Singhal"s dynamic information-structure algorithm, Lodha and Kshemkalyani"s fair mutual exclusion algorithm, Quorum-based mutual exclusion algorithms, Maekawa"s algorithm, Agarwal–El Abbadi quorum-based algorithm, Token- based algorithms, Suzuki–Kasami"s broadcast algorithm, Raymond"s tree- based algorithm,

Deadlock detection in distributed systems: Introduction, System model, Preliminaries, Models of deadlocks, Knapp"s classification of distributed deadlock detection algorithms, Mitchell and Merritt"s algorithm for the single resource model, Chandy–Misra–Haas algorithm for the AND model, Chandy–Misra–Haas algorithm for the OR model, Kshemkalyani–Singhal algorithm for the P-out-of-Q model.

Unit V

Global predicate detection: Stable and unstable predicates, Modalities on predicates, Centralized algorithm for relational predicates, Conjunctive predicates, Distributed algorithms for conjunctive predicates, Further classification of predicates.

Consensus and agreement algorithms: Problem definition, Overview of results, Agreement in a failure-free system (synchronous or asynchronous), Agreement in (message-passing) synchronous systems with failures, Agreement in asynchronous message-passing systems with failures, Wait- free shared memory consensus in asynchronous systems.

Peer-to-peer computing and overlay graphs: Introduction, Data indexing and overlays, Unstructured overlays, Chord distributed hash table, Content addressable networks (CAN), Tapestry, Some other challenges in P2P system design, Tradeoffs between table storage and route lengths, Graph structures of complex networks, Internet graphs, Generalized random graph networks, Small-world networks, Scale-free networks, Evolving networks.

Text Book:
1. Ajay D. Kshemkalyani, and Mukesh Singhal "Distributed Computing: Principles, Algorithms, and Systems", Cambridge University Press, 2008 (Reprint 2013).

Reference Books:
1. John F. Buford, Heather Yu, and Eng K. Lua, "P2P Networking and Applications", Morgan Kaufmann, 2009 Elsevier Inc.
2. Kai Hwang, Geoffrey C. Fox, and Jack J. Dongarra, "Distributed and Cloud Computing: From Parallel processing to the Internet of Things", Morgan Kaufmann, 2012 Elsevier Inc.

Course Outcomes (COs):
At the end of the course, the students will be able to:
1. Identify the design issues and Challenges in building distributed systems. (PO1,3,4)
2. Explore different ways of managing time (clock) and recording global state of distributed computation. (PO1,3,4)
3. Analyze basic distributed graph algorithms, synchronizers, and practical graph problems, P2P overlay problems (PO1,3,4)
4. Discuss ways to achieve various message ordering schemes and approaches for detecting termination of a distributed computation. (PO1,3,4)
5. Identify different assertion based, and tree based distributed algorithms to implement Distributed Mutual Exclusion. (PO1,3,4)

Multimedia Communications

Course Code: MCNE133   **Credits: 4:0:0**
Prerequisites: Nil   **Contact Hours: 56**
Course Coordinator: Dr. Anita Kanavalli

Course Contents:

Unit I
Introduction, Media and Data Streams, Audio Technology: Multimedia Elements, Multimedia Applications, Multimedia Systems Architecture, Evolving Technologies for Multimedia Systems, Defining Objects for Multimedia Systems, Multimedia Data Interface Standards, The need for Data Compression, Multimedia Databases. Media: Perception Media, Representation Media, Presentation Media, Storage Media, Characterizing Continuous Media Data Streams. Sound: Frequency, Amplitude, Sound Perception and Psychoacoustics, Audio Representation on Computers, Three Dimensional Sound Projection, Music and MIDI Standards, Speech Signals, Speech Output, Speech Input, Speech Transmission. Graphics and Images, Video Technology, Computer-Based Animation: Capturing Graphics and Images Computer Assisted Graphics and Image Processing, Reconstructing Images, Graphics and Image Output Options. Basics, Television Systems, Digitalization of Video Signals, Digital Television, Basic Concepts, Specification of Animations, Methods of Controlling Animation, Display of Animation, Transmission of Animation, Virtual Reality Modeling Language.

Unit II
Data Compression: Storage Space, Coding Requirements, Source, Entropy, and Hybrid Coding, Basic Compression Techniques, JPEG: Image Preparation, Lossy Sequential DCT-based Mode, Expanded Lossy DCT- based Mode, Lossless Mode, Hierarchical Mode. H.261 (Px64) and H.263: Image Preparation, Coding Algorithms, Data Stream, H.263+ and H.263L, MPEG: Video Encoding, Audio Coding, Data Stream, MPEG-2, MPEG-4, MPEG-7, Fractal Compression.

Unit III
Optical Storage Media: History of Optical Storage, Basic Technology, Video Discs and Other WORMs, Compact Disc Digital Audio, Compact Disc Read Only Memory, CD-ROM Extended Architecture, Further CD- ROM-Based Developments, Compact Disc Recordable, Compact Disc Magneto-Optical, Compact Disc Read/Write, Digital Versatile Disc. Content Analysis: Simple Vs. Complex Features, Analysis of Individual Images, Analysis of Image Sequences, Audio Analysis, Applications.

Unit IV

Data and File Format Standards: Rich-Text Format, TIFF File Format, Resource Interchange File Format (RIFF), MIDI File Format, JPEG DIB File Format for Still and Motion Images, AVI Indeo File Format, MPEG Standards, TWAIN.

Unit V

Multimedia Application Design: Multimedia Application Classes, Types of Multimedia Systems, Virtual Reality Design, Components of Multimedia Systems, Organizing Multimedia Databases, Application Workflow Design Issues, Distributed Application Design Issues.

Text Books:

1. Ralf Steinmetz, Klara Narstedt: Multimedia Fundamentals: Vol 1- Media Coding and Content Processing, First Edition, PHI, 2010.
2. Prabhat K. Andleigh, Kiran Thakrar: Multimedia Systems Design,1ˢᵗ Edition, PHI, 2011.

Reference Books:

1. K.R. Rao, Zoran S. Bojkovic and Dragorad A. Milovanovic: Multimedia Communication Systems: Techniques, Standards, and Networks, 1ˢᵗ Edition, PHI, 2010.
2. Nalin K Sharad: Multimedia information Networking, PHI, 2002.

Course Outcomes (COs):

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

1. Identify the basic concepts of media, data streams and audio technology. (PO1,3,4)
2. Implement different data compression techniques including video, audio and fractal compression (PO1,3,4)
3. Demonstrate different optical storage media including content Analysis. (PO1,3,4)
4. Identify the different data and file format standards like TIFF, RIFFF, MIDI and MPEG. (PO1,3,4)
5. Analyze multimedia application design methods like Virtual Reality design and workflow design. (PO1,3,4)

Network Security and Ethical Hacking

Course Code: MCNE134   **Credits: 4:0:0**
Prerequisites: N i l   **Contact Hours: 56**
Course Coordinator/s: Dr. Mohana Kumara S

Course Contents:

Unit I

Wireless network security: Wireless security, Wireless network threats, Wireless network measures, mobile device security, security threats, mobile device security strategy, IEEE 802.11 Wireless LAN overview, the Wi-Fi alliance, IEEE 802 protocol architecture. Security, IEEE 802.11i services, IEEE 802.11i phases of operation, discovery phase, Authentication phase, key management phase, protected data transfer phase.Web Security Considerations: Web Security Threats, Web Traffic Security Approaches. Secure Sockets Layer: SSL Architecture, SSL Record Protocol, Change Cipher Spec Protocol, Alert Protocol. HTTPS Connection Initiation, Connection Closure. Secure Shell (SSH) Transport Layer Protocol, User Authentication Protocol, Connection Protocol

Unit II

Transport Layer Security: Version Number, Message Authentication Code, Pseudorandom Functions, Alert Codes, Cipher Suites, Client Certificate Types, Certificate Verify and Finished Messages, Cryptographic Computations, and Padding. HTTPS Connection Initiation, Connection Closure. Cyber network security concepts**:** Security Architecture, antipattern: signature based malware detection versus polymorphic threads, document driven certification and accreditation, policy driven security certifications. Refactored solution: reputational, behavioural and entropy based malware detection. The problems: cyber antipatterns concept, forces in cyber antipatterns, cyber anti pattern templates, cyber security antipattern catalog.

Unit III

Casing the Establishment - What is footprinting- Internet Footprinting. –Scanning Enumeration - basic banner grabbing, Enumerating Common Network services. Case study Network Security Monitoring Securing permission - Securing file and folder permission. Using the encrypting file system. Securing registry permissions. Securing service- Managing service permission. Remote Access Vs Local access. Remote access. Local access. After hacking root.

Unit IV

Wireless Hacking: Wireless Foot printing, Wireless Scanning and Enumeration, Gaining Access, Tools that exploiting WEP Weakness, Denial of Services Attacks, Firewalls: Firewalls landscape, Firewall Identification-Scanning Through firewalls, packet Filtering,

Application Proxy Vulnerabilities, Denial of Service Attacks, Motivation of Dos Attackers, Types of DoS attacks, Generic Dos Attacks, UNIX and Windows DoS.

Unit V

Remote Control Insecurities, Discovering Remote Control Software, Connection, Weakness. VNC, Microsoft Terminal Server and Citrix ICA, Advanced Techniques Session Hijacking, Back Doors, Trojans, Cryptography, Subverting the systems Environment, Social Engineering, Web Hacking, Web server hacking web application hacking, Hacking the internet Use, Malicious Mobile code, SSL fraud, E-mail Hacking, IRC hacking, Global countermeasures to Internet User Hacking.

Text book:

1. William Stallings, Cryptography and Network Security, Pearson 6th edition.
2. Thomas J. Mowbray, "Cyber Security – Managing Systems, Conducting Testing, and Investigating Intrusions", Wiley.
3. Stuart McClure, Joel Scambray and Goerge Kurtz, Hacking Exposed 7: Network Security Secrets & Solutions, Tata Mc Graw Hill Publishers, 2010.
4. Bensmith, and Brian Komer, Microsoft Windows Security Resource Kit, Prentice Hall of India, 2010.

Reference Book:

1. Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay, Mc-GrawHill, 3rd Edition, 2015
2. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007. 2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004
3. Cyber security and Cyber Laws, Alfred Basta, Nadine Basta, Mary brown, ravindra kumar, Cengage learning.

Course Outcomes (COs):

At the end of the course, the students will be able to:
1. Understand the wireless security issues and threats (PO 1,3,4)
2. Explain   the transport layer security and addess the cyber security issues (PO 1,3,4)
3. Implement secure permission systems (PO 1,3,4)
4. Identify   the hacking issues and different types of attacks (PO   1,3,4)
5. Implement various ethical hacking issues (PO 1,3,4,5)

Client Server Programming

Course Code: MCNE135   **Credits: 4:0:0**
Prerequisites: Computer Networks   **Contact Hours: 56**
Course Coordinator: Dr. Anita Kanavalli

Course Contents:

Unit I

The Client Server Model and Software Design: Introduction, Motivation, Terminology and Concepts Concurrent Processing in Client-Server software: Introduction, Concurrency in Networks, Concurrency in Servers, Terminology and Concepts, An example of Concurrent Process Creation, Executing New Code, Context Switching and Protocol Software Design, Concurrency and Asynchronous I/O.
Program Interface to Protocols: Introduction, Loosely Specified Protocol Software Interface, Interface Functionality, Conceptual Interface Specification, System Calls, Two Basic Approaches to Network Communication, The Basic I/O Functions available in UNIX, Using UNIX I/O with TCP/IP.

Unit II

The Socket Interface: Introduction, Berkley Sockets, Specifying a Protocol Interface, The Socket Abstraction, Specifying an End Point Address, A Generic Address Structure, Major System Calls used with Sockets, Utility Routines for Integer Conversion, Using Socket Calls in a Program, Symbolic Constants for Socket Call Parameters.
Algorithms and Issues in Client Software Design: Introduction, Learning Algorithms instead of Details, Client Architecture, Identifying the Location of a Server, Parsing an Address Argument, Looking up a Domain Name, Looking up a well-known Port by Name, Port Numbers and Network Byte Order, Looking up a Protocol by Name, The TCP Client Algorithm, Allocating a Socket, Choosing a Local Protocol Port Number, A fundamental Problem in choosing a Local IP Address, Connecting a TCP Socket to a Server, Communicating with the Server using TCP, Reading a response from a TCP Connection, Closing a TCP Connection, Programming a UDP Client, Connected and Unconnected UDP Socket, Using Connect with UDP, Communicating with a Server using UDP, Closing a Socket that uses UDP, Partial Close for UDP, A Warning about UDP Unreliability.

Unit III

Example Client Software: Introduction, The Importance of Small Examples, Hiding Details, An Example Procedure Library for Client Programs, Implementation of Connect TCP, Implementation of Connect UDP, A Procedure that Forms Connections, Using the Example Library, The DAYTIME Service, Implementation of a TCP Client for DAYTIME, Reading from a TCP Connection, The Time Service, Accessing the TIME Service, Accurate Times and Network Delays, A UDP Client for the TIME Service, The ECHO Service, A TCP Client for the ECHO Service, A UDP Client for the ECHO Service.

Unit IV

Algorithms and Issues in Server Software Design: Introduction, The Conceptual Server Algorithm, Concurrent Vs Iterative Servers, Connection-Oriented Vs Connectionless

Access, Connection-Oriented Servers, Connectionless Servers, Failure, Reliability and Statelessness, Optimizing Stateless Servers, Four Basic Types of Servers, Request Processing Time, Iterative Server Algorithms, An Iterative Connection-Oriented Server Algorithm, Binding to a Well Known Address using INADDR_ANY, Placing the Socket in Passive Mode, Accepting Connections and using them. An Iterative Connectionless Server Algorithm, Forming a Reply Address in a Connectionless Server, Concurrent Server Algorithms, Master and Slave Processes, A Concurrent Connectionless Server Algorithm, A concurrent Connection-Oriented Server Algorithm, Using separate Programs as Slaves, Apparent Concurrency using a Single Process, When to use each Server Types, The Important Problem of Server Deadlock, Alternative Implementations.

Unit V

Iterative, Connectionless Servers (UDP): Introduction, Creating a Passive Socket, Process Structure, An example TIME Server. Iterative, Connection-Oriented Servers (TCP): Introduction, Allocating a Passive TCP Socket, A Server for the DAYTIME Service, Process Structure, An Example DAYTIME Server, Closing Connections, Connection Termination and Server Vulnerability. Concurrent, Connection-Oriented Servers (TCP): Introduction, Concurrent ECHO, Iterative Vs Concurrent Implementations, Process Structure, An example Concurrent ECHO Server, Cleaning up Errant Processes.

Reference Books:

1. Douglas E Comer, David L Stevens, "Internetworking With Tcp/Ip Vol 3 Client Server Programming And Applications" , Pearson Education Limited, 2015
2. David G. Messerschmitt "Understanding Networked Applications: A First Course" Morgan Kaufmann Publishers Inc. San Francisco, CA, USA ©1999
3. Doug Lowe, David J. Helda, "Client/Server computing for dummies". John Wiley & Sons, 1999
4. Leon TECH World, Robert Orfali, Dan Harkey, Jeri Edwards, "THE ESSENTAIL CLIENT/SERVER SURVIVAL GUIDE", Second Edition, Galgotia Publication.
5. Dawna Trawis Dewire, "CLIENT SERVER COMPUTING" Eighth edition, Tata McGraw Hill India Ltd, 2003.

Course Outcomes (COs):

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

1. Understand the client server model and protocols for program interface (PO 1,3,4)
2. Explain the algorithms of client sftware design (PO 1,3,4)
3. Implement the different client side sofware (PO 1,3,4,5)
4. Identify the server side requirement and design the software (PO 1,3,4,5)
5. Discuss the design of connectionless server side design (PO 1,3,4,5)

Electives-II

Wireless Adhoc Networks

Course Code: **MCNE141**
Prerequisites: **Computer Networks**
Course Coordinator/s: **Dr. Shilpa S Choudari**

Credits: 3:0:1
Contact Hours: 42+28

Course Contents:

Unit I

Wireless Ad-hoc Networks: Introduction, Issues in Ad-hoc Wireless Networks, Ad-hoc Wireless Internet; **MAC Protocols for Ad-hoc Wireless Networks**: Introduction, Issues in Designing a MAC Protocol, Design Goals of MAC Protocols, Classification of MAC protocols, Contention-Based Protocols -MACAW: A Media Access Protocol for Wireless LANs, Busy Tone Multiple Access Protocols; Contention-Based Protocols with Reservation Mechanisms -Distributed Packet Reservation Multiple Access Protocol, Collision Avoidance Time Allocation Protocol, Hop Reservation Multiple Access Protocol, MACA with Piggy-Backed Reservation, Real Time Medium Access Control Protocol; Contention-Based Protocols with Scheduling Mechanisms - Distributed Priority Scheduling and MAC in Ad Hoc Networks, Distributed Wireless Ordering Protocol, MAC Protocols that Use Directional Antennas - MAC Protocol Using Directional Antennas, Directional Busy Tone-Based MAC Protocol, Directional MAC Protocols for Ad Hoc Wireless Networks; MMAC: Multi-Channel MAC Protocol, MCSMA: Multi-Channel CSMA MAC Protocol, Power control MAC protocol. Recent development in MAC protocol for ad hoc network from the literature.

Unit II

Routing Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; Table Driven Routing Protocols-Destination Sequenced Distance-Vector Routing Protocol, Wireless Routing Protocol, Cluster-Head Gateway Switch Routing Protocol; On-Demand Routing Protocols -Dynamic Source Routing Protocol (DSR), Ad Hoc On-demand Distance-Vector Routing Protocol, Temporally Ordered Algorithm, Location-Aided Routing, Hybrid Routing Protocols; Core Extraction Distributed Ad Hoc Routing Protocol, Zone Routing Protocol, Zone-Based Hierarchical Link State Routing Protocol; Routing Protocol With Efficient Flooding Mechanisms - Preferred Link-Based Routing Protocol, Optimized Link State Routing; Hierarchical Routing Protocols - Hierarchical State Routing Protocol, Fisheye State Routing Protocol; Power-Aware Routing Protocols. Recent development in routing protocol for ad hoc network from the literature.

Unit III

Multicast Routing in Ad-hoc Wireless Networks: Introduction, Issues in Designing a Multicast Routing Protocol, Operation of Multicast Routing Protocols, An Architecture Reference Model for Multicast Routing Protocols, Classifications of Multicast Routing Protocols; Tree-based Multicast Routing Protocols- Bandwidth-Efficient Multicast Routing Protocol, Multicast Routing Protocol Based on Zone Routing, Multicast Core-

Extraction Distributed Ad Hoc Routing, Associativity-Based Ad Hoc Multicast Routing, Preferred Link-Based Multicast Protocol, Multicast Ad Hoc On-Demand Distance Vector Routing Protocol; Mesh-based Multicast Routing Protocols - On-Demand Multicast Routing Protocol, Dynamic Core-Based Multicast Routing Protocol, Neighbor Supporting Ad Hoc Multicast Routing Protocol; Energy-Efficient Multicasting - Energy-Efficient Reliable Broadcast and Multicast Protocols, Distributed Power-Aware Multicast Routing Protocol, Energy-Efficient Multicast Routing Protocol, Energy-Efficient Cluster Adaptation of Multicast Protocol; Multicasting With Quality Of Service Guarantees - Wireless Ad Hoc Real-Time Multicasting Protocol, Multicast Priority Scheduling Protocol; Application-Dependent Multicast Routing

Unit IV

Transport Layer Protocols for Ad-hoc Networks: Introduction, Issues in Designing a Transport Layer Protocol; Design Goals of a Transport Layer Protocol; Classification of Transport Layer Solutions; TCP over Transport Layer Solutions; Other Transport Layer Protocols for Ad-hoc Networks;

Security Protocols for Ad-hoc Networks: Security in Ad-hoc Wireless Networks, Issues and Challenges in Security Provisioning, Network Security Attacks, Key Management and Secure Routing Ad-hoc Wireless Networks.

Recent development in transport protocol and security provisioing for ad hoc network from the literature.

Unit V

Quality of Service in Ad-hoc Wireless Networks: Introduction, Issues and Challenges in Providing QoS in Ad-hoc Wireless Networks, Classification of QoS Solutions, MAC Layer Solutions – Cluster TDMA, IEEE802.11e, DBASE, Network Layer Solutions- QoS Routing Protocols, Ticket-Based QoS Routing Protocol, Predictive Location-Based QoS Routing Protocol, QoS-Enabled Ad Hoc On-Demand Distance Vector Routing Protocol, Bandwidth Routing Protocol, Asynchronous Slot Allocation Strategies; QoS Frameworks For Ad Hoc Wireless Networks - QoS Models, QoS Resource Reservation Signaling, INSIGNIA, SWAN

Energy Management in Ad-hoc Wireless Networks: Introduction, Need for Energy Management in Ad-hoc Wireless Networks, Classification of Energy Management Schemes, Battery Management Schemes.

Recent development in QOS provisioning and energy management protocol for ad hoc network from the literature.

Text Book:

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011

Reference Books:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.

3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002.

Course Outcomes (COs):

At the end of the course students should be able to:
1. Compare the challenge faced in wireless ad hoc network with other wireless networks in addition to the focus on MAC layer protocol design issues and proposed solutions by the research community (PO1, 3, 4)
2. Analyze and compare types of unicast- and multicast-routing protocols specifically designed to address the issues of wireless ad hoc network (PO1, 3, 4)
3. Examine the transport layer protocol design issues and proposed solutions in the literature with the focus on security provisioning concepts and protocols (PO1, 3, 4)
4. Evaluate energy management and QoS solutions to address the challenges of wireless ad hoc networks(PO1, 3, 4)
5. Review the state-of the-art literature on the prominent MAC, routing, transport layer protocols focusing efficient resource utilization and QoS provisioning (PO1, 3, 4,5)

Network Routing Algorithms

Course Code: MCNE142   **Credits: 4:0:0**
Prerequisites: Computer Networks   **Contact Hours: 42+28**
Course Coordinator: Dr. Monica R Mundada

Course Contents:

Unit I

NETWORK ROUTING: BASICS AND FOUNDATIONS:
Networking and Network Routing: An Introduction: Addressing and Internet Service: An Overview, Network Routing: An Overview, IP Addressing, On Architectures, Service Architecture, Protocol Stack Architecture, Router Architecture, Network Topology Architecture, Network Management Architecture, Public Switched Telephone Network, Communication Technologies, Standards Committees, Last Two Bits.
Routing Algorithms: Shortest Path and Widest Path: Bellman–Ford Algorithm and the Distance Vector Approach, Dijkstra's Algorithm, Comparison of the Bellman–Ford Algorithm and Dijkstra's Algorithm, Shortest Path Computation with Candidate Path Caching, Widest Path Computation with Candidate Path Caching, Widest Path Algorithm, k-Shortest Paths Algorithm

Unit II

Routing Protocols: Framework and Principles: Routing Protocol, Routing Algorithm, and Routing Table, Routing Information Representation and Protocol Messages, Distance Vector Routing Protocol, Link State Routing Protocol, Path Vector Routing Protocol, Link Cost
ROUTING IN IP NETWORKS: IP Routing and Distance Vector Protocol Family : Routers, Networks, and Routing Information: Some Basics, Static Routes, Routing Information Protocol, Version 1 (RIPv1), Routing Information Protocol, Version 2 (RIPv2), Interior Gateway Routing Protocol (IGRP), Enhanced Interior Gateway Routing Protocol (EIGRP), Route Redistribution
OSPF and Integrated IS-IS : From a Protocol Family to an Instance of a Protocol, OSPF: Protocol Features, OSPF Packet Format, Examples of Router LSAs and Network LSAs, Integrated IS-IS, Similarities and Differences Between IS-IS and OSPF

Unit III

Internet Routing Architectures: Internet Routing Evolution, Addressing and Routing: Illustrations, Current Architectural View of the Internet, Allocation of IP Prefixes and AS Number, Policy-Based Routing, Point of Presence, Traffic Engineering Implications, Internet Routing Instability
Router Architectures: Functions of a Router, Types of Routers, Elements of a Router, Packet Flow, Packet Processing: Fast Path versus Slow Path, Router Architectures. **IP**

Address Lookup Algorithms: Impact of Addressing on Lookup, Longest Prefix Matching, Naïve Algorithms, Binary Tries, Multibit Tries, Compressing Multibit Tries, Search by Length Algorithms, Search by Value Approaches, Hardware Algorithms, Comparing Different Approaches.

Unit IV

IP Packet Filtering and Classification: Importance of Packet Classification, Packet Classification Problem, Packet Classification Algorithms, Naïve Solutions, Two-Dimensional Solutions, Approaches ford Dimensions, Extending Two-Dimensional Solutions, Divide and Conquer Approaches, Tuple Space Approaches, Decision Tree Approaches, Hardware-Based Solutions.
ADVANCED ROUTING PROTOCOLS FOR WIRELESS NETWORKS: Wireless networking basic aspects, Basic routing concepts, AD hoc routing, Mesh routing, Vehicular routing, Sensor routing

Unit V

TOWARD NEXT GENERATION ROUTING: Quality of Service Routing: QoS Attributes, Adapting Shortest Path and Widest Path Routing: A Basic Framework, Update Frequency, Information Inaccuracy, and Impact on Routing, Lessons from Dynamic Call Routing in the Telephone Network, Heterogeneous Service, Single-Link Case, A General Framework for Source-Based QoS Routing with Path Caching, Routing Protocols for QoS Routing
MPLS and GMPLS: Traffic Engineering Extension to Routing Protocols, Multiprotocol Label Switching, Generalized MPLS, MPLS Virtual Private Networks. **Routing and Traffic Engineering with MPLS:** Traffic Engineering of IP/MPLS Networks, VPN Traffic Engineering, Routing/Traffic Engineering for Voice Over MPLS. **VoIP Routing: Interoperability through IP and PSTN :** PSTN Call Routing Using the Internet, PSTN Call Routing: Managed IP Approach, IP-PSTN Interworking for VoIP, IP Multimedia Subsystem, Multiple Heterogeneous Providers Environment and All-IP Environment of VoIP Services.

Reference Books:
1. Deepankar Medhi and Karthikeyan Ramasamy "Network routing: algorithms, protocols, and architectures" Morgan Kaufmann, 2017.
2. Campista, Miguel Elias Mitre, and Marcelo G. Rubinstein. *Advanced routing protocols for wireless networks*. John Wiley & Sons, Inc, 2014.
3. William Stallings "High speed networks and Internets Performance and Quality of Service", 2nd Edition, Pearson Education Asia, 2002. James D. "Network Analysis, Architecture, and Design" McCabe Elsevier Inc 3rd 2007

Course Outcomes (COs):

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

1. Understand the networking and routing algorithms (PO 1,3,4)
2. Explain the routing protocols and routing in IP networks (PO 1,3,4)
3. Implement different routing architectures (PO 1,3,4)
4. Identify the IP packet filtering and advanced wireless routing (PO 1,3,4)
5. Implement the next generation routing and VOIP services (PO 1,3,4,5)

Computer System Performance Analysis

Course Code: MCNE143   **Credits: 4:0:0**

Prerequisites: Probability Theory, matrices, software engineering aspects and queuing theory.

Course Coordinator: Dr. T N R Kumar   **Contact Hours: 56**

Course Contents:

Unit I

Introduction: The Art Of Performance Evaluation, Common Mistakes In Performance Evaluation, A Systematic Approach To Performance Evaluation, Selecting An Evaluation Technique, Selecting Performance Metrics, Commonly Used Performance Metrics, Utility Classification Of Performance Metrics, Setting Performance Requirements.

Unit II

Workloads, Workload Selection and Characterization: Types of Work Loads, Addition Instructions, Instruction Mixes, Kernels; Synthetic Programs, Application Benchmarks, Popular Benchmarks. Work Load Selection: Services Exercised, Level Of Detail; Representativeness; Timeliness, Other Considerations In Workload Selection. Work Load Characterization Techniques: Terminology, Averaging, Specifying Dispersion, Single Parameter Histograms, Multi Parameter Histograms, Principle Component Analysis, Markov Models, Clustering.

Unit III

Monitors, Program Execution Monitors and Accounting Logs: Monitors: Terminology and classification; Software and hardware monitors, Software versus hardware monitors, Firmware and hybrid monitors, Distributed System Monitors, Program Execution Monitors and Accounting Logs, Program Execution Monitors, Techniques for Improving Program Performance, Accounting Logs, Analysis and Interpretation of Accounting log data, Using accounting logs to answer commonly asked questions.

Unit IV

Capacity Planning and Benchmarking: Steps in capacity planning and management; Problems in Capacity Planning; Common Mistakes in Benchmarking; Benchmarking Games; Load Drivers; Remote-Terminal Emulation; Components of an RTE; Limitations of RTEs, **Experimental Design and Analysis:** Introduction: Terminology, Common mistakes in experiments, Types of experimental designs, 2^k Factorial Designs, Concepts, Computation of effects, Sign table method

for computing effects; Allocation of variance; General 2^k Factorial Designs, General full factorial designs with k factors: Model, Analysis of a General Design, Informal Methods.

Unit V

Queuing Models: Introduction: Queuing Notation; Rules for all Queues; Little"s Law, Types of Stochastic Process. Analysis of Single Queue: Birth- Death Processes; M/M/1 Queue; M/M/m Queue; M/M/m/B Queue with finite buffers; Results for other M/M/1 Queuing Systems. Queuing Networks: Open and Closed Queuing Networks; Product form networks, queuing Network models of Computer Systems. Operational Laws: Utilization Law; Forced Flow Law; Little"s Law; General Response Time Law; Interactive Response Time Law; Bottleneck Analysis; Mean Value Analysis and Related Techniques; Analysis of Open Queuing Networks; Mean Value Analysis;

Text Book:
1. Raj Jain: The Art of Computer Systems Performance Analysis, 1st edition, John Wiley and Sons, 2012.

Reference Books:
1. Paul J Fortier, Howard E Michel: computer Systems Performance Evaluation and prediction, 1st edition, Elsevier, 2009.
2. Trivedi K S: Probability and Statistics with Reliability, Queuing and Computer Science Applications, 1st edition, PHI, 2011.

Course Outcomes (COs):
At the end of the course, students should be able to:
1. Understand the techniques to approach performance problem and Compare two systems and determine the optimal value of a parameter.(PO1,3,4)
2. Identify performance bottlenecks and characterize the load on a system and Select the number and size of system components and predict the performance of future workloads.(PO1,3,4)
3. Understand the use of different analysis strategies like measurement, simulation, analytical modeling and Implement different techniques in experimental design like factorial design techniques.(PO1,3,4)
4. Understand how to use monitors and accounting logs of systems use to improve the performance of the system and Apply mathematical techniques with stress on learning the types of Queuing models.(PO1,3,4)
5. Apply queuing models to solve problems in computer Networks, Operating system, etc.(PO1,3,4)

Future Skills

Course Code: MCNE144
Prerequisites: Nil
Course Coordinator/s: Prof. Nagabhushana A M

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Introduction: Current industry overview, Future Skills 2020 research report from IFTF. **Sense making:** Introduction, VUCA (Volatility, Uncertainty, Complexity and Ambiguity).What is Sense Making? How Sense Making Helps? Steps in sense making, How to do effective sense making? Hurdles in effective sense making. **Assignment:** A short 1 hour assignment where students will be posed with a situation to exercise their Sense Making ability. It will be assessed at the end of the session.

Unit II

Virtual Collaboration(VC): Introduction, How VC helps? Characteristics of Virtual Collaboration, Types of Virtual Collaboration. Advantages, Disadvantages and Applications of VC. **Assignment:** The students will be given an assignment applying both the sensemaking skills and Virtual Collaboration skills using the cloud based tools to complete a specific task. This assignment will also cover working in a team using virtual collaboration   tools. In order to focus on learning of the specified skills, the end task is kept small and achievable in short time frame.

Unit III

Social Intelligence: Introduction, Hypothesis, Measuring Social Intelligence, Difference between intelligence and Social Intelligence, Derive some of the study done in Social networking theory. **Assignment:** The assignment will focus on students using their social network to accomplish a specific task.

Unit IV

Crosscultural competency: Introduction, Importance of cross cultural competence in workplace. Nuances of cross cultural differences, Examples to demonstrate the differences. **Assignment:** Students will have to work with a team member from another culture to complete a specific task.

Unit V

Cognitive Load management: Introduction, Current situation of information overload, Tools and techniques tohandle the cognitive load. Importance of these skills in

work place. **Assignment:** Students will be given a specific topic and time to quickly arrive at a good summary of the topic. They will be given access to internet and books to refer. Importance is given to how quickly they can gather, curate and present the summary of the topic.

Reference Books:

1. The detailed report can be found at http://www.iftf.org/uploads/media/SR1382A_UPRI_future_work_skills_sm.pdf
2. The reading material for individual lectures will be shared with the students using Tutor Space.

Course Outcomes (COs):

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

1. Identify the Future Work skills needed for next 5 years.(PO 1,3,4)
2. Illustrate sense Making Skills through assignments.(PO 1,3,4)
3. Survey the different Virtual Collaboration skills to complete an assignment. (PO 1,3,4)
4. Describe the social intelligence skill and application of the same. (PO 1,3,4)
5. Compose an assignment using Cross-cultural competence and load management skills. (PO 1,3,4,5)

Block Chain Technology

Course Code: MCNE145
Prerequisites: Nil
Course Coordinator/s: Dr. Parkavi A

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Introduction: Basic Cryptographic primitives used in Blockchain – Secure, Collison-resistant hash functions, digital signature, public key cryptosystems, zero-knowledge proof systems. Need for Distributed Record Keeping, Modelling faults and adversaries, Byzantine Generals problem, Consensus algorithms and their scalability problems, Why Nakamoto Came up with Blockchain based cryptocurrency

Unit II

Technologies Borrowed in Blockchain – hash pointers, Consensus, Byzantine Models of fault tolerance, digital cash etc.Bitcoin blockchain - Wallet - Blocks - Merkley Tree - hardness of mining - transaction verifiability - anonymity - forks - double spending - mathematical analysis of properties of Bitcoin. Bitcoin, the challenges, and solutions

Unit III

Abstract Models for BLOCKCHAIN - GARAY model - RLA Model - Proof of Work (PoW) as random oracle - formal treatment of consistency, liveness and fairness - Proof of Stake (PoS) based Chains - Hybrid models (PoW + PoS).Bitcoin scripting language and their use

Unit IV

Ethereum - Ethereum Virtual Machine (EVM) - Wallets for Ethereum - Solidity – Smart Contracts - The Turing Completeness of Smart Contract Languages and verification challenges, Using smart contracts to enforce legal contracts, comparing Bitcoin scripting vs. Ethereum Smart Contracts. Some attacks on smart contracts

Unit V

Hyperledger fabric, the plug and play platform and mechanisms in permissioned blockchain.Beyond Cryptocurrency – applications of blockchain in cyber security, integrity of information, E-Governance and other contract enforcement mechanisms. Limitations of blockchain as a technology, and myths vs. reality of blockchain technology

Reference Books:

1. S. Shukla, M.Dhawan, S. Sharma,S. Venkatesan "Blockchain Technology: Cryptocurrency and Applications" Oxford University Press,2019
2. Arvind Narayanan et. Al, "Bitcoin and cryptocurrency technologies: a comprehensive introduction", Princeton University Press,2016
3. Joseph Bonneau et al, SoK, "Research perspectives and challenges for Bitcoin and cryptocurrency", IEEE Symposium on security and Privacy,2015
4. J.A.Garay et al, "The bitcoin backbone protocol - analysis and applications", EUROCRYPT LNCS VOl 9057, (2015VOLII), pp 281-310,2015
5. Josh Thompson "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain
6. Programming' Create Space Independent Publishing Platform 2017

CourseOutcomes (COs):

At the end of the course,students should be able to:
1. Understand the basics of block chain technology (PO1,3,4)
2. Analyze the different technologies of block chain (PO1,3,4)
3. Describe the abstarct models of block chain (PO1,3,4)
4. Apply the smart contarct languages and verification languages (PO1,3,4)
5. Devlop the block chain technology on diffferent applications (PO 1,3,4,5)

Electives-III

Artificial Intelligence

Course Code: MCNE151 **Credits: 3:0:1**

Contact Hours: 42+28

Prerequisites: Knowledge of any advanced programming language, Algorithms and Data structures, Elementary Discrete Mathematics or similar.

Course Coordinator/s: Dr. Annapurna P Patil, Dr. Rajarajeswari S

Course Contents:

Unit I

Introduction: What is AI? **Intelligent Agents:** Agents and environment, Rationality, the natureof environment, the structure of agents. **Problem- solving by search:** Problem-solving agents, Example problems, searching for solution, uniformed search strategies informed search strategies, Heuristic functions, On-linesearch agents and unknown environments.On-line search agents and unknown environments.

Unit II

Logical Agents: Knowledge-based agents, the wumpus world, Logic, propositional logic, Reasoning patterns in propositional logic, Effective propositional model checking, Agents based on propositional logic **First- Order Logic**: Representation revisited, Syntax and semantics of first-order logic, usingfirst-order logic, Knowledge engineering in first-order logic. **Interference in First-order Logic**: Propositional vs first-order inference, Unification and lifting, Forward chaining, Backward chaining, Resolution. Forward chaining, Backward chaining.

Unit III

Planning: Definition, planning with state-space search, Planning graphs, other planning approaches analysis. **Uncertainty:** Acting under uncertainty, Basic probability Notations, Inference using full joint distributions, Independence, Bayes" rule and its use. **Learning fromExamples**: Forms of Learning, Supervised Learning, Learning Decision Trees Best Hypothesis Theory Regression and Classification with Linear Models ANN, Non Parametric Models SVM, Ensemble Learning, Practical Machine Learning. SVM, Ensemble Learning, Practical Machine Learning.

Unit IV

Learning Probabilistic Models: Statistical Learning, Learning with complete data Hidden Variables. **Natural Language Processing & communication:** Language Models Text Classification Information retrieval, Extraction, Phrase, structure grammars, Syntactic Analysis, Augmented Grammars & Semantic Interpretation, Machine translation, Speech recognition.Machine translation, Speech recognition.

Unit V

Genetic Algorithms: GA, Significance of genetic operators, Termination parameters, Niching and Speciation, Evolving Neural Networks, Theoretical grounding, Ant Algorithms.

Perception: Image Formation Earthly Image Processing operations,Object recognition by appearance, from structural Information 3D world,using world.

Robotics: Introduction, Hardware Perception planning to Move, planning uncertain movement, moving robotic software architecture, application domains.Evolving Neural Networks, Theoretical grounding, Ant Algorithms. Robotic software architecture, application domains.

Text Books:

1. Stuart Russel, Peter Norvig: Artificial Intelligence – A Modern Approach, 3rd Edition, Pearson Education, 2012. (Unit-1,2,3,4,5).
2. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, 3rd Edition, Tata McGraw Hill, 2011. (Unit-5).

Reference Books:

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.(Unit 5).
2. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.(unit 3).
3. http://nptel.ac.in

Course Outcomes (COs):

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

1. Identify problems that are amenable to specific solution by appropriate AI methods. (PO1,3,4)
2. Utilize various symbolic knowledge representation to specify domains and reasoning tasks of a situated software agent. Use different logical systems for inference over formal domain representations, and trace how a particular

inference algorithm works on a given problem specification. (PO1,3,4)

3. Formalize a given problem in the language/framework of different AI methods and solve using basic AI algorithms. (PO1,3,4)

4. Design and carry out an empirical evaluation of different algorithms on a problem formalization, and state the conclusions that the evaluation supports. (PO1,3,4)

5. Communicate scientific knowledge at different levels of abstraction in a variety of research settings (PO1,3,4)

IoT Technology and Applications

Course Code: MCNE152
Prerequisites: Nil
Course Coordinator/s: HanumanthaRaju R

Credits: 4:0:0
Contact Hours:56

Course Contents:

Unit I

Introduction to IoT: What is IoT?, IOT terms and Basic Definitions, Disambiguation of IoT vs IoE vs M2M vs Others, Characteristics of IoT. **Wireless Sensor Networks:** Potential Applications, WSN System Architecture, WSN Network Topologies, Components of a WSN Node. **Architecture of IoT systems:** Things in IoT, Applications of IoT and IoT Reference model, IoT Ecosystem, Enabling Technologies in IoT, Marketplace and Vision of IoT.

Unit II

Hardware aspects of IoT: Sensors and Actuators:
Introduction to Sensors: Workflow of a Sensor in a typical system, Classification of Sensors, Sampling DAC and ADC conversion. **Introduction to Actuators:** Workflow of an Actuator in a typical system, Classification of Actuators, Types of Sensors, Interfacing concepts to embedded systems.

Unit III

Communications and networking aspects of IoT:
High bandwidth networking: Ethernet, gigabit Ethernet, Ethernet topologies like bridge and switches, Passive optical fiber network and topologies, WiFi and WiMax. WiFi routers, radius servers, Wireless security with WPA-2, LEAP, enterprise WPA networks
Low Bandwidth Wireless Networks: FSK, LoRa modulation basics, LoRaWAN basics.
Peripherals networking: Basics of I2C, SPI, RS232, RS485 and CAN bus, Comparisons and use cases of I2C, SPI, RS232, RS485and CAN bus. Introduction to BLE 5 and industrial Wireless sensor networks, Security in low bandwidth wireless networks, Security in peripheral networks.

Unit IV

Software and middleware aspects of IoT:-
Middleware: Components of Middleware, Types of Databases, Micro services and API"s.
IP Communication protocols: HTTP, AMQP, MQTT and STOMP. Protocol definitions, use cases and differences.

Unit V

IoT Platform Design Methodology and Domain Specific IoT.

Futuristic view of IoT, problems pertaining to implementation like scaling, feasibility and management.

Text Books:

1. Srinivasa K G, Siddesh G.M and HanumanthaRaju R "Internet of Things", CENGAGE Leaning India, 2017. (ISBN:978-93-868-5895-   5).

References:

1. Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands - on Approach)", 1st Edition, VPT, 2014. (ISBN: 978-8173719547)
2. Designing the Internet of Things by Adrian McEwenSmart Cities, Software above the level of a single device, Ebooks on IoT by O"Reilly
3. Sentilo middleware http://www.sentilo.io/xwiki/bin/view/Sentilo.About.Product/Whatis
4. Mosquitto broker https://mosquitto.org/
5. Getting started with raspberry pi https://www.raspberrypi.org/resources/learn/
6. Arduino basics http://www.comm.pub.ro/dicm/C7_Serial_Bus.pdf OneM2m http://www.indiaeu-ictstandards.in/wp-
7. Wired peripheral protocols http://www.comm.pub.ro/dicm/C7_Serial_Bus.pdf
8. OneM2mhttp://www.indiaeu-ictstandards.in/wp content/uploads/2017/04/oneM2M-for-smart-city-TSDSI-   presentation-April-21st-2017-Omar-Elloumi.pdf
9. LoRa Modulation http://www.semtech.com/images/datasheet/an1200.22.pdf

Course Outcomes (COs):

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

1. Understand the basics of IoT.(PO1,3,4)
2. Demonstrate various components, layouts and views in creating IoT applications. (PO1,3,4)
3. Design applications using sensors and actuators.(PO1,3,4)
4. Demonstrate the working of long running tasks in the background   using IoT.(PO1,3,4)
5. Demonstrates how to write applications for smart world.(PO1,3,4,5)

Data Storage Technology and Networks

Course code: MCNE153   **Credits: 4:0:0**
Prerequisites: Nil   **Contact Hours: 56**

Course contents:

Unit I
STORAGE MEDIA AND TECHNOLOGIES: Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.

Unit II
USAGE AND ACCESS: Positioning in the Memory Hierarchy, Hardware and Software Design for Access, Performance issues

Unit III
LARGE STORAGES: Hard Disks, Networked Attached Storage, Scalability issues

Unit IV
STORAGE ARCHITECTURE: Storage Partitioning, Storage System Design, Caching, Legacy Systems.

Unit V
STORAGE AREA NETWORKS: Hardware and Software Components, Storage Clusters/Grids. Storage QoS–Performance, Reliability, and Security issues

Reference books:
1. The Complete Guide to Data Storage Technologies for Network-centric Computing Paperback– Import, Mar,1998 by Computer Technology Research Corporation
2. Data Storage Networking: Real World Skills for the CompTIA Storage by Nigel Poulton,2014

E BOOKS
1. https://eu.dlink.com/es/es/-/media/resource-centre/b2b-briefs/es/dlinkstoragetechnologiesandterminology.pdf
2. https://the-eye.eu/public/Books/qt.vidyagam.es/library/humble-Network-Security-Certificationbundle/Data%20Storage%20Networking_%20Real%20World%20IA%20Storage_%20Certification%20and%20Beyond/Data%20Storage%20Networking_%20Real%20World%20Skills_%20Certification%20and%20Beyond%20-%20Nigel%20Poulton.pdf

Course Outcomes (COs):

At the end of the course, the students will be able to:
1. Understand storage media and technologies (PO 1,3,4)
2. Identify how to access usage memory hierarchy(PO 1,3,4)
3. Explain issues in large storages (PO 1,3,4)
4. Explore diferent storage architectures (PO 1,3,4)
5. Analyze performance parameters on storage area networks (PO 1,3,4)

Advances in Operating Systems

Course Code: MCNE154
Prerequisites: Operating Systems
Course Coordinator/s: Dr. T N R Kumar

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Process Synchronization: Synchronizations Mechanisms – Concurrent Processes, Critical Section Problem, Synchronization Problems. **Distributed Operating Systems:** Architectures of Distributed Systems, Theoretical Foundations

Unit II

Distributed Mutual Exclusion - Classification of Mutual Exclusion and Associated Algorithms - A Comparative Performance Analysis, **Distributed Deadlock Detection** - Deadlock Handling Strategies, Issues - Control Organizations – Centralized, Distributed and Hierarchical Deadlock Detection Algorithms

Unit III

Agreement Protocols - System Model, Classification of Agreement Problems, Applications Of Agreement Algorithms. Distributed Resource Management**:** Distributed File Systems- Architecture - Mechanisms for Building Distributed File Systems - Design Issues - Log Structured File Systems, Distributed Shared Memory- Architecture- Algorithms For Implementing DSM – Memory Coherence And Protocols – Design Issues.

Unit IV

Distributed Scheduling – Issues In Load Distributing, Components Of Load Distributing Algorithm - Stability, Algorithms - Performance Comparison, Selecting A Suitable Load Sharing Algorithm, Requirements For Load Distributing -Task Migration and Issues. Failure Recovery: Classification, Backward And Forward Error Recovery, Recovery In Concurrent Systems - Consistent Set Of Check Points - Synchronous And Asynchronous Check Pointing And Recovery, Check Pointing For Distributed Database Systems- Recovery In Replicated Distributed Databases.

Unit V

Protection and Security- Resource Security And Protection- The Access Matrix Model And Its Implementations, Safety In Matrix Model- Advanced Models Of Protection, **Multiprocessor Operating Systems:** System Architectures, Inter Connection Networks, Caching, Hypercube Architecture. Multiprocessor Operating System - Structures, Design

Issues, Threads, Process Synchronization and Issues, Processor Scheduling: Issues, Co-Scheduling, Smart Scheduling.

Laboratory Work:
(The following programs can be executed on any available and suitable platform)
1. Design, develop and execute a program using any thread library to create the number of threads specified by the user; each thread independently generates a random integer as an upper limit, and then computes and prints the number of primes less than or equal to that upper limit along with that upper limit.
2. Rewrite above program such that the processes instead of threads are created and the number of child processes created is fixed as two. The program should make use of kernel timer to measure and print the real time, processor time, user space time and kernel space time for each process.
3. Design, develop and implement a process with a producer thread and a consumer thread which make use of a bounded buffer (size can be prefixed at a suitable value) for communication. Use any suitable synchronization construct.
4. Design, develop, and execute a program to solve a system of n linear equations using Successive Over-relaxation method and n processes which use Shared Memory API.
5. Design, develop, and execute a program to demonstrate the use of RPC.

Reference Books:
1. Mukesh Singhal, Niranjan G.Shivaratri, "Advanced concepts in operating systems: Distributed, Database and multiprocessor operating systems", TMH, 2009.
2. Andrew S.Tanenbaum, "Modern operating system", PHI, 2003
3. Pradeep K.Sinha, "Distributed operating system-Concepts and design", PHI, 2003.
4. Andrew S. Tanenbaum, "Distributed operating system", Pearson education, 2003.

Course Outcomes (COs):
At the end of the course, the students will be able to:
1. Implement a concurrent programming application using semaphores & monitors for process control. (PO 1,3,4)
2. Explain the basic concepts of Distributed Operating Systems and its architecture. (PO 1,3,4)
3. Implement deadlock avoidance, prevention & recovery. (PO 1,3,4)
4. Identify the Distributed resource management and design issues. (PO 1,3,4)
5. Implement various CPU scheduling, IPC memory management, recovery and concurrent algorithms. (PO 1,3,4)

Software Testing

Course Code: MCNE155
Prerequisites: SE
Course Coordinator/s: Pradeep Kumar D

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

A Perspective on Testing, Examples: Basic definitions, Test cases, Insights from a Venn diagram, Identifying test cases, Error and fault taxonomies, Levels of testing. Examples: Generalized pseudo code, the triangle problem, The Next Date function, The commission problem, The SATM (Simple Automatic Teller Machine) problem, The currency converter, Saturn windshield wiper.

Unit II

Boundary Value Testing, Equivalence Class Testing, Decision Table-Based Testing: Boundary value analysis, Robustness testing, Worst-case testing, Special value testing, Examples, Random testing, Equivalence classes, Equivalence test cases for the triangle problem, Next Date function, and the commission problem, Guidelines and observations. Decision tables, Test cases for the triangle problem, Next Date function, and the commission problem, Guidelines and observations. Path Testing, Data Flow Testing:DD paths, Test coverage metrics, Basis path testing, guidelines and observations, Definition-Use testing, Slice-based testing, Guidelines and observations.

Unit III

Levels of Testing, Integration Testing: Traditional view of testing levels, Alternative life-cycle models, The SATM system, separating integration and system testing. A closer look at the SATM system, Decomposition-based, call graph-based, Path-based integrations, System Testing, Interaction Testing: Threads, Basic concepts for requirements specification, Finding threads, Structural strategies and functional strategies for thread testing, SATM test threads, System testing guidelines, ASF (Atomic System Functions) testing example. Context of interaction, A taxonomy of interactions, Interaction, composition, and determinism, Client/Server Testing.

Unit IV

Process Framework: Validation and verification, Degrees of freedom, Varieties of software. Basic principles: Sensitivity, redundancy, restriction, partition, visibility, Feedback. The quality process, Planning and monitoring, Quality goals, Dependability properties, Analysis, Testing, Improving the process, Organizational factors, Fault-Based Testing, Test Execution: Overview, Assumptions in fault-based testing,

Mutation analysis, Fault-based adequacy criteria, Variations on mutation analysis. Test Execution: Overview, from test case specifications to test cases, Scaffolding, Generic versus specific scaffolding, Test oracles, Self-checks as oracles, Capture and replay.

Unit V

Planning and Monitoring the Process, Documenting Analysis and Test: Quality and process, Test and analysis strategies and plans, Risk planning, Monitoring the process, Improving the process, The quality team, Organizing documents, Test strategy document, Analysis and test plan, Test design specifications documents, Test and analysis reports.

Text Books:
1. Paul C. Jorgensen: Software Testing, A Craftsman''s Approach, 3rd Edition, Auerbach Publications, 2012.
2. Mauro Pezze, Michal Young: Software Testing and Analysis –Process, Principles and Techniques, 1st Edition, WileyIndia, 2011.

Reference Books:
1. Aditya P Mathur:Foundations of Software Testing, 1st Edition,Pearson Education, 2008.
2. Srinivasan Desikan, Gopalaswamy Ramesh: Software testing Principles and Practices, 2ndEdition, Pearson Education, 2007.

Course Outcomes (COs):
At the end of the course, a student should be able to:
1. Identify Test cases, Error and fault taxonomies, Levels of testing. (PO1,3,4)
2. Classify different types of testing (Boundary Value Testing, Equivalence Class Testing and Decision Table-Based Testing). (PO1,3,4)
3. Recognize Alternative life - cycle models, recognize Basic concepts for requirements specification, assess context of interaction. (PO1,3,4)
4. Recognize approaches for Test Execution: from test case specifications to test cases, Scaffolding, Generic versus specific scaffolding. (PO1,3,4)
5. Identify and plan strategies to test design specifications document. (PO1,3,4)

Electives-IV

Cloud infrastructure and services

Course Code : MCNE231   **Credits: 3:1:0**
Prerequisites: Nil   **Contact Hours: 42+28**
Course Coordinator: Dr. J Geetha

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

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

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

Unit IV
Cloud Resource Management and Scheduling: Policies and mechanisms for resource management, Application of control theory to task scheduling on a cloud, Stability of a two-level resource allocation architecture, Feedback control based on dynamic thresholds, Coordination of specialized autonomic performance managers, A utility-based model for cloud-based Web services, Resourcing bundling: Combinatorial auctions for cloud resources, Scheduling algorithms for computing clouds, Fair queuing, Start-time fair queuing, Borrowed virtual time, Cloud scheduling subject to deadlines, Scheduling MapReduce applications subject to deadlines, Resource management and dynamic scaling, Exercises and problems.

Unit V

Cloud Security, Cloud Application Development: Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor, Amazon web services: EC2 instances, Connecting clients to cloud instances through firewalls, Security rules for application and transport layer protocols in EC2, How to launch an EC2 Linux instance and connect to it, How to use S3 in java, Cloud-based simulation of a distributed trust algorithm, A trust management service, A cloud service for adaptive data streaming, Cloud based optimal FPGA synthesis .Exercises and problems.

Text Books:

1. Cloud Computing Theory and Practice, Dan C Marinescu, Elsevier (MK), 2013
2. Computing Principles and Paradigms, Rajkumar Buyya, James Broberg, Andrzej Goscinski, Willey, 2014
3. Cloud Computing Implementation, Management and Security, John W Ritting house, James F Ransome, CRC Press, 2013

Course Outcomes (COs):

After the course, students should be able to:

1. Understand different cloud delivery models and services (PO, 1,3,4)
2. Able to understand the cloud computing application paradigms (PO 1,3,4)
3. Apply the cloud virtulization methods (PO, 1,3,4)
4. Analyze the cloud scheduling techniques (PO 1,3,4)
5. Create cloud applications (PO 1,3,4)

High Speed Networks

Course Code: MCNE232   **Credits: 4:0:0**
Prerequisites: Computer Networks   **Contact Hours: 56**
Course Coordinator: Sanjeetha R

Course Contents:

Unit I

High-Speed Networks: Packet Switching Networks, Frame Relay Networks, The Emergence of High Speed LANs, Ethernet, Fiber Channel, Wireless LANs, Emerging Passive Optical Network Technologies (EPONs), Gigabit Ethernet, 10 Gigabit Ethernet: 802.3ae Emerging Standard, Fiber Optic and the Magic of Light, Wave Length Division Multiplexing (WDM), Dense Wavelength Division Multiplexing (DWDM).

Unit II

Broadband ISDN architecture and Protocols:
Service Capabilities, Bearer Services and Teleservices, Basic and Supplementary services, SS7 Architecture, Protocol Architecture, B-ISDN standards, Broadband services, Requirements, Architecture, B-ISDN Protocol Reference Model, B-ISDN Physical Layer, SONET/ SDH.

Unit III

ATM Traffic and Congestion Control: Asynchronous Transfer Mode, ATM Protocol Architecture, ATM Logical Connections, Transmission of ATM Cells, ATM Adaption Layers, Requirements for ATM Traffic and Congestion control, ATM Service Categories, ATM Traffic-Related Attributes, Traffic management Framework, Traffic management, ABR Traffic Management.

Unit IV

Congestion and Traffic Management: Effects of Congestion, Congestion and control, Traffic Management, Congestion Control in packet-Switching Networks, Frame Relay Congestion Control, the need for Flow and Error Control, ARQ Performance, TCP Traffic Control: TCP Flow Control, TCP Congestion Control, Performance of TCP over ATM.

Unit V

Performance Modelling and Estimation: Probability, Random Variables, Stochastic Processes, Queuing Models, Single-Server Queues, Multi-Server Queues, Queues with Priorities, Networks of Queues, Other Queuing Models, Self Similarity, Self-Similar Data traffic, Performance Implications of Self-Similarity, Modelling and Estimation of Self-Similar Data Traffic.

Reference Books:

1. William Stallings "ISDN and Broadband ISDN with Frame Relay and ATM" , 4th Edition, Pearson Education Asia, 2006.
2. Blen Carty "Broad band Networking" Tata McGraw-Hill Edition 2002.
3. William Stallings "High speed networks and Internets Performance and Quality of Service", 2nd Edition, Pearson Education Asia, 2006.
4. H. Jonathan Chao, Xiaolei Guo, "Quality Of Service Control In High-Speed Networks" Wiley-Interscience,2001

Course Outcomes (COs):

After the course, students should be able to:

1. Understand working different types of high speed networks (PO, 1,3,4)
2. Understand the broad band ISDN and protocols (PO 1,3,4)
3. Apply congestion control methods to ATM networks (PO, 1,3,4)
4. Analyze congestion control management and protocols (PO 1,3,4)
5. Create performance models and estimation strategies for high speed networks (PO 1,3,4,5)

Software Engineering and Modelling

Course Code: MCNE233   **Credits: 4:0:0**
Prerequisites: Basic Concepts of Software Engineering.   **Contact Hours: 56**
Course Coordinator/s: Dr. Annapurna P Patil

Course Contents:

Unit I

Agile development: What is agile? Agility and cost of change; What is an agile process? Extreme programming; Other agile process models. **Design Concepts:** Design process, Design Concepts, Design Models. **Web Application Design:** Web application design quality; Design quality and design pyramid; Interface design; Aesthetic design; Content design; Architecture design; Navigation design; Component-level design; Object oriented hypermedia design method.

Unit II

Software Modelling: Use case modelling: requirements modelling, use cases, identifying & documenting use cases, examples, **Static modelling**: association between classes, hierarchy types, constraints, categories of classes, **Object and class structuring**: criteria, modeling, categories, variations of classes, **Dynamic interaction modelling**: object interaction, message sequencing, examples, **State-dependent Dynamic interaction modellin**g : steps, modeling, examples.

Unit III

Formal Modeling and verification: The cleanroom strategy; Functional specification; Cleanroom design; Cleanroom testing; Formal methods: Concepts; Applying mathematical notation for formal specification; Formal specification languages. **Software Project Management:** The management spectrum; The management of people, product, process and project; The W5HH Principle; Critical practices. **Estimation for Software Projects:** Software project estimation; Decomposition techniques, Examples; Empirical estimation models; Estimation for Object-Oriented projects; specialized estimation techniques; the make / buy decision.

Unit IV

Software Project Scheduling: Basic concepts and principles of project scheduling; Defining task set and task network; Scheduling; Earned value analysis. **Risk Management:** Reactive versus proactive strategies; Software risks; risk identification; Risk projection; Risk refinement; Risk mitigation, monitoring and management; The RMMM plan.

Unit IV

Maintenance and Reengineering: Software maintenance; Software supportability; Reengineering; Business process reengineering; Software reengineering; Reverse

engineering; Restructuring; Forward engineering; The economics of reengineering. **Software Process Improvement (SPI):** Approaches to SPI; Maturity models; The SPI process; The CMMI; The People CMM; Other SPI frameworks: SPICE, Bootstrap, PSP and TSP, ISO; SPI return on investment.

Laboratory:
The Software Engineering Lab has been designed for students to be exposed to the following:

• To Understand and realize the concept of Software Engineering and UML using any case studies.
• The students would be exposed to experiment with the following concepts using any of the tools available:
• Identifying the Requirements from Problem Statements
• Modeling UML Use Case Diagrams
• Identifying Domain Classes from the Problem Statements
• State chart and Activity Modeling
• Modeling UML Class Diagrams and Sequence diagrams
• Estimation of Test Coverage Metrics and Structural Complexity
• Designing Test Suites for the case study
• The Students would also be required to Prepare a Work Breakdown Structure (WBS) and a mini project plan with PERT and Gantt charts

Text Book:
1. Roger S. Pressman**:** Software Engineering: A Practitioner"s Approach, Alternate edition, 7th Edition, McGraw Hill, 2010.
2. Software Modelling & Design, UML,Use cases, Patterns & Software architectures , Hassan Gomaa, Cambridge University Press,2011

Reference Books:
1. Ian Sommerville: Software Engineering, 8th Edition, Pearson, 2012.
2. Bernd Bruegge & Allen H. Dutoit : Object-Oriented Software Engineering Using UML, Patterns, and Java™ Third Edition, Prentice Hall ,2012

Course Outcomes (COs):
At the end of the course, the students will be able to:
1. Apply the concept of agile development and design any web application using the principles learnt. (PO 1,3,4)
2. Identify the concepts of Formal Modeling and verification methods and also the process of Project management and estimation. (PO 1,3,4)

3. Demonstrate the activities involved in Software Scheduling, Risk management and reverse engineering and Maintenance task. (PO 1,3,4)
4. Identify the approaches to Software Process Improvement. (PO 1,3,4)
5. Understand the concepts of Software Configuration Management, Product and Process metrics. (PO 1,3,4)

Enterprise Devices and Networking

Course Code: MCNE234   **Credits: 3:0:1**
Prerequisites: Networks   **Contact Hours: 42+28**
Course Coordinator: Dr. Mohana Kumara S

Course Contents:

Unit I

Introduction to Cloud Networking: Networking Basics- The network stack- Packets and frames- Networkequipment- Interconnect- Cloud Data Center- Cloud Networking- Characteristics of Cloud Networking- Ethernet usage- Virtualization- Convergence- Scalability- Software.

Data Center Evolution: Mainframes to the Cloud: The Data Center Evolution- Computer Networks-Ethernet

Enterprise versus Cloud Data Centers- Movement to the Cloud.

Unit II

Switch Fabric Technology: Switch Fabric Architecture Overview- Switch Fabric Topologies- Congestion Management- Flow Control- Traffic Management- Switch Chip Architecture ExamplesCloud Data Center Networking Topologies: Traditional Multitiered Enterprise Networks- Data Center Network Switch Types, Flat Data Center Networks, Rack Scale Architectures, Network Function Virtualization. Data Center Networking Standards: Ethernet Data Rate Standards, Virtual Local Area Networks- Data Center Bridging- Improving Network Bandwidth- Remote Direct Memory Access.

Unit III

Network Design Models: Hierarchical Network Models Benefits of the Hierarchical Model, Hierarchical Network Design, Core Layer, Distribution Layer, Access Layer, Hierarchical Model Examples, Hub-and-Spoke, Design Collapsed Core, Design Enterprise Architecture Model, Enterprise Campus Module, Enterprise Edge Area, E-Commerce Module, Internet Connectivity Module, VPN/Remote Access, Enterprise WAN, Service Provider Edge Module, Remote Modules, Enterprise Branch Module, Enterprise Data Center Module, Enterprise

Unit IV

Teleworker Module, High Availability Network Services, Workstation-to-Router Redundancy and LAN, High Availability Protocols, ARP Explicit Configuration, RDP, RIP, HSRP, VRRP, GLBP, Server Redundancy, Route Redundancy, Load Balancing, Increasing Availability, Link Media Redundancy

Data Center Design: Enterprise DC Architecture, Data Center Foundation Components, Data Center Topology Components, Data Center Network Programmability, SDN, Controllers, APIs, ACI, Challenges in the DC, Data Center Facility Aspects, Data Center Space, Data Center Power, Data Center Cooling, Data Center Heat, Data Center Cabling, Enterprise DC Infrastructure, Data Center Storage, Data Center Reference Architecture,

Unit V

Defining the DC Access Layer, Defining the DC Aggregation Layer, Defining the DC Core Layer, Security in the DC, Fabric Extenders, Virtualization Overview, Challenges, Defining Virtualization and Benefits, Virtualization Risks, Types of Virtualization, Virtualization Technologies, VSS, VRF, vPC, Device Contexts, Server Virtualization, Server Scaling, Virtual Switching, Network Virtualization Design Considerations, Access Control, Path Isolation, Services Edge, Data Center Interconnect, DCI Use Cases, DCI Transport Options, DCI L2 Considerations, Load Balancing in the DC, Application Load Balancing, Network Load Balancing.

Reference Books

1. Gary Lee, "Cloud Networking - Understanding Cloud based Data Center Networks", Elsevier, 2014
2. Gary A Donahue "Network Warrior" Shroff Publishers & Distributors" 2012.
3. John w capobianco "Automate Your Network: Introducing the Modern Approach to Enterprise Network Management, kindle Edition, 2019
4. Abhishek ratan "Practical Network Automation", second edition, Packt Publishing, 2018 Karim Okasha "Network Automation Cookbook", Packt Publishing, April 2020

Course Outcomes (COs):

After the course, students should be able to:
1. Understand cloud networking and data center evolution (PO, 1,3,4)
2. Understand the working of cloud data center switches (PO 1,3,4)
3. Design different enterprise network (PO, 1,3,4,5)
4. Analyze the different data center designs (PO 1,3,4)
5. Illustrate the virtulization risks and benefits (PO 1,3,4,5)

Software Project Management and Professional Ethics

Course Code: MCNE235
Prerequisites: Nil
Course Coordinator/s: Prof. Nagabhushana A M

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Introduction: Understanding Project Management, Defining the Project Manager''s Role, The Project Manager as the Planning Agent, The Downside of Project Management, Classification of Projects, Differing Views of Project Management, Concurrent Engineering: A Project Management Approach, Project Management Growth Concepts and definitions: Systems, Programs, and Projects: A Definition, Product versus Project Management: A Definition, The Many Faces of Success, The Many Faces of Failure, The Stage-Gate Process, Project Management Methodologies, Organizational Structures: Traditional (Classical) Organization, Matrix Organizational Form Modification of Matrix Structures, The Strong, Weak, Balanced Matrix.

Unit II

Organizing and staffing the project office and the team: The Staffing Environment, Selecting the Project Manager: An Executive Decision, Skill Requirements for Project and Program Managers, Next Generation Project Managers, Duties and Job Descriptions, Selecting the Project Management Implementation Team, Management Functions: Project Authority, Team Building as an Ongoing Process, Dysfunctions of a Team , Employee– Manager Problems, Management Pitfalls , Conflicts: The Conflict Environment, Conflict Resolution, The Management of Conflicts, Conflict Resolution Modes, the variables for success: Predicting Project Success, Project Management Effectiveness.

Unit III

Planning: General Planning, Life-Cycle Phases, Proposal Preparation, Kickoff Meetings, Understanding Participants'' Roles, Project Planning, The Statement of Work, Project Specifications, Milestone Schedules, Work Breakdown Structure, Detailed Schedules and Charts, Project Plan, Total Project Planning, Management Control, Configuration Management, Enterprise Project Management Methodologies, Project Audits, Network Scheduling Techniques: Network Fundamentals, Graphical Evaluation and Review Technique, Network Replanning, Estimating Activity Time, Estimating Total Project Time, Total PERT/CPM Planning, Project Graphics: Bar (Gantt) Chart, Other Conventional Presentation Techniques.

Unit IV

Pricing and Estimating: Types of Estimates, Pricing Process, Organizational Input Requirements, Labor Distributions, Overhead Rates, Materials/Support Costs, Pricing Out the Work, Smoothing Out Department Man-Hours, The Pricing Review Procedure, Project Risks, Life-Cycle Costing (LCC), Cost Control: Understanding Control, The Operating Cycle, Cost Account Codes, Budgets,The Earned Value Measurement System (EVMS), Variance and Earned Value, Trade off analysis in project environment: Methodology for Trade-off Analysis

Unit V

Risk Management: Definition of Risk, Tolerance for Risk, Definition of Risk Management, Certainty, Risk, and Uncertainty, Risk Identification, Risk Analysis, Qualitative Risk Analysis, Quantitative Risk Analysis, Probability Distributions and the Monte Carlo Process, Contract Management: Plan Procurement, Types of Contracts, Incentive Contracts, Contract Type versus Risk, Contract Administration Cycle, Quality Management: Definition of Quality, The Quality Movement, Quality Management Concepts, The Cost of Quality, The Seven Quality Control Tools, Implementing Six Sigma, Lean Six Sigma and DMAIC 914, Just-in-Time Manufacturing (JIT), Total Quality Management (TQM).

Reference Book:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 10th ed. Author: Harold Kerzner.

Course Outcomes (COs):

At the end of the course, the students will be able to:
1. Recognize issues in a realistic project scenario.(PO 1,3,4)
2. Employ work breakdown structures (WBS) in a project application.(PO 1,3,4)
3. Demonstrate the use of appropriate network scheduling techniques.(PO 1,3,4)
4. Produce a project proposal.(PO 1,3,4,5)
5. Discuss the implementation of a proposed plan.(PO 1,3,4,5)

Electives –V

Information and Network Security

Course Code: MCNE241   Credits: 4:0:0
Prerequisites: Nil   Contact Hours: 56
Course Coordinator/s: Mrs. Meeradevi A Kawalgi

Course Contents:

Unit I

Foundations of Network Security, Principles of Network Security, Network Security Terminologies, Network Security and Data Availability, Components of Network Security, Network Security Policies. File Encryption Solutions: Automatic File Encryption, Microsoft Encrypted File System (EFS), Creating Protective Folders, Group Encryption, Key Recovery and Management of Keys. Digital Signature, its properties: Digital Signature, its properties, requirements and security, various digital signature schemes (Elgamal and Schnorr), NIST digital Signature algorithm.

Unit II

Security on the Internet and World Wide Web, Components of Internet, Weak Points of Internet, Techniques of Web Hacking, Methods of Attacking Users. What is a Hash Function? The Birthday Problem, Non-cryptographic Hashes, Tiger Hash, HMAC, Uses of Hash Functions, Online Bids. Spam Reduction, Other Crypto-Related Topics, Secret Sharing, Key Escrow, Random Numbers, Texas Hold 'em Poker, Generating Random Bits, Information Hiding.

Unit III

Random number generation, Providing freshness, Fundamentals of entity authentication, Passwords, Dynamic password schemes, Zero-knowledge mechanisms, Cryptographic Protocols, Protocol basics, From objectives to a protocol, Analysing a simple protocol, Authentication and key establishment protocols. Configuring VPN's: VPN Fundamentals, IP Security, Protocol VPN, Design and Architecture, VPN Security, Configuring a VPN.

Unit IV

Security Risk Management- How Much Security Do You Really Need? Risk Management, Information Security Risk Assessment: Introduction, Information Security Risk Assessment: Case Studies, Risk Assessment in Practice. Legal Issues of Network Security: Laws on Licensing, Intellectual Properties, Liability and T-rans-border Data Flow. Legal Organizations, HIPAA (Health Insurance Portability and Accountability Act), Civil Litigations / Tort Law, Ethics and the Internet (RFC 1087).

Cryptographic Applications, Cryptography on the Internet, Cryptography for wireless local area networks, Cryptography for mobile telecommunications, Cryptography for secure payment card transactions, Cryptography for video broadcasting, Cryptography for identity cards, Cryptography for home users. Blockchain: Currency, Technology Stack, Blockchain, Protocol, Currency, The Double-Spend and Byzantine Generals', Computing Problems, How a Cryptocurrency Works, Blockchain: Contracts: Financial Services, Crowdfunding.

Text Books:

1. Michael E. Whitman and Herbert J. Mattord : ―Principles of Information Security, 4th Edition, Thomson, 2012.
2. Information Security: Principles and Practice, 2nd Edition by Mark Stamp Wiley
3. Everyday Cryptography: Fundamental Principles and Applications Keith M. Martin Oxford Scholarship Online: December 2013
4. Melanie Swan: Blockchain Blueprint For A New Economy Published By O'reilly Media, Inc, 2015.

Web Link:

1. https://webuser.hs-furtwangen.de/~heindl/ebte-08ss-digital-certificates-Vivek kumar.pdf

Reference Books:

1. Josef Pieprzyk, Thomas Hardjono, Jennifer Serberry Fundamentals of Computer Security, Springer.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay: Cryptography and Network Security, 3rd Edition, Special Indian Edition, Tata McGraw-Hill, 2015.
3. William Stallings, Cryptography and Network Security, Sixth Edition, Prentice Hall of India, 2014.

Course Outcomes (COs):

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

1. Master information security governance, and related legal and regulatory issues and also master understanding external and internal threats to an organization. (PO 1,3,4)
2. Get familiarity with information security awareness and a clear understanding of its importance and how threats to an organization are discovered, analyzed, and dealt with. (PO 1,3,4)
3. Master fundamentals of secret and public cryptography and master protocols for security services. (PO 1,3,4)
4. Get familiar with network security threats and countermeasures and familiar with

network security designs using available secure solutions (such as PGP, SSL, IPSec, etc). (PO 1,3,4)

5. Get familiar with advanced security issues and technologies (such as DDoS attack detection and containment, and anonymous communications,) and exposed to original research in network security and also exposed to the importance of integrating people, processes and technology. (PO 1,3,4,5)

Deep Learning

Course Code: MCNE242   **Credits: 4:0:0**
Prerequisites: Nil   **Contact Hours: 56**
Course Coordinator/s: Srinidhi H

Course Contents:

Unit I
Introduction: Human brain, neuron models, neural nets as directed graphs, feedback, neural architectures, knowledge representation, connection to artificial intelligence, Pytorch and Tensorflow.

Unit II
Learning Process: Error-correction learning, memory based learning, Hebbian learning, competitive learning, Boltzmann learning, credit assignment, learning with and without a teacher, learning tasks, memory, statistical learning theory, Backpropagation using MNSIT.

Unit III
Modern practical deep neural networks: Deep feedforward networks, regularization for deep learning, optimization for training deep models, convolutional Networks, Classification using Tensorflow and Pytorch.

Unit IV
Sequence Modelling: Recurrent and recursive nets, practical Methodology, applications. Reinforcement learning.

Unit V
Deep Learning Research: Linear factor models, auto encoders, variational auto encoders, restricted Boltzmann machine, generative adversarial networks,Transfer learning.

TextBooks:

1. Simon Haykin, Neural networks: A comprehensive foundation, Second Edition, Prentice Hall, New Delhi, 1999, ISBN-81-203- 2373-4.
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning, MIT Press, 2016.

Course Outcomes (COs):

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

1. Explain the concepts and applications of neural networks and deep learning. (PO1,3,4)
2. Explain how various types of learning work and how they can be used. (PO1,3,4)
3. Apply deep feedforward networks and convolutional to solve practical problems. (PO1,3,4)
4. Demonstrate how recurrent and recursive nets function and how practical problems can be mapped to them. (PO1,3,4)
5. Design end-to-end deep learning architectures involving various types of feedforward networks, auto encoders, RBM, and generative adversarial networks for practical applications. (PO1,3,4,5)

Web Technologies

Course Code: MCNE243
Prerequisites: Nil
Course Coordinator/s: Dr. J Geetha

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Introduction: From Browsers to Rich Clients – browser drawbacks, A solution – rich clients, Rich clients today. Web 1.0: HTML, URLs and HTTP, The WEB Model and REST – resources, representations, state, transfer – using HTTP methods. XML, XPATH and XSLT – XML Support in browsers, XPath support in browsers, XSLT support in Browsers.

Unit II

HTML 5: Detecting HTML 5 features – Canvas, video, local storage, web workers, offline applications, geo-location, placeholders, and input types. What does it all mean – doc type, root, headers, articles, dates and times, navigation and footers. Let"s call it a drawing surface – Simple shapes, canvas, Paths, texts, gradients and images. The past, present and future of local storage for web applications, A Form of madness – place holders, autofocus fields, email, web addresses, numbers as spin boxes and sliders, date and color pickers, search boxes.

Unit III

AJAX-I: Basic communication techniques – XHR, AJAX with images, Dynamic script loading, Cache control. AJAX patterns: Communication control patterns – predictive fetch, page preloading, submission throttling, periodic refresh, multi-stage download. Fallback patterns. AJAX libraries – JQuery.

Unit IV

AJAX-II: Syndication with RSS and Atom – RSS, Atom, XParser, Creating a news ticker, Web search with RSS. JSON – Array, object, mixing literals, syntax, encoding/decoding, JSON versus XML, server-side JSON tools. COMET: HTTP streaming – request delays, file modification example, using Iframes, browserspecific approaches, server-sent DOM events, connection management and server-side support.

Unit V

Mashups and Web services: The rise of mashups, geocoding, Google maps API. Introduction to Service Oriented Architecture, Combining protocols to build Web services – clarifying web services, REST Services, WS-* Web services using SOAP and WSDL, REST vs WS-* services.

Reference Books:

1. Professional AJAX, Nicholas C Zakas et al, 2nd Edition, Wrox publications,2007.
2. Professional Web 2.0 Programming, Eric Van Der VList et al, Wrox Publications, 2007
3. HTML 5 Up and Running, Mark Pilgrim, O"REILLY| GOOGLE Press, 2010.
4. SOA: Concepts, Technology and Design, Thomas Erl, Pearson, 2005

Course Outcomes (COs):

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

1. Develop a dynamic webpage by the use of java script and DHTML. (PO 1,3,4)
2. Write a well formed / valid XML document. (PO 1,3,4)
3. Connect a java program to a DBMS and perform insert, update and delete operations on DBMS table. (PO 1,3,4)
4. Write a server side java application called Servlet to catch form data sent from client, process it and store it on database. (PO 1,3,4)
5. Write a server side java application called JSP to catch form data sent from client and store it on database. (PO 1,3,4)

Privacy and Security in Online Social Media

Course Code: MCNE244
Prerequisites: Nil
Course Coordinator/s: Dr. Parkavi A

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I
What is Online Social Networks, data collection from social networks, challenges, opportunities, and pitfalls in online social networks,APIs.

Unit II
Collecting data from Online Social Media, Trust, credibility, and reputations in social systems.

Unit III
Trust, credibility, and reputations in social systems, Online social Media and Policing.

Unit IV
Information privacy disclosure,revelation and its effects in OSM and online social networks.

Unit V
Phishing in OSM & Identifying fraudulent entities in online social networks.

Reference Links:

1. http://www.amazon.com/Programming-Collective-Intelligence-BuildingApplications/dp/0596529325
2. http://www.amazon.com/Practical-Web-Applications-Experts-Voice/dp/1590599063
3. http://www.amazon.in/Building-Social-Applications-Gavin Bell/dp/8184048327? tag=googinhydr18418-21
4. http://www.amazon.in/The-Web-Application-Hackers Handbookebook/dp/B005LVQA9S?tag=googinhydr18418-21.

Course Outcomes (COs):
At the end of the course, the students will be able to:
1. Understand working of online social networks (PO 1,3,4)
2. Explore different methods used for data collection.(PO 1,3,4)
3. Describe credibility of online media (PO 1,3,4)
4. Identify the privacy policies of online social mdeia .(PO 1,3,4)
5. Explain and identify attacks on socual media .(PO 1,3,4)

Semantic Web and Social Networks

Course Code: MCNE245   **Credits: 4:0:0**
Prerequisites: Nil   **Contact Hours: 56**
Course Coordinator/s: Aparna R

Course Contents:

Unit I

Web Intelligence Thinking and Intelligent Web Applications, The Information Age, The World Wide Web, Limitations of Today's Web, The Next Generation Web, Machine Intelligence, Artificial Intelligence, Ontology, Inference engines, Software Agents, Berners-Lee www, Semantic Road Map, Logic on the semantic Web.

Unit II

Knowledge Representation for the Semantic Web Ontologies and their role in the semantic web, Ontologies Languages for the Semantic Web – Resource Description Framework (RDF) / RDF Schema, Ontology Web Language (OWL), UML, XML/XML Schema

Unit III

Ontology Engineering, Ontology Engineering, Constructing Ontology, Ontology Development Tools, Ontology Methods, Ontology Sharing and Merging, Ontology Libraries and Ontology Mapping, Logic, Rule and Inference Engines.

Unit IV

Semantic Web Applications, Services and Technology Semantic Web applications and services, Semantic Search, e-learning, Semantic Bioinformatics, Knowledge Base, XML Based Web Services, Creating an OWL-S Ontology for Web Services, Semantic Search Technology, Web Search Agents and Semantic Methods.

Unit V

Social Network Analysis and semantic web What is social Networks analysis, development of the social networks analysis, Electronic Sources for Network Analysis – Electronic Discussion networks, Blogs and Online Communities, Web Based Networks. Building Semantic Web Applications with social network features.

Text Books:

1. Godel and Turing, Berners Lee "Thinking on the Web" -,Wiley inter science, 2008.
2. Peter Mika "Social Networks and the Semantic Web" , Springer, 2007
3. Liyang Lu Chapman "Semantic Web and Semantic Web Services" Hall/CRC Publishers, (Taylor & Francis Group).
4. T.Segaran, C.Evans, J.Taylor, "Programming the Semantic Web", O'Reilly publishers,2013.

Course Outcomes (COs):

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

1. Understand web intelligence and intelligence web applications(PO1,3,4)
2. Explore knowledge implementation of web applications (PO1,3,4)
3. Apply ontology engineering (PO1,3,4)
4. Discuss and analyze eb applications   (PO1,3,4)
5. Conduct social network analysis (PO1,3,4, 5)

Electives-VI

Network Management

Course Code: MCNE251   **Credits: 4:0:0**
Prerequisites: Computer Networks   **Contact Hours: 56**
Course Coordinator: Dr. Monica R Mundada

Course Contents:

Unit I

Data communications and Network Management Overview: Analogy of Telephone Network Management, Communications protocols and Standards, Case Histories of Networking and Management, Challenges of Information *T*echnology Managers, Network Management: Goals, Organization, and Functions, Network and System Management, Network Management System Platform, Current Status and future of Network Management.

Unit II

SNMPV1 Network Management: Organization and Information Models, Managed network: Case Histories and Examples, The History of SNMP Management, The SNMP Model, The Organization Model, System Overview The Information Model.   SNMPv1 Network Management: Communication and Functional Models. The SNMP Communication Model, Functional Model.

Unit III

SNMP Management: SNMPv2: Major Changes in SNMPv2, SNMPv2 System Architecture, SNMPv2 Structure of Management Information, SNMPv2 Management Information Base, SNMPv2 Protocol, Compatibility With SNMPv1. SNMP Management: SNMPv3,Introduction,SNMPv3 Key Features,SNMPv3 Documentation Architecture, SNMPv3 Applications, SNMPv3 Management Information Base, Security, SNMPv3 User-based Security Model, Authentication Protocols, Encryption Protocol**.**

Unit IV

SNMP Management: RMON: What is Remote Monitoring? , RMON SMI and MIB, RMON1, RMON2, ATM Remote Monitoring, a Case Study of Internet Traffic Using RMON, ATM Networks.

Unit V

Network Management Tools and Systems: Network Management Tools, Network Statistics Measurement Systems, History of Enterprise Management, Network

Management systems, Commercial Network management Systems, System Management, Enterprise Management Solutions.

Text Book:

1. Network Management: Principles and Practice, Mai Subramanian, George institute of Technology, 2000, Pearson.

Course Outcomes (COs):

At the end of the course, students should be able to:
1. Identify five major functional areas of network management. (PO- 1,3,4)
2. Explore SNMP Management Information, Standard MIBs and SNMP protocol. (PO- 1,3,4)
3. Defend the need for security in networking monitoring and control. (PO-1,3,4
4. Devise Remote network monitoring System for statistics collection, alarms and filters. (PO-1,3,4)
5. Summarize complete network management plan for a moderate to large network enterprise through case studies. (PO-1,3,4)

Security Engineering

Course Code: MCNE252   **Credits: 4:0:0**
Prerequisites: Operating Systems   **Contact Hours: 56**
Course Coordinator: Vandana S Sardar

Course Contents:

Unit I

What Is Security Engineering Introduction, A framework, Examples. Usability and Psychology: Introduction, Attacks Based on Psychology: Pretexting, Phishing, Insights from Psychology Research, What the Brain Does Better Than Computer.

Unit II

Passwords Difficulties with Reliable Password Entry, Difficulties with Remembering the Password, Naive Password Choice, User Abilities and Training, Social-Engineering Attacks, Trusted Path, Phishing Countermeasures, The Future of Phishing, System Issues, Attacks on Password Entry.

Unit III

Access Control Introduction, Operating System Access Controls, Groups and Roles, Access Control Lists, Unix Operating System Security, Apple's OS/X, Windows — Basic Architecture, Capabilities, Windows — Added Features, Middleware, Database Access Controls, General Middleware Issues, ORBs and Policy Languages, Sandboxing and Proof-Carrying Code, Virtualization, Trusted Computing

Unit IV

Network Attack and Defense Introduction, Vulnerabilities in Network Protocols, Attacks on Local Networks, Attacks Using Internet Protocols and Mechanisms. Trojans, Viruses, Worms and Rootkits, Defense Against Network Attack, Filtering: Firewalls, Spam Filters, Censor ware and Wiretaps, Intrusion Detection

Unit V

The Bleeding Edge Introduction, Computer Games, Types of Cheating, Aimbots and Other Unauthorized Software, Virtual Worlds, Virtual Economies, Web Applications e Bay, Google. Social Networking Sites, Privacy Technology: Anonymous Email — The Dining Cryptographers and Mixes, Anonymous Web Browsing — Tor, Confidential and Anonymous Phone Calls, Email Encryption, Steganography and Forensics Countermeasures

Reference Books:

1. Rose Anderson, Security Engineering, 2nd Edition, Wiley 2012,
2. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education Limited,2019
3. Joseph Migga Kizza, Computer Network Security, Springer International Edition, 2009, Bruce Schneier, Applied Cryptography: Protocols, Algorithms, and Source Code in C", 2nd Edition, Wiley,2015

Course Outcomes (COs):

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

1. Identify different types of attacks (PO- 1,3,4)
2. Explore the password security measures (PO- 1,3,4)
3. Defend the need for access control information in OS (PO-1,3,4
4. Devise defense against attacks (PO-1,3,4)
5. Summarize the need for security in commercial applications (PO-1,3,4)

Mobile Computing

Course Code: MCNE253   **Credits: 4:0:0**
Prerequisites: Nil   **Contact Hours: 56**
Course Coordinator: Dr. Anita Kanavalli

Course Contents:

Unit I

Introduction to Mobile Computing – Applications of Mobile Computing- Generations of Mobile Communication Technologies- Multiplexing – Spread spectrum -MAC Protocols –SDMA-TDMA-FDMA-CDMA

Unit II

Mobile Telecommunication System Introduction to Cellular Systems – GSM – Services & Architecture – Protocols – Connection Establishment – Frequency Allocation – Routing – Mobility Management – Security – GPRSUMTS – Architecture – Handover – Security

Unit III

Mobile Network Layer: Mobile IP – DHCP – AdHoc– Proactive protocol-DSDV, Reactive Routing Protocols – DSR, AODV, Hybrid routing –ZRP, Multicast Routing-ODMRP, Vehicular Ad Hoc networks (VANET) MANET Vs VANET Security.

Unit IV

Mobile Transport and Application Layer: Mobile TCP– WAP – Architecture – WDP – WTLS – WTP –WSP – WAE – WTA Architecture – WML

Unit V

Mobile Platforms and Applications: Mobile Device Operating Systems – Special Constraints & Requirements – Commercial Mobile Operating Systems – Software Development Kit: iOS, Android, BlackBerry, Windows Phone – MCommerce – Structure – Pros & Cons – Mobile Payment System – Security Issues

Reference Books

1. Prasant Kumar Pattnaik, Rajib Mall, "Fundamentals of Mobile Computing", PHI Learning Pvt. Ltd, New Delhi – 2012.
2. Jochen H. Schller, "Mobile Communications", Second Edition, Pearson Education, New Delhi, 2007.
3. Dharma Prakash Agarval, Qing and An Zeng, "Introduction to Wireless and Mobile systems", Thomson Asia Pvt Ltd, 2005.
4. Uwe Hansmann, Lothar Merk, Martin S. Nicklons and Thomas Stober, "Principles of Mobile Computing", Springer, 2003.

5. William. C.Y. Lee, "Mobile Cellular Telecommunications-Analog and Digital Systems", Second Edition, Tata Mc Graw Hill Edition ,2006.
6. C.K. Toh, "AdHoc Mobile Wireless Networks", First Edition, Pearson Education, 2002.

Course Outcomes (COs):
At the end of the course, the students will be able to:
1. Understand the mobile comuting techniques and MAC protocols (PO1,3,4)
2. Explore the cellualr systems and GSM services (PO1,3,4)
3. Apply routing algorithm to mobile IP layer (PO1,3,4)
4. Discuss mobile application layer functions   (PO1,3,4)
5. Create commercial mobile applications (PO1,3,4, 5)

Software Oriented Architecture

Course Code: MCNE254
Prerequisites: Nil
Course Coordinator: Dr. Divakar H V

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

SOA Basics : Software Architecture – Types of IT Architecture – SOA – Evolution – Key components – perspective of SOA – Enterprise-wide SOA – Architecture – Enterprise Applications – Solution Architecture for enterprise application – Software platforms for enterprise Applications – Patterns for SOA – SOA programming models.

Unit II

SOA Analysis and Design: Service-oriented Analysis and Design – Design of Activity, Data, Client and business process services – Technologies of SOA – SOAP – WSDL – JAX – WS – XML WS for .NET – Service integration with ESB – Scenario – Business case for SOA – stakeholder OBJECTIVES – benefits of SPA – Cost Savings.

Unit III

SOA Governance: SOA implementation and Governance – strategy – SOA development – SOA governance – trends in SOA – event-driven architecture software a service – SOA technologies – proof-of concept – process orchestration – SOA best practices.

Unit IV

SOA Implementation: SOA based integration – integrating existing application – development of web services – Integration - SOA using REST RESTful services – RESTful services with and without JWS – Role of WSDL,SOAP and Java/XML mapping in SOA – JAXB Data binding.

Unit V

Application Integration: JAX –WS 2.0 client side/server side development – Packaging and Deployment of SOA component – SOA shopper case study – WSDL centric java WS with SOA-J – related software – integration through service composition (BPEL) – case study - current trends.

Reference Books:

1. Shankar Kambhampaly, "Service–Oriented Architecture for Enterprise Applications", Wiley 2008.
2. Mark D. Hansen, "SOA using Java Web Services", Practice Hall, 2007.
3. Waseem Roshen, "SOA-Based Enterprise Integration", Tata McGraw- HILL, 2009.

Course Outcomes (COs):

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

1. Understand the basics of SOA (PO 1,3,4)
2. Learn standards related to Web services: Web Services Description Language (WSDL), Simple Object Access Protocol (SOAP), and Universal Description, Discovery and Integration (UDDI).(PO 1,3,4)
3. Learn basic principles of Service-Oriented Architecture and apply these concepts to develop a sample application. (PO 1,3,4)
4. Conceptually model Web services and formulate specifications of them in the Resource Description Framework (RDF) and the Web Ontology Language (OWL). (PO 1,3,4)
5. Evaluate emerging and proposed standards for the main components of Web services architectures. (PO 1,3,4,5)

Applied Cryptography

Course Code: MCNE255   **Credits: 4:0:0**
Prerequisites: Basic Cryptography methods   **Contact Hours: 56**
Course Coordinator/s: Dr. Mohana Kumara S

Course Contnets:

Unit I

OSI security architecture: Classical encryption techniques, Cipher principles, Data encryption standard, Block cipher design principles and modes of operation, Evaluation criteria for AES, AES cipher, Triple DES, Placement of encryption function, Traffic confidentiality

Unit II

Key management: Diffie Hellman key exchange, Elliptic curve architecture and cryptography, Introduction to number theory, Confidentiality using symmetric encryption, Public key cryptography and RSA.

Unit III

Authentication requirements: Authentication functions, Message authentication codes, Hash functions, Security of hash functions and MACS, MD5 Message Digest algorithm, Secure hash algorithm, Ripened, HMAC digital signatures, Authentication protocols

Unit IV

Quantum Cryptography and Quantum Teleportation: Heisenberg uncertainty principle, polarization states of photons, quantum cryptography using polarized photons, local vs. non local interactions, entanglements, EPR paradox, Bell"s theorem, Bell basis, teleportation of a single qu-bit theory and experiments.

Unit V

Future trends: Review of recent experimental achievements, study on technological feasibility of a quantum computer candidate physical systems and limitations imposed by noise.

Text Books:

1. William Stallings, "Cryptography and Network Security -Principles and Practices", 3rd Edition, Prentice Hall of India, 2003.
2. Atul Kahate, "Cryptography and Network Security", Tata McGraw – Hill, 2003.
3. William Stallings, "Network Security Essentials: Applications and Standards", Pearson Education Asia, 2000.

Reference Books:

1. R. P. Feynman, "Feynman Contacts on computation", Penguin Books, 1996.
2. Gennady P. Berman, Gary D. Doolen, Ronnie Mainiri & Valdmis Itri Frinovich, "Introduction to quantum computers", World Scientific, Singapore, 1998.
3. Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography" Principles and Protocols",CRC Press.

Course Outcomes (COs):

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

1. Explain the concepts of principles and practice of cryptography and network security. (PO1,3,4)
2. Present an overview of the Feistel cipher, Distribution of Public Keys, digital signatures and Authentication protocols. (PO1,3,4)
3. Analyze the security of multiple encryption schemes and Triples DES. (PO1,3,4)
4. Build secure authentication systems by use of message authentication techniques. (PO1,3,4)
5. Explain the concepts of principles and practice of visual cryptography. (PO1,3,4)

Electives-VII

Start-up Engineering

Course Code: MCSE321   **Credits: 4:0:0**
Prerequisites: Nil   **Contact Hours: 56**
Course Coordinator/s: Prof. Nagabhushana A M

Course Contents:

Unit I

Introduction, Start up : past & present , NSF AUP Repeal: Internet for Business, The Key Features of Internet Startups, Technological Trends Toward Mobility and Decentralization, Start up engineering, Technologies, Design, Marketing, and Sales, Mobile HTML5 for the Final Project, Interactive Start, Webapp, Setup and Signup- AWS, Gravatar, Github, and Heroku, Connect to a Cloud Computer,Launch EC2 Instance, Mac: Connect to EC2 instance via Terminal.app, Windows: Connect to EC2 instance via Cygwin, Security Groups, Standard Operating System: Ubuntu 12.04.2 LTS on a t1.micro AWS instance, Deploy code to Test Heroku account.

Unit II

Linux and Server-Side Javascript (SSJS), Overview, Features of Linux, Virtual Machines and the Cloud, Virtualization, Cloud and IAAS/PAAS/SAAS, Linux , Filesystem-Usage of env, PATH, HOME, which, issues, ssh, scp, bash, apt-get, Compiling from source: ./configure; make; make install, Example of installation conflicts , Server-Side JS (SSJS), Install node and npm, node.js REPL, Editing code with nano, node.js programming, Using the libraries, Market Research, Wireframing, and Design, Idea, Execution, and Market, Importance of product/idea- execution/team and market, Idea Maze, Execution Mindset, Kind of Business: Startups & Small Businesses, Startups: Exhibit Economies of Scale, Pursue Large Markets, Market Sizing Calculations Early and Often, Market Research: Tools , framework for determining product tiers, Wireframing, Copywriting, and Design, Wireframing, Copywriting, Design.

Unit III

Introduction to HTML/CSS/JS, webpage program, HTTP Request to Rendered Page, Anatomy of web page, HTML: Skeleton and Semantics, CSS, JS, Separation of concerns, Tools , Deployment, DNS, and Custom Domains, Deployment: Dev, Staging, Production, Sidebar: Comparing EC2 vs. local laptops for development, Preliminaries: SSH/HTTP/HTTPS- accessible EC2 dev instance, Creating and managing git branches, Worked Example: Dev, Staging, Production, DNS, Custom

Domains, Finding a domain: domize.com, Registering a domain: dnsimple.com, Configuring DNS to work with Heroku, Setting up HTTPS and Google Apps,Social/Local/Mobile, Virality, Growth, Virality Equation, Local, Local Commerce, Graveyard of Startups.

Unit IV

Regulation, Disruption, Technologies of 2013, Gaining Context, Transportation and Lodging, Payments and Finance, Biotech, Antitrust and Acquisitions, Aspects of Regulation, Anticipate the Argument, A/B/C/D Theory of Regulation, Technological Legalization, Amazon.com, anesthetizing C, Square, Tesla, Facebook/Goldman, Uber, Angel List, Disruption and the Technologies of 2013, Industrial Robotics, 3D Printing, Telepresence, Quantified Self, Bitcoin, Autonomous Drones, Coda, Linux Command Line, three streams, Navigation and Filesystem, Downloading and Syncing, Basic Text Processing, Help, Superuser, Intermediate Text Processing, Intermediate bash, Linux Development Environment: Development Environment, Distributed Version Control Systems (DVCS).

Unit V

Linux Development Environment : Managing Setup and Configuration as Code, Mobile: Age of Internetification, Mobile Simply a Fad, Mobile Present & Future , Mobile technologies, Intermediate Javascript: rise of Javascript, Basics and Built-ins, Array, Date, RegExp, Math, String, JSON, Error, Built- in functions, Functional Programming (FP) and JS Functions, Object- Oriented Programming (OOP), Prototypal Inheritance,and JS Objects, Heuristics for OOP in JS, Node.js: Asynchrony, Flow Control, and Debugging: Motivation: reduce the impact of I/O latency withasynchronous calls, advantages and disadvantages of Node, Asynchronous Programming and Flow Control, Basic debugging with the Node Debugger.

Reference Books:

1. Materials on Startup Engineering, Balaji S. Srinivasan, Stanford University
2. http://www.wsj.com/articles/SB1000142405311190348090457651225090915629460#printMode
3. http://www.asymco.com/2012/01/17/the-rise-and-fall-of-personal-computing/
4. http://www.kpcb.com/blog/2012-internet-trends-update
5. http://www.nytimes.com/2011/05/08/technology/08class.html?pagewanted=all&_r=0
6. http://www.nytimes.com/2011/06/11/technology/11computing.html?pagewanted=all&_r=0
7. http://www.nytimes.com/projects/magazine/ideas/2009/#natural_science-

8. http://www.paulgraham.com/growth.html
9. http://blakemasters.com/peter-thiels-cs183-startup
10. http://web.stanford.edu/class/cs106b/textbook/CS106BX-Reader.pdf

Course Outcomes (COs):

At the end of the course, the students will be able to:
1. Describing startups and technology trends towards businesses. (PO 1,3,4)
2. Identifying software usage for businesses and ethics. (PO 1,3,4)
3. Figuring out the web usage for business launch. (PO 1,3,4)
4. Assessing the latest technologies for startups. (PO 1,3,4)
5. Preparing software for startups. (PO 1,3,4,5)

Malware Analysis

Course Code: MCNE322 **Credits: 4:0:0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator: Dr. Anita Kanavalli

Course Contents:

Unit I

INTRODUCTION: Introduction to malware, OS security concepts, malware threats, evolution of malware, malware types viruses, worms, rootkits, Trojans, bots, spyware, adware, logic bombs, malware analysis, static malware analysis, dynamic malware analysis. STATIC ANALYSIS:X86 Architecture- Main Memory, Instructions, Opcodes and Endianness, Operands, Registers, Simple Instructions, The Stack, Conditionals, Branching, Rep Instructions, C Main Method and Offsets.

Unit II

Antivirus Scanning, Fingerprint for Malware, Portable Executable File Format, The PE File Headers and Sections, The Structure of a Virtual Machine, Reverse Engineering- x86 Architecture, recognizing c code constructs in assembly, c++ analysis, Analyzing Windows programs, Anti-static analysis techniques obfuscation, packing, metamorphism, polymorphism

Unit III

DYNAMIC ANALYSIS: Live malware analysis, dead malware analysis, analyzing traces of malware- system-calls, api-calls, registries, network activities. Anti-dynamic analysis techniques anti-vm, runtime-evasion techniques, Malware Sandbox, Monitoring with Process Monitor, Packet Sniffing with Wireshark, Kernel vs. User-Mode Debugging, OllyDbg, Breakpoints, Tracing, Exception Handling, Patching

Unit IV

Malware Functionality: Downloader, Backdoors, Credential 6 10% Stealers, Persistence Mechanisms, Privilege Escalation, Covert malware launching- Launchers, Process Injection, Process Replacement, Hook Injection, Detours, APC injection.

Unit V

Malware Detection Techniques: Signature-based techniques: malware signatures, packed malware signature, metamorphic and polymorphic malware signature Non-signature based techniques: similarity-based techniques, machine-learning methods, invariant inferences Android Malware: Malware Characterization, Case Studies – Plankton, DroidKungFu, AnserverBot, Smartphone (Apps) Security

Reference Books

1. Michael Sikorski and Andrew Honig "Practical malware analysis The Hands-On Guide to Dissecting Malicious Software" No Starch Press Inc, 2012
2. Filiol "Computer viruses: from theory to applications", Eric Springer Science & Business Media, 2006
3. Xuxian Jiang and Yajin Zhou "Android Malware" by, Springer
4. Michael Davis, Sean Bodmer, Aaron Lemasters "Hacking exposed malware & rootkits: malware & rootkits security secrets & Solutions", McGraw-Hill, 2010
5. Victor Marak "Windows Malware Analysis Essentials", Packt Publishing, 2015

Course Outcomes (COs):

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

1. Understand the malware analysis and static analysis (PO1,3,4)
2. Explore the antivirus scanning and analye wwindos programs (PO1,3,4)
3. Apply different methods of dynamic malware techniques on programs (PO1,3,4)
4. Discuss malware functionality (PO1,3,4)
5. Create commercial applications using malware detection techniques (PO1,3,4, 5)

Cyber Physical Systems

Course Code: MCNE323
Prerequisites: Nil
Course Coordinator/s: Dr. Anita Kanavalli

Credits: 4:0:0
Contact Hours: 56

Course Contents:

Unit I

Modeling, design, analysis, and implementation of cyber-physical systems

Unit II

Dynamic behavior modeling-Continuous Dynamics: Newtonian Mechanics ,Actor Models ,Properties of Systems ,Feedback Control, Discrete Dynamics : Discrete Systems .,The Notion of State ,Finite-State Machines ,Extended State Machines , Nondeterminism ,Behaviors and Traces, Hybrid Systems , Modal Models Classes of Hybrid Systems .State machine composition: Composition of State Machines Concurrent Composition , Hierarchical State Machines Concurrent Models of Computation Structure of Models ,Synchronous-Reactive Models ,Dataflow Models of Computation ,Timed Models of Computation.

Unit III

Sensors and actuators Models of Sensors and Actuators, Common Sensors, Actuators. Embedded systems and networks Types of Processors, Parallelism

Unit IV

Feedback control systems- Analysis and verification techniques, temporal logic, and model checking- Invariants and Temporal Logic Invariants, Linear Temporal Logic. Reachability Analysis and Model Checking: Open and Closed Systems Reachability Analysis. Abstraction in Model Checking, Model Checking Liveness Properties.

Unit V

Machine learning topics: Introduction to ML Supervised, Unsupervised, Reinforcement Frameworks, Introduction to Matlab/Python/Numpy, Preprocessing and Dimensionality Reduction, Regression, Classification Algorithms

Reference Books/Web Links:

1. Edward A. Lee and Sanjit A. Seshia, Introduction to Embedded Systems, A Cyber-Physical Systems Approach, Second Edition, http://LeeSeshia.org, ISBN 978-1-312-42740-2, 2015.

2. Machine Learning Algorithms and Applicationshttps://www.researchgate.net/publication/303806260_Machine_Learning_Algorithms_and_Applications

Course Outcomes (COs):

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

1. Apply the afore mentioned cyber-physical systems fundamentals to application domains such as connected and autonomous vehicles, industrial internet, and smart and connected health (PO 1,3,4)
2. Implement cyber-physical systems solutions (e.g., embedded networking protocols, real-time scheduling algorithms, and networked control algorithms). (PO 1,3,4)
3. Explore (e.g., survey) cutting-edge research findings in cyber physical systems. (PO 1,3,4,5)
4. Apply feedbck control on varoious open and closed systems (PO 1,3 4,5)
5. Apply ML techniques on cyber pphysical systems (PO 1,3,4,5)

Storage Area Networks

Course Code: MCNE324   **Credits:** 4:0:0
Prerequisites: Computer Networks, Computer Organization,
Operating Systems   **Contact Hours:** 56
Course Coordinator/s: Dr. Divakar Harekal

Course Contents:

Unit I

Introduction: Information Storage, Evolution of Storage Architecture, Data Centre Infrastructure, Virtualization and Cloud Computing. Data Centre Environment: Application, DBMS, Host, Connectivity, Storage, Disk Drive Components, Disk Drive Performance, Host Access to Data, Direct-Attached Storage, Storage Design Based on Application, Disk Native Command Queuing, Introduction to Flash Drives.

Unit II

Data Protection: RAID Implementation Methods, Array Components, Techniques, Levels, Impact on Disk Performance, Comparison, Hot Spares. Intelligent Storage System: Components, Storage Provisioning, Types.

Unit III

Fiber Channel Storage Area Networks: FC Overview, Evolution, Components, FC Connectivity, Ports, FC Architecture, Fabric Services, Login Types, Zoning, FC Topologies, Virtualization in SAN.IP SAN and
FCoE: iSCSI, FCIP, FCoE.

Unit IV

Network-Attached Storage: Benefits, Components, NAS I/O Operation, Implementations, File Sharing Protocols, I/O Operations, Factors Affecting NAS Performance, File-Level VirtualizationObject Based and Unified Storage: Object Based Storage Devices, Content Addressed Storage, CAS Use Cases, Unified Storage. Backup Archive and Replication.

Unit V

Business Continuity: Information Availability, Terminology, Planning Lifecycle, Failure Analysis, Impact Analysis, Challenges, Adoption Considerations.Securing the Storage Infrastructure: Framework, Risk Triad, Domains Managing the Storage Infrastructure: Monitoring, Management Activities, Management Challenges, Information Lifecycle Management, Storage Tiering.

Text Book:

1. EMC Education Services, edited by Somasundaram G., Alok Shrivastava "Information Storage and Management"; 2nd edition, Wiley India, 2012, ISBN 9788126537501.

Reference Books:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, 1st Edition, Wiley India, 2012.

2. Robert Spalding: Storage Networks, The Complete Reference, 1st Edition, Tata McGraw Hill, 2011.

Course Outcomes (COs):

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

1. Identify the need for storage centric network and its benefits of its adoption (PO1,3,4)
2. Design a storage solution for an application depending on the IOPS and RAID requirements (PO1,3,4)
3. Have an understanding of the Fiber channel stack and working of the different layers (PO1,3,4)
4. Have an understanding of NAS, object oriented storage and backup and recovery (PO1,3,4)
5. Have a business continuity plan and ILM of an enterprise (PO1,3,4)

Digital Forensic and Cyber Crime

Course Code: MCNE325 **Credits: 4:0:0**
Prerequisites: Nil **Contact Hours: 56**
Course Coordinator/s: Dr Ramani S

Course Contents:

Unit 1

Understanding Cyber Crime: Indian IT Act 2008 and amendments, Computer Forensic and Investigations as a Profession, Understanding Computer Forensics.**Understanding Computer Investigations:** Preparing a Computer Investigation, Taking a Systematic Approach, Procedures for Corporate High-Tech Investigations, Understanding Data Recovery Workstations and Software.

Unit II

Working with Windows and DOS Systems: Understanding File Systems, Exploring Microsoft File Structures, Examining NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, Understanding MS-DOS Startup Tasks, and Understanding Virtual Machines.

Unit III

Data Acquisition: Understanding Storage Formats for Digital Evidence, Determining the best Acquisition Method, Contingency Planning for Image Acquisitions, Using Acquisition Tools, Validating Data Acquisitions, Using Remote Network Acquisition Tools.**Computer Forensics Analysis and Validation:** Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisitions.

Unit IV

Current Computer Forensics Tools: Evaluating Computer Forensic Tool Needs, Computer Forensics Software Tools, Computer Forensics Hardware Tools, Validating and Testing Forensics Software. **Recovering Graphics Files:** Recognizing a Graphics File, Understanding Data Compression, Locating and Recovering Graphics Files, Identifying Unknown File Formats, Understanding Copyright Issues with Graphics.

Unit V

Investigations, Exploring the Roles of the Client and Server in E-mail, Using Specialized E-mail Forensics Tools. Laboratory Lab exercises using forensic software and Case study data.

Text Book:

1. Nelson, Phillips, Frank, Enfinger and Steuart: Computer Forensics and Investigations, Cengage Learning, 2008. Chapters: 1, 2, 4, 6, 7, 8, 9, 10, 11, 12

Reference Books:

1. Marjie T. Britz: Computer Forensics and Cyber Crime – An Introduction, 2nd Edition, Pearson Education, 2012.
2. Harish Chander: Cyber Laws and IT Protection, PHI, 2012.
3. http://www.cyberforensics.in/default.aspx

Lab Exercises

The following exercises have to be performed using various open source software tools/utilities mentioned.

Software Tools:
- CyberCheck 4.0 – Academic Version
- CyberCheckSuite
- MobileCheck
- Network Session Analyser
- Win-LiFT
- TrueImager

- TrueTraveller
- PhotoExaminer Ver 1.1
- CDRAnalyzer

Forensics Exercises:

I) Disk Forensics:
1. Identify digital evidences
2. Acquire the evidence
3. Authenticate the evidence
4. Preserve the evidence
5. Analyze the evidence
6. Report the findings

II) 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

Course Outcomes (COs):

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

1. Recall the Indian IT Act 2008 and its amendments. (PO1,3,4)
2. Classify various types of computer crime. (PO1,3,4)
3. Apply computer forensic techniques to identify the digital fingerprints associated with criminal activities. (PO1,3,4)
4. Analyze hidden information from pictures and other files. (PO1,3,4)
5. Apply network forensic tools for network forensic and live data forensic analysis. (PO1,3,4)

Technical Seminar-I/II

Credits: 0:0:2

Course Code: MCS18/MCS28
Prerequisites: Nil

Rubrics for assessment of Seminar

Criteria	Distinguished (5)	Good (4)	Basic (3)	Unacceptable (1)	Score
Organization	-Extremely well organized. -Introduces the purpose of the presentation clearly and creatively. -Effectively includes smooth, clever transitions which are succinct but not broken up in order to connect key points -Student presents information in logical, interesting sequence which audience can follow. -Ends with an accurate conclusion showing thoughtful, strong	-Generally well organized. -Introduces the purpose of the presentation clearly. -Includes transitions to connect key points and better transitions from idea to idea are noted. -Most information presented is in logical sequence; A few minor points may be confusing -Ends with a summary of main points showing some evaluation of	- Somewhat organized. -Introduces the purpose of the presentation -Includes some transitions to connect key points but there is difficulty in following presentation. - Student jumps around topics. Several points are confusing. -Ends with a summary or conclusion; little evidence of evaluating content	-Poorly organized -Does not clearly introduce the purpose of the presentation -Uses ineffective transitions that rarely connect points; cannot understand presentation because there is no sequence of information. -Presentation is broken and disjointed; no apparent logical order of presentation-Ends without a summary	

	evaluation of the evidence presented.	the evidence presented.	based on Evidence.	or conclusion.
Content: Depth and Accuracy	-Speaker provides an accurate and complete explanation of key concepts and theories, drawing upon relevant literature. Applications of theory are included to illuminate issues. -Provides evidence of extensive and valid research on the selected topic, with multiple and varied sources. -Combines and evaluates existing ideas to form new insights. -Information completely accurate; all names and facts were precise and	-For the most part, explanations of concepts and theories are accurate and complete. Some helpful applications of theory are included. -Presents evidence of valid research on the selected topic, with multiple sources. -Combines existing ideas to form new insights. -No significant errors are made; a few inconsistencies or errors in information. -Level of presentation is	-Explanations of concepts and/or theories are inaccurate or incomplete. Little attempt is made to tie in theory. There is a great deal of information that is not connected to the current presentation. -Presents evidence of research on the selected topic, with sources. -Combines existing ideas. -Few errors are made to distract a knowledgeable listener, but some information is accurate.	-No reference is made to literature or theory. Presentation is not clear; information that does not support presentation in any way is unnecessarily included. -Presents little or no evidence of valid research on the selected topic. -Shows little evidence of the combination of ideas. -Information included is sufficiently inaccurate that indicates absence of accurate

	explicit -Level of presentation is appropriate for the audience.	generally appropriate.	-Portions of presentation are too elementary or too sophisticated for audience.	information. -Presentation consistently is too elementary or too sophisticated for the audience.	
Creativity	-Uses the unexpected to full advantage; very original, clever, and creative approach that captures audience's attention.	-Some originality apparent; clever at times; good variety and blending of materials/media.	-Little or no variation; a few original touches but for the most part material presented with little originality or interpretation.	-Bland and predictable. Repetitive with little or no variety; little creative energy used.	
Use of Communication Aids	-Graphics designed reinforce presentation and maximize audience understanding; use of media is varied and appropriate with media not being added simply for the sake of use.	-While graphics relate and aid presentation, media are not as varied and not as well connected to the presentation.	-occasional use of graphics that rarely support presentation; visual aids were not useful or clear, time wasting use of multimedia	-Student uses superfluous graphics, no graphics, or graphics that are so poorly prepared that they detract from the presentation.	

Use of Language	-Poised, clear articulation; proper volume; steady rate; enthusiasm; confidence; speaker is clearly comfortable in front of the group. - Presentation has no misspellings or grammatical errors.	-Clear articulation but not as polished; slightly uncomfortable at times Most can hear presentation.-Presentation has no more than two misspellings and/or grammatical errors	-Audience occasionally has trouble hearing the presentation; seems uncomfortable.-Presentation has three misspellings and/or grammatical errors.	-Student is anxious and cannot be heard or monotone with little or no expression.-Presentation has four or more spelling errors and/or grammatical errors.	
Eye Contact	-Maintains eye contact; seldom returning to notes; presentation is like a planned conversation.	- Student maintains eye contact most of the time but frequently returns to slides.	-Some eye contact, but not Maintained and at least half the time reads most of slides.	-Student reads all or most of slides with no eye contact.	
Viva Voce	-Demonstrates extensive knowledge of the topic by responding confidently, precisely and appropriately to all	-Demonstrates knowledge of the topic by responding accurately and Appropriately addressing questions . At ease	-Demonstrates some knowledge of rudimentary questions by responding accurately to questions.	-Demonstrates incomplete knowledge of the topic by responding inaccurately and Inappropriately to	

	audience questions.	with answers to all questions but fails to elaborate.		questions.	
Report	Document is fully compliant with required rules and structure. Document uses highly appropriate language and style.	Document has high degree of compliance with required rules and structure. Document uses appropriate language specific to the discipline	Document has low degree of compliance with required rules and structure Document uses mostly appropriate language and contains occasional spelling / grammatical errors	Document has minimal degree of compliance with required rules and structure Document contains inappropriate language or many spelling / grammatical errors	
Regularity	Reports to guide regularly for seminar discussion	Reports to guide often for seminar discussion	Does not report to guide for seminar discussion	Has not met the guide at all.	
Overall Presentation	Excellent	Good	Average	Poor	

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Annexure Table 1
<u>Rubrics</u> <u>for</u> <u>Assessment</u> <u>of</u> <u>Student</u> <u>Performance</u> <u>in</u> <u>Laboratory</u>

Trait	Barely Acceptable	Basic	Good	Very Good
Specifications	The program is producing incorrect results.	The program produces correct results but does not display them correctly.	The program works and produces the correct results and displays them correctly. It also meets most of the other specifications.	The program works and meets all of the specifications.
Readability	The code is poorly organized and very difficult to read.	The code is readable only by someone who knows what it is supposed to be doing.	The code is fairly easy to read.	The code is exceptionall well organize and very easy to follow.
Reusability	The code is not organized for reusability.	Some parts of the code could be reused in other	Most of the code could be reused in other programs.	The code could be reused as a

		programs.		whole or each routine could be reused.
Documentation	The documentation is simply comments embedded in the code and does not help the reader understand the code.	The documentation is simply comments embedded in the code with some simple header comments separating routines.	The documentation consists of embedded comment and some simple header documentation that is somewhat useful in understanding the code.	The documentation is well written and clearly explains what the code is accomplishing and how.
Delivery	The code was more than 2 weeks overdue.	The code was within 2 weeks of the due date.	The program was delivered within a week of the due date.	The program was delivered on time.
Efficiency	The code is huge and appears to be patched together.	The code is brute force and unnecessarily long.	The code is fairly efficient without sacrificing readability and understanding.	The code is extremely efficient without sacrificing readability and understanding.

Table 2
Rubrics for assessment of Seminar

Criteria	Distinguished (5)	Good	Basic	Unacceptable (1)	Score
Organization	- Extremely well organized. -Introduces the purpose of the presentation clearly and creatively. -Effectively includes smooth, clever transitions which are succinct but not broken up in order to connect key points -Student presents information in logical, interesting sequence which audience can follow. -Ends with an accurate	- Generally well organized. -Introduces the purpose of the presentation clearly. -Includes transitions to connect key points and better transitions from idea to idea are noted. - Most information presented is in logical sequence; A few minor points may be confusing -Ends with a summary of main	- Somewhat organized. -Introduces the purpose of the presentation -Includes some transitions to connect key points but there is difficulty in following presentation. - Student jumps around topics. Several points are confusing. -Ends with a summary or	- Poorly organized -Does not clearly introduce the purpose of the presentation -Uses ineffective transitions that rarely connect points; cannot understand presentation because there is no sequence of information. - Presentation is broken and disjointed; no apparent logical order of presentation-Ends without a	

	conclusion showing thoughtful, strong evaluation of the evidence presented.	points showing some evaluation of the evidence presented.	conclusion; little evidence of evaluating content based on Evidence.	summary or conclusion.	
Content: Depth and Accuracy	-Speaker provides an accurate and complete explanation of key concepts and theories, drawing upon relevant literature. Applications of theory are included to illuminate issues. -Provides evidence of extensive and valid research on the selected topic, with multiple and varied	-For the most part, explanations of concepts and theories are accurate and complete. Some helpful applications of theory are included. -Presents evidence of valid research on the selected topic, with multiple sources. -Combines existing ideas to form	-Explanations of concepts and/or theories are inaccurate or incomplete. Little attempt is made to tie in theory. There is a great deal of information that is not connected to the current presentation. -Presents evidence of research on the selected	-No reference is made to literature or theory. Presentation is not clear; information that does not support presentation in any way is unnecessarily included. -Presents little or no evidence of valid research on the selected topic. -Shows little evidence of the combination of ideas.	

	sources. -Combines and evaluates existing ideas to form new insights. -Information completely accurate; all names and facts were precise and explicit -Level of presentation is appropriate for the audience.	new insights. -No significant errors are made; a few inconsistencies or errors in information. -Level of presentation is generally appropriate.	topic, with sources. -Combines existing ideas. -Few errors are made to distract a knowledgeable listener, but some information is accurate. -Portions of presentation are too elementary or too sophisticated for audience.	-Information included is sufficiently inaccurate that indicates absence of accurate information. -Presentation consistently is too elementary or too sophisticated for the audience.	
Creativity	-Uses the unexpected to full advantage; very original, clever, and creative approach that captures audience's	-Some originality apparent; clever at times; good variety and blending of materials/media.	-Little or no variation; a few original touches but for the most part material presented with	- Bland and predictable. Repetitive with little or no variety; little creative energy used.	

	attention.		little originality or interpretation.		
Use of Communicatio n Aids	-Graphics designed reinforce presentation and maximize audience understanding; use of media is varied and appropriate with media not being added simply for the sake of use.	-While graphics relate and aid presentation, media are not as varied and not as well connected to the presentation.	- occasional use of graphics that rarely support presentation ; visual aids were not useful or clear, time wasting use of multimedia;	--Student uses superfluous graphics, no graphics, or graphics that are so poorly prepared that they detract from the presentation.	

Use of Language	-Poised, clear articulation; proper volume; steady rate; enthusiasm; confidence; speaker is clearly comfortable in front of the group. -Presentation has no misspellings or grammatical errors.	-Clear articulation but not as polished; slightly uncomfortable at times Most can hear presentation.-Presentation has no more than two misspellings and/or grammatical errors	-Audience occasionally has trouble hearing the presentation; seems uncomfortable .-Presentation has three misspellings and/or grammatical errors.	-Student is anxious and cannot be heard or monotone with little or no expression.-Presentation has four or more spelling errors and/or grammatical errors.	
Eye Contact	-Maintains eye contact; seldom returning to notes; presentation is like a planned conversation.	- Student maintains eye contact most of the time but frequently returns to slides.	-Some eye contact, but not Maintained and at least half the time	-Student reads all or most of slides with no eye contact.	

				reads most of slides.		
Viva Voce	-Demonstrates extensive knowledge of the topic by responding confidently, precisely and appropriately to all audience questions.	-Demonstrates knowledge of the topic by responding accurately and Appropriately addressing questions. At ease with answers to all questions but fails to elaborate.	-Demonstrates some knowledge of rudimentary questions by responding accurately to questions.	-Demonstrates incomplete knowledge of the topic by responding inaccurately and Inappropriately to questions.	
Report	Document is fully compliant With required rules and structure. Document uses highly appropriate language and style.	Document has high degree of compliance with required rules and structure. Document uses appropriate language specific to the discipline	Document has low degree of compliance with required rules and structure Document uses mostly appropriate language and contains occasional	Document has minimal degree of compliance with required rules and structure Document contains inappropriate language or many spelling /grammatical errors	

			spelling / grammatical errors		
Regularity	Reports to guide regularly for seminar discussion	Reports to guide often for seminar discussion	Does not report to guide for seminar discussion	Has not met the guide at all.	
Overall Presentation	Excellent	Good	Average	Poor	

Table 3
Rubrics for assessment of Internship

Deliverables for Student Performance in Internship:

Internship Title: _____

Company Name: _____

Name of Student: _____

Name of Supervisor at Company: _____

Name of Supervisor at College: _____

Each supervisor must fill a rubric for each student:

	Basic (0-4 Pts)	Good (5-7 Pts)	Very Good (10 Pts)	Total	
				Possible	Earned
Tools and new Technology Learnt	Few sources at the Industry, aware of quality	Multiple sources of high quality, good judgment of	Multiple sources of high quality, well researched	10	

	of resources and relevance to tools and Techniques at hand	the information, identification of gaps in knowledge at the Industry and Academics.	and analyzed, continuous efforts at acquiring Information. Identification of the application of the tools and Technology learnt to the present market.		
Relevance of the topic chosen to the current market	Fairly Relevant	Moderately Relevant	Highly Relevant	10	

				10	
Report Writing	Reasonably good organization and lacks clarity in few topics, complete, few omissions,	Sound organization and structure, clear, very few errors, complete, reasonably good style	Excellent organization, no technical or grammar errors, concise and precise, complete		
	grammatically correct, lacks style		documentation		
Demonstration of the Tools Learnt	Moderately be able to demonstrate the tools learnt at the Industry	Efficiently be able to demonstrate the skills learnt and be able to propose an application for the	Excellent demonstration of the tools and techniques learnt and be able to apply it to any	10	

		same.	simple case study.		
Presentation and viva voce	Reasonably good communication and presentation, able to give technical answers to some extent	Good , professional communication, good visual aids, able to give technical answers	Excellent professional and technical communication, effective presentations, able to analyze technically and clarify views in viva-voce	10	

Table 4

Rubrics for assessment of student performance in Project work I

Sl No		Level of achievement					Score
		Excellent (5)	Good (4)	Average (3)	Acceptable (2)	Unacceptable (1)	
1	**Identificatio n of Problem Domain and Detailed Analysis**	Purpose and need of the project is very well explained.	Purpose and need of the project is explained well.	Purpose and need of the Project is moderately explained	Purpose and need of the Project is satisfactorily explained	Purpose and need of the Project is not at all explained	
2	**Study of the Existing Systems / Literature Survey**	Existing systems are very well studied. Documents of high standards like IEEE	Existing systems are well studied. Documents of good standards like	Existing systems are moderately studied. Documents of average standards, online	Existing systems are satisfactorily studied. Documents of satisfactory standards,	Existing systems are not studied. Documents of very poor standards, online resources and books are studied.	

		papers, reputed online resources and books are studied.	internation al journal/con ference papers, good online resources and books are studied.	resources and books are studied.	online resources and books are studied		
3	**Objectives of the Proposed Work**	All objectives of the proposed work are very well defined.	All objectives of the proposedw ork are well defined.	Most of the objectives of the proposedw ork are well defined.	Only few objectives of the proposed work are well defined	Objectives of the proposed work are either not defined properly.	
4	**Design Methodolo gy**	Steps to be followed to solve the defined problem are clearly specified.M ost suitable design .Methodolo	Steps to be Followed to solve the defined problem is specified but detailing is not done. Suitable	Steps are mentioned but are unclear; without justificatio n to objectives Appropriat	Steps to be followed to solve the defined problem are not specified properly. Design Methodology used is	Steps to be followed to solve the defined problem are not at all specified. Design Methodology used is not correct and is notjustified	

		gy is used and is properly justified	design Methodology is used and properly justified	Methodology is used but not justified properly	ambiguous and not justified		
5	**Tools used for Design**	Clear Understanding	Acceptable	Good	Average	Not Acceptable	
6	**Planning of Project Work**	Time frame properly specified and being followed accurately	Time frame properly specified and being followed most of the time	Time frame properly specified, but not being followed	Time frame is vaguely specified, and is not followed	Time frame itself is not properly specified	
7	**Understanding of the modules**	Clear understanding	Acceptable	Good	Average	Not Acceptable	
	Demonstartion and Presentation	Objectives achieved as per time frame .Contents	Objectives achieved as per time frame. Contents of	Objectives achieved as per time frame. Contents of	Objectives not achieved as per time frame. Contents of	No objectives achieved. Contents of Presentations are not appropriate	

8		of Presentation Is Appropriate and well arranged. Proper eye contact with audience and clear voice with good spoken language	Presentation is appropriate but not well arranged. Satisfactory demonstration, clear voice with good spoken language but eye contact not proper	Presentation is appropriate but not well arranged. Presentation not satisfactory and average demonstration	presentation is not appropriate. Eye contact with few people and unclear voice	and not well delivered Poor delivery of presentation	
9	**Regularity**	Student reports to the guide regularlyand is consistent in work	Student does not report to guide very regularly but is consistent in the work	Student reports to the guide but lacks consistency	Student does not report to guide regularly and is not consistent in work	Student does not meet guide at all and the work is always incomplete	
	Report of	Project	Project	Project	Project report	Project report	

| 10 | Project Phase I | report is according to the specified format References and citations are appropriate and well mentioned | report is accordingto the specified format References and citations are appropriate but not mentioned well | report is according to the specified format with few mistakes In-sufficientreferences and citations | is not fully according to the specified format Insufficient references and citations | not prepared according to the specified format References and citations are not appropriate | |

Table 5

Rubrics for assessment of student performance in Project work II

		Level of achievement					
		Excellent (10)	Good (8)	Average (6)	Acceptable (4)	Unacceptable (2)	Score

	Incorporation of Suggestions	Changes are made as per modifications suggested during Project Phase I evaluationand new innovationns are added	Changes are made as per modificatio ns suggested during Project Phase I evaluation and is justified correctly	All major changesar e made as per modificati ons suggested during Project Phase I evaluation	Few changes are made as per modifications suggested during Project Phase I evaluation	Suggestions made during Project Phase I evaluation are not incorporated	
	Project Demonstratio n	All defined objectives are achieved with some more additional	All defined objective are achievedEa ch Module is working	Most of the defined objectives are achieved	Some of the defined objectives are achieved. Only few Modules are	Defined objectives are not achieved Modules are not in proper working form	

		features. Each Module is working well and is properly demonstrated All modules of project are well integrated and system working is accurate	satisfactorily and is properly demonstrated All modules of project are well integrate and system working is satisfactory	Most of the Modules are working and is satisfactorily demonrated Integration of all modules not done and system working is not very satisfactory	working and is demonstrated Modules of project are not properly integrated	which further leads to failure of integrated system	
	Demonstartion and Presentation	Contents of Presentation is Appropriate and well arranged Proper eye contact with	Contents of Presentation is appropriate but not well arranged Satisfactor	Contents of Presentation is appropriate but not well arranged	Contents of presentation is not appropriate Eye contact with few people and unclear voice	Contents of Presentations are not appropriate and not well delivered Poor delivery of presentation	

		audience and clear voice with good spoken language	y demonstration, clear voice with good spoken language but eye contact not proper	Presentation not satisfactory and average demonstration		
	Project Report	Project report is according to the specified format References and citations are appropriate and well mentioned	Project report is according to the specified format References and citations are appropriate but not mentioned well	Project report is according to the specifiedf ormat with few mistakes In-sufficient references and citations	Project report is not fully according to the specified format Insufficient references and citations	Project report not prepared according to the specified format References and citations are not appropriate	
	Conclusi	Results are	Results are	Results	Results	Results are not	

on and Discussion	presented in very appropriatemanner. Project work is well summarized and concluded. Future extensions in the project are very well specified	presented in good manner. Project work summary and conclusion not very appropriate. Future extensions in the project are well specified	presented are not much satisfactory Project work summary and conclusion not very appropriate. Future extensions in the project are specified	presented are not clear Project work summary and conclusion is vague Future extensions in the project are not clearly specified	presented properly Project work is not summarized and concluded properly Future extensions in the project are not at all specified	

Table 6
Interim Progress Assessment Rubric for Project work-II Evaluation

Project: _____

Name of Student: _____

Name of Supervisor: _____

Each supervisor on the project must fill a rubric for each student

	Barely acceptable (0 – 2 Pts)	Basic (3 Pts)	Good (4 Pts)	Very Good (5 Pts)	Total Possible	Total Earned
Problem formulation	• Bare formulation • Bare understanding of the problem, with scarce knowledge of relevant material	• Basic formulation • Basic understanding of the problem, but lack appropriate study of relevant material	• Clear formulation • Good understanding of the problem, with study of relevant material • Good system analysis	• Clear formulation with well defined scope • Very good understanding of the problem and relevant material • Near production	5	

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Self-motivation and project management	• Slow progress, with barely satisfactory result • Unresponsive to supervisor	• Slow progress, with basic project outcome • Rely on supervisor"s push to work	• Good progress • Need reminder sometimes • Minor problems in project	• Steady progress • Highly self-motivated Good project management	5	

Table 7

<u>Design</u> <u>Development</u> <u>and Solution</u> <u>Asset</u> <u>Rubric</u> <u>for</u> <u>Project</u> <u>work-II</u> <u>Evaluation</u>

Project: _____

Name of Student: _____

Name of Supervisor: _____

Each supervisor on the project must fill a rubric for each student

	Barely acceptable (0−2 Pts)	Basic (3 Pts)	Good (4 Pts)	Very Good (5 Pts)	Total	
					Possible	Earned
Analysis and solving skills	• Obvious solution, sketchy functionalities	• Simple, yet mostly complete solution that solves the stated problem	Comple te solution with nontrivial functionalities that meet the desired needs	• Provide solution to complex problems; Solution optimize desired needs	5	
Innovation in the Design Solution and self-study	• Basic concepts used correctly • Lack self-study, but apply previously taught technique on a satisfactory level	• Superficial usage of new concepts • Self-study of new technique, with basic	• Self-study of new concepts / technique, with good understanding • Minor innovative	• New concepts used frequently • Self-study of new technique and solve technical difficulties;	5	

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		understanding	Work	Innovativ work with research		
Self-motivation and project management	• Slow progress, with barely satisfactory result • Unresponsive to Supervisor	• Slow progress, with basic project outcome • Rely on supervisor"s push to work	• Good progress • Need reminder sometimes • Minor problems in project management	• Good progress • Need reminder sometimes • Minor problems	5	

Table 8 Written
Report Rubric for Project work-II Evaluation: Project:
Name of Student:
Name of Supervisor:

	Barely acceptable (0–2 Pts)	Basic (3 Pts)	Good (4 Pts)	Very Good (5 Pts)	Total	
					Possible	Earned
Content	-Important points covered only superficially -No major errors and misconception	-Covers important points -A few inaccurate or irrelevant points	-All major points covered and explained clearly and correctly	-Major points strongly supported with suitable detail	5	
Writing	-Frequent errors in spelling and grammar -Mostly readable, but a few points are hard to understand	Some errors in spelling and grammar Readable Follow basic written report structure	-A few errors inspelling and grammar -Readable and easy to understand	-Well proofread -Clear and easy tounderstand -Graphs and diagrams used appropriately	5	

Table 9　Final
Presentation　Rubric　for　Project　work-II　Evaluation　Project:

Name of
Student: _____　**Name of**
Supervisor:

	Barely acceptable (0 – 2 Pts)	Basic (3 Pts)	Good (4 Pts)	Very Good (5 Pts)	Total	
					Possible	Earned
Content	-Important points covered only superficially -No major errors Andmisconception	-Covers important points -A few inaccurate or irrelevant points	-All major points covered and explained clearly and correctly	-Major points strongly supported with suitable detail	5	
Presentation Skills	-Bare organization and preparation -Lack of confidence and familiarity in some parts of the presentation	-Basic organization and preparation -Confident in only some parts of the presentation	-Good organization and preparation -Confident in most parts of the presentation Attractive to audience	-Excellent organization and preparation Confident and relaxed in the whole -presentation Engaging to	5	
Communication	-Answer at least	-Answer	-Answer most	-Handle	5	

(Q/A)	one questions correctly -Need clarification	most questions correctly -Need clarification sometimes	questions correctly and concisely	difficult questions with ease and confidence -Illustrative explanation		