RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2023 – 2024
Batch (2023-2025)

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

I - IV SEMESTER M. TECH. (CNE)

COMPUTER NETWORKS 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 17 UG programs and 11 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^+' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. 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 67% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for 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, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, 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. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute 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 (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 78th rank among 1314 top Engineering Institutions & 23rd Rank among 105 School of Architecture in India forthe year 2023.

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. (under VTU research Center) 5. Ph.D. (Ramaiah Doctoral Fellowship) 6. M.Sc(Engg.) by Research

The Department of Computer Science and Engineering (CSE) has eminent emeritus professor, 19 faculty with the doctorate degree and 9 pursuing the doctoral studies. . Faculties are involved in institutional level activities and actively involved in interdisciplinary research activities. Deaprtment has 196 inernational journal papers, 152 international conference papers, 51 book chapters, 9 published patents and one granted patent on the credit during last three years. There are seven funded projects and many faculty-mentered student funded projects are currently active at the deparment. Faculty received 21 awards whereas student received 66 awards during last three years. There are many consultancy projects executed at the depatment from the MoUs with the industry like SAP, IBM, HP etc. The department has state of the art laboratories like SAP, IBM Centre of Excellence and CUDA learning center. The department is accredited by Nation Board of Accreditation (NBA).

Technical seminars, workshops and hackathons are conducted regularly for UG & PG students. The department conducts subjects with more of hands-on sessions and encourages students to take up MOOC based online courses in NPTEL, IIT Bombay X, Coursera, Udacity and edX. More than 850 MOOC certifications completed. The department encourages the students to conduct and participate in extra-curricular/sports activities. There are six professional clubs where professional and engineering events are conducted. 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. The alumni network is very active and regular meeting are conducted by the department.

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 Technology strive 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 graduates 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 Network 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 Network 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 Network 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 Computer Network Engineering. The mastery should be at a level higher than the requirements in the appropriate bachelor program.

PO4: An ability to learn and use modern tools and techniques relevant to the field of Computer Network Engineering, enabling them to proficiently execute netwwork engineering tasks and integrate new found knowledge into their skillset.

PO5: Acquire methods of engaging in life-long learning not only to predict and plan the projects of the future but also to mentor their peers.

PG Curriculum Course Credits

Scheme Structure of M.Tech Program from the Academic year 2023-24 (Batch 2023-25)

Semester	Professional Core Courses (PCC)	Professional Core Courses Lab (PCCL)	Professional Elective Courses - (PEC)	Mandatory Credit Courses (MCC)	Project Work / Seminar (PW)	Internship (INT)	Total semester load
First	6	2	11	3	-	-	22
Second	8	2	12	-	-	-	22
Third	4	-	4	-	4	4	16
Fourth	-	-	-	-	20	-	20
Total	**18**	**4**	**27**	**3**	**24**	**4**	**80**

M.Tech. in Computer Network Engineering
Scheme of Teaching and Examination Batch 2023-25

I SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours / week
					L	T	P	Total	
1	MCN11	Advanced Engineering Mathematics	Maths	PCC	2	1	0	3	4
2	MCN12	Advances in Computer Networks	CSE	PCC	3	0	0	3	3
3	MCNE13x	Professional Core Elective-I	CSE	PEC	3	0	0	3	3
4	MCNE14x	Professional Core Elective-II	CSE	PEC	4	0	0	4	4
5	MCNE15x	Professional Core Elective-III	CSE	PEC	4	0	0	4	4
6	RMI16	Research Methodology and IPR	CSE	MCC	3	0	0	3	3
6	MCNL17	Advanced Computer Networks Laboratory	CSE	PCCL	0	0	1	1	2
7	MCNL18	Application Development using Python Programming Laboratory	CSE	PCCL	0	0	1	1	2
Total					**19**	**1**	**2**	**22**	**25**

Where x=1,2,3…L –Lecture, T – Tutorial, P- Practical. Note: * Common curriculum across all branches

Professional Elective Course I		Professional Elective Course II		Professional Elective Course III	
Subject Code	**Subject**	**Subject Code**	**Subject**	**Subject Code**	**Subject**
MCNE131	Wireless Networks	MCNE141	Artificial Intelligence and Machine Learning	MCNE151	Cognitive Radio
MCNE132	Security Engineering	MCNE142	Enterprise Devices and Networking	MCNE152	IoT Technology and Applications
MCNE133	Digital Image and Video Processing	MCNE143	Distributed Systems	MCNE153	Quantum Computing
MCNE134	Data Storage Technology and Networks	MCNE144	Malware Analysis	MCNE154	Full Stack Development

M.Tech. in Computer Network Engineering Scheme of Teaching and Examination Batch 2023-25									
II SEMESTER									
Sl. No.	**Subject Code**	**Subject**	**Teaching Department**	**Category**	**Credits**				**Total contact hours/week**
					L	**T**	**P**	**Total**	
1	MCN21	Cloud Computing & Big data	CSE	PCC	3	1	0	4	5
2	MCN22	Cryptography and Network Security	CSE	PCC	4	0	0	4	4
3	MCNE23x	Professional Core Elective-IV	CSE	PEC	4	0	0	4	4
4	MCNE24x	Professional Core Elective-V	CSE	PEC	4	0	0	4	4
5	MCNE25x	Professional Core Elective-VI	CSE	PEC	4	0	0	4	4
6	MCNL26	Cloud Computing & Big data Laboratory	CSE	PCCL	0	0	1	1	2
7	MCNL27	Cryptography and Network Security Laboratory	CSE	PCCL	0	0	1	1	2
Total					**19**	**1**	**2**	**22**	**25**

Where x=1,2,3…L –Lecture, T – Tutorial, P- Practical

Professional Elective Course IV		**Professional Elective Course V**		**Professional Elective Course VI**	
Subject Code	**Subject**	**Subject Code**	**Subject**	**Subject Code**	**Subject**
MCNE231	Digital Forensic and Cyber Crime	MCNE241	Network Security and Ethical Hacking	MCNE251	Cyber Security and Cyber Law
MCNE232	High Performance Communication Network	MCNE242	Optical Networks	MCNE252	Blockchain Essentials and Dapps
MCNE233	Advanced Software Engineering	MCNE243	Advanced Operating System	MCNE253	Mobile Communication
MCNE234	Edge and Fog Computing	MCNE244	Social Network Analysis	MCNE254	Future Skills and Startup Engineering

M.Tech. in Computer Network Engineering
Scheme of Teaching and Examination Batch 2023-25

III SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	MCN31	Software Defined Networks	CSE	PCC	3	1	0	4	5
2	MCNE32x	Professional Core Elective-VII	CSE	PEC	4	0	0	4	4
3	MCNI33	Internship/Industrial Training	CSE	INT	0	0	4	4	4
4	MCNP34	Project Work - I	CSE	PW	0	0	4	4	4
Total					**7**	**1**	**8**	**16**	**17**

Where x=1,2,3…L –Lecture, T – Tutorial, P- Practical

Professional Elective Course VII	
Subject Code	**Subject**
MCNE321	Muticore Architecture and Programming
MCNE322	Deep Learning
MCNE323	Software Project Management and Professional Ethics
MCNE324	Networks Forensics

M.Tech. in Computer Network Engineering Scheme of Teaching and Examination Batch 2023-25									
IVSEMESTER									
Sl. No.	**Subject Code**	**Subject**	**Teaching Department**	**Category**	**Credits**				**Total contact hours /week**
					L	**T**	**P**	**Total**	
1	MCNP41	Project Work - II	CSE	PW	0	0	20	20	20
Total					**0**	**0**	**20**	**20**	**20**

L –Lecture, T – Tutorial, P- Practical

ADVANCED ENGINEERING MATHEMATICS	
Course Code: MCN11	**Credits: 2:1:0**
Pre-requisites: Engineering Mathematics I- IV	**Contact Hours: 28+28**
Course Coordinator: Dr. A. Sreevallabha Reddy	

Course Contents

Unit I

Linear Algebra – I Vectors and Linear Combinations, Vector Spaces, The Null space of A, Solving Ax = 0. The Complete Solution to Ax = b, Independence, Basis and Dimension, Dimensions of the Four Subspaces, Orthogonality of the Four Subspaces, Projections. Orthonormal Bases and Gram-Schmidt Method, Factorization into A = QR, Least Squares Approximations.

Unit II

Linear Algebra – II: Linear Transformation: Fundamentals, The Matrices of a linear Transformation., Change of basis. Introduction to Eigenvalues and Eigenvectors, Similarity and Diagonalization. Symmetric Matrices, The singular value decomposition (SVD).

Unit III

Random Variables: Review of Random Variables, Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution and Uniform distribution.

Unit IV

Joint Probability Distributions and Stochastic Process Joint probability distribution: Joint probability distribution (both discrete and continuous). Stochastic Processes: Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation.

Unit V

Markov Process, Introduction to Queuing and Applications: Introduction, Markov chain and Transition probabilities, Continuous Parameter Markov Chain, M/M/1: ∞/FIFO, K/FIFO, M/G/1 Queuing system characteristics, Case studies.

Text Books:

1. Gilbert Strang: Linear Algebra and its Applications, 5th Edition (2016).
2. David C Lay: Linear Algebra and its Applications, 5th Edition (2015).
3. Sheldon M. Ross : Probability models for Computer Science, Academic Press, 2009.
4. B.S.Grewal, Higher Engineering Mathematics, Khanna Publishers, 40th edition, 2007.
5. 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.

Reference Books:

1. Murray R Spiegel, John Schiller & R. Alu Srinivasan: Probability and Statistics, Schaum's Outlines, 2nd edition.
2. Kishor S. Trivedi: Probability & Statistics with Reliability, Queuing and Computer Science Applications, PHI, 2nd edition, 2002.
3. Garreth Williams: Linear Algebra with Applications, Jones and Bartlett Press, 4th edition, 2001.
4. Erwin Kreyszig: Advanced Engineering Mathematics, Wiley India,10th edition, 2015.

Course Outcomes (COs):

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

1. Solve the system of equations AX=B. (PO 1, 3)
2. Find SVD and PCA of the given matrix. (PO 1, 3)
3. Express the probability distribution arising in the study of engineering problems and their applications. (PO 1, 3)
4. Apply the Markov Chain in prediction of future events. (PO 1, 3)
5. Apply and calculate the various parameters of the queuing models. (PO 1, 3)

ADVANCES IN COMPUTER NETWORKS	
Course Code: MCN12	**Credits: 3:0:0**
Pre-requisites: Computer Networks	**Contact Hours: 42**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents:

Unit I

FOUNDATION: Building a Network, Applications, Requirements Architecture Software Performance PACKETS Packet Delay Packet Delay Variability Packet Size Error Detection. IP Version 4, IP version 6-IPv6 Header, IPv6 addresses, IPv6 Host Address Assignment, ICMPv6.

Unit II

Routing:Update Algorithms-Distance-Vector Routing-Update Algorithm, Distance-Vector Slow-Convergence Problem, Loop-Free Distance Vector Algorithms-DSDV, AODV, Link-State Routing-Update Algorithm-Shortest-Path-First Algorithm, Classless Internet Domain Routing: CIDR, Provider-Based Routing, User Datagram Protocol – UDP, QUIC, DCCP.

Unit III

TCP transport, TCP Header, TCP Connection Establishment, TCP Offloading, TCP Sliding Windows, TCP Delayed ACKs, Nagle Algorithm, TCP Flow Control, Silly Window Syndrome, TCP Timeout and Retransmission, TCP Reno and Congestion Management- Slow Start- TCP Reno Per-ACK Responses, Threshold Slow Start, TCP Tahoe and Fast Retransmit, TCP Reno and Fast Recovery, TCP NewReno, TCP and Bottleneck Link Utilization- TCP Queue Sizes.

Dynamics of TCP- Bottleneck Links with Competition- Example 1: linear bottleneck, Example 2: router competition, Example 3: competition and queue utilization, TCP Fairness with Synchronized Losses- Example: Faster additive increase, Longer RTT.

Unit IV

Queuing and Scheduling: Fair Queuing- Bit-by-bit Round Robin Weighted Fair Queuing, The GPS Model, Deficit Round Robin Stochastic Fair Queuing, Hierarchical Weighted Fair Queuing- A Hierarchical Weighted Fair Queuing Algorithm.

Quality of Service- Real-time Traffic, Integrated Services / RSVP, Global IP Multicast, RSVP, Differentiated Services, Real-time Transport Protocol (RTP)

Unit V

Wireless and Mobile Networks: Introduction, Wireless Links and Network Characteristics, WiFi: 802.11 Wireless LANs, Cellular Networks: 4G and 5G, Mobility Management: Principles, Mobility Management in Practice.

Security in Computer Networks- Securing Wireless LANs and 4G/5G Cellular Networks, Securing Wireless LANs and 4G/5G Cellular Network

Reference Books:

1. Peter L Dordal: An Introduction to Computer Networks, 2nd Edition, Academic Torrents, 2020.
2. Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, 5th Edition, 2019.
3. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach, 8th edition, Addison-Wesley, 2021.
4. Behrouz A. Forouzan: Data Communications and Networking with TCP/IP protocol Suite, 6th edition, McGraw Hill Education, 2022.

Course Outcomes (COs):

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

1. Analyze the fundamental concepts in networks and addressing mechanism using IPv4 and IPv6 (PO-1,2,3)
2. Illustrate routing using various routing protocols and algorithms. (PO-1,2,3)
3. Identify various congestion control mechanism and bottlenecks in TCP(PO-1,2,3)
4. Illustrate Queuing and Scheduling mechanism and analyze the performance of applications using QOS (PO-1,2,3)
5. Identify issues related to mobility in Internet and cellular networks and security in computer network. (PO-1,2,3)

ELECTIVES - I

WIRELESS NETWORKS	
Course Code: MCNE131	**Credits: 3:0:0**
Pre-requisites: Computer Networks	**Contact Hours: 42**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents:

Unit I

Wireless Communication Technology: Overview of Wireless Communication - Spectrum Considerations, Line-Of-Sight Transmission, Fading in the Mobile Environment, Channel Correction Mechanisms, Digital Signal Encoding Techniques, Coding and Error Control, Orthogonal Frequency Division Multiplexing (OFDM, Spread Spectrum. **The Wireless Channel**- Antennas, Spectrum Considerations, Line-Of-Sight Transmission, Fading in the Mobile Environment, Channel Correction Mechanism.

Unit II

Wireless LAN Technology- Overview and Motivation, IEEE 802 Architecture, IEEE 802.11 Architecture and Services, IEEE 802.11 Medium Access Control, IEEE 802.11 Physical Layer, Gigabit Wi-Fi, Other IEEE 802.11 Standards, IEEE 802.11I Wireless LAN Security. **Bluetooth and IEEE 802.15**- The Internet of Things, Bluetooth Motivation and Overview, Bluetooth Specifications, Bluetooth High Speed and Bluetooth Smart, IEEE 802.15, ZigBee

Unit III

Cellular Wireless Networks- Principles of Cellular Networks, First-Generation Analog, Second-Generation TDMA, Second-Generation CDMA, Third-Generation Systems. **Mobile Applications and Mobile IP**- Mobile Application Platforms, Mobile App Development, Mobile Application Deployment, Mobile IP. **Long Range Communications**- Satellite Parameters and Configurations, Satellite Capacity Allocation, Satellite Applications, Fixed Broadband Wireless Access, WiMAX/IEEE 802.16 Smart Grid.

Unit IV

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, MAC Protocols that Use Directional Antennas - MAC Protocol Using Directional Antennas.

Routing Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols;

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.

Unit V

Vehicular ad hoc networks- architecture, challenges and primary applications, enabling technologies - DSRC, Wireless Access in Vehicular Environment (WAVE) stack, Data disseminations in VANET, Routing in VANET. Modeling and Simulation of Vehicular Networks: VANET simulation environment, Mobility models, Networking models, Signal propagation models, Model for Incorporating Vehicles as Obstacles in VANET Simulation Environments

Reference Books:

1. Cory Beard and William Stallings, Wireless Communication Networks and Systems, Pearson, 2016
2. C. Siva Ram Murthy and B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011
3. Xin Wang, "Mobile Ad-Hoc Networks Applications", inteo, 2011.

Course Outcomes (COs):

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

1. Explore concepts and principles of wireless communication with the evolution of latest wireless networks. (PO1, 2, 3, 4)
2. Examine the wireless network LAN and short range communication technologies (PO1, 2, 3, 4)
3. Compare the challenge faced in wireless ad hoc network with other wireless networks in addition to the focus on MAC/Network layer protocol design issues and proposed solutions by the research community (PO1, 2, 3, 4)
4. Explore Wireless Mobile Networks and Applications (PO1, 2, 3, 4)
5. Model the vehicular network application in simulated environment focusing efficient resource utilization and QoS provisioning (PO1, 2, 3, 4,5)

SECURITY ENGINEERING	
Course Code: MCNE132	**Credits: 3:0:0**
Pre-requisites: Operating Systems	**Contact Hours: 42**
Course Coordinator: Dr. Shilpa Chaudhari	

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)

DIGITAL IMAGE AND VIDEO PROCESSING	
Course Code: MCNE133	**Credits: 3:0:0**
Pre-requisites: Nil	**Contact Hours: 42**
Course Coordinator: Dr. Manjula R Chougala	

Course Contents

Unit I

Introduction: Fundamentals of Digital Image Processing, Origins of Digital Image Processing, Examples of fields that use DIP, Preliminary Steps in Digital Image Processing, Components of an Image Processing System. **Representation of Digital Image:** Elements of Visual Perception, A Simple Image Formation Model, Basic Concepts in Sampling and Quantization, Representing Digital Images, Spatial and Intensity Resolution, Relationships Between Pixels.

Unit II

Image Enhancement and Mathematical Preliminaries: Basic Gray Level Transformations, Histogram Processing, Smoothing Spatial Filters: Linear and Non Linear, Sharpening filters, Homomorphic Filtering. Gradient filters. **Notations, and mathematical coding:** Vectors and Matrices, row and column ordering, Properties of Fourier transformation, Matrix theory, Image Transformation functions: Log Transformation, Gamma Transformation, , Spatial Filtering: Correlation and Convolution, Vector Representaion, Filter Masks.

Unit III

Image Restoration, Reconstruction and Color Image Processing: A Model of the Image degradation/Restoration process, Noise Models, Estimation of Noise Parameters , Restoration in the Presence of Noise Only– Spatial Filtering: Mean Filters and Adaptive Filters, Periodic Noise Reduction by Frequency Domain Filtering: Band pass and Band Reject Filters, Geometric Mean Filter. **Color Fundamentals**: Color Models, Pseudocolor Image Processing, Basics of Full-Color Image Processing, Color Transformations, Smoothing and Sharpening, Color Segmentation, Reduction of Noise in Color Images, Color Image Compression.

Unit IV

Morphological Image Processing and Image Compression: Preliminaries, Dilation and Erosion, Opening and Closing, The Hit-or-Miss, Transformation, Some Basic Morphological Algorithms. Image Segmentation: Detection of Discontinuities, Edge Linking and Boundary Detection, Thresholding, Region-Based Segmentation. **Image**

Compression: Fundamentals, Image Compression Models, Error-free (Lossless) compression, Lossy Compression

Unit V

Video Segmentation and Tracking, Motion Estimation, Standard file formats: Analog video, Digital video, Image Segmentation, Thresholding, Clustering, Bayesian Methods, Graph-Based Methods and Region-Based Motion Segmentation and Tracking, Image compression: Quantization, Huffman coding, Arithmetic coding, symbol coding. **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

Text Books:

1. Rafael C Gonzalez and Richard E. Woods: Digital Image Processing, PHI 2nd Edition 2005
2. 'Fundamentals of Digital Image Processing', A K Jain, Pearson, 2004, 2015.
3. M. Tekalp," Digital video Processing", Prentice Hall International.

Reference Books:

1. Bovik, "Handbook of Image & Video Processing", Academic Press, 2000
2. Yao Wang, Jorn Ostermann and Ya Qin Zhang, "Video Processing and Communications", Prentice Hall Publishers, 2002.

Course Outcomes (COs):

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

1. Identify the fundamental concepts of Image Representation and Processing. (PO-1, PO-3, PO-4)
2. Apply Mathematical notations and transformation method of Image Analysis and Image Enhancement techniques (PO-1, PO-3, PO-4)
3. Understand the Intensity transformation for Image reconstruction and color image Processing. (PO- 1, PO-2, PO-4)
4. Understand Image feature extraction, classification, and Image compression techniques. (PO-1, PO-3, PO-4)
5. Analyze the video segmentation and tracking Virtual Reality design, workflow design and file formats. (PO-1, PO-3, PO-4)

DATA STORAGE TECHNOLOGY AND NETWORKS	
Course Code: MCNE134	**Credits: 3:0:0**
Pre-requisites: Computer Networks	**Contact Hours: 42**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction to Storage Area Networks : What is storage area Network, SAN Components, SAN Connectivity, SAN storage, SAN Servers, Server centric and storage centric architecture, Architecture of Intelligent Disk sub systems, Hard disks and Internal I/O Channels, JBOD, Storage virtualization using RAID, RAID levels(All), Caching, Intelligent Disk Subsystems. Storage technologies: Direct Attached Storage(DAS), Network Attached Storage(NAS), Storage Area Network(SAS).

Unit II

Fiber Channel Internals and Technologies: Fiber Channel, Layers, Optical Cables, Classes of service, Fiber channel Data movement, Data Transport, Flow Control, Addressing, Fiber Channel Topologies, Port Types, Fiber Channel arbitrated loop Protocols, Fiber Channel Login, Fiber Channel Fabric Services, Routing Mechanisms, Zoning. Gigabit Transport Technology, Inter- switch links

Unit III

Storage Virtualization and Basic Software for Storage Networking: Storage Virtualization, Implementation Considerations, Storage Virtualization in Server, Storage Devices, Network, Symmetric and Asymmetric Storage Virtualization in the Network. Software for SANs, Shared Access Data Managers, Computer System I/O Performance, Volumes: Resilience, Performance and flexibility, File Systems and Application Performance

Unit IV

Advanced Software for storage Networking: Data Replication, Different types of data replication, Synchronous and Asynchronous Replication, Using data Replication, Clusters, Data Center Clusters, Cluster Data Models, Cluster File Systems, Disaster Recovery and Global Clusters, Clusters and Storage Area Networks, Backup Management for SANs, Enterprise Data Protection and Backup Architecture.

Unit V

Application and Management of Storage Networks :Application of Storage Networks, Storage Sharing, Availability of Data, Adaptability and Scalability of IT Systems, Capacity Planning, NAS Case Study: The International Image Processing, SAN Case study: The Import Auto Industry, SAN/NAS Management Case Study: The Southwestern CD Company

Reference Books:

1. Ulf Troppens, Wolfgang Muller-Freidt, Rainer Wolafka: Storage Networks Explained, John Wiley Publishers, 2nd Edition, 2009.
2. Robert Spalding "Storage Networks: The Complete Reference, 1st Edition, TataMcGraw, 2003
3. Richard Barker Paul Massiglia: Storage Area Network Essentials-A Complete Guide to Understanding and Implementing SANs, John Wiley Publisher, 2008

Course Outcomes (COs):

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

1. Identify the need for storage centric network and RAID requirements. (PO-1,2,3)
2. Examine the working of Fiber Channel Storage Area Networks (PO-1,3)
3. Demonstrate the Storage Virtualization in Server (PO-1,3)
4. Select the advanced Software for storage Networking. (PO-1,2,3)
5. Interpret the Applications of Storage Networks and Management. (PO-1,3,4)

ELECTIVES - II

ARTIFICIAL INTELLIGENCE AND MACHINE LEANING	
Course Code: MCNE141	**Credits: 4:0:0**
Pre-requisites: Knowledge of Algorithms, Elementary Discrete Mathematics and Probability theory.	**Contact Hours: 42**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction: What is AI? Foundation and History of Artificial Intelligence. **Intelligent Agents**: Agents and Environments, Rationality, The Nature of Environments, The Structure of Agents. **Problem-solving by search**: Problem Solving Agents, Example Problems, Searching for Solution, Uniformed Search Strategies, Informed Search Strategies, Heuristic Functions.

Unit II

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Reasoning patterns in propositional Logic, Agents Based on Propositional Logic.

First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First-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.

Unit III

Introduction to Machine Learning: What is Machine Learning, Key Terminology, Key tasks of machine learning, Well posed learning problems, Designing a Learning system, Perspective and Issues in Machine Learning. **Concept Learning**: Introduction, A Concept Learning Task, Concept Learning as Search, Find-S, Version Spaces and the Candidate-Elimination Algorithm. **Decision Tree** - Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Issues in Decision Tree Learning.

Unit IV

Artificial Neural Networks - Introduction, Neural Network Representation, Appropriate problems for Neural Network Learning, Perceptrons, Multilayer

Networks and the Backpropagation algorithm. **Bayesian Learning** - Introduction, Bayes theorem, Naive Bayes Classifier, The EM Algorithm.

Unit V

Instance Based Learning - Introduction, k-nearest neighbor learning, Locally Weighted Regression, radial basis function, Case-based reasoning. **Genetic Algorithms** – Representing hypotheses, Genetic Operators, Fitness Function and Selection, An Illustrative Example. **Reinforcement Learning** – Introduction, The Learning Task, Q Learning.

Text Books:

1. Stuart J Russel and Peter Norvig: Artificial Intelligence - A Modern Approach, 4th Edition, Pearson Education, 2021.
2. Tom M Mitchell, Machine Learning, McGraw-Hill Education (Indian Edition), 2013.

Reference Books:

1. Elaine Rich, Kevin Knight, Shivashankar B Nair: Artificial Intelligence, 3rd Edition, Tata McGraw hill, 2011.
2. Deepak Khemani : Artificial Intelligence, Tata McGraw Hill Education 2013.
3. Peter Harrington: Machine learning in Action, Manning - Shelter Island, 2012.
4. Ethem Alpaydin: Introduction to Machine Learning, 3rd Edition, PHI Learning, 2016.

Course Outcomes (COs):

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

1. Identify the modern view of Artificial Intelligence and the problem solving techniques. (PO-1,2,3,4,5)
2. Apply the knowledge representation and Inference techniques to solve real world problems using the agent Philosophy.(PO-1,2,3,4,5)
3. Demonstrate proficiency in applying scientific method to models of machine learning (PO-1,2,3,4,5)
4. Analyze the concept of Artificial neural networks and Bayes classifier for problem solving (PO-1,2,3,4,5)
5. Examine the different applications of Instance Based Learning, Reinforcement Learning and genetic algorithm with their societal impact. (PO-1,2,3,4,5)

ENTERPRISE DEVICES AND NETWORKING	
Course Code: MCNE142	**Credits: 4:0:0**
Pre-requisites: Computer Networks	**Contact Hours: 56**
Course Coordinator: Dr. J Geetha	

Course Contents

Unit I

Introduction to Cloud Networking: Networking Basics - The network stack- Packets and frames- Network equipment- 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- SwitchChip Architecture Examples.

Cloud 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 rattan, 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. Discover the cloud networking and data center evolution (PO, 1,3,4)
2. Demonstrate 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 virtualization risks and benefits (PO 1,3,4,5)

DISTRIBUTED SYSTEMS	
Course Code: MCNE143	**Credits: 43:0:0**
Pre-requisites: Operating Systems	**Contact Hours: 56**
Course Coordinator: Dr. TNR Kumar	

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 (Reprint2013).

Reference Books:

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

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)

MALWARE ANALYSIS	
Course Code: MCNE144	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Sangeetha V	

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. Interpret 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. Identify the various malware functionality (PO1,3,4)
5. Create commercial applications using malware detection techniques (PO1,3,4, 5)

ELECTIVE - III

COGNITIVE RADIO	
Course Code: MCNE151	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Unit I

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

Unit II

Cognitive radio architecture: Cognition cycle – orient, plan, decide and act phases, Organization, SDR as a platform for Cognitive Radio – Hardware and Software Architectures, Overview of IEEE 802.22 standard for broadband wireless access in TV bands.

Unit III

Spectrum sensing and dynamic spectrum access: Introduction – Primary user detection techniques – energy detection, feature detection, matched filtering, cooperative detection and other approaches, Fundamental Tradeoffs in spectrum sensing, Spectrum Sharing Models of Dynamic Spectrum Access - Unlicensed and Licensed Spectrum Sharing, Fundamental Limits of Cognitive Radio..

Unit IV

Mac and network layer design for cognitive radio: MAC for cognitive radios – Polling, ALOHA, slotted ALOHA, CSMA, CSMA / CA, Network layer design – routing in cognitive radios, flow control and error control techniques.

Unit V

Advanced topics in cognitive radio: Overview of security issues in cognitive radios, auction based spectrum markets in cognitive radio networks, public safety and cognitive radio, cognitive radio for Internet of Things.

Reference Books:

1. Alexander M. Wyglinski, Maziar Nekovee, Thomas Hou, Cognitive Radio Communications and Networks, Academic Press, Elsevier, 2010. (Unit I to IV)
2. Huseyin Arslan (Ed.), Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems, Springer, 2007. (Unit V)
3. Bruce Fette, Cognitive Radio Technology‖, Newnes, 2006. Kwang-Cheng Chen, Ramjee Prasad, Radio Networks‖, John Wiley and Sons, 2009.
4. Ezio Biglieri, Professor Andrea J. Goldsmith, Dr Larry J. Greenstein, Narayan B. Mandayam, H. Vincent Poor: Principles of Cognitive Radio‖ , Cambridge University Press, 2012.

Course Outcomes (COs):

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

1. Understand the rapid advances in Cognitive radio technologies (PO1,2,3,5)
2. Discover defined radio and cognitive radio techniques and their essential functionalities PO1,2,3,5)
3. Identify the basic architecture and standard for cognitive radio. (PO1,2,3,5)
4. Demonstrate the physical, MAC and Network layer design of cognitive radio. (PO1,2,3,5)
5. Analyze the applications and advanced features of cognitive radio. (PO1,2,3,5)

IoT TECHNOLOGY AND APPLICATIONS	
Course Code: MCNE152	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari / Mrs. Veena G S	

Course Contents

Unit I

Introduction to IoT: What isIoT?, IOT terms and Basic Definitions,Disambiguation of IoT vs IoEvsM2M vs Others,Characteristics of IoT.

Wireless Sensor Networks: Potential Applications, WSN System Architecture, WSN Network Topologies,Components of a WSNNode.

Architecture of IoT systems: Things in IoT, Applications of IoTandIoTReference model, IoT Ecosystem, Enabling Technologies in IoT, Marketplace and VisionofIoT.

Unit II

Hardware aspects of IoT:Sensors andActuators.

Introduction to Sensors: Workflow of a Sensor in a typical system, Classification of Sensors, Sampling DAC andADC conversion.

Introduction to Actuators: Workflow ofan Actuator in a typical system, Classification of Actuators, Types of Sensors, Interfacingconcepts 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. WiFirouters, radius servers,Wireless security with WPA-2, LEAP,enterprise WPA networks

Low Bandwidth Wireless Networks:FSK, LoR a modulation basics, LoR a WAN basics. **Peripherals networking:**Basics of I2C,SPI,RS232,RS485and CAN bus,Comparisons and usecases of I2C, SPI, RS232, RS485 and CAN bus. Introduction to BLE5 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, Microservices and API's.IP Communication

protocols: HTTP, AMQP, MQTT and STOMP. Protocol definitions, usecases 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.

TextBooks:

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

References:

1. Vijay Madisetti and Arshdeep Bahga: Internet of Things (A Hands - on Approach), 1st Edition, VPT, 2014. (ISBN:978-8173719547)
2. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley; 1st edition, 2013.

Course Outcomes (COs):

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

1. Identify the basic components of IoT. (PO1,3,4)
2. Recognize the usage various sensors and actuators in applications of IoT. (PO1,3,4)
3. Select appropriate communication protocols for IoT applications depending on distance and data rate. (PO1,3,4)
4. Compare IoT specific protocols like MQTT, AMQP and STOMP for data sharing between devices. (PO1,3,4)
5. Identify components for various domain specific IoT applications. (PO1,3,4,5)

QUANTUM COMPUTING	
Course Code: MCNE153	**Credits: 4:0:0**
Pre-requisites: Linear Algebra, Python Programming.	**Contact Hours: 56**
Course Coordinator: Dr. Rajarajeswari S	

Course Contents

Unit I

Introduction: Introduction to Quantum Computing, Introduction to quantum mechanics: Linear algebra, the postulates of quantum mechanics Quantum Computing software: Introduction to Qiskit, Quantum Qudit simulator, QCAD, Quack, qasm2circ. Programming a quantum computer: The IBMQ, coding a quantum computer using a simulator to carry out basic quantum measurement and state analysis.

Unit II

Quantum correlations: Bell inequalities and entanglement, Schmidt decomposition, superdense coding, teleportation.

Unit III

Quantum computation: Quantum Ciruits, Quantum Fourier transform and its applications

Unit IV

Quantum Search Algorithms: Solovay-Kitaev theorem, Deutsch-Jozsa algorithm, Bernstein-Vazirani Algorithm, Simon's algorithm, Shor's algorithm, Grover's algorithm, Quantum counting, Quantum walk search algorithm. Implementation using Qiskit

Unit V

Quantum Information: Quantum noise and Quantum operations, Distance measures, Quantum Error Correction, Quantum cryptography: Private Key Cryptography, Privacy amplification and information reconciliation, QKD, privacy and coherent information, security of Quantum Key distribution. Implementation using Qiskit.

Text Books:

1. Quantum Computing, A Gentle Introduction Eleanor G. Rieffel, and Wolfgang H. Polak MIT press, 2014.
2. Quantum Computation and Quantum Information, M. A. Nielsen & I.Chuang, Cambridge University Press, 2013.
3. https://qiskit.org/documentation/

References

1. Quantum Computing for Everyone, Chris Bernhardt, The MIT Press, Cambridge, 2020
2. Quantum Computing Explained- David McMahon Wiley-Interscience, IEEE Computer Society, 2008.
3. Phillip Kaye, Raymond Laflamme et. al., An introduction to Quantum Computing, Oxford University Press, 2007.
4. David McMahon-Quantum Computing Explained-Wiley-Interscience, IEEE Computer Society, 2008.
5. The mathematics of quantum mechanics Martin Laforest, Ph.D. university of waterloo, Quantum cryptography school for young students

Course Outcomes (COs):

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

1. Analyze the behavior of basic quantum computation and Simulate basic quantum measurement and state analysis using Qiskit. (PO-1, 2, 3, 5)
2. Elaborate on quantum non-locality and simulation of the density operators. (PO-1, 3, 5)
3. Prove basic facts about quantum information channels and Implement information channels in the quantum circuit model. (PO-1, 3, 5)
4. Compare, in terms of time complexity, the quantum advantage expected from the quantum alogrithms with respect to their classical counterparts. (PO-1, 2, 3, 5)
5. Simulate a simple quantum error-correcting code. (PO-1, 2, 3, 5)

FULL STACK DEVELOPMENT	
Course Code: MCNE154	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. J Geetha	

Course Contents

Unit I

HTML5 and Java script Basics: Introduction, Cascading Styles Sheet: Concept of CS, Creating Style Sheet, CSS Properties, CSS Styling (Background, Text Format, Controlling Fonts), CSS Id and Class, Box Model (Border, Padding, Margin properties), CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class)

Unit II

JavaScript syntax, Types of Data and Variables, Operations and calculations, The Document Object, Using Events.

JavaScript Advanced: Scopes and Closures, understand "this" and prototypes, OO concepts as applied to JS and prototypal inheritance, Understanding the meaning of asynchronous. Event loops, Promises.

Unit III

Introduction to Server-side JS Framework – Node.js: Introduction - What is Node.js, Architecture, Feature of Node JS, Installation and setup - Creating web servers with HTTP (Request & Response), Understand dependence management: npm and package.json File system APIs.

Unit IV

CRUD Operations using Node.js: Event Handling - GET & POST implementation, Use Express.js to create a REST API. Use GET, POST. Connect to NoSQL MongoDB Database using Node.js, Implementation of CRUD operations.

Unit V

Introduction to Client-side JS Framework – Building blocks of React

Create-react-app - Create first React app using this CLI, JSX - Understand what it is and how it's required to create components, Simple functional components, CSS - Load CSS and use it via class Name, props - Passing props to components to make them reusable, Event handling, State - Using class components for storing state (legacy), State via hooks - Using use State hook.

Text Books:

1. Web Application Design and Implementation: Apache 2, PHP5, MySQL, JavaScript, and Linux/UNIX Steven A. Gabarro, Wiley-IEEE Computer Society Press,2007.
2. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda: ng-book, The Complete Book on Angular 4, September 2016.
3. KrasimirTsonev: Node.js by Example Paperback, May 2015.

Reference Links:

1. Web link for Node.js: https://nodejs.org/en/
2. Web link for MongoDB: https://www.mongodb.com/
3. https://reactjs.org/

Course Outcomes (COs):

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

1. Design a web Page using HTML tags. (PO-1,2,3)
2. Create and style basic web page. (PO-1,2,3)
3. Explore Node.js features. (PO-1,2,3)
4. Create component based web pages using React features. (PO-1,2,3)
5. Design Front-end web pages and connect to the Back-end Databases. (PO-1,2,3)

RESEARCH METHODOLOGY AND IPR	
Course Code: RMI16	**Credits: 3:0:0**
Pre-requisites: Nil	**Contact Hours: 42**
Course Coordinator: A M Nagabhushan	

Course Contents

Unit I

Introduction: Meaning of Research, Objectives of Engineering Research, and Motivation in Engineering Research, Types of Engineering Research, Finding and Solving a Worthwhile Problem. Ethics in Engineering Research, Ethics in Engineering Research Practice, Types of Research Misconduct, Ethical Issues Related to Authorship.

Unit II

Literature Review and Technical Reading, New and Existing Knowledge, Analysis and Synthesis of Prior Art Bibliographic Databases, Web of Science, Google and Google Scholar, Effective Search: The Way Forward Introduction to Technical Reading Conceptualizing Research, Critical and Creative Reading, Taking Notes While Reading, Reading Mathematics and Algorithms, Reading a Datasheet. Attributions and Citations: Giving Credit Wherever Due, Citations: Functions and Attributes, Impact of Title and Keywords on Citations, Knowledge Flow through Citation, Citing Datasets, Styles for Citations, Acknowledgments and Attributions, What Should Be Acknowledged, Acknowledgments in, Books Dissertations, Dedication or Acknowledgments.

Unit III

Building Intellectual Property Rights, Law of Patents, Fundamentals of Patent Law - Evolution of the patent system, Patentability Requirements; Patentable Subject Matter; Industrial Applicability/Utility; Novelty; Anticipation by publication; Anticipation by public knowledge and public use; Anticipation by public display; Anticipation by sale; Inventive Step/Non-Obviousness; Novelty Assessment; Inventive Step Assessment; Specification, Drafting of A Patent Specification - Introduction Patent Specification; Provisional Specification Complete Specification, Parts of the complete specification; Patent Procedure in India - PATENT PROCEDURE; Registration and Renewal fee payment; Patent Infringement - Infringement of a patent; Literal Infringement; Equivalence Infringement; Indirect Infringement; Defenses - Experiment - Research or Education - Bolar Exemption- Government use- Patent ExhaustionPatent Misuse- Inequitable Conduct - Remedies- Injunction- Account of profits- Costs; International

Patent Regimes - International Instruments; Paris Convention; TRIPS AGREEMENT; PCT; BUDAPEST TREATY, Patenting Biotechnology Inventions - Unique nature of Biotechnology; Patentability Requirements and Biotechnology Inventions; Patentable Subject Matter- USA- Europe- India; Patentability of Software Inventions - Patentability of Software Inventions in USA; Patentability of software inventions in Europe; Patentability of Software Inventions in India.

Unit IV

Law of Copyright and Designs, Understanding Copyright Law - Historical Overview – Justification For Copyright Law - The Natural Law Justification - The Economic Rationale of Copyright Clause, Basic Concepts Underlying copyright Law - Idea – Expression Dichotomy Originality / Creativity – Fixation Email dated 09082022 HB Term of Protection, Subject - Matter of Copyright - Literary Works - Dramatic Works - Musical Work - Artistic Works - Cinematograph Films and Sound recordings, Acquisition of Copyright in India, Rights of the Copyright Owner - Economic Rights - Moral Right or Droid Moral Right of Authorship or Paternity Rights - Rights against Distortion or Mutilation of the Original Works or Integrity Rights - Limitations - Limitations set under International Regime – Berne Convention - Rome Convention - Trips Agreement - Three Step Test, Infringement of Copyright -Transfer of copyright - License and Assignment - License and consent -Duration of a License Form and Content - Disputes in Respect of License -Types of Licenses - Exclusive and Non-Exclusive Licenses.

Unit V

Basic Principles of Design Rights - Justification for Protecting Designs - Historical Perspective - Features of Shape, configuration, Pattern or Ornament - or Composition of lines or colour - New or Original - Applied to an Article, Excluded Subject - Matter - Method or Principle of Construction - Features Dictated Solely by Function - Mechanical Device - Trademark, or Property Mark, or Artistic Work - immoral Designs and Designs Contrary to Public order–Rights of the Owner of Designs and Tests for Infringement. Assignment of Design Rights, Infringement of Designs. Case Studies on Patents. Case study of Curcuma (Turmeric) Patent, Case study of Neem Patent, Case study of Basmati patent, Case study of Apple Inc. v. Samsung Electronics Co., Ltd.

Text Book:

1. Dipankar Deb, Rajeeb Dey, Valentina E. Balas: Engineering Research Methodology, ISSN 1868- 4394, ISSN 1868-4408 (electronic), Intelligent

Systems Reference Library, ISBN 978-981-13- 2946-3, ISBN 978-981-13-2947-0(eBook), https://doi.org/10.1007/978-981-13-2947-0

Reference Book:

1. David V. Thiel: Research Methods for Engineers, Cambridge University Press, 978-1-107-03488- 4.

Course Outcomes (COs):

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

1. To know the meaning of engineering research.
2. To know the procedure of Literature Review and Technical Reading.
3. To know the fundamentals of patent laws and drafting procedure.
4. Understanding the copyright laws and subject matters of copyrights and designs
5. Understanding the basic principles of design rights.

ADVANCED COMPUTER NETWORKS LABORATORY	
Course Code: MCNL17	**Credits: 0:0:1**
Pre-requisites: Computer Networks	**Contact Hours: 28**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

This laboratory course helps students to visualize the computer networking concepts through various experiments using Wireshark Packet Tracer (any other open source tool can also be used) and Network simulators like NS3. Following are the list of experiments on the specific computer network concepts.

1. **Diagnostic commands related to TCP/IP networking:** Diagnostic commands help you detect TCP/IP networking problems. Some of the diagnostic commands are arp, hostname, ipconfig, netstat, ping, route, and tracert**.**
2. **Exploring Network layer facilities related to Internet Protocol (IP) and Internet Control Message Protocol (ICMP):** Possible lab can be tracing IP and ICMP using Wireshark
3. **Exploring Network layer facilities related to Dynamic Host Configuration Protocol (DHCP):** Possible lab can be tracing DHCP using Wireshark
4. **TCP Socket Programming:** Using TCP/IP sockets, write a client – server program where the client sends the file name and the server send back the contents of the requested file if present.
5. **UDP Socket Programming:** Write a program on datagram socket for client/server to display the messages on client side, typed at the server side.
6. **Wired Network with Constant Bit rate (CBR) data transmission over UDP:** Possible lab can be based on designing and simulating a wired network with duplex links between 'n' nodes with CDR over UDP. Set the queue size, vary the bandwidth and analyze the performance.
7. **Wired Network with Constant Bit rate (CBR) data transmission:** Possible lab can be based on designing and simulating a wired network with duplex links between 'n' nodes with CDR over UDP and TCP. Set the queue size, vary the bandwidth and analyze the performance.
8. **Mobility Management in wireless network:** Possible lab can be based on designing and simulating a 2D and 3D ad-hoc wireless network and observe the effect of low mobility, moderate mobility and high mobility on CBR application.

9. **Wireless LAN:** Possible lab can be based on designing and simulating simple Extended Service Set with transmitting nodes in wireless LAN and determine the performance with varying bandwidth and traffic.
10. **Ad-hoc Network:** Possible lab can be based on designing and simulating a wireless network in Adhoc mode with combinations for enabling and disabling RTS/CTS and fragmentation. Observe its performance w.r.t end-to-end delay, throughput, and packet delivery ratio.
11. **Routing protocol:** Possible lab can be based on designing and simulating a wireless network to implement AODV routing protocol and observe the number of packets sent and received with the parameters throughput, delay, packet loss.
12. **TCP Performance in wired Network:** Possible lab can be based on designing and simulating a wired network with 'n' nodes that utilizes TCP as its end-to-end transmission protocol. Observe the network performance in addition to congestion window and ssthreshold of two TCP variants (Reno and Tahoe).
13. **TCP Performance in wireless Network:** Possible lab can be based on designing and simulating a wireless network that utilizes TCP as its end-to-end transmission protocol, and determine the performance with varying bandwidth and traffic.
14. **IEEE 802.11n Wi-Fi network with multiple types of services:** Possible lab can be based on designing and simulating an IEEE 802.11n Wi-Fi network with multiple TOS. Considering the number of stations, the HT MCS value (0 to 7), the channel width (20 or 40 MHz) and the guard interval (long or short, observe the network performance in terms of aggregated UDP throughput. The user can also specify the distance between the access point and the stations (in meters), and can specify whether RTS/CTS is used or not.

Reference Books:

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach, 8th edition, Addison-Wesley, 2021.
2. Behrouz A. Forouzan, Data Communications and Networking with TCP/IP Protocol Suite, 6th Edition,McGraw Hill, 2021.
3. Cory Beard and William Stallings, Wireless Communication Networks and Systems, Pearson, 2016.

Course Outcomes (COs):

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

1. Explore and analyze the wired/wireless networking concepts using packet tracer tool or basic diagnostic commands. (PO1,3,4)
2. Design and develop socket API based data transmission over the wired/wireless networks. (PO1,3,4)
3. Design and simulate the wired and wireless network scenarios for exploring TCP/IP protocol layes concpets using network simulation environment. (PO1,3,4)

APPLICATION DEVELOPMENT USING PYTHON PROGRAMMING LABORATORY	
Course Code: MCNL18	**Credits: 0:0:1**
Pre-requisites: Nil	**Contact Hours: 28**
Course Coordinator: Dr. Parkavi A	

Course Contents

There shall be a minimum of 2 exercises conducted on each of the following topics.

1. Python Basics and Control Structures
2. Functions
3. Strings, lists, list comprehensions
4. Tuples and dictionaries
5. Lambdas and Regular Expression
6. Objects and classes
7. Files and Exception Handling
8. Singly Linked List
9. Doubly Linked List
10. Numerical Programming with Numpy
11. Numerical Programming with Pandas
12. Data Visualization using matplotlib
13. GUI Programming
14. Manipulation of images using PIL/Pillow

Reference Books:

1. Campbell, J., Gries, P., Montojo, J., & Wilson, G. (2016): Practical programming: An Introduction to Computer Science using Python. Pragmatic Bookshelf, 2nd Edition, 2016.

CourseOutcomes (COs):

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

1. Design and implement python programs utilizing control structures, functions, strings and built-in data structures in Python. (PO1,2,3,4,5)
2. Employ object-oriented programming, files and exception handling and Linked List for solving problems using Python. (PO1,2,3,4,5)
3. Design and implement the concepts of numerical programming, Data Visualization and GUI programming using Python. (PO1,2,3,4,5)

CLOUD COMPUTING AND BIG DATA	
Course Code: MCS21	**Credits: 3:1:0**
Pre-requisites: Nil	**Contact Hours: 42+28**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

Unit I

Introduction: Cloud Computing, Delivery Models & Services, Ethical Issues, Cloud Vulnerabilities, Challenges, **Cloud Infrastructure**: Amazon, Google, Azure & Online Services, Open-Source Private Clouds, Cloud Storage Diversity and Vendor Lock-In, Service and Compliance Level Agreements. **Applications & Paradigms**: Challenges, Existing and New Application Opportunities, Architectural Styles of Cloud Applications; Workflows Coordination of Multiple Activities, Coordination based on a State Machine Model -The Zoo Keeper. Different Cloud Architectures, Applications: Healthcare, Energy systems, Transportation, Manufacturing, Education, Government, Mobile Communication, Application Development.

Unit II

Cloud Resource Virtualization: Layering and Virtualization, Virtual Machine Monitors, Virtual Machines, Full Virtualization and Paravirtualization, Hardware Support for Virtualization, A Performance Comparison of Virtual Machines, and The Darker side of Virtualization. **Cloud Resource Management and Scheduling**: Policies and Mechanisms for Resource Management, Resource Bundling: Combinatorial auctions for Cloud Resources, Scheduling Algorithms for Computing Clouds, Fair queuing, Start Time Fair Queuing, Borrowed Virtual Time. **Cloud Security**: Cloud Security Risks, Privacy and Privacy Impact Assessment, Trust, Operating System Security, Virtual Machine Security, Security of Virtualization.

Unit III

Introduction to Big Data: What is big data and why is it Important? Industry Examples of Big Data: Big Data and the New School of Marketing. Marketing. – Advertising and Big data. Types of Digital data, Big Data - Characteristics, Evolution of Big Data, Challenges; Comparison with BI. Cloud Computing and Big Data, Cloud Services for Big Data, Big Data Technology. **NoSQL Data Management:** Introduction to NoSQL, Aggregate Data Models, Graph Databases, Distribution Models.

Unit IV

Basics of Hadoop: Data! Data Storage and Analysis, Data Format, Analyzing the Data with Hadoop, Data Flow. The Hadoop Distributed File System: The Design of HDFS, HDFS Concepts, Data Flow - Anatomy of a File Read - Anatomy of a File Write. **Developing a MapReduce Application**: MapReduce Workflows, writing a Unit Test, Anatomy of a MapReduce Job Run, Classic MapReduce (MapReduce 1), YARN (MapReduce 2), Failures, Job Scheduling, Shuffle and Sort.

Unit V

Interacting with Hadoop Ecosystem: Pig-Data Model, Developing and Testing Pig Latin Scripts. Hive-Data Model and Implementation, Hive Data Manipulation and HiveQL Queries. Hbase - Data Model and Implementation. **Analyzing Big Data**: The Challenges of Data Science, Introducing Apache Spark. Scala for Data Scientists, The Spark Programming Model, Record Linkage, Getting Started: The Spark Shell and Spark Context, Bringing Data from the Cluster to the Client, Shipping Code from the Client to the Cluster, From RDDs to Data Frames. Analyzing Data with the DataFrame API.

Text Books:

1. Marinescu, Dan C. **Cloud computing: theory and practice**. Morgan Kaufmann, 2022. – 3rd Edition – Elsevier.
2. White, Tom. **Hadoop: The definitive guide**. " O'Reilly Media, Inc.", 2012. Third Edition.
3. Ryza, Sandy, Uri Laserson, Sean Owen, and Josh Wills. **Advanced analytics with spark: patterns for learning from data at scale**. " O'Reilly Media, Inc.", 2017. 2nd Edition.

Reference Books/Links:

1. Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Kai Hwang, Jack Dongarra, Geoffrey Fox. MK Publishers.
2. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, McGraw Fill, 2010.
3. Cloud Computing A hands - on approach – Arshdeep Bahga & Vijay madisetti Universities press.
4. https://docs.rightscale.com/cm/designers_guide/cm-cloud-computing-system-architecture-diagrams.html

Course Outcomes (COs):

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

1. Describe the Delivery models, Services and Applications of Cloud Computing. (PO 1,2,3)
2. Demonstrate Cloud Resource Virtualization, Resource Management & Scheduling and Cloud Security (PO-1,2,3)
3. Interpret Big Data Concepts and NoSQL Data Management with respect to Cloud (PO-1,2,3)
4. Examine the role of Hadoop in various MapReduce Applications (PO-1,2,3)
5. Analyze the Big Data using Hadoop Ecosystem and Spark Programming model. (PO-1,2,3)

CRYPTOGRAPHY AND NETWORK SECURITY	
Course Code: MCN22	**Credits: 4:0:0**
Pre-requisites: Computer Networks	**Contact Hours: 56**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction - Security Attacks, Security Services, Security Mechanisms, Cryptography. **Classical Encryption Techniques** - Symmetric Cipher Model, Substitution Techniques, Transposition Techniques. **Block Ciphers and the Data Encryption Standard** - Traditional Block Cipher Structure, the Data Encryption Standard, A DES Example. **Advanced Encryption Standard** - AES Structure, AES Transformation Functions, AES Key Expansion, An AES Example.

Unit II

Public-Key Cryptography and RSA - Principles of Public-Key Cryptosystems, The RSA Algorithm. **Other Public-Key Cryptosystems**- Diffie–Hellman Key Exchange, Elgamal Cryptographic System, Elliptic curve Cryptography. **Cryptographic Key Management and Distribution**- Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using Asymmetric Encryption, Distribution of Public Keys , X.509 Certificates, Public-Key Infrastructure. **User Authentication** - Remote User-Authentication Principles, Remote User-Authentication Using Symmetric Encryption, Kerberos.

Unit III

Cryptographic Hash Functions - Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Requirements and Security, Secure Hash Algorithm (SHA) 352, SHA-3 362. **Message Authentication Codes**- Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes. **Digital Signatures** - Digital Signatures, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm.

Unit IV

Transport-Level Security- Web Security Considerations, Transport Layer Security, HTTPS. **Wireless Network Security** - Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security. **Electronic Mail Security** - Internet Mail Architecture, Email Formats, Email Threats

and Comprehensive Email Security, S/MIME. **IP Security -** IP Security Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

Unit V

Network Endpoint Security – Firewalls, Intrusion Detection Systems, Malicious Software, Distributed Denial of Service Attacks. **Cloud Security - Cloud** Computing, Cloud Security Concepts, Cloud Security Risks and Countermeasures, Cloud Security as a Service, An Open-Source Cloud Security Module. **Internet of Things (IoT) Security -** The Internet of Things, IoT Security Concepts and Objectives, An Open-Source IoT Security Module.

Text Books:

1. William Stallings: Cryptography and Network Security-principles and practices, 8th Edition, Pearson India Education Services, 2023.

Reference Books:

1. Behrouz A. Forouzan, Debdeep Mukhopadhyay: Cryptography and Network Security, 3rd Edition, Special Indian Edition, Tata McGraw-Hill, 2015.
2. Cryptography, Network Security and Cyber Laws – Bernard Menezes, Ravinder Kumar, Cengage Learning, 2018.
3. Charles P. Pfleeger, Shari Lawrence Pfleeger, Jonathan Margulies: Security in computing, 5th Edition, Pearson India Education Services, 2015.

Course Outcomes (COs):

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

1. Analyze the key management issues involved in symmetric key cryptosystems with respect to public key Cryptosystems (PO-1,2,3,4).
2. Demonstrate the various key distribution and management schemes (PO-1,2,3,4)
3. Apply Cryptographic Hash Functions & and verify messages using well known signature generation and verification algorithms (PO-1,2,3,4).
4. Examine the working of various Network security protocols. (PO-1, 2,3,4).
5. Illustrate the different network strategies, Cloud and Internet of Things (IoT) Security strategy (PO-1,2,3,4)

ELECTIVES - IV

DIGITAL FORENSIC AND CYBER CRIME	
Course Code: MCNE231	**Credits: 4:0:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Understanding the digital forensics profession and investigations, An overview of digital forensics, Preparing for digital investigations, maintaining, Maintaining professional conduct, preparing a digital forensics investigation, Procedures for private-sector, high tech investigation, understanding, Data recovery workstations and software, conducting an investigation, understanding forensics lab accreditation requirement, Determining the physical requirement for digital lab, Selecting a basic forensic workstation, building a business case for developing a forensics lab and preparing a business case study.

Unit II

Working with Windows and CLI Systems: Understanding File Systems, Exploring Microsoft File Structures, Examining NTFS Disks, Understanding Whole Disk Encryption, Understanding the Windows Registry, Understanding Microsoft Startup Tasks, understanding windows 7,8 and NT and later 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, performing RAID data acquisitions, Using Remote Network Acquisition Tools, Using other Acquisition Tools. Understanding acquisition procedure for mobile device, acquisition in cloud computing. **Computer Forensics Analysis and Validation:** Determining What Data to Collect and Analyze, Validating Forensic Data, Addressing Data-Hiding Techniques, Performing Remote Acquisitions. Conducting a cloud investigation.

Unit IV

Current digital Forensics Tools: Evaluating digital Forensic Tool Needs, digital Forensics Software Tools, Computer Forensics Hardware Tools, understanding Email servers, using specialized email forensics tools. Applying digital forensics to social media, Mobile device Forensics, understanding mobile device forensics, cloud forensics legal and technical challenges in cloud forensics.

Unit V

Network Forensics: Network Forensic Overview, Performing Live Acquisitions, Developing Standard Procedures for Network Forensics, Using Network Tools. **E-mail Investigations:** Exploring the Role of E-mail in Investigations, Exploring the Roles of the Client and Server in E-mail, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools. Laboratory Lab exercises using forensic software and Case study data.

Text Book:

1. Bill Nelson, Phillips, Frank, Christopher Steuart: Guide to Computer Forensics and Investigations, 5th Edition Cengage Learning, 2014. (Chapters: 1, 2, 3, 5, 6, 9, 10, 13)

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.

Web Reference:

1. http://www.cyberforensics.in/default.aspx

Course Outcomes (COs):

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

1. Conduct, preparing a digital forensics investigation. (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)

HIGH PERFORMANCE COMMUNICATION NETWORK	
Course Code: MCNE232	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Monica R Mundada	

Course Contents

Unit I

High Speed Networks: Frame Relay. Packet-Switching Networks. Frame Relay Networks. Asynchronous Transfer Mode (ATM). ATM Protocol Architecture. ATM Logical Connections. ATM Cells. ATM Service Categories. ATM Adaptation Layer (AAL).

Unit II

Packet switched network: OSI and IP Model. Ethernet (IEEE 802.3): Physical Layer, MAC, LLC and Token ring (IEEE 802.5): Physical layer, MAC. LLC, FDDI, DQDB, SMDS, Internetworking with SMDS.

Unit III

Asynchronous transfer mode: ATM Overview, ATM protocol architecture, Detail functionality of ATM layer: ATM header structure, addressing, signaling, routing, ATM adaptation layer (need different types and comparison). ATM service categories, ATM QOS parameters, Classical IP over ATM.

Unit IV

Wireless networks: Wireless Networks: Wireless Channel: Path loss, Shadow fading, Multipath flat fading, Intersymbol Interference, Doppler frequency shift, Capacity limits of wireless channels,Link level design, channel access, network design

Unit V

Optical networks: Optical link- Transmitter, Receiver, fiber, subcarrier multiplexing, WDM systems, Optical Cross-Connects, Optical LANs: single hop LAN, Multi hop LAN, SONET/SDH: Layers, Frame Structure, SONET Multiplexing, SONET Networks.

Text Books:

1. William Stallings: High Speed Networks: Performance and Quality of Service, 2nd Edition, Pearson Education, 2002.
2. William Stallings: ISDN and Broadband ISDN with Frame Relay and ATM, 4th Edition, Pearson Education Asia, 2002
3. Jean Walrand & PravinVaria: High Performance Communication Networks, 2nd Edition, 2009.

References:

1. Behrouz. A, Forouzan: Data Communication and Networking, Tata McGrawHill,2008
2. William Stallings: ISDN and Broad band ISDN with Frame Relay and ATM, 4th edition (Pearson Education), 2009.
3. SumitKasera and PankajSethi: ATM Networks Concept and Protocol, Tata McGraw Hill Publication, 2006.
4. Rajiv Ramaswami,Kumar N: Optical Networks, Morgan Kaufmann Publishers 2nd Edition, 2008.

Course Outcomes (COs):

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

1. Demonstrate In-depth knowledge in high speed networks and estimate the link performance. (PO-1,2,3)
2. Analyze the working of packet switches networks. (PO-1,2,3)
3. Illustrate the Backbone and Trunking Technologies(ATM,SDH,SONET) (PO-1,2,3)
4. Identify the critical analysis and novel ideas in the area of wireless network (PO-1,2,3)
5. Summarize the independent study to prepare a Technical document to address optical network (PO-1,2,3)

ADVANCED SOFTWARE ENGINEERING	
Course Code: MCNE233	**Credits: 4:0:0**
Pre-requisites: Software Engineering	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Unit I

Process Models: A Generic Process Model, Process Assessment and Improvement, Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models, Process Technology, Product and Process. (T1: Chapter-2)**Agile Development:** What Is Agility? Agility and the Cost of Change, What Is an Agile Process?, Extreme Programming (XP), Other Agile Process Models, Agile Unified Process (AUP), A Tool Set for the Agile Process. (T1: Chapter-3)

Unit II

DevOps Culture and Practices: Getting started with DevOps, Implementing CI/CD and continuous deployment. (T2: Chapter-1)**Continuous Integration and Continuous Delivery**: The CI/CD principles, Using a package manager, Using Jenkins, Using Azure Pipelines, Using GitLab CI. (T2: Chapter-6). **Requirements Engineering**: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management (T3: Chapter-4).

Unit III

Design Concepts: Design within the Context of Software Engineering, The Design Process, Design Concepts, The Design Model. (T1: Chapter-8)**Architectural Design:** Software Architecture, Architectural Genres, Architectural Styles, Architectural Design, Assessing Alternative Architectural Designs, Architectural Mapping Using Data Flow (T1: Chapter-9)**User Interface Design:** The Golden Rules, User Interface Analysis and Design, Interface Analysis, Interface Design Steps, WebApp Interface Design (T1: Chapter-11)

Unit IV

Quality Concepts: What Is Quality?, Software Quality, The Software Quality Dilemma, Achieving Software Quality. (T1: Chapter-14)**Review Techniques**: Cost Impact of Software Defects, Defect Amplification and Removal, Review Metrics and Their Use, Reviews: A Formality Spectrum, Informal Reviews, Formal Technical Reviews. (T1: Chapter-15) **Software Quality Assurance:** Background Issues,

Elements of Software Quality Assurance, SQA Tasks, Goals, and Metrics, Formal Approaches to SQA, Statistical Software Quality Assurance, Six Sigma for Software Engineering, Software Reliability, The ISO 9000 Quality Standards, The SQA Plan (T1: Chapter-16).

Unit V

Software Reuse: The reuse landscape, Application frameworks, Software product lines, COTS product reuse. (T3: Chapter-16)**Component-based Software Engineering:** Components and component models, CBSE processes, Component composition. (T3: Chapter-17)**Service-Oriented Architecture:** Services as reusable components, Service engineering, Software development with services. (T3: Chapter-19)**Aspect-Oriented Software Engineering:** The separation of concerns, Aspects, join points and pointcuts, Software engineering with aspects. (T3: Chapter-21).

Text Books:

1. Pressman, Roger S. Software Engineering: A Practitioner's Approach, 7th Edition, McGraw-Hill.ISBN 9780073375977, 2010.
2. Krief, Mikael. Learning DevOps, 1st Edition, Packt Publishing Ltd. ISBN 9781838642730, 2019.
3. Sommerville, Ian.Software Engineering, 9th Edition, Pearson Education. ISBN 9780137035151, 2011.

Reference Textbooks:

1. Verona, Joakim, Practical DevOps, 1st Edition, Packt Publishing Ltd. ISBN 9781785882876,2016.
2. Blaha, Michael, and James Rumbaugh. Object-Oriented Modeling and Design with UML, 2nd Edition, Pearson Education, ISBN 9780130159205, 2004.

Course Outcomes (COs):

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

1. Identify various software development processes and methodologies. (PO: 1, 2, 3 & 5)
2. Apply the DevOps pipeline process starting with continuous integration and continuous deployment principles. (PO: 1, 2, 3 & 5)
3. Recognize the different Design principles, Architectural Design and User Interface Design for developing a high-quality system or product. (PO: 1, 2, 3 & 5)
4. Recognize the need for applying the Software Quality Assurance practice throughout the software process. (PO: 1, 2, 3 & 5)
5. Summarize the need for reusing the software components. (PO: 1, 2, 3 & 5)

FOG AND EDGE COMPUTING	
Course Code: MCNE234	**Credits: 4:0:0**
Pre-requisites: Networks	**Contact Hours: 56**
Course Coordinator: Dr. Rajarajeswari S.	

Course Contents

Unit I

Internet of Things (IoT) and New Computing Paradigms, Addressing the Challenges in Federating Edge Resources, Integrating IoT + Fog + Cloud Infrastructures: System Modeling and Research Challenges

Unit II

Management and Orchestration of Network Slices in 5G, Fog, Edge, and Clouds, Optimization Problems in Fog and Edge Computing, Middleware for Fog and Edge Computing: Design Issues.

Unit III

Data Management in Fog Computing, Predictive Analysis to Support Fog Application Deployment, Using Machine Learning for Protecting the Security and Privacy of Internet of Things (IoT) Systems.

Unit IV

Applications and Issues: Fog Computing Realization for Big Data Analytics, Exploiting Fog Computing in Health Monitoring, Smart Surveillance Video Stream Processing at the Edge for Real-Time Human Objects Tracking, Fog Computing Model for Evolving Smart Transportation Applications.

Unit V

Testing Perspectives of Fog-Based IoT Application, Legal Aspects of Operating IoT Applications in the Fog, Modeling and Simulation of Fog and Edge Computing Environments Using iFogSim Toolkit

Text Book:

1. Rajkumar Buyya, Satish Narayana Srirama,: Fog and Edge Computing: Principles and Paradigms, Wiley, ISBN: 978-1-119-52498-4 January 2019

Reference Books:

1. Jie Wu , Wei Chang, Fog/Edge Computing For Security, Privacy, and Applications: Advances in Information Security, Springer 6 January 2022
2. Ajith Singh, "Fog and Edge Computing: simply in depth", ISBN-13 979-8725825428, 21 March 2021.
3. Deepak Gupta, Aditya Khamparia: Fog, Edge, and Pervasive Computing in Intelligent IoT Driven Applications, IEEE Press, Wiley, 2021.
4. Muhammad Maaz Rehan and Mubashir Husain Rehmani: Blockchain-enabled Fog and Edge Computing: Concepts, Architectures, and Applications, CRC Press, First edition, 2020.

Course Outcomes (COs):

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

1. Provide insights on transitioning from current Cloud-centric and 4G/5G wireless environments to Fog Computing (PO- 1,2,3, 4, 5).
2. Review underlying technologies, limitations, and challenges along with future research direction and discuss generic conceptual framework for optimization problems in fog computing (PO- 1,2,3, 4, 5).
3. Discuss major components of Fog and Edge computing architectures such as middleware, interaction protocols, and autonomic management . (PO-1,2,3, 4, 5).
4. Identify potential technical challenges and offers suggestions for possible solutions for real time problems (PO- 1,2,3, 4, 5).
5. Design and develop simulation scenarios for Edge and Fog Computing using network simulator/ iFogSim Toolkit. (PO- 1,2,3, 4, 5).

ELECTIVES - V

NETWORK SECURITY AND ETHICAL HACKING	
Course Code: MCNE241	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari	

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, anti-pattern: 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 anti patterns concept, forces in cyber anti patterns, cyber anti pattern templates, cyber security anti pattern catalog.

Unit III

Casing the Establishment - What is foot printing- Internet Foot printing. –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 Books:

1. William Stallings, Cryptography and Network Security, Pearson 6th edition.
2. Thomas J. Mowbray: CyberSecurity–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 Books:

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

Course Outcomes (COs):

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

1. Discuss the wireless security issues and threats (PO1,3,4)
2. Explain the transport layer security and address the cyber security issues (PO1,3,4)
3. Implement secure permission systems (PO1,3,4)
4. Identify the hacking issues and different types of attacks (PO1,3,4)
5. Implement various ethical hacking issues (PO1,3,4,5)

OPTICAL NETWORKS	
Course Code: MCNE242	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator Dr. Shilpa Chaudhari	

Course Contents

Unit I

OPTICAL SYSTEM COMPONENTS: Light propagation in optical fibers – Loss & bandwidth, System limitations, Non-Linear effects; Solitons; Optical Network Components – Couplers, Isolators & Circulators, Multiplexers & Filters, Optical Amplifiers, Switches, Wavelength Converters.

Unit II

OPTICAL NETWORK ARCHITECTURES: Introduction to Optical Networks; SONET / SDH, Metropoliton-Area Networks, Layered Architecture; Broadcast and Select Networks – Topologies for Broadcast Networks, Media-Access Control Protocols, Testbeds for Broadcast & Select WDM; Wavelength Routing Architecture.

Unit III

OPTICAL RECEIVER AND TRANSMISSION SYSTEMS: Fundamental receiver operation and detailed performance calculations. Point to point link analysis, Noise effects on system performance. Carrier to noise ration evaluation for analog link.

Unit IV

WDM CONCEPTS AND COMPONENTS: Operational principle of WDM, Passive components: Couplers, Multiplexers & Filters, Tunable sources. Semiconductor Optical Amplifier: pumping and amplifier gain, EDFA, Wavelength converters.

Unit V

OPTICAL NETWORKS: Basic networks, network topologies. SONET / SDH: transmission formats and speed, optical interface, SONET/SDH rings. Broadcast-and-select WDM networks, Wavelength routed networks: optical cross connect, nonlinear effects on network performance.

Text Books:

1. Biswanath Mukherjee University of California, Davis Davis, CA - Optical Network Design and Planning, 2008
2. Rajiv Ramaswami and Kumar N. Sivarajan, ―Optical Networks: A Practical Perspective‖, Harcourt Asia Pte Ltd., Second Edition 2006
3. Gerd Keiser, Optical Fiber Communication, McGraw Hill, Fifth Edition, 2013.
4. G.P Agrawal, Fiber Optic Communication Systems, John Wiley and Sons, Fourth Edition, 2010.
5. Partha Pratim Sahu, Advances in Optical Networks and Components, 2021 Taylor & Francis Group, LLC

Course Outcomes (COs):

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

1. Explore the basic elements of optical fiber transmission link, fiber modes configurations and structures.(PO-1,2,3)
2. Recognize and classify the structures of Optical fiber and types(PO-1,2,3)
3. Classify various Optical sources and detectors to discuss their principle. (PO-1,2,3)
4. Design and implement WDM networks. (PO-1,2,3)
5. Compare the characteristics of fiber optic receivers(PO-1,2,3)

ADVANCED OPERATING SYSTEM	
Course Code: MCNE243	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator Dr. Shilpa Chaudhari	

Course Contents

Unit I

Introduction to the Linux Kernel- Obtaining the Kernel Source, The Kernel Source Tree, Building the Kernel, Loadable kernel module

Debugging - Getting Started, Bugs in the Kernel, Debugging by Printing, Oops, Kernel Debugging Options

Process Management – process descriptor and task structure, process creation, The Linux Implementation of Threads, process termination

Unit II

Process Scheduling – Multitasking, Linux's Process Scheduler, Policy, Linux scheduling algorithm, The Linux Scheduling Implementation, Preemption and Context Switching, Real-Time Scheduling Policies, Scheduler-Related System Calls

System Call implementation - Communicating with the Kernel, APIs, POSIX, and the C Library, Syscalls, System Call Handler, System Call Context

Unit III

Kernel Data Structures - What Data Structure to Use, When,

Interrupt Handlers - Top Halves Versus Bottom Halves, Registering an Interrupt Handler

Bottom Halves - softirq, tasklets, Work Queues

Timer- Jiffies, Hardware Clocks and Timers, The Timer Interrupt Handler

Unit IV

Memory Management – Pages, Zones, Getting Pages, kmalloc, vmalloc, slab layer,

The Process Address Space- Address Spaces, memory descriptor

The Page Cache- Approaches to Caching, The Linux Page Cache

Unit V

The Virtual Filesystem - Common Filesystem Interface, Filesystem Abstraction Layer, Unix Filesystems, VFS Objects and Their Data Structures, The Superblock Object, Superblock Operations, The Inode Object, Inode Operations, The Dentry Object, Dentry Operations, The File Object, File Operations

Devices and Modules - Device Types, The Device Model, sysfs

Reference Books:

1. Robert Love, Linux kernel development, 3rd edition, 2010
2. BILLIMORIA, Kaiwan N. Linux Kernel Programming: A comprehensive guide to kernel internals, writing kernel modules, and kernel synchronization. Packt Publishing Ltd, 2021.
3. BHARADWAJ, Raghu. Mastering Linux Kernel Development: A kernel developer's reference manual. Packt Publishing Ltd, 2017.

Course Outcomes (COs):

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

1. Examine the kernel components for building kernel image from kernel source (PO-1,2,3)
2. Analyze kernl process and CPU scheduling to observe the process manamgement (PO-1,2,3,5)
3. Design the interrupt handler considering kernel synchronization (PO-1,2,3,5)
4. Demonstrate memory manamgent at kernel level (PO-1,2,3,5)
5. Design device driver as lodable kernle module (PO-1,2,3,5)

SOCIAL NETWORK ANALYSIS	
Course Code: MCNE244	**Credits: 4:0:0**
Pre-requisites: Computer Networks	**Contact Hours: 56**
Course Coordinator Dr. Parkavi A	

Course Contents

Unit I

Introduction: What is Social Network Analysis, Why do we study Social Networks, Application of Social Network Analysis, Preliminaries, Three levels of Social Network Analysis, Historical Development, Graph Visualization Tools?

Network Measures: Network Basics, Node Centrality, Assortativity, Transitivity and Reciprocity, Similarity, Degeneracy.

Unit II

Network Growth Models: Properties of Real-World Networks,Random Network Model, Ring Lattice Network Model,Watts–Strogatz Model, Preferential Attachment Model, Price's Model,Local-world Network Growth Model,Network Model with Accelerating Growth, Aging in Preferential Attachment

Link Analysis:Applications of Link Analysis, Signed Networks, Strong and Weak Ties, Link Analysis Algorithms, PageRank, Personalised PageRank, DivRank, SimRank, PathSIM

Unit III

Community Structure in Networks: Applications of Community Detection, Types of Communities, Community Detection Methods.

Link Prediction : Applications of Link Prediction, Temporal Changes in a Network , Problem Definition,Evaluating Link Prediction Methods ,Heuristic Models ,Probabilistic Models,Supervised Random Walk, Information-theoretic Model ,Latest Trends in Link Prediction

Unit IV

Cascade Behaviours and Network Effects: Preliminaries and Important Terminologies, Cascade Models, Case Study – The "Indignados" Movement

Anomaly Detection in Networks: Outliers versus Network-based Anomalies, Challenges, Anomaly Detection in Static Networks, Anomaly Detection in Dynamic Networks.

Unit V

Graph Representation Learning: Machine Learning Pipelines, Intuition behind, Representation Learning, Benefits of Representation Learning, Criterion for Graph Representation Learning, Graph Representation Learning Pipeline, Representation Learning Methods.

Applications and Case Studies: Malicious Activities on OSNs, Sockpuppets in OSNs, Collusion on Online Social Networks, Modelling the Spread of COVID-19, Recommender Systems.

Reference Books:

1. Tanmoy Chakraborty: Social Network Analysis, First edition, Wiley, 2021.
2. John Scott: Social Network Analysis, 4th edition, Sage, Los Angeles, 2017

Course Outcomes (COs):

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

1. Examine the need for Social Network Analysis and various measures (PO 1,3,4,5)
2. Identify the various Network growth models (PO 1,3,5)
3. Apply the concept of community structure in Network. (PO 1,2,4,5)
4. Analyze the various anomaly detection methods in network (PO 1,3,4,5)
5. Demonstrate the machine learning pipelines with various applications (PO 1,2,4,5)

ELECTIVES - VI

CYBER SECURITY AND CYBER LAW	
Course Code: MCNE251	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Monica R Mundada	

Course Contents

Unit I

Introduction to Cybercrime: Cybercrime: Definition and Origins of the Word, Cybercrime and Information Security, Who are Cybercriminals?, Classifications of Cybercrimes, Cybercrime: The Legal Perspectives, Cybercrimes: An Indian Perspective, Cybercrime and the Indian ITA 2000, A Global Perspective on Cybercrimes, Cybercrime Era: Survival Mantra for the Netizens. **Cybercrime**: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit Card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication Service Security, Attacks on Mobile/Cell Phones,

Unit II

Mobile Devices: Security Implications for organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops. **Cyber offenses**: How Criminals Plan Them: How Criminals Plan the Attacks, Social Engineering, Cyberstalking, Cybercafe and Cybercrimes, Botnets: The Fuelfor Cybercrime, Attack Vector, Cloud Computing

Unit III

Understanding Computer Forensics: Introduction, Historical Background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber forensics and Digital Evidence, Forensics Analysis of E-Mail, Digital Forensics Life Cycle, Chain of Custody Concept, Network Forensics, Approaching a Computer Forensics Investigation, Setting up a Computer Forensics Laboratory: Understanding the Requirements, Computer Forensics and Steganography

Unit IV

Tools and Methods Used in Cybercrime: Introduction, Proxy Servers and Anonymizers, Phishing, Password Cracking, Keyloggers and Spywares, Virus and Worms, Trojan Horsesand Backdoors, Steganography, DoS and DDoS Attacks, SQL

Injection, Buffer Overflow, Attacks on Wireless Networks. Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Unit V

Relevance of the OSI 7 Layer Model to Computer Forensics, Forensics and Social Networking Sites: The Security/Privacy Threats, Computer Forensics from Compliance Perspective, Challenges in Computer Forensics, Special Tools and Techniques, Forensics Auditing, Anti-forensics

Cyber Crimes and Cyber Security: The Legal Perspectives, Why do we need cyberlaws: The Indian context, The Indian IT Act, Challenges to Indian law and Cybercrime scenario in India, Digital Signatures and the Indian Act, Cybercrime and Punishment, Cyber law, Technology and Students: Indian Scenario

Text Book:

1. Nina Godbole and Sunit Belapure: Cyber Security: Understanding Cyber Crimes, Computer Forensics And Legal Perspectives, Wiley India Pvt Ltd, ISBN: 978-81-265-21791, 2011.

Reference Book:

1. Mayank Bhushan, Raj kumar Singh Rathore and Aatif Jamshed: Fundamental of Cyber Security: Principles, Theory and Practices, BPB Publications, ISBN: 978-93-8655-155-9, First Edition, 2017.

Course Outcomes (COs):

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

1. Recognize Cybercrimes and its impact on information security (PO 1,3,4,5)
2. Assess Security challenges in mobile and wireless devices (PO 1,3, 5)
3. Appraise various digital forensics techniques in real life situations. (PO 1,2,4,5)
4. Demonstrate the tools and methods learnt in identifying cybercrimes. (PO 1,3,4,5)
5. Identify suitable network security and awareness in Indian cyber laws and punishments (PO 1,2,4,5)

BLOCK CHAIN ESSENTIALS & DAPPS	
Course Code: MCSE251	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Parkavi A	

Course Contents

Unit I

Introduction, Purpose and Scope, Results of the Public Comment Period, Document Structure, Blockchain Categorization, Permissionless, Permissioned, Blockchain Components, Cryptographic Nonce, Transactions, Asymmetric-Key Cryptography, Ledgers, Blocks, Chaining Blocks, Consensus Models, Forking, Smart Contracts, Blockchain Limitations and Misconceptions, Application Considerations, Additional Blockchain Considerations.

Unit II

Introduction to Cryptography & Cryptocurrencies, Cryptographic Hash Functions, Hash Pointers and Data Structures, Digital Signatures, Public Keys as Identities, A Simple Cryptocurrency, How Bitcoin Achieves Decentralization, Centralization vs. Decentralization, Distributed consensus, Consensus without identity using a block chain, Incentives and proof of work, Mechanics of Bitcoin, Bitcoin transactions, Bitcoin Scripts, Applications of Bitcoin scripts, Bitcoin blocks, The Bitcoin network, Limitations and improvements.

Unit III

Blockchain 3.0: Justice Applications Beyond Currency, Economics, and Markets, Blockchain Technology Is a New and Highly Exective Model for Organizing Activity, Distributed Censorship-Resistant Organizational Models, Namecoin, Digital Art: Blockchain Attestation Services (Notary, Intellectual Property Protection), Blockchain Government, Efficiency and Coordination Applications Beyond Currency, Economics, and Markets, Blockchain Science: Gridcoin, Foldingcoin, Blockchain Genomics, Blockchain Health, Blockchain Learning: Bitcoin MOOCs and Smart Contract Literacy, Blockchain Academic Publishing: Journalcoin, Centralization-Decentralization Tension and Equilibrium, Advanced Concepts.

Unit IV

Ethereum, DApp, Components, EVM, Etherscripter, Hyperledger, Digital Tokens, OmiseGO, EOS, Tether, MetaMask, Wallet Seed, MetaMask Transactions, Objectives of the Hyperledger Project, Mist, Mist wallet, Truffle, Features, Development-Truffle

boxes, Truffle Box, Creating a Truffle Box, Community truffle box, Embark, Solidity, Smart Contracts, Statically typed Language, Contract and Interfaces, Hyperledger Fabric, Mode of operation, Hyperledger Iroha, Components.

Unit V

Hyperledger Sawtooth, Components, Validator registry, Consensus, DApps, Seafood supply chain traceability, Marketplace Digital Asset Exchange, Cello: Features, operator dashboard, Comparison of Bitcoin, Ethereum and Hyperledger, Multichain, Language support, Security, Mining, HydraChain: Smart contracts and HydraChain, IOTA, Corda, Elements Project, deployed Elements., Chain Core, operations available, Development & Security, CoCo Framework, Specialties, Benefits, Tierion, Chainpoint, Benefits of Tierion, BigchainDB, Models, Transaction Models, Block Models.

Text Books:

1. Dylan Yaga, Peter Mell, Nik Roby, Karen Scarfone, Blockchain Technology Overview, NIST Report 8202,US Department of Commerce, Oct 2018.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder: Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press, 2016

Reference Books:

1. Melanie Swan, Block chain, Blueprint for A New Economy, O'Reilly, 2015.
2. Sainul Abideen, Block chain Expert, BlockChain E-Book, Cybrosys Technologies.
   https://www.blockchainexpert.uk/book/blockchain-book.pdf

Course Outcomes (COs):

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

1. Analyze the fundamental elements of block chain technology(PO1,3,4)
2. Demonstrate the application of hashing and public key cryptography in protecting the blockchain (PO1,3,4)
3. Analyse the block chain applications in a structured manner. (PO1,3,4)
4. Develop block chain based solutions and write smart contract using Ethereum Framework. (PO1,3,4)
5. Use smart contract in real world applications (PO 1,3,4,5)

MOBILE COMMUNICATION	
Course Code: MCNE253	**Credits: 4:0:0**
Pre-requisites: Wireless Networks	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Unit I

System Architecture Evolution - High-Level Architecture of LTE; User Equipment, Evolved UMTS Terrestrial Radio Access Network, Evolved Packet Core, Communication Protocols, Example Signaling Flows, Bearer Management

Orthogonal Frequency Division Multiple Access - Principles of OFDMA, Benefits and Additional Features of OFDMA, Single Carrier Frequency Division Multiple

Multiple Antenna Techniques - Diversity Processing, Spatial Multiplexing, Beamforming

Unit II

Architecture of the LTE Air Interface - Air Interface Protocol Stack, Logical, Transport and Physical Channels, The Resource Grid, Multiple Antenna Transmission, Resource Element Mapping

Cell Acquisition - Acquisition Procedure, Synchronization Signals, Downlink Reference Signals, Physical Broadcast Channel, Physical Control Format Indicator Channel

Data Transmission and Reception, Data Transmission Procedures, Transmission of Scheduling Messages on the PDCCH, Data Transmission on the PDSCH and PUSCH, Uplink Control Information, Transmission of Uplink Control Information on the PUCCH, Uplink Reference Signals

Random Access -Transmission of Random-Access Preambles on the PRACH, Non-Contention-Based Procedure, Contention-Based Procedure

Unit III

5G Fundamentals – use cases, network architectures, base station architecture

Air Interface – numerology, radio frames and slots, resource blocks and bandwidth parts, channel bandwidths

Downlink signals and channels – downlink channel mappings, synchronization signals, physical broadcast channel, SS/PBCH blocks and bursts

Unit IV

Downlink transmission schemes – PBCH, PDCCH, PDSCH
FLOW OF DOWNLINK DATA – SDAP layer, PDCP layer, RLC layer, MAC layer
System information – master information block, system information block 1

Unit V

EPC for 5G - Introduction, Key EPC functions, (Enhanced) Dedicated Core Networks ((e) DECOR), Control and User Plane Separation (CUPS
Session management - PDU Session concepts, PDU Session types, User plane handling, Mechanisms to provide efficient user plane connectivity, Session authentication and authorization
Protocols - Introduction ,5G non-access stratum (5G NAS) , NG application protocol (NGAP) , Hypertext transfer protocol (HTTP) , Transport layer security (TLS) , Packet forwarding control protocol (PFCP) , GPRS tunnelling protocol for the User Plane (GTP-U) , Extensible Authentication Protocol (EAP) , IP security (IPSec), Stream Control Transmission Protocol (SCTP), Generic routing encapsulation (GRE)

Reference Books:

1. Chris Johnson, 5G New Radio in Bullets, 1st edition, 2019
2. STEFAN ROMMER, PETER HEDMAN, MAGNUS OLSSON, LARS FRID, SHABNAM SULTANA, CATHERINE MULLIGAN, 5G CORE NETWORKS - Powering Digitalization, Academic Press, 2020
3. Christopher Cox, AN INTRODUCTION TO LTE, LTE, LTE-ADVANCED, SAE, VoLTE AND 4G MOBILE COMMUNICATIONS, Second Edition, John Wiley & Sons, 2014

Course Outcomes (COs):

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

1. Explore concepts and principles of 4G communication with the evolution of cellular networks. (PO1, 2, 3, 4)
2. Analyze the working of LTE architecture (PO1, 2, 3, 4)
3. Outline the working of 5G architecture (PO1, 2, 3, 4)
4. Explore downlink transmission schemes (PO1, 2, 3, 4)
5. Illustrate 5G protocols (PO1, 2, 3, 4,5)

FUTURE SKILLS AND STARTUP ENGINEERING	
Course Code: MCNE254	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Naghabhushan A M	

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

Cross-cultural 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

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.

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. Compare the Virtual Collaboration skills to complete an assignment. (PO 1,3,4)
4. Examine the social intelligence skill and application of the same. (PO 1,3,4)
5. Design an assignment using Cross-cultural competence and load management skills. (PO 1,3,4)

CLOUD COMPUTING AND BIG DATA LABORATORY	
Course Code: MCNL26	**Credits: 0:0:1**
Pre-requisites: Nil	**Contact Hours: 28**
Course Coordinator: Dr. Ganeshayya Shidaganti	

Course Contents

List of problems for which student should develop program and execute in the Laboratory

1. Downloading and Installing Hadoop;
2. Understanding Hadoop Distributed File system (HDFS); Explore Basic Hadoop Commands; Different Hadoop Modes. Startup scripts, Configuration files.
3. Understanding Anatomy of MapReduce Job Run and Workflows and Developing various MapReduce Applications.
4. Downloading and Installing Apache Spark; Running Apache Spark Applications using Scala.
5. Developing and Testing Pig Latin Scripts.
6. Understanding Hive Shell and Manipulating HiveQL Quires.
7. Installation of various Hypervisors and Instantiation of VMs with image file using Open Source Hypervisors such as Virtual Box, VMWare Player, Xen, OpenVZ and KVM.
8. Implementation of various Scheduling Mechanisms and Load Balancing Mechanisms using Open Source Cloud Simulator.

References:

1. Tom White "**Hadoop: The Definitive Guide**" Forth Edition, O'reilly Media, 2015.
2. Marinescu, Dan C. **Cloud computing: theory and practice**. Morgan Kaufmann, 2022. – 3rd Edition – Elsevier.
3. Ryza, Sandy, Uri Laserson, Sean Owen, and Josh Wills. **Advanced analytics with spark: patterns for learning from data at scale**. " O'Reilly Media, Inc.", 2017.
4. Gates, Alan, and Daniel Dai**. Programming pig: Dataflow scripting with hadoop.** " O'Reilly Media, Inc.", 2016..
5. Capriolo, Edward, Dean Wampler, and Jason Rutherglen. **Programming Hive: Data warehouse and query language for Hadoop.** " O'Reilly Media, Inc.", 2012.Mining Concepts and Techniques", 2nd Edition, Elsevier, Reprinted 2008

Course Outcomes (COs):

1. Explore the Hadoop Ecosystem and MapReduce Programming to perform various Business Applications associated with Big Data Analytics. (PO-1, 2, 3, 4, 5)
2. Analyze Big Data Applications Using Pig and Hive and Spark. (PO-1, 2, 3, 4, 5).
3. Apply the concepts of Virtual Machines/Hypervisors, Scheduling and Load Balancing Mechanisms in Cloud using Open-Source Software. (PO-1, 2, 3, 4, 5)

CRYPTOGRAPHY AND NETWORK SECURITY LABORATORY	
Course Code: MCNL27	**Credits: 0:0:1**
Pre-requisites: Computer Networks	**Contact Hours: 28**
Course Coordinator: Dr. Sangeetha V	

Course Contents

1. Implement Ceaser Cipher using C/C++/Python.
2. Implement Affine Cipher with any sample equation using C/C++/Python.
3. Implement Playfair Cipher with key entered by user using C/C++/Python.
4. Implement Polyalphabetic Cipher using C/C++/Python.
5. Implement AutoKey Cipher using C/C++/Python.
6. Implement Hill Cipher using C/C++/Python.
7. Implement public key cryptography RSA algorithm using C/C++/Python.
8. Implement the Signature Scheme for Digital Signature Standard.
9. Implement Simplified DES to Make a study of IDS (For ex. Snort).
10. Implement Diffie Hellman Secret Key Exchange Algorithm.
11. Demonstrate using Cryptool the Triple DES with CBC mode, Weak DES keys, Hash generation and sensitivity of hash functions to plaintext modifications.
12. Demonstrate using Cryptool the attack on RSA encryption with short RSA modulus and Digital Signature Visualization.
13. Demonstrate vulnerability scanning using Nessuss tool.
14. Demonstrate security scanner using NMap tool.

Suggested Learning Resources:

1. Behrouz A. Forouzan, Debdeep Mukhopadhyay: Cryptography and Network Security, 3nd Edition, Special Indian Edition, Tata McGraw-Hill, 2015.
2. William Stallings, Cryptography and Network Security-principles and practices, Seventh Edition, 2017 Pearson
3. Snort - https://www.snort.org/downloads
4. Cryptool- https://www.cryptool.org/en/jct/downloads
5. Nessus-https://www.filehorse.com/download-nessus/
6. NMap- https://nmap.org/download

Course Outcomes (COs):

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

1. Build cryptosystems by applying symmetric and public key encryption algorithms. (PO-1,2, 3, 4)
2. Develop a signature scheme using Digital signature standard. (PO-1, 2, 3,4)
3. Demonstrate the security system using open-source tools. (PO-1, 2, 3, 4)

SOFTWARE DEFINED NETWORKS	
Course Code: MCN31	**Credits: 3:1:0**
Pre-requisites: Computer Networks	**Contact Hours: 42+28**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Unit I

How SDN Works - Fundamental Characteristics of SDN, SDN Operation, SDN Devices, 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 Open Flow Specification – Open Flow Overview – The Open Flow switch, The Open Flow Controller, The Open Flow protocol, The Controller-switch secure channel

Unit II

Open Flow 1.0 and Open Flow Basics, Open Flow 1.1 Additions, Open Flow 1.2 Additions, Open Flow 1.3 Additions, Open Flow Limitations. Open flow 1.4 additions – Bundles, Eviction and vacancy events, enhanced support for multiple controller, optical port support, and flow table synchronization. OpenFlow 1.5 Additions - Enhanced L4–L7 Support, Pipeline Processing Enhancements, Egress Tables, Fitness for Carrier Use, Bundle Enhancements, Enhanced Support for Multiple Controllers, Enhanced Support for Tunnels, Enhancements to Flow Entry Statistics.

Unit III

SDN Controllers- Introduction, General Concepts,VMware, Nicira, OpenFlow-Related,

Mininet, NOX/POX, Trema, Ryu, Big Switch Networks/Floodlight, Layer 3 Centric, L3VPN, Path Computation Element Server, Plexxi, Plexxi Affinity, Cisco OnePK, Relationship to the Idealized SDN Framework.

Building an SDN Framework- Introduction, The Juniper SDN Framework, IETF SDN Framework(s), SDN(P), ABNO, Open Daylight Controller/Framework, API, High Availability and State Storage, Analytics, Policy

Unit IV

The Journey to Network Functions Virtualization (NFV) Era – NFV Architectural framework- Need for a framework, ETSI framework for NFV, understanding the ETSI framework, A closer look at ETSI's NFV framework, NFV framework summary,

Benefits of NFV- Hardware flexibility, faster service life cycle, scalability and elasticity, leveraging existing tools, rapid development and vendor independence, validation of new solutions, amorphous service offering, operational efficiency and agility.

Virtualization of Network Functions: Designing NFV Networks –NFV Design considerations, NFV transformation challenges, Virtualization of Network Infrastructure and Services – NFV for Routing infrastructure, virtualization of network security, virtualization of mobile communication networks

Unit V

Use Cases for Bandwidth Scheduling, Manipulation, and Calendaring - Introduction, Bandwidth Calendaring, Base Topology and Fundamental Concepts, OpenFlow and PCE Topologies, Example Configuration, OpenFlow Provisioned Example, Enhancing the Controller, Overlay Example Using PCE Provisioning, Expanding Your Reach: Barbarians at the Gate, Big Data and Application Hyper-Virtualization for Instant CSPF, Expanding Topology

Use Cases for Data Center Overlays, Big Data, and Network Function Virtualization-Introduction, Data Center Orchestration, Creating Tenant and Virtual Machine State, Forwarding State, Data-Driven Learning, Control-Plane Signaling, Scaling and Performance Considerations,Puppet (DevOps Solution), Network Function Virtualization - NFV in Mobility, Optimized Big Data

Use Cases for Input Traffic Monitoring, Classification, and Triggered Actions-Introduction, The Firewall, Firewalls as a Service, Network Access Control Replacement, Extending the Use Case with a Virtual Firewall, Feedback and Optimization, Intrusion Detection/Threat Mitigation

Tutorial topic 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. Thomas D.Nadeau & Ken Gray: SDN Software Defined Networks O'Reilly publishers, First edition, 2013.
3. 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.

Course Outcomes(COs):

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

1. Identify the fundamental characteristics of SDN. (PO1,3,4)
2. Compare the various OpenFlow specifications. (PO1,3,4)
3. Illustrate implementation of SDN controllers and building of SDN framework. (PO1,3,4)
4. Examine the NFV framework and Virtualization of Network Functions. (PO1,3,4)
5. Illustrate use of SDN and NFV for bandwidth scheduling, data center orchestration and Network Access Control. (PO1,3,4,5)

ELECTIVES - VII

MULTI CORE ARCHITECTURE AND PROGRAMMING	
Course Code: MCNE321	**Credits: 4:0:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari /Mallegowda M	

Course Contents

Unit I

Introduction to Multi-Core Architecture: Motivation for Concurrency in Software, Parallel Computing Platforms,Parallel Computing in Microprocessors, Differentiating Multi-Core Architectures from Hyper- Threading Technology, Multi-Threading On Single-Core Versus Multi-Core Platforms Understanding Performance, Amdahl's Law, Growing Returns: Gustafson's Law. System Overview of Threading: Defining Threads, System View of Threads, Threading Above the Operating System, Threads Inside The OS, Threads Inside The Hardware, What Happens When A Thread Is Created, Application Programming Models And Threading, Virtual Environment: Vms And Platforms, Runtime Virtualization, System Virtualization.

Unit II

F9undamental Concepts Of Parallel Programming: Designing For Threads, Task Decomposition, Data Decomposition,Data Flow Decomposition, Implications Of Different Decompositions, Challenges You'll Face, Parallel Programming Patterns, A Motivating Problem: Error Diffusion, Analysis Of The Error Diffusion Algorithm, An Alternate Approach: Parallel Error Diffusion, Other Alternatives.

Unit III

Threading And Parallel Programming Constructs: Synchronization, Critical Sections, Deadlock, SynchronizationPrimitives, Semaphores, Locks, Condition Variables, Messages, Flow Control- Based Concepts, Fence, Barrier, Implementation-Dependent Threading Features. Threading Apis : Threading Apls For Microsoft Windows, Win32/MFC Thread Apls, Threading Apls For Microsoft. NET Framework, Creating Threads, Managing Threads, Thread Pools, Thread Synchronization, POSIX Threads, Creating Threads, Managing Threads, Thread Synchronization, Signaling, Compilation And Linking.

Unit IV

Openmp: A Portable Solution For Threading: Challenges In Threading A Loop, Loop-Carried Dependence, Data-RaceConditions, Managing Shared And Private Data, Loop

Scheduling And Portioning, Effective Use Of Reductions, Minimizing Threading Overhead, Work-Sharing Sections, Performance-Oriented Programming, Using Barrier And No Wait, Interleaving Single-Thread And Multi-Thread Execution, Data Copy-In And Copy-Out, Protecting Updates Of Shared Variables, Intel Task Queuing Extension To Openmp, Openmp Library Functions, Openmp Environment Variables, Compilation, Debugging, Performance.

Unit V

Solutions To Common Parallel Programming Problems: Too Many Threads, Data Races, Deadlocks, And Live Locks,Deadlock, Heavily Contended Locks, Priority Inversion, Solutions For Heavily Contended Locks, Non-Blocking Algorithms, ABA Problem, Cache Line Ping-Ponging, Memory Reclamation Problem, Recommendations, Thread-Safe Functions And Libraries, Memory Issues, Bandwidth, Working In The Cache, Memory Contention, Cache-Related Issues, False Sharing, Memory Consistency, Current IA-32 Architecture, Itanium Architecture, High-Level Languages, Avoiding Pipeline Stalls On IA-32,Data Organization For High Performance.

Text Books:

1. Multicore Programming , Increased Performance through Software Multi-threading by Shameem Akhter and Jason Roberts , Intel Press , 2006
2. Hennessey and Patterson: Computer Architecture A Quantitative Approach, 4th Edition, Elsevier, 2012.

Reference Book:

1. Kai Hwang, NareshJotwani: Advanced Computer Architecture - Parallelism, Scalability, Programmability, 2nd Edition, Tata McGraw Hill, 2011.

Course Outcomes (COs):

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

1. Identify performance related parameters in the field of Computer Architecture. (PO1,3,4)
2. Identify the limitations of ILP and the need for multi-core architectures. (PO1,3,4)
3. Analyze the issues related to multiprocessing and suggest solutions. (PO1,3,4)
4. Appraise the salient features of different multi-core architectures and how they exploit parallelism. (PO1,3,4)
5. Explain the concept of multi-threading and OpenMP. (PO1,3,4)

DEEP LEARNING	
Course Code: MCNE322	**Credits: 4**
Pre-requisites:	**Contact Hours: 56**
Course Coordinator: Dr Sangeetha J	

Course Contents

Unit I

Introduction: What is a Neural Network?, The Human Brain, Models of a Neuron, Neural Networks Viewed As Directed Graphs, Feedback, Network Architectures, Rosenblatt's Perceptron: Introduction, Perceptron, The Perceptron Convergence Theorem, Relation Between the Perceptron and Bayes Classifier for a Gaussian Environment. (Text Book 1 – Introduction 1, Chapter 1)

Multilayer Perceptrons: Introduction, Batch Learning and On-Line Learning, The Back-Propagation Algorithm, XOR Problem, Heuristics for Making the Back-Propagation Algorithm Perform Better, Back Propagation and Differentiation. (Text Book 1 - Chapter 4)

Unit II

Regularization for Deep Learning: Parameter Norm Penalties - L2 Parameter Regularization, Dataset Augmentation, Semi-Supervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Dropout, Adversarial Training. (Text Book 2 - Chapter 7)

Optimization for Training Deep Models: Challenges in Neural Network Optimization – Ill Conditioning, Local Minima, Plateaus, Saddle Points and Other Flat Regions. Cliffs and Exploding Gradients, Basic Algorithms, Algorithms with Adaptive Learning Rates (Text Book 2 - Chapter 8)

Unit III

Convolution neural networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Convolutional Networks and the History of Deep Learning, Text Book 2 - Chapter 9)

Sequence Modeling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks, The Long Short-Term Memory and Other Gated RNNs (Text Book 2 - Chapter 10)

Unit IV

Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition.(Text Book 2 - Chapter 11)

Applications: Large-Scale Deep Learning, Computer Vision, Speech Recognition, Natural Language Processing, Other Applications.(Text Book 2 - Chapter 12)

Autoencoders: Undercomplete Autoencoders, Regularized Autoencoders, Representational Power, Layer Size and Depth, Stochastic Encoders and Decoders, Denoising Autoencoders, Learning Manifolds with Autoencoders, Contractive Autoencoders, Predictive Sparse Decomposition, Applications of Autoencoders.(Text Book 2 - Chapter 14)

Unit V

Deep Generative Models: Boltzmann Machines, Restricted Boltzmann Machines, Deep Belief Networks, Deep Boltzmann Machines, Boltzmann Machines for Real-Valued Data, Convolutional Boltzmann Machines, Boltzmann Machines for Structured or Sequential Outputs, Other Boltzmann Machines, Back-Propagation through Random Operations, Directed Generative Nets, Drawing Samples from Autoencoders, Generative Stochastic Networks, Other Generation Schemes, Evaluating Generative Models.(Text Book 2 - Chapter 20)

Text Books:

1. Simon Haykin, Neural networks and Learning Machines, Third Edition, Pearson,2016
2. Ian Goodfellow, YoshuaBengio and Aaron Courville, Deep Learning, MIT Press,2016.

References:

1. Neural Networks and Deep Learning by Michael Nielsen http://neuralnetworksanddeeplearning.com/

Course Outcomes (COs):

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

1. Illustrate the concepts and applications of single layer and multilayer perceptron. (PO - 1, 2, 3, 4, 5)
2. Illustrate the regularization and optimization for training deep learning models. (PO - 1, 2, 3, 4, 5)
3. Apply deep feed forward networks like convolutional and recurrent recursive nets function to solve practical problems. (PO - 1, 2, 3, 4, 5)
4. Demonstrate the practical methodology, autoencoders and applications of deep learning network. (PO - 1, 2, 3, 4, 5)
5. Design end-to-end deep learning architectures involving various types of deep generative models for practical applications. (PO - 1, 2, 3, 4, 5)

SOFTWARE PROJECT MANAGEMENT AND PROFESSIONAL ETHICS	
Course Code: MCSE324	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Jayalakshmi D S	

Course Contents

Unit I

Introduction: Importance of Software Project Management, Project, Software Projects versus Other Types of Project, Contract Management and Technical Project Management, Activities Covered by Software Project Management, Plans, Methods and Methodologies, Categorizing Software Projects, Stakeholders, Setting Objectives, The Business Case, Project Success and Failure, Management and Management Control, Traditional versus Modern Project Management Practices

Project Evaluation and Programme Management: Project Portfolio Management, Evaluation of Individual Projects, Cost-benefit Evaluation Techniques, Risk Evaluation

An Overview of Step Wise Project Planning

Unit II

Selection of an Appropriate Project Approach: Introduction, Build or Buy?, Choosing Methodologies and Technologies, Software Processes and Process Models, Choice of Process Models, Structure versus Speed of Delivery, The Waterfall Model, The Spiral Model, Software Prototyping, Other Ways of Categorizing Prototypes, Incremental Delivery, Atern/Dynamic Systems Development Method, Rapid Application Development, Agile Methods, Extreme Programming (XP), Scrum, Managing Iterative Processes, Selecting the Most Appropriate Process Model.

Software Effort Estimation: Introduction, Where are Estimates Done?, Problems with Over- and Under-Estimates, The Basis for Software Estimating, Software Effort Estimation Techniques, Bottom-up Estimating, The Top-down Approach and Parametric Models, Expert Judgement, Estimating by Analogy, Albrecht Function Point Analysis, Function Points Mark I, COSMIC Full Function Points, COCOMO II: A Parametric Productivity Model, Cost Estimation, Staffing Pattern, Effect of Schedule Compression, Capers Jones Estimating Rules of Thumb.

Unit III

Activity Planning: Objectives, When to Plan, Project Schedules, Projects and Activities,

6.6 Sequencing and Scheduling Activities, Network Planning Models, Formulating a Network Model, Adding the Time Dimension, The Forward Pass, The Backward Pass, Identifying the Critical Path, Activity Float, Shortening the Project Duration, Identifying Critical Activities, Activity-on-Arrow Network,

Risk Management: Introduction, Risk, Categories of Risk, Framework for Dealing with Risk, Risk Identification, Risk Assessment, Risk Planning, Risk Management, Evaluating Risks to the Schedule, Applying the PERT Technique, Monte Carlo Simulation, Critical Chain Concepts.

Unit IV

Resource Allocation: Introduction, The Nature of Resources, Identifying Resource Requirements, Scheduling Resources, Creating Critical Paths, Counting the Cost, Being Specific, Publishing the Resource Schedule, Cost Schedules, The Scheduling Sequence

Monitoring and Control: Introduction, Creating the Framework, Collecting the Data, Review, Project Termination Review, Visualizing Progress, Cost Monitoring, Earned Value Analysis, Prioritizing Monitoring, Getting the Project Back to Target, Change Control, Software Configuration Management (SCM)

Managing Contracts: Types of Contract, Stages in Contract Placement, Typical Terms of a Contract, Contract Management, Acceptance.

Unit V

Software Quality: Introduction, The Place of Software Quality in Project Planning, The Importance of Software Quality, Defining Software Quality, Software Quality Models, ISO 9126, Product and Process Metrics, Product versus Process Quality Management, Quality Management Systems, Process Capability Models, Techniques to Help Enhance Software Quality, Testing, Software Reliability, Quality Plans

Working in Teams: Introduction, Becoming a Team, Decision Making, Organization and Team Structures, Coordination Dependencies, Dispersed and Virtual Teams, Communication Genres, Communication Plans, Leadership

Project Closeout: Reasons for Project closure, project closure process, performing a financial closure, project closeout report

Text book:

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management, 6th Edition (Special Indian Edition), McGraw Hill Education, 2017.

Reference Books:

1. Kathy Schwalbe, Information Technology Project Management, 7th edition, Cengage learning, 2014.
2. Pankaj Jalote, Software Project Management In Practice, Pearson India; 1st edition, 2016.

Course Outcomes (COs):

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

1. Recognize issues in a realistic project scenario. (PO-1,2, 3,4, 5)
2. Select suitable approaches for project effort estimation. (PO-1,2, 3,4, 5)
3. Plan project activities in consideration with identified project risks. (PO-1, 2, 3,4, 5)
4. Identify suitable methods for resource allocation, project monitoring and control as per the contract. (PO-1,2, 3,4, 5)
5. Appraise the use different software quality models, organizational structures and communication plans to ensure successful project closure. (PO-1,2, 3,4, 5)

NETWORK FORENSICS	
Course Code: MCSE324	**Credits: 4:0:0**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Sangeetha V	

Course Contents

Unit I

Introduction to Network Forensics, What Is Forensics? Handling Evidence, Cryptographic Hashes, Chain of Custody, Incident Response, The Need for Network Forensic Practitioners

Host-Side Artifacts: Services, Connections, Tools, Netstat, Nbstat, ifconfig/ipconfig, Sysinternals, ntop, Task Manager/Resource Monitor, ARP, /proc Filesystem

Unit II

Packet Capture and Analysis: Capturing Packets, Tcpdump/Tshark, Wireshark, Tap, Port Spanning, ARP Spoofing, Passive Scanning, Packet Analysis with Wireshark, Packet Decoding, Filtering, Statistics, Following Streams, Gathering Files, Network Miner.

Attack Types: Denial of Service Attacks, SYN Floods, Malformed Packets, UDP Floods, Amplification Attacks, Distributed Attacks, Backscatter, Vulnerability Exploits, Insider Threats, Evasion, Application Attacks

Unit III

Location Awareness: Time Zones, Using Whois, Traceroute, Geolocation, Location-Based Services, WiFi Positioning.

Preparing for Attacks: NetFlow, Logging, Syslog, Windows Event Logs, Firewall Logs, Router and Switch Logs, Log Servers and Monitors, Antivirus, Incident Response Preparation, Google Rapid Response, Commercial Offerings, Security Information and Event Management.

Unit IV

Intrusion Detection Systems: Detection Styles, Signature-Based, Heuristic, Host-Based versus Network-Based, Snort, Suricata and Sagan, Bro, Tripwire, OSSEC, Architecture, Alerting.

Using Firewall and Application Logs: Syslog, Centralized Logging, Reading Log Messages, LogWatch, Event Viewer, Querying Event Logs, Clearing Event Logs, Firewall Logs, Proxy Logs, Web Application Firewall Logs, Common Log Format,

Unit V

Correlating Attacks: Time Synchronization, Time Zones, Network Time Protocol, Packet Capture Times, Log Aggregation and Management, Windows Event Forwarding, Syslog, Log Management Offerings, Timelines, Plaso, Packet Total, Security Information and Event Management

Network Scanning, Port Scanning, Operating System Analysis, Scripts, Banner Grabbing, Ping Sweeps, Vulnerability Scanning, Port Knocking, Tunneling, Passive Data Gathering, The Onion Router (TOR)

Text Books:

1. Messier, Ric. Network forensics. John Wiley & Sons, 2017.

Reference Books:

1. Joshi, R. C., and Emmanuel S. Pilli. Fundamentals of Network Forensics. London: Springer, 2016.
2. Dutt, Dinesh G. Cloud Native Data Center Networking: Architecture, Protocols, and Tools. O'Reilly Media, 2019.

Course Outcomes (COs):

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

1. Examine the forensic methodologies (PO 1,3,4)
2. Identify network based forensic evidence sources (PO 1,3,4)
3. Analyze wired and wireless network traffic (PO 1,3,4)
4. Create a timeline of user activity from network-based evidence (PO 1,3,4)
5. Summarize the techniques used by attackers to evade detection (PO 1,3,4)

INTERNSHIP / INDUSTRIAL TRAINING	
Course Code: MCNI33	**Credits: 0:0:4**
Pre-requisites: Nil	**Contact Hours: 28**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Internship Work-flow

1. Students submit the initial details including broad area of work and choice of guide in a prescribed format
2. The PG Coordinator along with Head of the department finalizes the guide allocation process
3. Students are given an option to change the guide with mutual consent by applying through prescribed form
4. Students submit the Internship details to guide on the day of registration
5. Problem statement is submitted to PG Coordinator within one week of registration.
6. Students update their progress on weekly basis
7. Weekly meeting with guide is also recorded.
8. Guide evaluates the student on a regular basis according to the rubrics defined in the worksheet for total of 100 marks
9. Evaluation is based on following criteria
    - Tools and technology learnt
    - Relevance of the topic chosen to the current market
    - Report writing
    - Demonstration of tools learnt
    - Presentation of the work carried out as part of internship and viva voce

Course Outcomes(COs):

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

1. Appraise the requirements of the software projects and project managment for instry related projects (PO- 1,2, 3, 4, 5)
2. Design, implement and validate the system according to the requirement and project plan (PO- 1,2, 3, 4)
3. Identify technical tools and technology relavant to inductry project deveopment (PO- 1, 3, 4)
4. Exploit effective tools and techniques for technical report writing and presentation (PO- 1,2, 3, 4, 5)
5. Work in industry driven proejct team (PO- 1, 3, 4, 5)

PROJECT WORK - I	
Course Code: MCNI34	**Credits: 0:0:4**
Pre-requisites: Nil	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Porject Work-flow

1. Students submit the broad area of work and choice of guide in a prescribed format.
2. The PG Coordinator along with Head of the department finalizes the guide allocation process.
3. Students are given an option to change the guide with mutual consent by applying through prescribed form.
4. Students submit the project details to guide on the day of registration
5. Problem statement is submitted to PG Coordinator within one week of registration.
6. Students update their progress on weekly basis
7. Weekly meeting with guide is also recorded.
8. Guide evaluates the student on a regular basis according to the rubrics defined in the worksheet for total of 100 marks
9. Evaluation is based on following criteria
    - Identification of problem domain, relevance of the topic chosen to the current market
    - Study of existing system/literature survey - comparison in terms of various functional and performance parameters
    - Identification of research gaps and formulation of problem statement
    - Literature survey paper draft preparation/submission/publication
    - Objective of the proposed work, methodology and planning for achieving the objectives
    - Software requirement specification document preparation
    - Initial draft of High level design and low level design document preparation
    - Implementation details -Tools and technology to be used
    - Demonstration, presentation and viva voce of the work done (in two phases - mid-term review and final review)
    - Regularity
    - Project phase-I report

Course Outcomes (COs):

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

1. Compare and contrast the available literature in the context of the project for formulation of project problem statement (PO- 1,2, 3, 4, 5)
2. Write the research article on the litarature study done (PO- 1,2, 3, 4, 5)
3. Formulate the requirements of the chosen projects and project managment plan (PO- 1,2, 3, 4, 5)
4. Utilize technical tools and technology relavant to the project deveopment (PO- 1, 3, 4)
5. Exploit effective tools and techniques for technical report writing and presentation (PO- 1,2, 3, 4, 5)

PROJECT WORK II	
Course Code: MCNP41	**Credits: 0:0:20**
Pre-requisites: Project Work - I	**Contact Hours: 56**
Course Coordinator: Dr. Shilpa Chaudhari	

Course Contents

Project Work-flow

1. Students will continue the work done in project -I. (Course Code: MCSI34 / MCNI34)
2. The PG Coordinator, guide along with Head of the department relook into the project titles and objectives based on the finding from the project work -I (Course Code: MCSI34 / MCNI34).
3. Students are given an option to change problem statement in the same area wherein they done the literature survey in project -I. (Course Code: MCSI34 / MCNI34) by applying through prescribed form.
4. Students submit the project details to guide on the day of registration
5. Revised problem statement is submitted to PG Coordinator within one week of registration.
6. Students update their progress on weekly basis
7. Weekly meeting with guide is also recorded.
8. Guide evaluates the student on a regular basis according to the rubrics defined in the worksheet for total of 100 marks
9. Evaluation is based on following criteria
    - Revised (if necessary)problem statement, objective of the proposed work and methodology used for to achieve the objectives,
    - High level design and low level design document preparation
    - Implementation details -Tools and technology used
    - Research article draft on the original work done - preparation/submission/publication
    - Demonstration, presentation and viva voce of the work done in two phase - mid-term review an final review)
    - Regularity
    - Project phase-II report

CourseOutcomes(COs):

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

1. Design the software system using SRS document created in Proejct work-I (PO- 1, 3, 4)
2. Develop the dsigned system using relavant technical tools and technology (PO- 1, 3, 4)
3. Test the developed system for result analysis (PO- 1,2, 3, 4, 5)
4. Write the research article on the original work done (PO- 1,2, 3, 4, 5)
5. Demonstrate the work done with the help of effective tools and techniques for technical report writing and presentation (PO- 1,2, 3, 4, 5)