RAMAIAH
Institute of Technology

CURRICULUM

for the Academic year 2021 – 2022

(Batch of 2021 – 2023)

COMPUTER SCIENCE AND ENGINEERING

I - IV Semester M. Tech (CSE)

COMPUTER SCIENCE AND ENGINEERING

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

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 15 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 is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 60% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility 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. **M S Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 65 & world ranking 578 for the year 2020.**

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 secured All India Rank 8th for the year 2020 for Atal Ranking of Institutions on Innovation Achievements (ARIIA), by 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. MSRIT is a member of DELNET, CMTI and VTU E-Library Consortium. MSRIT has a modern auditorium and several hi-tech conference halls with video conferencing facilities. 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, M S Ramaiah Institute of Technology has achieved 65th rank among 1143 top Engineering institutions of India for the year 2021 and is 1st amongst the Engineering colleges affiliated to VTU, Karnataka.**

About the Department:

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

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

VISION OF THE INSTITUTE

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

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

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

QUALITY POLICY

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

VISION OF THE DEPARTMENT

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

MISSION OF THE DEPARTMENT

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

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

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

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

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

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

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

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

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

PROGRAM OUTCOMES (POs):

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

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

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

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

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

Curriculum Course Credits Distribution

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

SCHEME OF TEACHING
I SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	MCS11	Advanced Engineering Mathematics	PCC	4	0	0	4	56
2.	MCS12	Advances in Computer Networks	PCC	3	1	0	4	42
3.	MCSE13x	Elective-I	PEC	*	*	*	4	*
4.	MCSE14x	Elective-II	PEC	*	*	*	4	*
5.	MCSE15x	Elective-III	PEC	*	*	*	4	*
6.	MCSL16	Computer Networks Laboratory	PCC	0	0	1	1	28
7.	MCSL17	Python Programming Laboratory	PCC	0	0	1	1	28
8.	MCS18	Technical Seminar-I	PCC	0	0	2	2	--
Total							**24**	

II SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1.	MCS21	Cloud Infrastructure and Services	PCC	3	1	0	4	42+28
2.	MCS22	Big Data Analytics	PCC	4	0	0	4	56
3.	MCSE23x	Elective-IV	PEC	*	*	*	4	*
4.	MCSE24x	Elective-V	PEC	*	*	*	4	*
5.	MCSE25x	Elective-VI	PEC	*	*	*	4	*
6.	MCSL26	Cloud Computing Laboratory	PCC	0	0	1	1	28
7.	MCSL27	Data Analytics Laboratory	PCC	0	0	1	1	28
8.	MCS28	Technical Seminar-II	PCC	0	0	2	2	--
			Total				**24**	

III SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	MCS31	Research Methoddology and IPR	PCC	3	1	0	4	42+28
2	MCSE32x	Elective -VII	PEC	*	*	*	4	*
3	MCS33	Internship/Industrial Training	Internship	0	0	4	4	*
4	MCS34	Project Work-I	Project	0	0	6	6	*
			Total				**18**	

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

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

IV SEMESTER

Sl. No.	Course Code	Course Name	Category	Credits				Contact Hours
				L	T	P	Total	
1	MCS41	Project Work-II	Project	0	0	22	22	*
			Total	**22**				

Electives

Course Code	Course Name
List of Elective-I	
MCSE131	Advanced Algorithms
MCSE132	Advances in Operating Systems
MCSE133	Network Security and Ethical Hacking
MCSE134	Wireless Adhoc Networks
MCSE135	Pattern Recognition
List of Elective-II	
MCSE141	Data Base Modelling and design
MCSE142	Blockchain Technology
MCSE143	Computer System Performace Analysis
MCSE144	Future Skills
MCSE145	Soft Computing
List of Elective-III	
MCSE151	Artificial Intelligence
MCSE152	Web Search and Inforrmation Retrieval
MCSE153	Advances in Image Processing
MCSE154	Software Testing
MCSE155	Business Intelligence and Applications
List of Elective-IV	
MCSE231	Distributed Systems
MCSE232	Semantic Web and Social Networks
MCSE233	Software Engineering and Modelling
MCSE234	Data Storage Technology and Networks

MCSE235	Software Project Management and Professional Ethics
List of Elective-V	
MCSE241	Natural Language Processing
MCSE242	Software Defined Networks
MCSE243	Web Technologies
MCSE244	Privacy and Security in Online Social Media
MCSE245	Information and Network Security
List of Elective-VI	
MCSE251	Machine Learning
MCSE252	IoT Technology and Applications
MCSE253	Multicore Architecture and Programming
MCSE254	Robotics and Automation
MCSE255	Applied Cryptography
List of Elective-VII	
MCSE321	Startup Engineering
MCSE322	Deep Learning
MCSE323	Cyber Physical Systems
MCSE324	Storage Area Networks
MCSE325	Digital Forensic and Cyber Crime

Note:

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

Advanced Engineering Mathematics

Course Code: MCS11 **Credits: 4:0:0**
Prerequisites:Engineering Mathematics I- IV **Contact Hours: 56**
Course Coordinator/s: Dr S. Ramprasad

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.The Search for a Good Basis, Complex Numbers, Hermitian and Unitary Matrices. Introduction toEigenvalues and Eigenvectors, Similarity and Diagonalization. Symmetric Matrices, Positive Definite Matrices, The singular value decomposition (SVD), Principal Component Analysis (PCA).

UNIT III

Random Variables and Probability Distributions

Random Variables (Discrete and Continuous), Probability density function, Cumulative distribution function, Mean, Variance, Moment generating function. Probability Distributions**:** Binomial distribution, Poisson distribution, Normal distribution, Exponential distribution and Uniform distribution.

UNIT IV

Joint Probability Distributions and Stochastic Process

Joint probability distribution: Joint probability distribution (both discrete and continuous), Conditional expectation.

Stochastic Processes:Introduction, Classification of stochastic processes, discrete time processes, Stationary, Ergodicity, Autocorrelation and Power spectral density.

UNIT V

Markov Process , Introduction to Queuing and Applications

Introduction, Markov chain and Transition probabilities, Continuous Parameter Markov Chain, Pure Birth and Pure Death Process, Birth and Death Process, Renewal Process. Single server with infinite system capacity queuing models.

M/M/1: ∞/FIFO, K/FIFO
M/M/s:∞/FIFO, K/FIFO
M/G/1 Queuing system characteristics, Case studies.

Text Books:

1. 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 publishers- 10th edition-2015.

Course Outcomes (COs):

1. Students can be able to solve the system of equations AX=B.
2. Students can Find SVD and PCA of the given matrix.
3. Students can be able to express the probability distribution arising in the study of engineering problems and their applications.
4. Students can be able to apply the Markov Chain in prediction of future events.
5. Students can be able to apply and calculate the various parameters of the queuing models.

Advances in Computer Networks

Course Code:MCS12 **Credits: 3:1:0**
Prerequisites: Computer Networks **Contact Hours: 4 2 + 2 8**
Course Coordinator: Dr. Monica R Mundada

Course Contents

Unit I

Application Layer: The Web and HTTP: Overview of HTTP, Non-Persistent and Persistent Connections, HTTP Message Format, User-Server Interaction-Cookies, Web Caching, The Conditional GET. File Transfer- FTP: FTP Commands and Replies, Electronic Mail in the Internet: SMTP, Comparison with HTTP, Mail Access Protocols. DNS—The Internet's Directory Service: Services Provided by DNS, Overview of How DNS Works, DNS Records and Messages, Peer-to Peer Applications: P2P File Distribution, Distributed Hash Tables (DHTs).

Unit II

Transport layer: Multiplexing and Demultiplexing, socket programming with TCP, Socket programming with UDP. Connectionless Transport-UDP: UDP Segment Structure, UDP Checksum, Connection-Oriented Transport-TCP: The TCP Connection, TCP Segment Structure, Round-Trip Time Estimation and Timeout, Reliable Data Transfer, Flow Control, TCP Connection Management, TCP congestion control.

Unit III

Network Layer: Virtual Circuit and Datagram Networks - Virtual-Circuit Networks, Datagram Networks, The Internet Protocol (IP): Forwarding and Addressing in the Internet - Datagram Format, IPv4 Addressing, Internet Control Message Protocol (ICMP), IPv6. Routing Algorithms - The Link-State (LS) Routing Algorithm, The Distance-Vector (DV) Routing Algorithm, Hierarchical Routing. Routing in the Internet - Intra-AS Routing in the Internet: RIP, Intra-AS Routing in the Internet: OSPF, Inter-AS Routing: BGP

Unit IV

Data Link Layer: Error-Detection and Correction Techniques - Cyclic Redundancy Check (CRC). Multiple Access Links and Protocols - Channel Partitioning Protocols, Random Access Protocols – CSMA, CSMA/CD, Taking-Turns Protocols Switched Local Area Networks - Address Resolution Protocol (ARP), Ethernet, Ethernet Frame Structure, Link-Layer Switches - Self-Learning, Virtual Local Area Networks (VLANs), Multiprotocol Label Switching (MPLS)

Unit V

Wireless Networks and Mobile Networks: Introduction, WiFi 802.11 Wireless LANs- The 802.11 Architecture, Mobility in the Same IP Subnet, Advanced Features in 802.11. Cellular Internet Access-An Overview of Cellular Architecture, Mobility Management Principles, Addressing, Routing to a Mobile Node, Mobile IP, Managing Mobility in Cellular Networks, Routing Calls to a Mobile User, Handoffs in GSM.

Reference Books:

1. James F. Kurose and Keith W. Ross: Computer Networking: A Top-Down Approach, 6th edition, Addison-Wesley, 2013.
2. Larry L. Peterson and Bruce S Davie: Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
3. Forouzan: Data Communications and Networking, 5th edition, McGraw Hill Education 2013.
4. Tanenbaum: Computer Networks, 4th Ed, Pearson Education/PHI, 2003.
5. William Stallings: Data and Computer Communications, 8th Edition, Pearson Education, 2012.
6. Nader F. Mir: Computer and Communication Networks, Prentice hall, 2007

Course Outcomes (COs):

Attheendofthecourse,studentsshouldbeableto:

1. Describe the various application layer protocols used by TCP/IP reference model. (PO1,3,4)
2. Differentiate between connection oriented and connection less services of transport layer. (PO1,3,4)
3. Solve problems of routing using various routing protocols and algorithms. (PO1,3,4)
4. Illustrate access control protocols of data link layer. (PO1,3,4)
5. Identify issues related to wireless networks, cellular networks and mobility in Internet. (PO1,3,4)

Computer Networks Laboratory

Course Code: MCSL16 **Credits: 0:0:1**
Prerequisites: - **Contact Hours: 28**
Course Coordinator: Sanjeetha R

Course Contents

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

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

Reference Books:

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

Course Outcomes (COs):

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

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

Python Programming Laboratory

CourseCode:MCSL17 **Credits: 0:0:1**
Prerequisites:- **Contact Hours: 28**
Course Coordinator/s: Dr. Rajarajeswari S

Course Contents

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

After the course, students should be able to:

1. Adapt and combine standard algorithms to solve a given problem (includes numericalas well as non-numerical algorithms)(PO1,3,4)
2. Adequately use standard programming constructs: repetition, selection,

functions,Composition, modules, aggregated data (arrays, lists, etc.)(PO1,3,4)

3. Create, debug and test a software application using the Python programming language.(PO1,3,4)

Cloud infrastructure and Services

Course code : MCS21 **Credits: 4:0:0:0**
Prerequisites: - **Contact Hours: 42+28**
Course Coordinator: Dr. Rajarajeswari S

Unit 1

Introduction: Cloud Computing: Defn, Cloud Computing delivery models & Services, Ethical issues, Cloud vulnerabilities, Challenges.

Cloud Infrastructure: Amazon, Google, Azure & online services, open-source private clouds. Storage diversity and vendor lock-in, intercloud, Energy use & ecological impact of data centers, Energy efficiency in clouds service level and compliance level agreement, user experience, Software licensing.

Unit 2

Cloud Computing: Applications & Paradigms, Challenges, existing and new application opportunities, Architectural styles of cloud applications, Cloud Computing System Architecture Diagrams, Workflows coordination of multiple activities, Coordination based on a state machine model -the Zoo Keeper, The Map Reduce programming model, Apache Hadoop, A case study: The GrepTheWeb application. How to install Hadoop on the eclipse on a Window system? Aneka platform.

Unit 3

Virtualization: Introduction, Characteristics of virtualized environments: Increased security, Managed execution, Portability , Taxonomy of virtualization techniques, Execution virtualization, Other types of virtualization, Virtualization and cloud computing, Pros and cons of virtualization, Advantages of virtualization. The other side of the coin: disadvantages, Technology examples, Xen: Para virtualization , VMware: full virtualization, Microsoft Hyper-V.

Unit 4

Cloud Resource Management and Scheduling: Policies and mechanisms for resource management Resource bundling, combinatorial auctions for cloud Scheduling algorithms for computing clouds, fair queuing, start time fair queuing, borrowed virtual time, Cloud scheduling subject to deadlines, Resource management and application scaling. **Cloud Applications Benchmark & Tuning:** Introduction, workload characteristics, Application performance Metrics, design, tools, deployment, load testing, Case study, Healthcare, energy Systems, Transportation systems, Manufacturing Industry, Education, Biology, Geoscience.

Unit 5

Storage systems: DFS, Lustre, IBM GPFS, GFS, Apache couch, and Mongo DB, Hadoop, Locks & Chubby, TPS, SQL, NoSQL, google storage systems, Amazon storage options,

Microsoft storage system, open-source cloud platform storage systems, Google Big Table, Apache Cassandra, Megastore. **Cloud security:** Introduction, CSA architecture, authentication, SSO, Authorization, IAM, Data Security, Key management Auditing, Risks, privacy and privacy impacts assessments. Trust, Security- OS, VM, VMM, shared images, Management OS.

Text Book:

1. Cloud Computing: Theory and Practice, Dan Marinescu, 1st edition, MK Publishers, 2013.
2. Mastering Cloud Computing Foundations and Applications Programming Rajkumar Buyya Christian Vecchiola S. Thamarai Selvi, Morgan Kaufmann is an imprint of Elsevier
3. AWS Certified Developer - Associate Guide Vipul Tankariya Bhavin Parmar First published: September 2017 Published by Packt Publishing Ltd. Livery Place 35 Livery Street Birmingham B3 2PB, UK. ISBN 978-1-78712-562-9

Reference Books:

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

Course Delivery

The course will be delivered through lectures, presentations, classroom discussions, practice exercises and practical sessions.

Course Outcomes (COs):

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

1. Analyze the transformation let to the evolution of Cloud computing, it's impact on the enterprises and list the different services offered by service providers.
2. Design different Cloud Computing system architecture, workflows according to requirements applying map reduce model.
3. Compare performance of virtual machines, Virtual machine security.
4. Create combinatorial auctions for cloud scheduling algorithms for computing clouds.
5. Assess the Cloud security**,** the risks involved, its impact and cloud service providers.

Big Data Analytics

Course code: MCS22 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator: Dr. Jayalakshmi D S

Unit I

Meet Hadoop: Data, Data Storage and Analysis, Querying All Data, Beyond Batch, Comparison with Other Systems: Relational Database Management Systems, Grid Computing, Volunteer Computing Hadoop Fundamentals MapReduce A Weather Dataset: Data Format, Analyzing the Data with Unix Tools, Analyzing the Data with Hadoop: Map and Reduce, Java MapReduce, Scaling Out: Data Flow, Combiner Functions, Running a Distributed MapReduce Job, Hadoop Streaming The Hadoop Distributed Filesystem The Design of HDFS, HDFS Concepts: Blocks, Namenodes and Datanodes, HDFS Federation, HDFS High-Availability, The Command-Line Interface, Basic Filesystem Operations, Hadoop Filesystems Interfaces, The Java Interface, Reading Data from a Hadoop URL, Reading Data Using the File System API, Writing Data, Directories, Querying the Filesystem, Deleting Data, Data Flow: Anatomy of a File Read, Anatomy of a File Write.

Unit II

YARN Anatomy of a YARN Application Run: Resource Requests, Application Lifespan, Building YARN Applications, YARN Compared to MapReduce, Scheduling in YARN: The FIFO Scheduler, The Capacity Scheduler, The Fair Scheduler, Delay Scheduling, Dominant Resource Fairness Hadoop I/O Data Integrity, Data Integrity in HDFS, Local File System, Checksum File System, Compression, Codecs, Compression and Input Splits, Using Compression in MapReduce, Serialization, The Writable Interface, Writable Classes, Implementing a Custom Writable, Serialization Frameworks, File-Based Data Structures: Sequence File

Unit III

Developing a MapReduce Application The Configuration API, Combining Resources, Variable Expansion, Setting Up the Development Environment, Managing Configuration, Generic Options Parser, Tool, and Tool Runner, Writing a Unit Test with MR Unit: Mapper, Reducer, Running Locally on Test Data, Running a Job in a Local Job Runner, Testing the Driver, Running on a Cluster, Packaging a Job, Launching a Job, The MapReduce Web UI, Retrieving the Results, Debugging a Job, Hadoop Logs, Tuning a Job, Profiling Tasks, MapReduce Workflows: Decomposing a Problem into MapReduce Jobs, Job Control, Apache Oozie How MapReduce Works Anatomy of a MapReduce Job Run, Job Submission, Job Initialization, Task Assignment, Task Execution, Progress and Status Updates, Job Completion, Failures: Task Failure, Application Master Failure, Node Manager Failure, Resource Manager Failure, Shuffle and Sort: The Map Side, The Reduce Side, Configuration

Tuning, Task Execution: The Task Execution Environment, Speculative Execution, Output Committers

Unit IV

MapReduce Types and Formats: MapReduce Types, Input Formats: Input Splits and Records Text Input, Binary Input, Multiple Inputs, Database Input (and Output) Output Formats: Text Output, Binary Output, Multiple Outputs, Lazy Output, Database Output, Flume Installing Flume, An Example, Transactions and Reliability, Batching, The HDFS Sink, Partitioning and Interceptors, File Formats, Fan Out, Delivery Guarantees, Replicating and Multiplexing Selectors, Distribution: Agent Tiers, Delivery Guarantees, Sink Groups, Integrating Flume with Applications, Component Catalog

Unit V

Pig Installing and Running Pig, Execution Types, Running Pig Programs, Grunt, Pig Latin Editors, An Example: Generating Examples, Comparison with Databases, Pig Latin: Structure, Statements, Expressions, Types, Schemas, Functions, Data Processing Operators: Loading and Storing Data, Filtering Data, Grouping and Joining Data, Sorting Data, Combining and Splitting Data. Spark An Example: Spark Applications, Jobs, Stages and Tasks, A Java Example, A Python Example, Resilient Distributed Datasets: Creation, Transformations and Actions, Persistence, Serialization, Shared Variables, Broadcast Variables, Accumulators, Anatomy of a Spark Job Run, Job Submission, DAG Construction, Task Scheduling, Task Execution, Executors and Cluster Managers: Spark on YARN

Textbook:

1. Hadoop: The Definitive Guide Tom White O'Reilley Third Edition, 2012

Reference Books:

1. SPARK: The Definitive Guide Matei Zaharia and Bill Chambers, Oreilly 2018
2. Apache Flume: Distributed Log Collection for Hadoop, D'Souza and Steve Hoffman Oreilly 2014

Course Outcomes (COs):

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

1. To take typical BigData,filte rand wrangle the data.(PO1,3,4)
2. To recognize the domain for analysis.(PO1,3,4)
3. To identify the type of domain-specific analytics to be deployed.(PO1,3,4)
4. To carry out mathematical approach in analytics.(PO1,3,4)
5. To be ready as a Data Scientist leading towards suitable job inanalytics in industry or to pursue research towards higher degree.(PO1,3,4)

Cloud Computing Laboratory

Course Code: MCSL26 **Credits: 0:0:1**
Prerequisites: - **Contact Hours: 28**
Course Coordinator: Dr. Rajarajeswari S

List of Experiments:

Use Eucalyptus or Open Nebula or equivalent to set up the cloud and demonstrate:

1. Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.
2. Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.
3. Install a C compiler in the virtual machine and execute a sample program.
4. Show the virtual machine migration based on the certain condition from one node to the other.
5. Find procedure to install storage controller and interact with it.
6. Find procedure to setup the one node Hadoop cluster.
7. Mount the one node Hadoop cluster using FUSE.
8. Write a program to use the API"s of Hadoop to interact with it.
9. Write a word count program to demonstrate the use of Map and Reduce tasks.

List of Experiments:

1. SaaS: Google Drive
   - With your Gmail account, create a spreadsheet to share with the people at the same table, invite them.
   - See how you can simultaneously edit the document you just created PaaS: google Maps
     http://maps.google.com/maps/api/staticmap?center=Eiffel+Tower&zoom=12 & size=512x512&sensor=false
2. Design Virtual Machine using VM player and test Client server application using Virtual Machine
3. Design Virtual Machine using VM player and test Client server application using Virtual Box
4. Compare the pros and cons of VM player and Virtual Box
5. Paas – Deploy Applications to google App Engine - simple web applications
6. Paas – Deploy Applications to google App Engine - web applications with database
7. Deploy Applications to cloud foundry using VMC
8. Deploy Applications to cloud foundry using Micro cloud foundry
9. Deploy Applications to cloud foundry using Eclipse
10. To Set up a Hadoop Cluster – Single Node

11. To Set up a Hadoop Cluster – Multi Node
12. Execute Map Reduce Programs in Hadoop Cluster
13. Study of Future Grid

Reference Books:

1. Cloud Computing: Theory and Practice, Dan Marinescu, 1st edition, MK Publishers, 2013.
2. Distributed and Cloud Computing, From Parallel Processing to the Internet of Things, Kai Hwang, Jack Dongarra, Geoffrey Fox. MK Publishers.
3. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, McGraw Fill, 2010
4. Cloud computing A Hands on Approach Arshdeep Bahga,Vijay Madisetti Universities Publications
5. Online Readings: http://www.pds.ewi.tudelft.nl/ , http://csrc.nist.gov/publications/nistpubs

Course Outcomes (COs):

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

1. Examine the set of cloud using Nebula or any equivalent methods (PO1,3,4)
2. Describe different kinds of Internet-connected product concepts.(PO1,3,4)
3. Explore the cloud services for different experiments (PO1,3,4,5)

Data Analytics Laboratory

Course Code: MCSL27 **Credits: 0:0:1**
Prerequisites: - **Contact Hours: 28**
Course Coordinator: Dr. Jayalakshmi D S

Course Contents

Part –A

1. Installing R on personal machines. Retrieving R packages. Basics of R, RStudio, R Markdown. Basic data types and operations: numbers, characters and composites. Vectors, creating sequences, common functions.
2. Data set import and export: Importing tabular data. Simple summaries of categorical and continuous data. R style basics
3. Writing functions in R. If/else statements . A common data cleaning task. For/while loops. Using apply() to iterate over data. Using with() to specify environment
4. Data exploration and visualization: Introduction to plyr. Multivariate statistical summaries. Introduction to ggplot2 graphics. Testing for differences in means between two groups QQ plots, Tests for 2x2 tables, Plotting confidence intervals.
5. Generate association rule using apriori algorithm and visualize them. Construct decision tree and naïve Bayesian classifiers. Visualize and compare the results for accuracy.
6. Build clusters using K-means and Hierarchical clustering and visualize the results. Perform linear regression on a dataset and visualize the results.
7. ANOVA Linear regression Assessing multicollinearity, Diagnosing and interpreting regression Interpreting categorical variables in regression, Interaction terms in regression.

Part – B

1. HDFS

1. Copy file foo.txt from local disk to the user‟s directory in HDFS
2. Get a directory listing of the user‟s home directory in HDFS
3. Get a directory listing of the HDFS root directory
4. Display the contents of the HDFS file user/fred/bar.txt
5. Move that file to the local disk, named as baz.txt
6. Create a directory called input under the user‟s home directory
7. Delete the directory input old and all its contents
8. Verify the copy by listing the directory contents in HDFS

2. MapReduce

1. Create a JOB and submit to cluster

2. Track the job information
3. Terminate the job
4. Counters in MR Jobs with example
5. Map only Jobs and generic map examples
6. Distributed cache example
7. Combiners, Secondary sorting and Job chain examples

3. MapReduce (Programs) Using movie lens data

1. List all the movies and the number of ratings
2. List all the users and the number of ratings they have done for a movie
3. List all the Movie IDs which have been rated
4. List all the Users who have rated the movies
5. List of all the User with the max, min, average ratings they have given against any movie
6. List all the Movies with the max, min, average ratings given by any user

4. Extract facts using Hive

Use HiveQL to filter and aggregate click data to build facts about user's movie preferences. The query results will be saved in a staging table used to populate the Oracle Database. The moveapp_log_json table contains an
activity column. Activity states are as follows:

1. RATE_MOVIE
2. COMPLETED_MOVIE
3. PAUSE_MOVIE
4. START_MOVIE
5. BROWSE_MOVIE
6. LIST_MOVIE
7. SEARCH_MOVIE
8. LOGIN
9. LOGOUT
10. INCOMPLETE_MOVIE

hive> SELECT * FROM movieapp_log_json LIMIT 5; hive> drop table movieapp_log_json;

hive> CREATE EXTERNAL TABLE movieapp_log_json (custId INT, movieId INT, genreId INT, time STRING, recommended STRING, activity INT, rating INT, price FLOAT)

ROW FORMAT SERDE 'org.apache.hadoop.hive.contrib.serde2.JsonSerde'

LOCATION '/user/oracle/moviework/applog/';

hive> SELECT * FROM movieapp_log_json LIMIT 20;

hive> SELECT MIN(time), MAX(time) FROM movieapp_log_json

PURCHASE_MOVIE

Hive maps queries into Map Reduce jobs, simplifying the process of querying large datasets in HDFS. HiveQL statements can be mapped to phases of the Map Reduce framework. Selection and transformation operations occur in map tasks, while aggregation is handled by reducers. Join operations are flexible: they can be performed in the reducer or mappers depending on the size of the leftmost table.

1. Write a query to select only those clicks which correspond to starting, browsing, completing, or purchasing movies. Use a CASE statement to transform the RECOMMENDED column into integers where 'Y' is 1 and 'N' is 0. Also, ensure GENREID is not null. Only include the first 25 rows.
2. Write a query to select the customer ID, movie ID, recommended state and most recent rating for each movie.
3. Load the results of the previous two queries into a staging table. First, create the staging table.
4. Next, load the results of the queries into the staging table.

5. Extract sessions using Pig

While the SQL semantics of HiveQL are useful for aggregation and projection, some analysis is better described as the flow of data through a series of sequential operations. For these situations, Pig Latin provides a convenient way of implementing data flows over data stored in HDFS. Pig Latin statements are translated into a sequence of Map Reduce jobs on the execution of any STORE or DUMP command. Job construction is optimized to exploit as much parallelism as possible, and much like Hive, temporary storage is used to hold intermediate results. As with Hive, aggregation occurs largely in the reduce tasks. Map tasks handle Pig's FOREACH and LOAD, and GENERATE statements. The EXPLAIN command will show the execution plan for any Pig Latin script. As of Pig 0.10, the ILLUSTRATE command will provide sample results for each stage of the execution plan. In this exercise you will learn basic Pig Latin semantics and about the fundamental types in Pig Latin, Data Bags and Tuples.

1. Start the Grunt shell and execute the following statements to set up a dataflow with the click stream data. Note: Pig Latin statements are assembled into Map Reduce jobs which are launched at execution of a DUMP or STORE statement.
2. Group the log sample by movie and dump the resulting bag.
3. Add a GROUP BY statement to the sessionize.pig script to process the click stream data into user sessions.

Text Books:

1. Robert I. Kabacoff, "R in Action", Manning Publications; 1 edition, 2011
2. Zumel, N., & Mount, J. "Practical data science with R", 2014
3. Vignesh Prajapati, "Big data analytics with R and Hadoop", SPD 2013.

4. Seema Acharya and Subhashini Chellappan, “Big Data and Analytics”, 1st edition, Wiley, 2015

Reference Books:

1. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.
2. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.
3. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
4. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
5. Alan Gates, "Programming Pig", O'Reilley, 2011

Course Outcomes(COs):

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

1. Describe big data and use cases from selected business domains.(PO1,3,4)
2. Explain NoSQL big data management .Install, configure ,and run Hadoop and HDFS (PO1,3,4)
3. Use Hadoop related to olssuchasHBase ,Cassandra ,Pig, and Hive for big data Analytics. (PO1,3,4, 5)

Research Methodology and IPR

Course Code: MCS31 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator: Dr Jagadish S Kallimani

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

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

Unit V

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

Reference Books:

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

Course Outcomes (COs):

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

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

Electives-I

Advanced Algorithms

Course Code: MCSE131 **Credits: 3:0:1**
Prerequisites: Knowledge of Analysis and Design of Algorithm
Course Coordinator: Dr. Jagadish S Kallimani **Contact Hours: 42+28**

Course Contents

Unit I

Analysis Techniques: Growth of Functions, Asymptotic notations, Standard notations and common functions, Recurrences and Solution of Recurrence equations – The Substitution method, The recurrence – tree method, The master method, Amortized Analysis: Aggregate, Accounting and Potential Methods.

Unit II

Graph Algorithms: Bellman-Ford Algorithm, Single source shortest paths in a DAG, Johnson‟s Algorithm for sparse graphs, Maximum bipartite matching. **Trees:** B-trees, Red-Black trees **Hashing**: General Idea, Hash Function, Separate Chaining, Open addressing, Rehashing, Extendible hashing.

Unit III

Number – Theoretic Algorithms: Elementary notations, GCD, Modular Arithmetic, Solving modular linear equations, The Chinese remainder theorem, Powers of an element, RSA cryptosystem. **Heaps:** Heaps, Priority Queues, Binomial Heaps, Fibonacci Heaps.

Unit IV

String Matching Algorithms: Naïve string matching, Rabin – Karp algorithm, String matching with finite automata, Knuth-Morris-Pratt algorithm, Boyer-Moore Algorithms.

Unit V

Algorithmic Puzzles: Magic Square, *n*-queens problem, Glove Selection, Ferrying Soldiers, Jigsaw Puzzle Assembly, A Stack of Fake Coins, Maximum Sum Descent, Hats of Two Colors, Pluses and Minuses, Searching for a Pattern, Locker Doors, Palindrome Counting, Inverting a Coin Triangle, Sorting 5 in 7.

Text Books:

1. T H Cormen, C E Leiserson, R L Rivest and C Stein: Introduction to Algorithms, 3/e, PHI, 2011.

2. Mark Allen Weiss: Data Structures and Algorithm Analysis in C++, 3rd Edition, Pearson Education, 2011.
3. Anany Levitin and Maria Levitin: Algorithmic Puzzle, Oxford University Press, 2011

Reference Books:

1. Ellis Horowitz, Sartaj Sahni, S Rajasekharan: Fundamentals of Computer Algorithms, University Press, 2007.
2. Alfred V Aho, John E Hopcroft, J D Ullman: The Design and Analysis of Computer Algorithms, Pearson Education, 2011.

Course Outcomes (COs):

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

1. Devise recurrence relations and amortized cost of various operations. (PO1,3,4)
2. Illustrate graph algorithms such as Bellman-Ford, Shortest path, bipartite matching, B-trees, Red-Black trees and hashing techniques. (PO1,3,4)
3. Identify the methods for solving modular linear equations, Chinese remainder theorem and RSA cryptosystem, types of heaps such as Binomial and Fibonacci heaps. (PO1,3,4)
4. Assess the string matching algorithms such as Boyer-Moore and Knuth-Morris-Pratt algorithm. (PO1,3,4)
5. Compose mathematical models, objective functions and constraints to solve algoritshmic puzzles (PO 1,3,4,5)

Advances in Operating Systems

Course Code: MCSE132 **Credits: 4:0:0**
Prerequisites: Operating Systems **Contact Hours: 56**
Course Coordinator/s: Dr. T N R Kumar

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

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

Laboratory Work:

(The following programs can be executed on any available and suitable platform)

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

Reference Books:

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

Course Outcomes (COs):

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

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

Network Security and Ethical Hacking

Course Code: MCSE133 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Mohana Kumara S

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

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

Unit V

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Wireless Ad-hoc Networks

Course Code: MCSE134 **Credits: 3:0:1**
Prerequisites: Computer Networks **Contact Hours: 42+28**
Course Coordinator/s: Dr. Shilpa S Choudari

Course Contents

Unit I

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

Unit II

Routing Protocols for Ad-hoc Wireless Networks: Introduction, Issues in Designing a Routing Protocol for Ad-hoc Wireless Networks; Classification of Routing Protocols; **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; **Table Driven Routing Protocols**-Destination Sequenced Distance-Vector Routing Protocol, Cluster-Head Gateway Switch Routing Protocol; **On-Demand Routing Protocols** -Dynamic Source Routing Protocol (DSR), Ad Hoc On-demand Distance-Vector Routing Protocol; **Hybrid Routing Protocols-** Core Extraction Distributed Ad Hoc Routing Protocol, Zone Routing Protocol; **Routing Protocol With Efficient Flooding Mechanisms** - Preferred Link-Based Routing Protocol, Optimized Link State Routing; **Hierarchical Routing Protocols** - Hierarchical State Routing Protocol, Fisheye State Routing Protocol; Power-Aware Routing Protocols; **Tree-based Multicast Routing Protocols**- Multicast Routing Protocol Based on Zone Routing, Multicast Core-Extraction Distributed Ad Hoc Routing, Multicast Ad Hoc On-Demand Distance Vector Routing Protocol; **Mesh-based Multicast Routing Protocols** - On-Demand Multicast Routing Protocol; Energy-Efficient Multicasting; Multicasting with Quality Of Service Guarantees - Wireless Ad Hoc Real-Time Multicasting Protocol

Unit III

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

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

Unit IV

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

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

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

Text Book:

1. C. Siva Ram Murthy & B. S. Manoj: Ad-hoc Wireless Networks, 2nd Edition, Pearson Education, 2011
2. Xin Wang, “Mobile AdHoc Networks Applications”, inteo, 2011.

Reference Books:

1. Ozan K. Tonguz and Gianguigi Ferrari: Ad-hoc Wireless Networks, John Wiley, 2007.
2. Xiuzhen Cheng, Xiao Hung, Ding-Zhu Du: Ad-hoc Wireless Networking, Kluwer Academic Publishers, 2004.
3. C.K. Toh: Ad-hoc Mobile Wireless Networks- Protocols and Systems, Pearson Education, 2002.

Course Outcomes (COs):

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

1. Compare the challenge faced in wireless ad hoc network with other wireless networks in addition to the focus on MAC layer protocol design issues and proposed solutions by the research community (PO1, 2, 3, 4)
2. Analyze and compare types of unicast- and multicast-routing protocols specifically designed to address the issues of wireless ad hoc network (PO1, 2, 3, 4)
3. Examine the transport layer protocol design issues and proposed solutions in the literaturewith the focus on security provisioning concepts and protocols (PO1, 2, 3, 4)
4. Evaluate energy management and QoS solutions to address the challenges of wireless ad hoc networks (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)

Pattern Recognition

Course Code: MCSE135 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Anita Kanavalli

Course Contents

Unit I

Introduction: Definition of PR, Applications, Datasets for PR, Different paradigms for PR, Introduction to probability, events, random variables, Joint distributions and densities, moments. Estimation minimum risk estimators, problems.

Unit II

Representation: Data structures for PR, Representation of clusters, proximity measures, size of patterns, Abstraction of Data set, Feature extraction, Feature selection, Evaluation.

Unit III

Nearest Neighbor based classifiers & Bayes classifier: Nearest neighbor algorithm, variants of NN algorithms, use of NN for transaction databases, efficient algorithms, Data reduction, prototype selection, Bayes theorem, minimum error rate classifier, estimation of probabilities, estimation of probabilities, comparison with NNC, Naive Bayes classifier, Bayessian belief network.

Unit IV

Naive Bayes classifier, Bayessian belief network, Decision Trees: Introduction, DT for PR, Construction of DT, Splitting at the nodes, Over fitting & Pruning, Examples, Hidden Markov models: Markov models for classification, Hidden Markov models and classification using HMM.

Unit V

Clustering: Hierarchical (Agglomerative, single/complete/average linkage, wards, Partitional (Forgy's, k-means, Isodata), clustering large data sets, examples, An application: Handwritten Digit recognition.

Text Books:

1. V Susheela Devi, M Narsimha Murthy, Pattern Recognition (An Introduction), Universities Press,2011.
2. Earl Gose, Richard Johnsonbaugh, Steve Jost, Pattern Recognition & Image Analysis, PH,1996.

Reference Book:

1. Duda R. O., P.E. Hart, D.G. Stork, Pattern Classification, John Wiley and sons, 2000

Course Outcomes (COs):

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

1. Understand the different paradigms of Pattern Recognition (PO1, 3, 4)
2. Analyze the data structures of PR and data abstraction (PO1, 3, 4)
3. Examine the classifiers and implement the algorithms (PO1, 3, 4)
4. Evaluate the decision trees of PR and different moddelsPO1, 3, 4)
5. Review the clustering in PR and develop applications (PO1, 3, 4,5)

Electives-II

Data Base Modelling and Design

Course Code: MCSE141 **Credits: 3:1:0**
Prerequisites: - **Contact Hours: 42+28**
Course Coordinator/s: Dr. Seema S

Course Contents

UnitI

Database models and overview of Relational data model: Database models: Flat data model, Entity relationship model, Relation model, Object oriented data model, Object relation model, Semi structured model, graph data model, Spatial Databases, Enhanced Entity-Relationship (EER) Model: Subclasses, Super classes, and Inheritance, Specialization and Generalization, Constraints and Characteristics of Specialization and Generalization Hierarchies, Modeling of UNION Types Using Categories, A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions, Querying relational model with relational algebra.

Unit II

Query Languages: Overview of querying with SQL, Introduction to NOSQL Systems, Characteristics of NOSQL Systems, and Categories of NOSQL Systems. NOSQL Graph Databases, Graph Database with Neo4J

Unit III

Indexing and Hashing: Basic Concepts, Ordered Indices, B+-Tree Index Files, B+-Tree Extensions, Multiple-Key access, Static Hashing, Dynamic Hashing, Comparison of Ordered Indexing and Hashing, Bitmap Indices, Index Definition in SQL.

Unit IV

Query Processing and Optimization: Overview, Measures of Query Cost, Selection Operation, Sorting, Join Operation, Other Operations, Evaluation of Expressions **Query Optimization:** Transformation of Relational Expressions, Estimating Statistics of Expression Results, Choice of Evaluation Plans.

Unit V

Parallel and Distributed Databases: **:** Introduction, I/O Parallelism, operator level parallelism, Inter-query Parallelism, Intra-query Parallelism, Intra-operation Parallelism, Interoperation Parallelism, Query Optimization Homogeneous and Heterogeneous Databases, Distributed Data Storage, Distributed Transactions, Commit Protocols, Concurrency Control in Distributed Databases, Availability, Distributed Query Processing, Heterogeneous Distributed Databases, Cloud-Based Databases, Directory Systems

Text Books:

1. Database System Concepts, Abraham Silberschatz, Henry F.Korth, Sixth Edition, McGraw Hill Education.
2. Fundamentals of Database Systems, Ramez Elmasri,Shamkant B.Navathe, Fifth Edition, Pearson Publications.

Reference book:

1. Database Management Systems, Raghu Ramakrishnan, Johanners Gehrke, Second Edition.McGraw-Hill Education.

Course Outcomes (COs):

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

1. Understand different database model and the overview of relation data base model.(PO1,3,4)
2. Understand the different query languages and systems.(PO1,3,4)
3. Analyze the concepts of indexing and hashing.(PO1,3,4)
4. Apply the query processing and optimization to databases (PO1,3,4)
5. Analyze the processing the queries in distributed and parallel databases (PO 1,3,4,5)

Block Chain Technology

Course Code: MCSE142 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: 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,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
3. Melanie Swan, Block chain, BLUEPRINT FOR A NEW ECONOMY, O'Reilly,2015.
4. BLOCKCHAIN, Cybrosys Technologies.

Course Outcomes (COs):

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

1. Understand the basics of block chain technology (PO1,3,4)
2. Analyze the different technologies of block chain (PO1,3,4)
3. Describe the abstarct models of block chain (PO1,3,4)
4. Apply the smart contarct languages and verification languages (PO1,3,4)
5. Devlop the block chain technology on diffferent applications (PO 1,3,4,5)

Computer System Performance Analysis

Course Code: MCSE143 **Credits: 4:0:0**
Prerequisites: Probability Theory, matrices, software engineering aspects and queuing theory.
Course Coordinator: Dr. T N R Kumar **Contact Hours: 56**

Course Contents:

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

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

Unit V

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

Text Book:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Future Skills

Course Code: MCSE144 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Prof. Nagabhushana 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

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

Unit V

Cognitive Load management: Introduction, Current situation of information overload, Tools and techniques tohandle the cognitive load. Importance of these skills in work place. **Assignment:** Students will be given a specific topic and time to quickly

arrive at a good summary of the topic. They will be given access to internet and books to refer. Importance is given to how quickly they can gather, curate and present the summary of the topic.

Reference Books:

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

Course Outcomes (COs):

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

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

Soft Computing

Course Code: MCSE145 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Jagadish S Kallimani

Course Contents

Unit I

Introduction: Neural networks, Fuzzy logic, Genetic algorithms, Hybrid systems,**Artificial Neural Networks:** Fundamental concept, Evolution, Basic model of ANN, Important terminologies of ANN, MP neuron, Hebb Network.

Unit II

Supervised Learning Network: Perceptron Networks, Adaptive linear neuron, multiple adaptive linear neurons, Back propagation Network.

Unit III

Introduction to Fuzzy logic, classical sets and fuzzy sets: Classical sets, Fuzzy sets.**Classical relations and fuzzy relations:** Cartesian product of relation, Classical relation, Fuzzy relations, Tolerance and equivalence relations. **Membership functions:** Features, Fuzzification, methods of membership value assignments.

Unit IV

Defuzzification: Lambda-cuts for fuzzy sets, Lambda-cuts for fuzzy relations, Defuzzification methods. Fuzzy decision making: Individual, multiperson, multiobjective, multiattibute, and fuzzy Bayesian decision making.

Unit V

Genetic algorithms: Introduction, Basic operations, Traditional algorithms, Simple GA, General genetic algorithms, the schema theorem, Genetic programming, applications.

Reference Books:

1. Principles of Soft computing, S N Sivanandam, Deepa S. N, Wiley, India, (Chapters 1, 2, 3(Up to 3.5), 7, 8, 9, 10, 13, 15 (up to 15.6 & 15.9,15,10).
2. Neuro-fuzzy and soft computing, J.S.R. Jang, C.T. Sun, E. Mizutani, PHI (EEE edition) ISBN: 978-81-203-2243-1

Course Outcomes (COs):

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

1. Identify and describe soft computing techniques and their roles in building intelligent machines (PO1,3,4)
2. Identify the components and building block hypothesis of Genetic algorithm. (PO1,3,4)
3. Examine the features of neural network and its applications. (PO1,3,4)
4. Apply defuzzification concepts (PO 1,3,4)
5. Develop genetic algorithm based real time applications (PO 1,3,4,5)

Electives -III

Artificial Intelligence

Course Code: MCSE151 **Credits: 3:1:0**

Contact Hours: 42+28

Prerequisites: Advanced programming language, Algorithms and Data structures, Elementary Discrete Mathematics

Course Coordinator/s: Dr. Annapurna P Patil

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, Uninformed 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, Effective Propositional Model Checking, 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

Planning: Definition, Planning with State-Space Search, Planning Graphs, Other Planning Approaches Analysis. **Uncertainty:** Acting under Uncertainty, Basic Probability Notations, Inference using Full Joint Distributions, Independence, Bayes' Rule, and its Use. **Learning from Examples**: Forms of Learning, Supervised Learning, Learning Decision Trees, Artificial Neural Networks, Support Vector Machines, Ensemble Learning.

Unit IV

Natural Language Processing: Language Models, Text Classification, Information Retrieval, Information Extraction. **Natural Language-communication:** Phrase Structure Grammars, Syntactic Analysis, Augmented Grammars, and Semantic Interpretation, Machine translation, Speech recognition.

Unit V

Genetic Algorithms: Genetic Algorithms Introduction, Significance of Genetic Operators, Termination Parameters, Niching and Speciation, Evolving Neural Networks, Theoretical

Grounding, Ant Algorithms. **Robotics:** Introduction, Hardware, Perception, Planning to Move, Planning Uncertain Movement, Moving, Robotic Software Architecture, Application Domains. **Philosophical Foundations:** Weak and Strong AI, The Ethics and Risks of Developing AI, **AI: The Present and Future**.

Text Books:

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

Reference Books:

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

Course Outcomes (COs)

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

1. Identify the modern view of artificial intelligence and its applications based on agent Philosophy. (PO-1,2,3)
2. Apply First-Order Logic to solve the Knowledge Engineering process. (PO-1,2,3)
3. Examine the various methods of handling uncertainty; planning and learning to real-world problems. (PO-1,2,3,4,5)
4. Demonstrate an understanding of the role of Natural Language processing in building
   intelligent systems. (PO-1,2,5)
5. Explain the influence of biologically inspired phenomena in genetic algorithms and the future of AI. (PO-1,2,5)

Web Search and Information Retrieval

Course Code: MCSE152 **Credits: 3:0:1**
Prerequisites: - **Contact Hours: 42+28**
Course Coordinator/s: Dr. J Geetha

Course Contents

Unit I

Introduction: Overview, History of IR, **Text Operations:** Document preprocessing, Document Clustering, Text Compression, **Indexing:** Inverted files, **Mathematics for IR:** Set Theory, Mathematical Logic, Probability and Linear algebra, **Classic IRModels:** Boolean Model, Vector space model: tf-idf weighing, Probabilistic Model. **Language models for IR:** The language model and the query likelihood model.

Unit II

Evaluation Measures: Precision, Recall, Alternative Measures, **Reference Collections:** TREC, **Relevance Feedback and Query Expansion**, **Text Classification:** The text classification problem, **Flat clustering:** Clustering in information retrieval, Problem Statement, **Hierarchical clustering:** Hierarchical agglomerative clustering, Single-link and Complete-link clustering.

Unit III

String Matching algorithms: Knuth Morris Pratt and Rabin Karp, **Stemming algorithm:** Porter, **Map reduce algorithms:** tf- idf calculation and indexing**, Classification:** Naive Bayes algorithm, **Clustering:** k-means algorithm. **Machine learning Algorithms:** Machine-learned scoring, Result ranking by machine learning

Unit IV

Web search basics: Background and history, Web characteristics, Advertising as the economic model, The search user experience, Index size and estimation , Near-duplicates and shingling, **Web Crawling and Indexing:** Overview, Crawling, Distributing Indexes, Connectivity Servers

Unit V

Link analysis: Web as a graph**,** Page Rank, Hubs and Authorities. **Introduction toSemantic Web:** Purpose, Semantic Web Stack, RDF, RDFS, Ontology, Web ontology language (OWL) and ontology tools**.**

Text Books:

1. Ricardo Baeza-Yates, Berthier Ribeiro-Neto: Modern Information Retrieval, Pearson Education, 1999.
2. Introduction to Information Retrieval. C.D. Manning, P. Raghavan, H. Schütze. Cambridge UP, 2008.

Reference Books:

1. William B Frakes, Ricardo Baeza Yates: Information Retrieval Data Structures and Algorithms, PH PTR, 1992.
2. David A Grossman, Ophir Frieder: Information Retrieval Algorithms and Heuristics, 2e, Springer, 2004
3. Mathematics for Classical Information Retrieval: Roots and Applications: Dariush Alimohammadi,http://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1002&context=zeabook.

Course Outcomes(COs):

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

1. Understand the basic concepts of IR(PO1,3,4)
3. Apply the eveluation measures and clustering (PO1,3,4)
4. Implement different algorithms (PO1,3,4)
5. Understand the eb searrch basics (PO 1,3,4)
6. Develop web based applications (PO 1,3,4,5)

Advances in Image Processing

Course Code:MCSE153 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Mrs.Veena G S

Course Contents

Unit I

Digital Image Fundamentals: What is Digital Image Processing? fundamental Steps in Digital Image Processing, Components of an Image processing system, elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships between Pixels, Linear and Nonlinear Operations.

Unit II

Image Transforms: Two-dimensional orthogonal & unitary transforms, properties of unitary transforms, two dimensional discrete Fourier transform. Discrete cosine transform, sine transform, Hadamard transform, Haar transform, Slant transform, KL transform.

Unit III

Image Enhancement: Image Enhancement in Spatial domain, Some Basic Gray Level Trans -formations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations.

Unit IV

Basics of Spatial Filtering Image enhancement in the Frequency Domain filters, Smoothing Frequency Domain filters, Sharpening Frequency Domain filters, homomorphic filtering.

Unit V

Model of image degradation/restoration process, noise models, Restoration in the Presence of Noise, Only-Spatial Filtering Periodic Noise Reduction by Frequency Domain Filtering, Linear Position-Invariant Degradations, inverse filtering, minimum mean square error (Weiner) Filtering, Color Fundamentals. Color Models, Pseudo color Image Processing., processing basics of full color image processing.

Reference Books:

1. "Digital Image Processing", Rafael CGonzalez, Richard E. Woods, etl , TMH, 2nd Edition 2010.
2. "Fundamentals of Digital Image Processing", Anil K. Jain, Pearson Education, 2001.
3. "Digital Image Processing and Analysis", B. Chanda and D. Dutta Majumdar, PHI, 2003.

Course Outcomes (COs):

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

1. Examine various types of images, intensity transformations and applying various filtering techniques. (PO1,3,4)
2. Show how higher-level image concepts such as edge detection, segmentation representation can be implemented and used. (PO1,3,4)
3. To manipulate both binary and grayscale digital images using morphological filters and operators to achieve a desired result. (PO1,3,4)
4. Apply image processing algorithms in practical applications. (PO1,3,4)
5. Create real time applications using color fundamentals (PO 1,3,4,5)

Software Testing

Course Code: MCSE154 **Credits: 4:0:0**
Prerequisites: SE **Contact Hours: 56**
Course Coordinator/s: Pradeep Kumar D

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

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

Unit V

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Business Intelligence and Applications

Course Code: MCSE155 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr T N R Kumar

Course Contents

Unit I

Development Steps, BI Definitions, BI Decision Support Initiatives, Development Approaches, Parallel Development Tracks, BI Project Team Structure, Business Justification, Business Divers, Business Analysis Issues, Cost – Benefit Analysis, Risk Assessment, Business Case Assessment Activities, Roles Involved in These Activities, Risks of Not Performing Step, Hardware, Middleware, DBMS Platform, Non Technical Infrastructure Evaluation

Unit II

Managing the BI Project, Defining and Planning the BI Project, Project Planning Activities, Roles and Risks Involved in These Activities, General Business Requirement, Project Specific Requirements, Interviewing Process.

Unit III

Differences in Database Design Philosophies, Logical Database Design, Physical Database Design, Activities, Roles and Risks Involved in These Activities, Incremental Rollout, Security Management, Database Backup and Recovery

Unit IV

Growth Management, Application Release Concept, Post Implementation Reviews, Release Evaluation Activities, The Information Asset and Data Valuation, Actionable Knowledge – ROI, BI Applications, The Intelligence Dashboard.

Unit V

Business View of Information technology Applications: Business Enterprise excellence, Key purpose of using IT, Type of digital data, basics of enterprise reporting, BI road ahead.

Text Books:

1. Larissa T Moss and Shaku Atre, Business Intelligence Road map: The Complete Project Lifecycle for Decision Support Applications, Addison Wesley Information Technology Series, 2003
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, Wiley India, 2011

Reference Books:

1. David Loshin, Business Intelligence: The Savvy Manager's Guide, Morgan Kaufmann
2. Brian Larson, Delivering Business Intelligence with Microsoft SQL Server 2005, McGraw Hill, 2006
3. Lynn Langit, Foundations of SQL Server 2008 Business Intelligence, A press ,2011

Course Outcomes (COs):

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

1. Understand the business intelligence and approaches (PO1,3,4)
2. Show the business planning activities (PO1,3,4)
3. Apply business intelligence to data base design (PO1,3,4)
4. Implement business growth manageent methods (PO1,3,4)
5. Develop real time IT business applications (PO 1,3,4,5)

Electives-IV

Distributed Systems

Course Code: MCSE231 **Credits: 4:0:0**
Prerequisites: OS **Contact Hours: 56**
Course Coordinator/s: Sini Anna Alex

Course Contents

Unit I

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

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

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

Unit II

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

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

Unit III

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

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

Unit IV

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

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

Unit V

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

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

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

Text Book:

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

Reference Books:

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

Course Outcomes (COs):

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

1. Identify the design issues and Challenges in building distributed systems. (PO-1, 3, 4, PSO-1, 3)
2. Explore different ways of managing time (clock) and Analyze basic distributed graph algorithms. (PO-3, 4, 9, PSO-1)
3. Discuss ways to achieve various message ordering schemes and approaches for detecting termination of a distributed computation. (PO-1, 3, 4, 9, PSO-1, 2)
4. Identify different assertion based, and tree based distributed algorithms to implement Distributed Mutual Exclusion. (PO-3, 9, PSO-1, 2, 3)
5. Understand the distributed hash table and P2P overlay problems (PO-3, 9, PSO-1, 2, 3)

Semantic Web and Social Networks

Course Code: MCSE232 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Aparna R

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Books:

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

Course Outcomes (COs):

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

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

Software Engineering and Modelling

Course Code: MCSE233 **Credits: 4:0:0**
Prerequisites: Basic Concepts of Software Engineering. **Contact Hours: 56**
Course Coordinator/s: Dr. Annapurna P Patil

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Book:

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

Reference Books:

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

Course Outcomes (COs):

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

1. Apply the concept of agile development and design any web application using the principles learnt. (PO-1,2,3,5)
2. Illustrate the process of Software Modeling on a case study using Unified Modeling Language (UML).(PO-1,2,3,5)
3. Identify the concepts of Formal Modelling and Verification methods; Project Management, and estimation. (PO-1,2,3,5)
4. Demonstrate the activities involved in Software Scheduling and Risk Management to a case study. (PO-1,2,3,4,5)
5. Identify the approaches to Software maintenance and reengineering and Software Process Improvement. (PO-1,2,3,4,5)

Data Storage Technology and Networks

Course code: MCSE234 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Divakar H V

Course contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Reference books:

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

E BOOKS

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

Course Outcomes (COs):

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

1. Understand storage media and technologies (PO 1,3,4)
2. Identify how to access usage memory hierarchy(PO 1,3,4)
3. Explain issues in large storages (PO 1,3,4)
4. Explore diferent storage architectures (PO 1,3,4)
5. Analyze performance parameters on storage area networks (PO 1,3,4)

Software Project Management and Professional Ethics

Course Code: MCS235 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Prof. Nagabhushana A M

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Reference Book:

1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling, 10th ed. Author: Harold Kerzner.
2. Kathy Schwalbe: Project Management in IT, India edition, Cengage Learning, 2007
3. Project Management: Choudhry S., Tata McGraw-Hill,2010
4. Projects: Planning, Analysis, Financing, Implementation, and Review Prasana Chandra, 5th edition, Tata McGraw-Hill publishing company limited,2005
5. Project management a system approach to planning scheduling and controlling
6. Harold Kerzner, CBS Publisher and distributors, 2002.
7. A management guide to PERT and CPM- WEIST and LEVY Eastern Economy of PH 2002.
8. T R Banga, N K Agarwal and S C Sharma -Industrial engineering and Management Sciences, -Khanna Publishers

Course Outcomes (COs):

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

1. Recognize issues in a realistic project scenario.(PO 1,3,4)
2. Employ work breakdown structures (WBS) in a project application.(PO 1,3,4)
3. Demonstrate the use of appropriate network scheduling techniques.(PO 1,3,4)
4. Produce a project proposal.(PO 1,3,4,5)
5. Discuss the implementation s of a proposed plan.(PO 1,3,4,5)

Electives-V

Natural Language Processing

Course Code: MCSE241 **Credits: 4:0:0**
Prerequisites: Artificial Intelligence **Contact Hours: 56**
Course Coordinator/s: Dr. Jagadish S Kallimani

Course Contents

Unit I

Introduction: Knowledge in Speech and Language Processing, Ambiguity, Models and Algorithms; Language, Thought, and Understanding; The State of the Art and The Near-Term Future; **Regular Expressions and Automata**; **Morphology and Finite-State Transducers:** Lexicon-free FSTs: The Porter Stemmer, Human Morphological Processing.

Unit II

N-grams: Counting Words in Corpora, Smoothing, N-grams for Spelling and Pronunciation, Entropy; **Word Classes and Part-of-Speech Tagging**: Part- of-Speech Tagging, Rule-based Part-of-speech Tagging, Stochastic Part-of- speech Tagging, Transformation-Based Tagging; **Context-Free Grammars for English:** Constituency, Context-Free Rules and Trees, Sentence-Level Constructions, The Noun Phrase.

Unit III

Parsing with Context-Free Grammars: The Earley Algorithm; **Features and Unification:** Feature Structures, Unification of Feature Structures, Features Structures in the Grammar, Implementing Unification, Parsing with Unification Constraints; **Lexicalized and Probabilistic Parsing:** Probabilistic Context-Free Grammars, Problems with PCFGs.

Unit IV

Representing Meaning: First Order Predicate Calculus, Some Linguistically Relevant Concepts, Related Representational Approaches, Alternative Approaches to Meaning; **Semantic Analysis:** Syntax-Driven Semantic Analysis, Attachments for a Fragment of English; **Lexical Semantics**: Relations Among Lexemes and Their Senses, WordNet: A Database of Lexical Relations, The Internal Structure of Words.

Unit V

Discourse: Reference Resolution, Text Coherence, Discourse Structure; **Generation:** Introduction to Language Generation, An Architecture for Generation; **Machine Translation:** Language Similarities and Differences, The Transfer Metaphor.

Text Book:

1. Daniel Jurafsky and James H Martin, "Speech and Language Processing: an introduction to Natural Language Processing, Computational Linguistics and Speech Recognition", Prentice Hall, 2nd Edition, 2008.

Rerefence Book:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

Course Outcomes (COs):

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

1. Interpret how speech and language technology relies on formal models to capture knowledge, and language processing deals with subparts of words (morphology). (PO 1,3,4)
2. Illustrate the way *N*-gram tool is used for spelling and pronunciation processing, and part-of-speech tagging mechanism using various categories. (PO 1,3,4)
3. Describe feature structures and unification operation which is used to combine them, and probabilistic parsing to capture more syntactic information. (PO 1,3,4)
4. Outline representations used to bridge the gap from language to commonsense Knowledge (semantic processing), and meanings associated with lexical items. (PO 1,3,4)
5. Emphasize problems that NLP systems face, natural language outputs construction from non-linguistic inputs and machine translation framework approaches. (PO 1,3,4)

Software Defined Networks

Course Code: MCSE242 **Credits: 4:0:0**
Prerequisites: Data communications and Computer networks
Course Coordinator: Sanjeetha R **Contact Hours: 56**

Course Contents

Unit I

Introduction - Traditional Switch Architecture.
Why SDN-Evolution of Switches and Control Planes, Cost, SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs.
The Genesis of SDN: Forerunners of SDN: Early efforts, Network Access Control, Orchestration, Virtualization manager network plugins, FORCES, 4D Centralized Network Control, Ethane, Software Defined Networking is Born, Network Virtualization.
How SDN Works - Fundamental Characteristics of SDN, SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods. Data Center Needs, Network Virtualization.

Unit II

How SDN Works Contd. -SDN Controller- SDN controller core modules, SDN controller interfaces, Existing controller implementations, potential issues with the SDN Controller, SDN Applications, Alternate SDN Methods – SDN via APIs, Benefits and Limitations of SDN via APIs, SDN via hypervisor based overlay networks.
The OpenFlow Specification– OpenFlow Overview – The OpenFlow switch, The OpenFlow Controller, The OpenFlow protocol, The Controller- switch secure channel, OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 Additions, OpenFlow 1.2 Additions, OpenFlow 1.3 Additions, OpenFlow Limitations.
Benefits and Limitations of SDN via APIs, OpenFlow Limitations.

Unit III

The OpenFlow SpecificationContd. Openflow 1.4 additions – Bundles, Eviction and vacancy events, enhanced support for multiple controller, optical port support, and flow table synchronization.
Alternative Definitions of SDN - Potential Drawbacks of Open SDN, SDN via APIs – Legacy APIs in Network Devices, NETCONF/YANG, BGP- LS/PCE-P, REST, Examples of SDN via APIs, Ranking SDN via APIs, SDN via Hypervisor-Based Overlays – Overlay Controller, Overlay Operation, Examples of SDN via Hypervisor-Based Overlays, Ranking SDN via Hypervisor-Based Overlays, SDN

via Opening Up the Device, Network Functions Virtualization, Alternatives Overlap and Ranking.
flow table synchronization, Alternatives Overlap and Ranking.

Unit IV

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

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

Unit V

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

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

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

Text Book:

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

Reference Book:

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

Course Outcomes(COs):

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

1. Describe the fundamental characteristics of SDN. (PO1,3,4)
2. Differentiate between various Open Flow specifications. (PO1,3,4)
3. Identify different ways of implementing SDN. (PO1,3,4)
4. Compare and contrast different types of controller models in SDN. (PO1,3,4)
5. Illustrate use of SDN in Data Centers and other environments (PO1,3,4)
6. Explore the various aplications of SDN (PO1,3,4,5)

Web Technologies

Course Code: MCSE243 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. J Geetha

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

Mashups and Web services: The rise of mashups, geocoding, Google maps API. Introduction to Service Oriented Architecture, Combining protocols to build Web

services – clarifying web services, REST Services, WS-* Web services using SOAP and WSDL, REST vs WS-* services.

Reference Books:

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

Course Outcomes (COs):

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

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

Privacy and Security in Online Social Media

Course Code: MCSE244 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Parkavi A

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Books:

1. Toby Segaran, Programming Collective Intelligence: Building Smart Web 2.0 Applications, 1st Edition, Orielly.
2. Quentin Zervaas, Practical Web 2.0 Applications with PHP, A press; 1st Corrected ed., Corr. 3rd printing edition
3. Gavin Bell, Building Social Web Applications: Establishing Community at the Heart of Your Site, Shroff/O'Reilly; First edition
4. Dafydd Stuttard , Marcus Pinto The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws , Wiley; 2nd edition

Course Outcomes (COs):

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

1. Understand working of online social networks (PO 1,3,4)
2. Explore different methods used for data collection.(PO 1,3,4)
3. Describe credibility of online media (PO 1,3,4)
4. Identify the privacy policies of online social mdeia .(PO 1,3,4)
5. Explain and identify attacks on socual media .(PO 1,3,4)

Information and Network Security

Course Code: MCSE245 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Mrs. Meeradevi A Kawalgi

Course Contents

Unit I

Introduction to Information Security: Introduction; what is security? Key Approaches to information security implementation; The Security System Development Life Cycle; Why security is needed: Attacks, How to Plan for Security: Information Security Policy, Standards and Practices: Definitions, Enterprise Information Security Policy (EISP), Issue-Specific Security Policy (ISSP), The Information Security Blueprint: the ISO 27000 series.

Unit II

Introduction: Security Goals, Cryptographic Attacks, Services and Mechanism, Techniques. Mathematics of Cryptography: Integer Arithmetic, Modular Arithmetic, Matrices, Linear Congruence and Traditional Symmetric-Key Ciphers: Symmetric-Key Ciphers, Stream and Block Ciphers.

Unit III

Categories of Traditional Ciphers: Substitution Ciphers, Transposition Ciphers. Data Encryption Standard (DES): DES Structure, DES Analysis, Advanced Encryption Standard (AES): History of AES, Transformations used by AES, Key Expansion, The AES Ciphers, Examples, Asymmetric Key Cryptography: RSA Cryptosystem, Key management: Symmetric-key Distribution, Kerberos, X.509, Public Key Infrastructures (PKI).

Unit IV

Digital signature: process, services, Digital signature schemes: RSA digital signature scheme, Digital certificates: Introduction, Types of Digital Certificates, The Parties to Digital Certificate, Contents of Digital Certificate: Certification Validation Added to a Process,

Security Risk Management- How Much Security Do You Really Need, Risk Management, Information Security Risk Assessment: Introduction, Information Security Risk Assessment: Case Studies, Risk Assessment in Practice.

The Trusted Computing Architecture- Introduction to Trusted Computing, TPM Provisioning, Exact Mechanics of TPM.

Unit V

IP Security: IP Security Overview, Applications of IPsec, Benefits of IPsec, Routing applications, IPsec documents, IPsec services, Transport and Tunnel modes, IP Security

policy, Security Technology: Intrusion Detection and Prevention systems: Types of IDPS, IDPS Detection Methods, Firewalls: Firewall Processing Modes, Firewall architecture, Blockchain: Currency: Technology Stack: Blockchain, Protocol, Currency , The Double-Spend and Byzantine Generals' ,Computing Problems, How a Cryptocurrency Works, Blockchain: Contracts: Financial Services, Crowdfunding.

Text Books:

1. Michael E. Whitman and Herbert J. Mattord : ―Principles of Information Security, 4th Edition, Thomson, 2012.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay: Cryptography and Network Security, 3nd Edition, Special Indian Edition, Tata McGraw-Hill, 2015.
3. William Stallings, Cryptography and Network Security, Sixth Edition, Prentice Hall of India, 2014.
4. Melanie Swan: Blockchain Blueprint for A New Economy Published By O'reilly Media, Inc, 2015.

Web Link:

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

Reference Books:

1. Josef Pieprzyk, Thomas Hardjono, Jennifer Serberry Fundamentals of Computer Security, Springer.

Course Outcomes (COs):

The students should be able to

1. 1.Infer security system development life cycle and information security planning (PO 1,2,3).
2. Explain different cryptographic attacks and mathematics for cryptography (PO 1,2,3).
3. Illustrate the categories of ciphers, encryption standards and key management techniques (PO 1,2,3).
4. Summarize digital signature and goals achieved at application and transport layer (PO 1,2,3).
5. Employ Blockchain technology and security at network layer (PO 1,2,3).

Electives-VI

Machine Learning

Course Code: MCSE251 **Credits: 3:0:1**

Contact Hours:42+28

Prerequisites: Artificial Intelligence, Probability theory, Linear Algebra and python programming environment

Course Coordinator: Dr. Sangeetha J

Course Contents

Unit I

Machine Learning Basics - What is Machine Learning, Key Terminology, Key tasks of machine learning, How to choose the right algorithm, Steps in developing a machine learning application. **Introduction:** Well posed learning problems, designing a Learning system, Perspective and Issues in Machine Learning. **Decision Tree -** Decision Tree Representation, Appropriate Problems for Decision Tree Learning, Basic Decision Tree Learning Algorithm, Issues in Decision Tree Learning. Chapter 1 of Text Book 2; Chapter 1, 3 to Text Book 1;

Unit II

Linear Regression - Finding best-fit lines with linear regression, locally weighted linear regression, the bias/variance tradeoff. **Logistic Regression** - Classification with logistic regression and the sigmoid function: a tractable step function, Using optimization to find the best regression coefficients **Support Vector Machines** - Separating data with the maximum margin, Finding the maximum margin, Efficient optimization with the SMO algorithm. Chapter 5, 6, 8 of Text Book 2.

Unit III

Artificial Neural Networks - Introduction, Neural Network Representation, Appropriate problems, Perceptron, The Backpropagation algorithm. **Genetic Algorithms** - Representing hypotheses, Genetic Operators, Fitness Function and Selection, an Illustrative Example. **Dimensionality Reduction:** Principal Component Analysis and Singular Value Decomposition Chapter 4, 9 of Text Book 1 and 13, 14 of Text Book 2.

Unit IV

Unsupervised Learning: K-means clustering - The k-means clustering algorithm, Improving Cluster performance with postprocessing, Bisecting k-means. **Apriori Algorithm** - Association analysis, The Apriori principle, Finding frequent item sets with the Apriori algorithm, Mining association rules from frequent item sets. **Frequent Pattern Growth Algorithm** - FP-trees: an efficient way to encode a dataset, Build an FP-tree, Mining frequent items from an FP-tree. **Bayesian Learning -** Introduction, Bayes theorem,

Naive Bayesian Classifier, The EM Algorithm. Chapter 10, 11, 12 of Text Book 2 and Chapter 6 of Text Book 1.

Unit V

Instance Based Learning - Introduction, k-nearest neighbor learning, locally weighted regression, radial basis function, case-based reasoning. **Analytical Learning:** Learning with perfect domain theories, explanation based learning of search control knowledge; **Reinforcement Learning** - Introduction, Learning Task, Q Learning, Temporal difference learning. Chapter 8, 11, 13 of Text Book 1.

Text Books:

1. Tom M Mitchell, "Machine Learning", McGraw-Hill Education (Indian Edition), 2013.
2. Peter Harrington. "Machine learning in action", Shelter Island, NY: Manning Publications Co, 2012.

Reference Books:

1. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, PHI Learning, 2016.
2. Géron, Aurélien. "Hands-on machine learning with Scikit-Learn and TensorFlow: concepts, tools, and techniques to build intelligent systems", O'Reilly Media, Inc., 2017.

Course Outcomes (COs):

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

1. Distinguish between, supervised, unsupervised and semi-supervised learning. (PO1,3,4)
2. Apply the appropriate machine learning strategy for any given problem. (PO1,3,4)
3. Suggest tree and probabilistic learning algorithms for any given. Problem. (PO1,3,4)
4. Modify existing machine learning algorithms to improve classification efficiency. (PO1,3,4)
5. Design systems that uses the appropriate graph models of machine learning (PO1,3,4)

IoT Technology and Applications

Course Code: MCSE252 **Credits: 4:0:0**
Prerequisites: - **Contact Hours:56**
Course Coordinator/s: HanumanthaRaju R

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

IoT Platform Design Methodology and Domain Specific IoT.

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

Text Books:

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

References:

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

Course Outcomes (COs):

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

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

Multi-core Architecture and Programming

Course Code: MCSE253 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Mr. 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 andThreading, Virtual Environment: Vms And Platforms, Runtime Virtualization, System Virtualization.

Unit II

Fundamental 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

Reductions, Minimizing Threading Overhead, Work-Sharing Sections, Performance Oriented Programming, Using Barrier and No Wait, Loop, Loop-Carried Dependence, Data-Race Conditions, Managing Shared and Private Data, Loop Scheduling and

Portioning, Effective Use of **Openmp: A Portable Solution For Threading:** Challenges In Threading A 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, Naresh Jotwani: 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. Solve the issues related to multiprocessing and suggest solutions. (PO1,3,4)
4. Point out the salient features of different multi-core architectures and how they exploit parallelism. (PO1,3,4)
5. Understand the concept of multi threading and OPENMP. (PO1,3,4)

Robotics and Automation

Course Code: MCSE254 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Mohana Kumara S

Course Contents

Unit I

BASIC CONCEPTS Brief history-Types of Robot–Technology-Robot classifications and specifications-Design and controlissues- Various manipulators – Sensors - work cell - Programming languages.

Unit II

DIRECT AND INVERSE KINEMATICS Mathematical representation of Robots - Position and orientation – Homogeneous transformation. Various joints- Representation using the Denavit Hattenberg parameters -Degrees of freedom-Direct kinematics-Inverse kinematics-SCARA robots- Solvability – Solution methods-Closed form solution.

Unit III

FUNDAMENTAL CONCEPTS OF INDUSTRIAL AUTOMATION Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

Unit IV

DESIGN OF MECHATRONIC SYSTEMS Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system.

Unit V

PROGRAMMABLE AUTOMATION Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

Text Books:

1. R.K. Mittal and I.J. Nagrath, Robotics and Control, Tata McGraw Hill, New Delhi,4th Reprint, 2005.
2. JohnJ. Craig, Introduction to Robotics Mechanics and Control, Third edition, Pearson Education, 2009
3. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, Industrial Robotics, McGraw-Hill Singapore, 1996

4. Mikell P Groover, “Automation Production Systems and Computer- Integrated Manufacturing” Pearson Education, New Delhi, 2001. 2. Bolton W, “Mechatronics“, Pearson Education, 1999.

Reference Books:

1. Mikell P Groover, "Industrial Robots – Technology Programmes and Applications” McGraw Hill, New York, USA. 2000.
2. Steve F Krar, “Computer Numerical Control Simplified”, Industrial Press, 2001.
3. Joffrey Boothroyd, Peter Dewhurst and Winston A. Knight, “Product Design for manufacture and Assembly”, CRC Press, 2011

Course Outcomes (COs):

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

1. Understand the basic concepts of Robotics (PO1,3,4)
2. Analyze inverse kinematics (PO1,3,4)
3. Explain the fundamental concepts of Industrial automation (PO1,3,4)
4. Design mechatronics system (PO1,3,4)
5. Understand the programmable automation. (PO1,3,4)

Applied Cryptography

Course Code: MCSE255 **Credits: 4:0:0**
Prerequisites: Basic Cryptography methods **Contact Hours: 56**
Course Coordinator/s: Dr. Mohana Kumara S

Course Contnets

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Books:

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

Reference Books:

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

Course Outcomes (COs):

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

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

Electives-VII

Start-up Engineering

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

Course Contents

Unit I

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

Unit II

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

Unit III

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

Configuring DNS to work with Heroku, Setting up HTTPS and Google Apps,Social/Local/Mobile, Virality, Growth, Virality Equation, Local, Local Commerce, Graveyard of Startups.

Unit IV

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

Unit V

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

Reference Books:

1. Materials on Startup Engineering, Balaji S. Srinivasan, Stanford University
2. http://www.wsj.com/articles/SB10001424053111903480904576512250915629460#printMode
3. http://www.asymco.com/2012/01/17/the-rise-and-fall-of-personal-computing/
4. http://www.kpcb.com/blog/2012-internet-trends-update
5. http://www.nytimes.com/2011/05/08/technology/08class.html?pagewanted=all&_r=0
6. http://www.nytimes.com/2011/06/11/technology/11computing.html?pagewanted=all&_r=0
7. http://www.nytimes.com/projects/magazine/ideas/2009/#natural_science-
8. http://www.paulgraham.com/growth.html

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

Course Outcomes (COs):

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

1. Describing startups and technology trends towards businesses. (PO 1,3,4)
2. Identifying software usage for businesses and ethics. (PO 1,3,4)
3. Figuring out the web usage for business launch. (PO 1,3,4)
4. Assessing the latest technologies for startups. (PO 1,3,4)
5. Preparing software for startups. (PO 1,3,4,5)

Deep Learning

Course Code: MCSE322 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Srinidhi H

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

TextBooks:

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

Course Outcomes (COs):

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

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

Cyber Physical Systems

Course Code: MCSE323 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr. Anita Kanavalli

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Reference Books/Web Links:

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

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

Course Outcomes (COs):

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

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

Advances in Storage Area Networks

Course Code: MCSE324 **Credits: 4:0:0**
Prerequisites: Computer Networks, Computer Organization, Operating Systems **Contact Hours: 56**
Course Coordinator/s: Dr. Divakar Harekal

Course Contents

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Book:

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

Reference Books:

1. Ulf Troppens, Rainer Erkens and Wolfgang Muller: Storage Networks Explained, 1st Edition, Wiley India, 2012.
2. Robert Spalding: Storage Networks, The Complete Reference, 1st Edition, Tata McGraw Hill, 2011.

Course Outcomes (COs):

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

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

Digital Forensic and Cyber Crime

Course Code: MCSE325 **Credits: 4:0:0**
Prerequisites: - **Contact Hours: 56**
Course Coordinator/s: Dr Ramani S

Course Contents

Unit 1

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

Unit II

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

Unit III

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

Unit IV

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

Unit V

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

Text Book:

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

Reference Books:

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

Lab Exercises

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

Software Tools:

- CyberCheck 4.0 – Academic Version
- CyberCheckSuite
- MobileCheck
- Network Session Analyser
- Win-LiFT
- TrueImager
- TrueTraveller
- PhotoExaminer Ver 1.1
- CDRAnalyzer

Forensics Exercises:

I) Disk Forensics:

1. Identify digital evidences
2. Acquire the evidence
3. Authenticate the evidence
4. Preserve the evidence
5. Analyze the evidence
6. Report the findings

II) Network Forensics:

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

Course Outcomes (COs):

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

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

Technical Seminar-I/II

Credits: 0:0:2

Course Code: MCS18/MCS28
Prerequisites: -

Rubrics for assessment of Seminar

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

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

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

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

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

Annexure Table 1

Rubrics for Assessment of Student Performance in Laboratory

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

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

Table 2
Rubrics for assessment of Seminar

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

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

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

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

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

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

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

Table 3

Rubrics for assessment of Internship

Deliverables for Student Performance in Internship:

Internship Title: _____

Company Name: _____

Name of Student: _____

Name of Supervisor at Company: _____

Name of Supervisor at College: _____

Each supervisor must fill a rubric for each student:

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

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

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

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

Table 4

Rubrics for assessment of student performance in Project work I

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

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

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

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

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

Table 5

Rubrics for assessment of student performance in Project work II

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

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

		features. Each Module is working well and is properly demonstrated All modules of project are well integrated and system working is accurate	satisfactoril y and is properly demonstrat ed All modules of project are well integrate and system working is satisfactory	Most of the Modulesar e workin and is satisfactor ily demon rated Integratio n of all modules not done and system working is not very satisfactor y	working and is demonstrated Modules of project are not properly integrated	which further leads to failure of integrated system	
	Demonstar tion and Presentatio n	Contents of Presentation is Appropriate and well arranged Proper eye contact with	Contents of Presentatio nis appropriate but not well arranged Satisfactor	Contents of Presentati on is appropriat e but not well arranged	Contents of presentation is not appropriate Eye contact with few people and unclear voice	Contents of Presentations are not appropriate and not well delivered Poor delivery of presentation	

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

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

Table 6

Interim Progress Assessment Rubric for Project work-II Evaluation

Project: _____

Name of Student: _____

Name of Supervisor: _____

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

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

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

Table 7

Design Development and Solution Asset Rubric for Project work-II Evaluation

Project: _____

Name of Student: _____

Name of Supervisor: _____

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

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

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

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

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

Table 9 Final Presentation Rubric for Project work-II Evaluation Project: _____ Name of Student: _____ Name of Supervisor: _____

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

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