GALGOTIAS UNIVERSITY

Syllabus of

Course Book M.Tech.(CSE) 2018-19

Name of School: Computing Science and Engineering

Department: Computer Science and Engineering

Year: 2018-19

Curriculum

Semester I

Sl. No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT I/II	ETE
1	CENG5001	Professional Communication Skills	0	0	2	1	50	-	50
2	MATH5001	Advanced Numerical and Statistical Methods	3	1	0	4	20	50	100
3	MCSE1110	Advanced Design and Analysis of Algorithms	3	0	0	3	20	50	100
4	MCSE1120	Advanced Computer Networks	3	0	0	3	20	50	100
5	MCSE1130	Advanced Operating Systems	3	0	0	3	20	50	100
6	MCSE1140	Big Data Technologies	3	0	0	3	20	50	100
7	MCSE1111	Advanced Design and Analysis of Algorithms Lab	0	0	2	1	50	-	50
8	MCSE1121	Advanced Computer Networks Lab	0	0	2	1	50	-	50
9	MCSE1141	Big Data Technologies Lab	0	0	2	1	50	-	50

Semester II

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	CAT I/II	ETE
1	MCSE1210	Network Security	3	0	0	3	20	50	100
2	MCSE1220	Advanced Computer Graphics	3	0	0	3	20	50	100
3	MCSE1230	Cloud Computing Technologies	3	0	0	3	20	50	100
4	MCSE9130	Big Data Mining and Analytics (Elective-1)	3	0	0	3	20	50	100
5	MCSE9210	Real Time Systems (Elective-2)	3	0	0	3	20	50	100
6	MCSE1211	Network Security Lab	0	0	2	1	50	-	50
7	MCSE1221	Advanced Computer Graphics Lab	0	0	2	1	50	-	50

Semester III

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	SLMT5001	Quantitative and Communication Proficiency	0	0	4	2	50		100
2	MCSE2310	Software Requirements Engineering	3	0	0	3	20	50	100
3	MCSE9330	Social Network Analysis (Elective-3)	3	0	0	3	20	50	100
4	MCSE9410	Data Visualization Techniques (Elective-4)	3	0	0	3	20	50	100
5	MCSE2311	Software Requirements Engineering Lab	0	0	2	1	50	-	50
6	MCSE2381	M. Tech Dissertation Part-1	0	0	0	5	50	-	50

Semester IV

Sl No	Course Code	Name of the Course					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCSE2481	M. Tech Dissertation-Final	0	0	30	15	50		50

List of Electives

Basket-1

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	CAT I/II	ETE
1	MCSE9110	IoT Technology and Applications	3	0	0	3	20	50	100
2	MCSE9120	IoT on Cloud	3	0	0	3	20	50	100
3	MCSE9130	Big Data Mining and Analytics	3	0	0	3	20	50	100
4	MCSE9140	Data Science and Big Data Analytics	3	0	0	3	20	50	100

Basket-2

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	CAT I/II	ETE
1	MCSE9210	Real Time Systems	3	0	0	3	20	50	100
2	MCSE9220	Mobile and Pervasive Computing	3	0	0	3	20	50	100
3	MCSE9230	Parallel Programming Paradigms	3	0	0	3	20	50	100
4	MCSE9240	Information Retrieval Techniques	3	0	0	3	20	50	100

Basket-3

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCSE9310	Formal models of software systems	3	0	0	3	9	50	100
2	MCSE9320	Embedded Software Development	3	0	0	3	10	50	100
3	MCSE9330	Social Network Analysis	3	0	0	3	11	50	100
4	MCSE9340	Bio-inspired Computing	3	0	0	3	12	50	100

Basket-4

Sl No	Course Code	Name of the Electives					Assessment Pattern		
			L	T	P	C	IA	MTE	ETE
1	MCSE9410	Data Visualization Techniques	3	0	0	3	20	50	100
2	MCSE9420	Reconfigurable Computing	3	0	0	3	20	50	100
3	MCSE9430	Mobile Application Development	3	0	0	3	20	50	100
4	MCSE9440	Information Storage Management	3	0	0	3	20	50	100

Detailed Syllabus

CENG5001	Professional Communication Skills	L	T	P	C
Version No.1.0	**Date of Approval: 19/06/2015**	0	0	4	2
Prerequisite/Exposure					
Co-requisites					

Course Objectives:

1. To develop the professional and communication skills of learners in a technical environment.
2. To enable the students to acquire functional and technical writing skills.
3. To acquire state-of-the-art presentation skills in order to present technical topics to both technical and non-technical audience.

Course Outcomes:

1. The learners will be able to exhibit their language proficiency
2. The learners should develop the skill in *Describing, Investigating, Designing and Making* and *Using Technology.*
3. students should acquire functional and technical writing skills.
4. To acquire state-of-the-art presentation skills in order to present technical topics to both technical and non-technical audience

Course Content

Module-I: Functional Language

Basic structures- Tense agreement, Prepositional phrases, Techno-words : Basic Concepts 62, 63, Pronunciation : sounds of syllables: Past tense & plural endings , Technical Expression, Organisational techniques in technical writing, Guided writing: Paragraph Writing, Note Making, Presentation Skills Techniques of presentation (general topics: speech without visual aids) , Listening to speeches and comprehending, Graphical Skills Flow chart : Process and Functional description

Module-II: Functional Language

Basic structures- Voice, Conditionals ,Techno-words : Basic Concepts 64,65,67 ,Pronunciation : Word Stress: two syllable words, Technical Expression Mechanics of Technical Writing and Syntax ,Guided writing: Letter and email, Presentation Skills Interpersonal Communication Skills , Writing techniques for Power point presentation, Group Discussion , Graphical Skills Technical Illustrations and Instructions

Module-III

Functional Language Basic structures- Modal Verbs and Phrasal verbs, Techno-words: Basic Concepts 68,69,70,71, Pronunciation: Word Stress: compound words, Technical Expression Mechanics of Technical Writing and Syntax, Guided writing: Technical Description.

Module-IV

Functional Language Basic structures- Modal Verbs and Phrasal verbs ,Techno-words: Basic Concepts 72,73,74, Functional vocabulary 87, Pronunciation: Sentence Stress ,Technical Expression Guided and Free writing: Abstract and Technical articles, Presentation Skills Nuances of Presentation to a Technical audience, Graphical Skills Oral Presentation of graphical representation

Module-V

Presentation Skills, Graphical Skills, Nuances of Presentation to a Technical audience
Presentation of graphical representation,

1. English Vocabulary in Use Advanced, McCarthy & Felicity, CUP, 2003
2. Sky Pronunciation CD-ROM
3. Cambridge Advanced Learner's Dictionary CD-ROM
4. English Master : Grammar

References

1. Writing, Researching, Communicating, Keith et al, Tata McGraw-Hill, 1989
2. Advanced English Grammar, Martin, CUP, 2006

Course Code:MATH5001	Advanced Numerical and Statistical Methods	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Unit -I

System of Linear Equations: Direct Methods- Gauss elimination – Pivoting, Partial and Total Pivoting, Triangular factorization method using Crout LU decomposition, Cholesky method, Iterative Method- Gauss-Seidel and Jacobi method, ill conditioned matrix System of Non-linear equation- Newton Raphson and Modified Newton Raphson Method. Iterative methods.

Unit -II

Interpolation and Approximation: Lagrange, Spline and Hermite interpolation, Approximations, Error of approximation, Norms for discrete and continuous data, least square approximation.

Unit -III

Numerical Integration: Newton Cotes closed Quadrature, Gauss Legendre Quadrature, Multiple Integration.

Unit -IV

Numerical Solution of Differential Equations: Finite Difference Schemes, Numerical solution of Ordinary differential equation using Modified Euler's method, Runge-Kutta method of 2nd, 3rd and 4th orders, Predictor- Corrector method, Solution of Laplace's and Poisson's equations by Liebman's method, Solution of one dimensional time dependent heat flow.

Unit -V

Probability and statistics: Review of concept of probability, Random Variables, Continuous and discrete distribution function, moments and moments generating functions, Binomial, Poisson, Negative Binomial, Geometric and Hyper-geometric Distributions, Uniform, Normal, Exponential, Gamma and Beta distributions. Point and Interval estimation, Testing of Hypothesis (t-test and chi square test), Analysis of variance and Introduction of Design of experiments.

Text Books:

1. Numerical Methods for Scientific and Engineering Computation (6^{th} edition) by Jain, Iyengar & Jain, New Age International publishers.
2. Probability & Statistics for Engineers & Scientists (9^{th} edition) by R.E.Walpole, R,H,Myers & K.Ye.

Reference Books:

1. Numerical Methods by E Balagurusamy, Tata McGraw Hill
2. Curtis F. Gerald and Patrick O Wheatley, Applied Numerical Analysis, Pearson Education Ltd.
3. Introductory Methods of Numerical Analysis by S.S. Sastry, PHI learning Pvt Ltd.
4. Numerical methods for Engineers (6^{th} edition), Steven C. Chapra and Raymond P. Caynale.
5. Numerical Methods in Engineering & Science (9^{th} edition), by B.S.Grewal
6. Statistical Methods by S.P. Gupta, Sultan Chand and Sons
7. Probability and Statistics by Schaum's series (3^{rd} edition)

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1110	Advanced Design and Analysis of Algorithms	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure	Data Structures and Algorithms				
Co-requisites					

Course Objectives

1. To know the importance of the complexity of a given algorithm.
2. To study various algorithmic design techniques.
3. To utilize data structures and/or algorithmic design techniques in solving new problems.
4. To know and understand basic computability concepts and the complexity classes P, NP, and NP-Complete.

Course Outcomes

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

1. Analyze the complexity of the algorithms and use technique divide and conquer to solve the problems
2. Identify feasible solutions for different problems through greedy method and minimize the solutions space and to solve the problems through dynamic programming.
3. Solve the problems through graph algorithms.
4. Justify that a certain problem is NP-Complete
5. Understand and apply linear programming concepts to real time applications.

Course Content

Unit I: Introduction **9 lecture hours**

Overview of algorithmic design**,** asymptotic notation and its properties, Growth of Functions, Time complexity and Analysis of algorithms, Recurrence Relations.

Unit II: Sorting and Searching Algorithms **9 lecture hours**

Brute Force Method - Sorting in Quadratic time, insertion , selection and Bubble sort; Divide and conquer method- Sorting in Logarithmic time – Quick Sort , merge Sort , Shell Sort , Heap sort; Non-comparison sorts - Sorting in Linear Time - Counting Sort , Radix Sort , Bucket Sort; Worst Case and best case analysis of all sorting algorithms; Linear Search, Binary Search, Hashing, Randomized select , randomized quick sort.

Unit III: Algorithms for Trees **9 lecture hours**

Binary Tree - Binary Tree traversals, Binary Search Tree, heap, priority Queues, Red Black Trees, B-Trees.

Unit IV : Graph Algorithms **8 lecture hours**

Graph Searching- Breadth-First Search, Depth-First Search, DAGs and topological sorting, minimum spanning tree, shortest path, backtracking, Network flow algorithms.

Unit V: Greedy Algorithms, Amortized Analysis and Dynamic Programming **10 lecture hours**

Longest common subsequence, Greedy Algorithms - Knapsack problem; Huffman codes, Algorithms for String Matching, Theory of NP-completeness; Turing machines and the halting problem, Applications of Algorithms in Databases, Information Retrieval and Web Searching, Data Mining

Text Books

1. Cormen, Leiserson, Rivest and Stein, “Introduction to Algorithms”, 2nd Edition, by, McGraw-Hill, 2000.
2. E. Horowitz, and S. Sahni, “Fundamentals of Computer Algorithms”, Computer Science Press (1978).

Reference Books

1. Jon Kleinberg and Eva Tardos. Algorithm Design. Pearson Education, 2007.
2. Sanjoy Das Gupta, Christos Papadimitriou, Umesh Vazirani, Algorithms 1st Edition, Mcgraw Higher Ed, 2006.
3. Alfred V. Aho, John E. Hopcroft, Jeffery D.Ulman, Data Structures and Algorithms, Pearson; 1st edition, 2001.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1120	Advanced Computer Networks	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure	Computer Networks				
Co-requisites					

Course Objectives

The objective of this course is to:

1. An ability to understand the basic concept of data communications and computer networks (e.g., different network types, applications, protocols, OSI layered architecture model, switching methodologies)
2. Provide the skills needed for algorithms in computer networks for various situations that one may encounter in a career in Computer Science.
3. Learn different algorithmic methodologies to design efficient algorithms and protocols in network field.

Course Outcomes

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

1. To develop knowledge about physical structure of computer network
2. To understand the fundamental concepts in routing and addressing
3. To analysis the problem in different layer during the communication in network
4. To understand the congestion control and transport protocols
5. To became expert to use of Internet and public network
6. To able to understand the connection management in network at transport layer

Course Content

Unit I: Networking Standards and Specification **8 lecture hours**

Networking standards and specifications, Need for standardization, ISO and the IEEE standards, The IEEE 802 Project

Unit II: Addressing and Routing **8 lecture hours**

Network names and addresses, Physical layer addressing: the MAC address, Network layer addressing: The IP address, Network layer address: The IPX address.

Unit III: Overview of OSI and TCP/IP Protocol Suite **8 lecture hours**

Converting network names to IP addresses, Resolving IP addresses to physical addresses, Addressing and routing.

Unit IV: TCP/IP Protocol Suite **8 lecture hours**

TCP/IP Protocol Suite, TCP/IP Protocol Suite advantages, Internet Protocol (IP), Transport Layer Protocols -TCP and UDP, File Transfer protocols - FTP and TFTP, Mail and news protocols - SMTP, POP3, NNTP and IMAP, Other Protocols Suite – ICMP and ARP.

Unit V: Other Networking Protocols **8 lecture hours**

The IPX/SPX Protocol Suite, NetBEUI, AppleTalk Protocol, File sharing protocols - SMB, NCP, and NFS, Routing protocols - RIP, OSPF and BGP, Network Management Protocol – SNMP and CIMP, Convergent Protocols – H.323 and SIP

Text Books

1. Behrouz A. Forouzan, TCP/IP Protocol Suite, Third Edition, Tata McGraw-Hill, 2005.
2. W. Richard Stevens, TCP/IP Illustrated, The Protocols, Pearson Education, 2004.
3. D. E. Comer, Internetworking with TCP/IP Principles, Protocols and Architecture Vol - I, Pearson Education, 2001.

Reference Books

1. Internetworking with TCP/IP: Design, Implementation, and Internals by Douglas E. Comer, Stevens. Prentice Hall. Hardcover- 30 April, 2004.
2. Networks Fundamental Video 3 - the Transmission Control Protocol/internet Protocol (Tcp/ip) Stack by Delmar.Delmar. Unknown Binding- 1 December, 2002.
3. Advanced IP Routing in Cisco Networks (McGraw-Hill Technical Expert) by Terry Slattery, Bill Burton. Osborne McGraw-Hill. Paperback- 1 October, 2000.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1130	Advanced Operating Systems	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure	Operating System				
Co-requisites					

Course Objectives

1. To learn the fundamentals of Operating Systems.
2. To gain knowledge on Distributed operating system concepts that includes architecture, Mutual exclusion algorithms, Deadlock detection algorithms and agreement protocols.
3. To gain insight on to the distributed resource management components viz. the algorithms for implementation of distributed shared memory, recovery and commit protocols.
4. To know the components and management aspects of Real time, Mobile operating systems.

Course Outcomes

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

1. Discuss the various synchronization, scheduling and memory management issues.
2. Demonstrate the Mutual exclusion, Deadlock detection and agreement protocols of Distributed operating system.
3. Discuss the various resource management techniques for distributed systems.
4. Identify the different features of real time and mobile operating systems.
5. Install and use available open source kernel.
6. Modify existing open source kernels in terms of functionality or features used.

Course Content

Unit I: Introduction **8 lecture hours**

Operating system concept - processes and threads, process model, process creation, process termination, process hierarchies, and process states, Implementation of processes, Threads- Thread model, thread usage, Implementation of threads in user space and kernel, Hybrid implementations.

Unit II: Inter Process Communication **8 lecture hours**

Race conditions, critical regions, Mutual Exclusion with busy waiting, sleep and wakeup, Semaphores, Mutexes, Monitors, Message passing; Scheduling- scheduling in batch systems, Interactive systems, Real time systems, Thread scheduling.

Unit III: Deadlocks **8 lecture hours**

Deadlocks-Introduction, Deadlock Detection and Recovery – Deadlock Detection with one resource of each type, with multiple resource of each type, recovery from deadlock; Deadlock Avoidance, Deadlock Prevention

Unit IV : Memory and Device Management **8 lecture hours**

Introduction, Swapping, Paging, Virtual memory – Demand paging, page replacement Algorithms; File System Management- Organization of File System, File Permissions, MS DOS and UNIX file system case studies, NTFS; Device Management- I/O Channels, Interrupts and Interrupt Handling, Types of device allocation.

Unit V: Distributed Operating Systems **8 lecture hours**

Distributed operating system concept – Architectures of Distributed Systems, Distributed Mutual Exclusion, Distributed Deadlock detection, Agreement protocols, Threads, processor Allocation, Allocation algorithms, Distributed File system design; Real Time Operating Systems: Introduction to Real Time Operating Systems, Concepts of scheduling , Real time Memory Management.

Text Books

1. Mukesh Singhal and Niranjan, "Advanced Concepts in Operating Systems", TMH, 1st Edition, 2001
2. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, 2nd Edition, 2006
3. Andrew S. Tanenbaum, "Distributed Operating Systems", Pearson Education, 2nd Edition, 2001.
4. Pradeep K. Sinha, "Distributed Operating Systems and concepts", PHI, First Edition, 2002

Reference Books

1. Mukesh Singhal and Niranjan G. Shivaratri, "Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems", Tata McGraw-Hill, 2001.
2. Abraham Silberschatz; Peter Baer Galvin; Greg Gagne, "Operating System Concepts", Seventh Edition, John Wiley & Sons, 2004.
3. Daniel P Bovet and Marco Cesati, "Understanding the Linux kernel", 3rd edition, O'Reilly, 2005.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1140	Big Data Technologies	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure	Data Mining				
Co-requisites					

Course Objectives

1. To understand the competitive advantages of big data analytics.
2. To understand the big data frameworks.
3. To learn data analysis methods.
4. To learn stream computing.
5. To gain knowledge on Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics.

Course Outcomes

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

1. Understand how to leverage the insights from big data analytics.
2. Analyze data by utilizing various statistical and data mining approaches.
3. Perform analytics on real-time streaming data.
4. Understand the various NoSql alternative database models.

Course Description

This course teaches fundamental concepts and tools needed to understand the emerging role of Data analytics in Organizations.

Course Content

Unit I: INTRODUCTION TO BIG DATA **8 lecture hours**

Big Data – Definition, Characteristic Features – Big Data Applications - Big Data vs Traditional Data - Risks of Big Data - Structure of Big Data - Challenges of Conventional Systems - Web Data – Evolution of Analytic Scalability - Evolution of Analytic Processes, Tools and methods - Analysis vs Reporting - Modern Data Analytic Tools.

Unit II: HADOOP FRAMEWORK **9 lecture hours**

Distributed File Systems - Large-Scale FileSystem Organization – HDFS concepts - MapReduce Execution, Algorithms using MapReduce, Matrix-Vector Multiplication – Hadoop YARN

Unit III: DATA ANALYSIS **13 lecture hours**

Statistical Methods:Regression modelling, Multivariate Analysis - Classification: SVM & Kernel Methods - Rule Mining - Cluster Analysis, Types of Data in Cluster Analysis, Partitioning Methods, Hierarchical Methods, Density Based Methods, Grid Based Methods, Model Based Clustering Methods, Clustering High Dimensional Data - Predictive Analytics – Data analysis using R.

Unit IV : MINING DATA STREAMS **8 lecture hours**

Streams: Concepts – Stream Data Model and Architecture - Sampling data in a stream - Mining Data Streams and Mining Time-series data - Real Time Analytics Platform (RTAP) Applications - Case Studies - Real Time Sentiment Analysis, Stock Market Predictions.

Unit V: BIG DATA FRAMEWORKS **9 lecture hours**

Introduction to NoSQL – Aggregate Data Models – Hbase: Data Model and Implementations – Hbase Clients – Examples – .Cassandra: Data Model – Examples – Cassandra Clients – Hadoop Integration. Pig – Grunt – Pig Data Model – Pig Latin – developing and testing Pig Latin scripts - Hive – Data Types and File Formats – HiveQL Data Definition – HiveQL Data Manipulation – HiveQL Queries.

Text Books

1. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, ―Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

Reference Books

1. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
2. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis, O‘Reilly Media, 2013.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1111	Advanced Design and Analysis of Algorithms Lab	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	0	0	2	1
Prerequisite/Exposure	Data Structures and Algorithms				
Co-requisites					

List of Experiments:

1. Write C++ programs to implement the following: a) Prim's algorithm. b) Kruskal's algorithm.
2. Write a C++ program to find optimal ordering of matrix multiplication. (Note: Use Dynamic programming method).
3. Consider the problem of eight queens on an (8x8) chessboard. Two queens are said to attack each other if they are on the same row, column, or diagonal. Write a C++ program that implements backtracking algorithm to solve the problem i.e. place eight non-attacking queens on the board.
4. Write a C++ program to find the strongly connected components in a digraph.
5. Write a C++ program to implement file compression (and un-compression) using Huffman's algorithm. .
6. Write a C++ program to implement dynamic programming algorithm to solve all pairs shortest path problem.
7. Write a C++ program to solve 0/1 knapsack problem using the following: a) Greedy algorithm. b) Dynamic programming algorithm. c) Backtracking algorithm. d) Branch and bound algorithm.
8. Write a C++ program that uses dynamic programming algorithm to solve the optimal binary search tree problem.
9. Write a C++ program for solving traveling sales person's problem using the following: a) Dynamic programming algorithm. b) The back tracking algorithm.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Course Code: MCSE1121	Advanced Computer Networks Lab	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	0	0	2	1
Prerequisite/Exposure	Computer Networks				
Co-requisites					

List of Experiments:

1. Configuration and logging to a CISCO Router and introduction to the basic user Interfaces. Introduction to the basic router configuration and basic commands.
2. Configuration of IP addressing for a given scenario for a given set of topologies.
3. Configure a DHCP Server to serve contiguous IP addresses to a pool of four IP devices with a default gateway and a default DNS address. Integrate the DHCP server with a BOOTP demon to automatically serve Windows and Linux OS Binaries based on client MAC address.
4. Configure, implement and debug the following: Use open source tools for debugging and diagnostics. a. ARP/RARP protocols b. RIP routing protocols c. BGP routing d. OSPF routing protocols e. Static routes (check using netstat)
5. Configure DNS: Make a caching DNS client, and a DNS Proxy; implement reverse DNS and forward DNS, using TCP dump/Wireshark characterize traffic when the DNS server is up and when it is down.
6. Configure FTP Server on a Linux/Windows machine using a FTP client/SFTP client characterise file transfer rate for a cluster of small files 100k each and a video file of 700mb.Use a TFTP client and repeat the experiment.
7. Configure a mail server for IMAP/POP protocols and write a simple SMTP client in C/C++/Java client to send and receive mails
8. Implement Open NMS+ SNMPD for checking Device status of devices in community MIB of a linux PC. Using yellow pages and NIS/NFS protocols implement Network Attached Storage Controller (NAS). Extend this to serve a windows client using SMB. Characterize the NAS traffic using wireshark.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Course Code: MCSE1141	Big Data Technologies Lab	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	0	0	2	1
Prerequisite/Exposure	Data Mining				
Co-requisites					

LIST OF EXPERIMENTS:

Hadoop

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an MR program that processes a weather dataset R
4. Implement Linear and logistic Regression
5. Implement SVM / Decision tree classification techniques
6. Implement clustering techniques
7. Visualize data using any plotting framework
8. Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Course Code: MCSE1210	Network Security	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure	Computer Networks				
Co-requisites					

Course Objectives

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

Course Outcomes

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

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

Unit I: INTRODUCTION **10 lecture hours**

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

Unit II: BLOCK CIPHERS & PUBLIC KEY ENCRYPTION **10 lecture hours**

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

Unit III: HASH FUNCTIONS AND DIGITAL SIGNATURES **10 lecture hours**

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

Unit IV : E-MAIL, IP & WEB SECURITY **8 lecture hours**

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

Unit V: SYSTEM SECURITY **9 lecture hours**

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

Text Books

1. Behrouz A. Ferouzan, ―Cryptography & Network Security‖, Tata Mc Graw Hill, 2007.
2. Bruce Schneier and Neils Ferguson, ―Practical Cryptography‖, First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
3. Charles Pfleeger, ―Security in Computing‖, 4th Edition, Prentice Hall of India, 2006.
4. Charlie Kaufman and Radia Perlman, Mike Speciner, ―Network Security, Second Edition, Private Communication in Public World‖, PHI 2002.

Reference Books

1. Douglas R Simson ―Cryptography – Theory and practice, First Edition, CRC Press, 1995.
2. Man Young Rhee, ―Internet Security: Cryptographic Principles‖, ―Algorithms and Protocols‖, Wiley Publications, 2003.
3. Ulysess Black, ―Internet Security Protocols‖, Pearson Education Asia, 2000.
4. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1220	Advanced Computer Graphics	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure	Basics of Computer Graphics				
Co-requisites					

Course Objectives

1. To study the graphics techniques, packages and algorithms.
2. To enable the Students to understand the Graphics rendering and hardware.
3. To enable the Students to learn visualization techniques.

Course Outcomes

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

1. Create interactive graphics applications using one or more graphics application programming interfaces.
2. Use illumination models.
3. Explain graphics hardware.
4. Apply surface rendering and visualization techniques.

Course Content

Unit I: INTRODUCTION **8 lecture hours**

Overview, Modeling, Procedural Models, Fractal Models, and Grammar based models, particle systems, and viewing, Rasterization and Ray tracing

Unit II: Illumination **8 lecture hours**

Vertex/Geometry/Pixel programming, Illumination mode, specular reflection model, shading models for curve surfaces, Radiosity method, Rendering, Recursive ray tracing, Texture mapping.

Unit III: Graphics Hardware **8 lecture hours**

Graphics hardware architecture, Object representation and levels of detail.

Unit IV : Surface Rendering **8 lecture hours**

Parametric and implicit surfaces, Meshing, Visibility and shadow computation, Global illumination.

Unit V: Visualization Techniques **9 lecture hours**

Introduction to volume visualization, Introduction to animation, Image based rendering, Filler

Text Books

1. Watt A. and M. Watt, Advanced, Animation and Rendering Techniques, Addison Wesley, 1992.
2. Hearn D. and P. Baker, Computer Graphics C Version, Pearson Education India; 2 edition, 2002.

Reference Books

1. Neider, J., T. Davis, and M. Woo, OpenGL Programming Guide, Addison-Wesley, 1993.
2. Luebke D., M. Reddy, J. Cohen, A. Varshney, B. Watson, R. Huebner, Level of Detail for 3D Graphics, 2003.
3. James D. Foley, Andries van Dam, Steven K. Feiner and John Hughes, Computer Graphics: Principles and Practice, Second Edition in C, Addison-Wesley, 1995.
4. Dan Ginsburg, Budi Purnomo, Dave Shreiner and Aatab Munshi, OpenGL ES 3.0 Programming Guide 2nd Edition, Kindle Edition, 2014.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1230	Cloud Computing Technologies	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the concepts of cloud and utility computing.
2. To understand the various issues in cloud computing.
3. To familiarize themselves with the lead players in cloud.
4. To appreciate the emergence of cloud as the next generation computing paradigm.
5. To be able to set up a private cloud.

Course Outcomes

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

1. Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
2. Identify the architecture, infrastructure and delivery models of cloud computing.
3. Explain the core issues of cloud computing such as security, privacy and interoperability.
4. Choose the appropriate technologies, algorithms and approaches for the related issues.

Course Content

Unit I: INTRODUCTION **9 lecture hours**

Evolution of Cloud Computing -System Models for Distributed and Cloud Computing - NIST Cloud Computing Reference Architecture -IaaS - On-demand Provisioning - Elasticity in Cloud - Examples of IaaS Providers - PaaS - Examples of PaaS Providers - SaaS - Examples of SaaS Providers - Public , Private and Hybrid Clouds – Google App Engine, Amazon AWS - Cloud Software Environments - Eucalyptus, Open Nebula, Open Stack, Nimbus

Unit II: VIRTUALIZATION **9 lecture hours**

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

Unit III: VIRTUALIZATION INFRASTRUCTURE **9 lecture hours**

G Comprehensive Analysis – Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines –Desktop Virtualization – Application Virtualization – Work with AppV – Mobile OS for smart phones – Mobile Platform Virtualization – Collaborative Applications for Mobile platforms

Unit IV : PROGRAMMING MODEL **9 lecture hours**

Map Reduce Hadoop Distributed File Systems – Hadoop I/O – Developing Map Reduce Applications – Working of Map Reduce – Types and Formats – Setting up Hadoop Cluster

Unit V: CLOUD INFRASTRUCTURE AND SECURITY **9 lecture hours**

Architectural Design of Compute and Storage Clouds - Inter Cloud Resource Management - Resource Provisioning and Platform Deployment - Global Exchange of Cloud Resources - Security Overview – Cloud Security Challenges – Software as a Service Security – Security Governance – Risk Management – Security Monitoring – Security Architecture Design – Data Security – Application Security – Virtual Machine Security.

Text Books

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.

Reference Books

1. Jim Smith, Ravi Nair, "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005.
2. Danielle Ruest, Nelson Ruest, “Virtualization: A Beginner‟s Guide”, McGraw-Hill Osborne Media, 2009.
3. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012. 7. Rajkumar Buyya, Christian Vecchiola, and Thamarai Selvi, “Mastering Cloud Computing”, Tata McGraw Hill, 2013.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE1210	**Network Security Lab**	L	T	P	C
Version No. 01	**Date of Approval: 19/06/18**	0	0	2	1
Prerequisite/Exposure	Computer Networks				
Co-requisites					

LIST OF EXPERIMENTS:

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

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

Course Code: MCSE1220	Advanced Computer Graphics Lab	L	T	P	C
Version No. 01	**Date of Approval: 19/06/2018**	0	0	2	1
Prerequisite/Exposure	Basics of Computer Graphics				
Co-requisites					

List of Experiments:

1. Implementation of Algorithms for drawing 2D Primitives – Line (DDA, Bresenham) – all slopes Circle (Midpoint)
2. 2D Geometric transformations – Translation Rotation Scaling Reflection Shear Window-Viewport
3. Composite 2D Transformations
4. 3D Transformations - Translation, Rotation, Scaling.
5. 3D Projections – Parallel, Perspective.
6. Creating 3D Scenes.
7. Image Editing and Manipulation - Basic Operations on image using any image editing software, Creating gif animated images, Image optimization.
8. 2D Animation – To create Interactive animation using any authoring tool.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

SLMT5001	**Quantitative and Communication Proficiency**	L 0	T 0	P 4	C 2
Version No.	1.0				
Prerequisite					
Objectives:	1. This module would train the students on the quick ways to solve quantitative aptitude problems. 2. To equip the students with the required soft skills that would instill confidence and courage in them, to take up new opportunities for their career				
Expected Outcome:	The students will gain the ability to solve quantitative aptitude problems in a simple way using short-cut methods, within a short time span given during the placement drives.				
Module I	**Quantitative Aptitude**				
Number System, Partnership, Compound Interest, Simple Interest, Profit and Loss, Problems on Clock, Calendar and Cubes, Permutation and Combination, Allegation and mixtures, Time and Distance, Height and Distance, Problems on Ages, Trains, Boats and Streams, Probability.					
Module II	**Communication Proficiency**				
Self analysis to challenges., Attitude- perceptions– Positive approach – ideas & approach Goal setting – vision -Time management - planning -Entrepreneurial skills - Leadership skills People management – team work, leadership -Decision making – problem identification Interview skills – getting familiar with one's CV – presentation and performance - giving and receiving feedback, setting expectations and exhibiting professional behavior.					

Course Code: MCSE2310	Software Requirements Engineering	L	T	P	C
Version No. 01	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure	Software Engineering				
Co-requisites					

Course Objectives

1. Understand the basics of requirements engineering.
2. Learn different techniques used for requirements elicitation.
3. Know the role played by requirements analysis in requirement integration.
4. Appreciate the use of various methodologies for requirements development.
5. Study the current trends in requirements prioritization and validation.

Course Outcomes

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

1. Prepare SRS including the details of requirements engineering.
2. Describe the stages of requirements elicitation.
3. Analyze software requirements gathering.

Course Content

Unit I: REQUIREMENTS ENGINEERING OVERVIEW 9 lecture hours

Software Requirement Overview – Software Development Roles –Software Development Process Kernels – Commercial Life Cycle Model – Vision Development – Stakeholders Needs & Analysis – Stakeholder needs –Stakeholder activities.

Unit II: REQUIREMENTS ELICITATION 9 lecture hours

The Process of Requirements Elicitation – Requirements Elicitation Problems – Problems of Scope – Problems of Understanding – Problems of Volatility – Current Elicitation Techniques – Information Gathering – Requirements Expression and Analysis – Validation – An Elicitation Methodology Framework – A Requirements Elicitation Process Model – Methodology over Method – Integration of Techniques – Fact-Finding – Requirements Gathering – Evaluation and Rationalization – Prioritization – Integration and Validation.

Unit III: **REQUIREMENTS ANALYSIS 9 lecture hours**

Identification of Functional and Non Functional Requirements – Identification of Performance Requirements – Identification of safety Requirements – Analysis – Feasibility and Internal Compatibility of System Requirements – Definition of Human Requirements Baseline.

Unit IV: REQUIREMENTS DEVELOPMENT 9 lecture hours

Requirements analysis – Requirements Documentation – Requirements Development Workflow – Fundamentals of Requirements Development – Requirements Attributes Guidelines Document – Supplementary Specification Document – Use Case Specification Document – Methods for Software Prototyping – Evolutionary prototyping –Throwaway prototyping.

Unit V: REQUIREMENTS VALIDATION 9 lecture hours

Validation objectives – Analysis of requirements validation – Activities – Properties – Requirement reviews – Requirements testing – Case tools for requirements engineering.

Text Books

1. Ian Sommerville, Pete Sawyer, ―Requirements engineering: A Good Practice Guide‖, Sixth Edition, Pearson Education, 2004.
2. Dean Leffingwe, Don Widrig, ―Managing Software Requirements A Use Case Approach‖, Second Addition, Addison Wesley, 2003.

Reference Books

1. Karl Eugene Wiegers, ―Software Requirements‖, Word Power Publishers, 2000.
2. Ian Graham, ―Requirements Engineering and Rapid Development‖, Addison Wesley, 1998.
3. Wiegers, Karl, Joy Beatty, ‖Software requirements‖, Pearson Education, 2013.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE2310	Software Requirements Engineering Lab	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	0	0	2	1
Prerequisite/Exposure	Software Engineering				
Co-requisites					

List of Exercises:

Choose any one application for performing the following phases

1. Program Analysis and Project Planning. Thorough study of the problem – Identify project scope, Objectives, Infrastructure. – PROJECT PLAN DOCUMENTATION
2. Software requirement Analysis Describe the individual Phases / Modules of the project, Identify deliverables. – SRS DOCUMENTATION
3. Data Modeling Use work products – Data dictionary, Use case diagrams and activity diagrams, build and test class diagrams, Sequence diagrams , add interface to class diagrams. – DESIGN DOCUMENTATION
4. Software Development and Debugging Use technology of your choice to develop and debug the application– CODE DOCUMENTATION
5. Software Testing Perform validation testing, Coverage analysis, memory leaks, develop test case hierarchy, Site check and Site monitor. – TEST CASE DOCUMENTATION

SUGGESTED LIST OF APPLICATIONS:

1. Student Marks Analyzing System.
2. Quiz System.
3. Online Ticket Reservation System
4. Payroll System
5. Course Registration System
6. Stock Maintenance.
7. Any real time applications can be taken.

Continuous Assessment Pattern

Internal Assessment (IA)	End Term Test (ETE)	Total Marks
50	50	100

MCSE2381	**M.Tech Dissertation Part-1**	L 0	T 0	P 10	C 5
Version No.	1.0				
Prerequisite					
Objectives:	The Dissertation Work for M.Tech consists of Dissertation Work – I and Dissertation Work–II. Dissertation Work–I is to be undertaken during III semester and Dissertation Work–II, which is generally a continuation of Dissertation Work–I and is to be undertaken during IV semester. At the end of the semester students present the following contents.				

At the end of the semester students present the following contents.

- Title
- Abstract
- Introduction
- Literature Survey
- References

MCSE2481	**M.Tech Dissertation-Final**	L 0	T 0	P 30	C 15
Version No.	1.0				
Prerequisite					
Objectives:	The Dissertation Work for M.Tech consists of Dissertation Work – I and Dissertation Work–II. Dissertation Work–I is to be undertaken during III semester and Dissertation Work–II, which is generally a continuation of Dissertation Work–I and is to be undertaken during IV semester. At the end of the semester students present the following contents.				

At the end of the semester students present the following contents.

- Title
- Abstract
- Introduction
- Literature Survey
- Methodology
- Modules Split-up and Gantt Chart
- Proposed System (Phase 1)
- Equations /Design and software to be used
- Algorithms / Techniques used
- Expected outcomes
- Publish the research in reputed journal/conference

List of Electives

Course Code:MCSE9110	IoT Technology and Applications	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the fundamentals of Internet of Things.
2. To learn about the basics of IOT protocols.
3. To build a small low cost embedded system using Raspberry Pi.
4. To apply the concept of Internet of Things in the real world scenario.

Course Outcomes

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

1. Analyze various protocols for IoT Develop web services to access/control IoT devices.
2. Design a portable IoT using Rasperry Pi.
3. Deploy an IoT application and connect to the cloud.
4. Analyze applications of IoT in real time scenario.

Course Content

Unit I: INTRODUCTION TO IoT **9 lecture hours**

Internet of Things - Physical Design- Logical Design- IoT Enabling Technologies - IoT Levels & Deployment Templates - Domain Specific IoTs - IoT and M2M - IoT System Management with NETCONF-YANG- IoT Platforms Design Methodology

Unit II: IoT ARCHITECTURE **9 lecture hours**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

Unit III: IoT PROTOCOLS **9 lecture hours**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus– Zigbee Architecture – Network layer – 6LowPAN - CoAP - Security

Unit IV : BUILDING IoT WITH RASPBERRY PI & ARDUINO **9 lecture hours**

Building IOT with RASPERRY PI- IoT Systems - Logical Design using Python – IoT Physical Devices & Endpoints - IoT Device -Building blocks -Raspberry Pi -Board - Linux on Raspberry Pi - Raspberry Pi Interfaces -Programming Raspberry Pi with Python - Other IoT Platforms - Arduino.

Unit V: CASE STUDIES AND REAL-WORLD APPLICATIONS **9 lecture hours**

Real world design constraints - Applications - Asset management, Industrial automation, smart grid, Commercial building automation, Smart cities - participatory sensing - Data Analytics for IoT – Software & Management Tools for IoT Cloud Storage Models & Communication APIs - Cloud for IoT - Amazon Web Services for IoT.

Text Books

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015.
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
3. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9120	IoT on Cloud	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the basics of Internet of Things.
2. To get an idea of some of the application areas where Internet of Things can be applied.
3. To understand the middleware for Internet of Things.
4. To understand the concepts of Web of Things.
5. To understand the concepts of Cloud of Things with emphasis on Mobile cloud computing.
6. To understand the IOT protocols.

Course Outcomes

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

1. Identify and design the new models for market strategic interaction.
2. Design business intelligence and information security for WoB.
3. Analyze various protocols for IoT.
4. Design a middleware for IoT.
5. Analyze and design different models for network dynamics.

Course Content

Unit I: INTRODUCTION **10 lecture hours**

Definitions and Functional Requirements –Motivation – Architecture - Web 3.0 View of IoT– Ubiquitous IoT Applications – Four Pillars of IoT – DNA of IoT - The Toolkit Approach for End-user Participation in the Internet of Things. Middleware for IoT: Overview – Communication middleware for IoT –IoT Information Security

Unit II: IOT PROTOCOLS **8 lecture hours**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFID Protocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE 802.15.4 – BACNet Protocol – Modbus – KNX – Zigbee Architecture – Network layer – APS layer – Security

Unit III: WEB OF THINGS **10 lecture hours**

Web of Things versus Internet of Things – Two Pillars of the Web – Architecture Standardization for WoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals and Business Intelligence. Cloud of Things: Grid/SOA and Cloud Computing – Cloud Middleware – Cloud Standards – Cloud Providers and Systems – Mobile Cloud Computing – The Cloud of Things Architecture.

Unit IV : INTEGRATED **9 lecture hours**

Integrated Billing Solutions in the Internet of Things Business Models for the Internet of Things - Network Dynamics: Population Models – Information Cascades - Network Effects - Network Dynamics: Structural Models - Cascading Behaviour in Networks - The Small-World Phenomenon.

Unit V: APPLICATIONS **8 lecture hours**

The Role of the Internet of Things for Increased Autonomy and Agility in Collaborative Production Environments - Resource Management in the Internet of Things: Clustering, Synchronisation and Software Agents. Applications - Smart Grid – Electrical Vehicle Charging.

Text Books

1. The Internet of Things in the Cloud: A Middleware Perspective - Honbo Zhou – CRC Press – 2012.
2. Architecting the Internet of Things - Dieter Uckelmann; Mark Harrison; Florian Michahelles(Eds.) – Springer – 2011
3. Networks, Crowds, and Markets: Reasoning About a Highly Connected World - David Easley and Jon Kleinberg, Cambridge University Press - 2010
4. The Internet of Things: Applications to the Smart Grid and Building Automation by -Olivier Hersent, Omar Elloumi and David Boswarthick - Wiley -2012
5. Olivier Hersent, David Boswarthick, Omar Elloumi , "The Internet of Things – Key applications and Protocols", Wiley, 2012

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code:MCSE9130	Big Data Mining and Analytics	L	T	P	C
Version No.1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure	Data Mining				
Co-requisites					

Course Objectives

1. To understand the computational approaches to Modeling, Feature Extraction.
2. To understand the need and application of Map Reduce.
3. To understand the various search algorithms applicable to Big Data.
4. To analyse and interpret streaming data.
5. To learn how to handle large data sets in main memory.
6. To learn the various clustering techniques applicable to Big Data.

Course Outcomes

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

1. Design algorithms by employing Map Reduce technique for solving Big Data problems.
2. Design algorithms for Big Data by deciding on the apt Features set.
3. Design algorithms for handling petabytes of datasets.
4. Design algorithms and propose solutions for Big Data by optimizing main memory consumption.
5. Design solutions for problems in Big Data by suggesting appropriate clustering techniques.

Course Content

Unit I: DATA MINING AND LARGE SCALE FILES **9 lecture hours**

Introduction to Statistical modeling – Machine Learning – Computational approaches to modeling – Summarization – Feature Extraction – Statistical Limits on Data Mining - Distributed File Systems – Map-reduce – Algorithms using Map Reduce – Efficiency of Cluster Computing Techniques

Unit II: SIMILAR ITEMS **9 lecture hours**

M2M high-level ETSI architecture - IETF architecture for IoT - OGC architecture - IoT reference model - Domain model - information model - functional model - communication model - IoT reference architecture.

Unit III: MINING DATA STREAMS **9 lecture hours**

Stream Data Model – Sampling Data in the Stream – Filtering Streams – Counting Distance Elements in a Stream – Estimating Moments – Counting Ones in Window – Decaying Windows.

Unit IV : LINK ANALYSIS AND FREQUENT ITEMSETS **9 lecture hours**

Page Rank –Efficient Computation - Topic Sensitive Page Rank – Link Spam – Market Basket Model – A-priori algorithm – Handling Larger Datasets in Main Memory – Limited Pass Algorithm – Counting Frequent Item sets.

Unit V: CLUSTERING **9 lecture hours**

Introduction to Clustering Techniques – Hierarchical Clustering –Algorithms – K-Means – CURE – Clustering in Non – Euclidean Spaces – Streams and Parallelism – Case Study: Advertising on the Web – Recommendation Systems.

Text Books

1. Jure Leskovec, AnandRajaraman, Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, Second Edition, 2014.
2. Jiawei Han, MichelineKamber, Jian Pei, “Data Mining Concepts and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
3. Ian H.Witten, Eibe Frank “Data Mining – Practical Machine Learning Tools and Techniques”, Morgan Kaufman Publications, Third Edition, 2011.
4. David Hand, HeikkiMannila and Padhraic Smyth, “Principles of Data Mining”, MIT PRESS, 2001

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9140	Data Science and Big Data Analytics	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure	Data Mining				
Co-requisites					

Course Objectives

1. Gain a foundation level understanding on big data and the state of the practice of analytics.
2. Introduces Data Analytics Lifecycle to address industry challenges that leverage big data.
3. Provides grounding in basic and advanced analytic methods and an introduction to big data analytics technology and tools, including MapReduce and Hadoop.
4. Provide a practical opportunity to apply methods and tools to help investigate a big data analytics real world problem.

Course Outcomes

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

1. Explain the phases and activities of the data analytics lifecycle and identify the main activities and deliverables.
2. Select and execute appropriate advanced analytic methods for candidate selection, categorization, and predictive modeling.
3. Explore and make an initial analysis of the data, using R and help in creation of initial hypotheses regarding potential relationships within the data that can then be explored using more advanced analytic methods.
4. Students will have the knowledge and practical experience to immediately participate effectively in big data and other analytics projects.

Course Content

Unit I: Introduction to Big Data Analytics **9 lecture hours**

Overview of big data, the state of practice of analytics, the Data Scientist role, and big data analytics in industry verticals.

Unit II: Overview of Data Analytics Lifecycle **9 lecture hours**

Phases of a typical analytics lifecycle – discovery, data preparation, model planning, model building, communicating results and findings, and operationalizing, Critical activities in each phase of the lifecycle.

Unit III: Initial Analysis of the Data **9 lecture hours**

Introduction to R programming, initial exploration and analysis of the data using R, and basic visualization using R.

Unit IV : Advanced Analytics and Statistical Modeling for Big Data Theory and Methods
9 lecture hours

Core methods used by a Data Scientist, including candidate selection using the Naïve Bayesian Classifier, categorization using K-means clustering and association rules, predictive modelling using decision trees, linear and logistic regression, and time-series analysis, and text analysis.

Unit V: Advanced Analytics and Statistical Modeling for Big Data – Technology and Tools
9 lecture hours

Analytic tools for unstructured data, including MapReduce and the Hadoop ecosystem. It also details in-database analytics with SQL extensions and other advanced SQL techniques and MADlib functions for in-database analytics.

Text Books

1. Analytics in Practice, by Soumendra Mohanty, Tata Mcgraw hill Education(2011), IsBn-13:-9780070707061.
2. Agile Analytics: A value Driven approach to Business intelligence and Data Warehousing, by Ken w. Collier, Pearson Education (2012), ISBN-13:- 9788131786826.
3. MapReduce Design Patterns**,** by Donald Miner, O'Reilly (2012), ISBN- 13:-9789350239810.
4. David Hand, HeikkiMannila and Padhraic Smyth, "Principles of Data Mining", MIT PRESS, 2001

Reference Books

1. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
2. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9210	Real Time Systems	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To learn real time operating system concepts, the associated issues & Techniques.
2. To understand design and synchronization problems in Real Time System.
3. To explore the concepts of real time databases.
4. To understand the evaluation techniques present in Real Time System.

Course Outcomes

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

1. Apply principles of real time system design techniques to develop real time applications.
2. Make use of database in real time applications.
3. Make use of architectures and behaviour of real time operating systems.
4. Apply evaluation techniques in application.

Course Content

Unit I: REAL TIME SYSTEM AND SCHEDULING 9 lecture hours

Introduction– Structure of a Real Time System –Task classes – Performance Measures for Real Time Systems – Estimating Program Run Times – Issues in Real Time Computing – Task Assignment and Scheduling – Classical uniprocessor scheduling algorithms –Fault Tolerant Scheduling..

Unit II: SOFTWARE REQUIREMENTS ENGINEERING 9 lecture hours

Requirements engineering process – types of requirements – requirements specification for real time systems – Formal methods in software specification – structured Analysis and Design – object oriented analysis and design and unified modelling language – organizing the requirements document – organizing and writing documents – requirements validation and revision.

Unit III: INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9 lecture hours

Buffering data – Time relative Buffering- Ring Buffers – Mailboxes – Queues – Critical regions – Semaphores – other Synchronization mechanisms – deadlock – priority inversion – process stack management – run time ring buffer – maximum stack size – multiple stack arrangement – memory management in task control block - swapping – overlays – Block page management – replacement algorithms – memory locking – working sets – real time garbage collection – contiguous file systems.

Unit IV : REAL TIME DATABASES 9 lecture hours

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues, Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

Unit V: EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9 lecture hours

Reliability Evaluation Techniques – Obtaining parameter values, Reliability models for Hardware Redundancy–Software error models. Clock Synchronization–Clock, A Nonfault– Tolerant Synchronization Algorithm – Impact of faults – Fault Tolerant Synchronization in Hardware – Fault Tolerant Synchronization in software.

Text Books

1. C.M. Krishna, Kang G. Shin, ―Real-Time Systems‖, McGraw-Hill International Editions, 1997
2. Philip.A.Laplante, ―Real Time System Design and Analysis‖, Prentice Hall of India, 3rd Edition, 2004.
3. Rajib Mall, ―Real-time systems: theory and practice‖, Pearson Education, 2009.

Reference Books

1. R.J.A Buhur, D.L Bailey, ―An Introduction to Real-Time Systems‖, Prentice Hall International, 1999.
2. Stuart Bennett, ―Real Time Computer Control-An Introduction‖, Prentice Hall of India, 1998.
3. Allen Burns, Andy Wellings, ―Real Time Systems and Programming Languages‖, Pearson Education, 2003

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9220	Mobile and Pervasive Computing	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To learn the basic architecture and concepts till Third Generation Communication systems.
2. To understand the latest 4G Telecommunication System Principles.
3. To introduce the broad perspective of pervasive concepts and management.
4. To explore the HCI in Pervasive environment.
5. To apply the pervasive concepts in mobile environment.

Course Outcomes

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

1. Obtain a thorough understanding of Basic architecture and concepts of till Third Generation Communication systems.
2. Explain the latest 4G Telecommunication System Principles.
3. Incorporate the pervasive concepts.
4. Implement the HCI in Pervasive environment.
5. Work on the pervasive concepts in mobile environment.

Course Content

Unit I: INTRODUCTION **9 lecture hours**

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

Unit II: OVERVIEW OF A MODERN 4G TELECOMMUNICATIONS SYSTEM
9 lecture hours

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

Unit III: PERVASIVE CONCEPTS AND ELEMENTS **9 lecture hours**

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

Unit IV: HCI IN PERVASIVE COMPUTING **9 lecture hours**

Prototype for Application Migration - Prototype for Multimodalities - Human–Computer Interface in Pervasive Environments - HCI Service and Interaction Migration – Context Driven HCI Service Selection - Interaction Service Selection Overview - User Devices - Service-Oriented Middleware Support - User History and Preference - Context Manager - Local Service Matching - Global Combination - Effective Region - User Active Scope - Service Combination Selection Algorithm

Unit V: PERVASIVE MOBILE TRANSACTIONS **9 lecture hours**

Pervasive Mobile Transactions - Introduction to Pervasive Transactions - Mobile Transaction Framework - Unavailable Transaction Service - Pervasive Transaction Processing Framework - Context-Aware Pervasive Transaction Model - Context Model for Pervasive Transaction Processing - Context-Aware Pervasive Transaction Model - A Case of Pervasive Transactions - Dynamic Transaction Management - Context-Aware Transaction Coordination Mechanism - Coordination Algorithm for Pervasive Transactions - Participant Discovery - Formal Transaction Verification - Petri Net with Selective Transition.

Text Books

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications, Springer, 2016.
2. J.Schiller, ―Mobile Communication‖, Addison Wesley, 2000.
3. Juha Korhonen, ―Introduction to 4G Mobile Communications‖ , Artech House Publishers, 2014.

Reference Books

1. Kolomvatsos, Kostas, Intelligent Technologies and Techniques for Pervasive computing, IGI Global, 2013.
2. M. Bala Krishna, Jaime Lloret Mauri, ―Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks‖, CRC 2016.
3. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, ― Pervasive Computing: Concepts, Technologies and Applications ‖ CRC Press, 2016.

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code:MCSE9230	Parallel Programmig Paradigms	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To familiarize the issues in parallel computing.
2. To describe distributed memory programming using MPI.
3. To understand shared memory paradigm with Pthreads and with OpenMP.
4. To learn the GPU based parallel programming using OpenCL.

Course Outcomes

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

1. Identify issues in parallel programming.
2. Develop distributed memory programs using MPI framework.
3. Design and develop shared memory parallel programs using Pthreads and using OpenMP.
4. Implement Graphical Processing OpenCL programs.

Course Content

Unit I: FOUNDATIONS OF PARALLEL PROGRAMMING 9 lecture hours

Motivation for parallel programming – Need-Concurrency in computing – Basics of processes, multitasking and threads – cache – cache mappings – caches and programs – virtual memory – Instruction level parallelism – hardware multi-threading – Parallel Hardware-SIMD – MIMD – Interconnection networks – cache coherence –Issues in shared memory model and distributed memory model –Parallel Software- Caveats- coordinating processes/ threads- hybrid model – shared memory model and distributed memory model - I/O – performance of parallel programs-– parallel program design.

Unit II: DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9 lecture hours

Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMDprograms– MPI_Send and MPI_Recv – message matching – MPI- I/O – parallel I/O – collective communication – Tree-structured communication -MPI_Reduce – MPI_Allreduce, broadcast, scatter, gather, allgather – MPI derived types – dynamic process management – performance evaluation of MPI programs- A Parallel Sorting Algorithm.

Unit III: SHARED MEMORY PARADIGM WITH PTHREADS 9 lecture hours

Basics of threads, Pthreads – thread synchronization – critical sections – busy waiting – mutex – semaphores – barriers and condition variables – read write locks with examples - Caches, cache coherence and false sharing – Thread safety-Pthreads case study.

Unit IV : SHARED MEMORY PARADIGM: OPENMP 9 lecture hours

Basics OpenMP – Trapezoidal Rule-scope of variables – reduction clause – parallel for directive – loops in OpenMP – scheduling loops –Producer Consumer problem – cache issues – threads safety in OpenMP – Two- body solvers- Tree Search.

Unit V: GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA **9 lecture hours**

Introduction to OpenCL – Example-OpenCL Platforms- Devices-Contexts - OpenCL programming – Built-In Functions-Programs Object and Kernel Object – Memory Objects - Buffers and Images – Event model – Command-Queue - Event Object - case study. Introduction to CUDA programming.

Text Books

1. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, ―OpenCL programming guide‖, Addison Wesley, 2011
2. M. J. Quinn, ―Parallel programming in C with MPI and OpenMP‖, Tata McGraw Hill, 2003.
3. Peter S. Pacheco, ―An introduction to parallel programming‖, Morgan Kaufmann, 2011.

Reference Books

1. Rob Farber, ―CUDA application design and development‖, Morgan Haufmann, 2011.
2. W. Gropp, E. Lusk, and A. Skjellum, ―Using MPI: Portable parallel programming with the message passing interface‖, Second Edition, MIT Press, 1999

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9240	Information Retrieval Techniques	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the basics of information retrieval with pertinence to modelling, query operations and indexing.
2. To get an understanding of machine learning techniques for text classification and clustering.
3. To understand the various applications of information retrieval giving emphasis to multimedia IR, web search.
4. To understand the concepts of digital libraries.

Course Outcomes

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

1. Build an Information Retrieval system using the available tools.
2. Identify and design the various components of an Information Retrieval system.
3. Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval.
4. Design an efficient search engine and analyze the Web content structure.

Course Content

Unit I: INTRODUCTION: MOTIVATION **9 lecture hours**

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics– The impact of the web on IR —IR Versus Web Search–Components of a Search engine.

Unit II: MODELING **9 lecture hours**

Taxonomy and Characterization of IR Models – Boolean Model – Vector Model - Term Weighting – Scoring and Ranking –Language Models – Set Theoretic Models - Probabilistic Models – Algebraic Models – Structured Text Retrieval Models – Models for Browsing

Unit III: **INDEXING** **9 lecture hours**

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching - Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency.

Unit IV : CLASSIFICATION AND CLUSTERING **9 lecture hours**

Text Classification and Naïve Bayes – Vector Space Classification – Support vector machines and Machine learning on documents. Flat Clustering – Hierarchical Clustering –Matrix decompositions and latent semantic indexing – Fusion and Meta learning.

Unit V: SEARCHING THE WEB **9 lecture hours**

Searching the Web –Structure of the Web –IR and web search – Static and Dynamic Ranking – Web Crawling and Indexing – Link Analysis - XML Retrieval Multimedia IR: Models and Languages – Indexing and Searching Parallel and Distributed IR – Digital Libraries.

Text Books

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, ―Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008.
2. Implementing and Evaluating Search Engines‖, The MIT Press, Cambridge, Massachusetts London, England, 2010

Reference Books

1. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, ―Modern Information Retrieval: The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011.
2. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, ―Information Retrieval

Continuous Assessment Pattern

Internal Assessment (IA)	CAT I/II	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9310	Formal Models of Software Systems	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the goals, complexity of software systems, the role of Specification activities and qualities to control complexity.
2. To understand the fundamentals of abstraction and formal systems.
3. To learn fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems.
4. To understand formal specification models based on set theory, calculus and algebra and apply to a case study.
5. To learn Z, Object Z and B Specification languages with case studies.

Course Outcomes

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

1. Understand the complexity of software systems, the need for formal specifications activities and qualities to control complexity.
2. Gain knowledge on fundamentals of abstraction and formal systems.
3. Learn the fundamentals of logic reasoning- Propositional Logic, temporal logic and apply to models systems.
4. Develop formal specification models based on set theory, calculus and algebra and apply to a typical case study.
5. Have working knowledge on Z, Object Z and B Specification languages with case studies.

Course Content

Unit I: SPECIFICATION FUNDAMENTALS **9 lecture hours**

Role of Specification- Software Complexity - Size, Structural, Environmental, Application, domain, Communication Complexity, How to Control Complexity. Software specification, Specification Activities-Integrating Formal Methods into the Software Life-Cycle. Specification Qualities- Process Quality Attributes of Formal Specification Languages, Model of Process Quality, Product Quality and Utility, Conformance to Stated Goals Quality Dimensions and Quality Model.

Unit II: FORMAL METHODS **9 lecture hours**

Abstraction- Fundamental Abstractions in Computing. Abstractions for Software Construction. Formalism Fundamentals - Formal Systems, Formalization Process in Software Engineering Components of a Formal System- Syntax, Semantics, and Inference Mechanism. Properties of Formal Systems - Consistency. Automata-Deterministic Finite Accepters, State Machine Modeling Nondeterministic Finite Accepters, Finite State Transducers Extended Finite State Machine. Case Study—Elevator Control. Classification of C Methods-Property-Oriented Specification Methods, Model-Based Specification Techniques.

Unit III: **LOGIC** **9 lecture hours**

Propositional Logic - Reasoning Based on Adopting a Premise, Inference Based on Natural Deduction. Predicate Logic - Syntax and Semantics, Policy Language Specification, knowledge Representation Axiomatic Specification. Temporal Logic -.Temporal Logic for Specification and Verification, Temporal Abstraction Propositional Temporal Logic (PTL), First Order Temporal Logic (FOTL).Formal Verification, Verification of Simple FOTL, Model Checking, Program Graphs, Transition Systems.

Unit IV : SPECIFICATION MODELS **9 lecture hours**

Mathematical Abstractions for Model-Based Specifications-Formal Specification Based on Set Theory, Relations and Functions. Property-Oriented Specifications- Algebraic Specification, Properties of Algebraic Specifications, Reasoning, Structured Specifications. Case Study—A Multiple Window Environment: requirements, Modeling Formal Specifications. Calculus of Communicating Systems: Specific Calculus for Concurrency. Operational Semantics of Agents, Simulation and Equivalence, Derivation Trees, Labeled Transition Systems.

Unit V: FORMAL LANGUAGES **9 lecture hours**

The Z Notation, abstractions in Z, Representational Abstraction, Types, Relations and Functions, Sequences, Bags. Free Types-Schemas, Operational Abstraction -Operations Schema Decorators, Generic Functions, Proving Properties from Z specifications, Consistency of Operations. Additional Features in Z. Case Study: An Automated Billing System. The Object-Z Specification Language- Basic Structure of an Object-Z, Specification. Parameterized Class, Object-Orientation, composition of Operations-Parallel Communication Operator, Nondeterministic Choice Operator, and Environment Enrichment. The B-Method -Abstract Machine Notation (AMN), Structure of a B Specification, arrays, statements. Structured Specifications, Case Study- A Ticketing System in a Parking.

Text Books

1. Mathematical Logic for computer science, second edition, M.Ben-Ari, Springer,2003.
2. Logic in Computer Science- modeling and reasoning about systems, 2nd Edition, Cambridge University Press, 2004.
3. Specification of Software Systems, V.S. Alagar, K. Periyasamy, David Grises and Fred B Schneider, Springer –Verlag London, 2011.

Reference Books

1. The ways Z: Practical programming with formal methods, Jonathan Jacky, Cambridge University Press, 1996.
2. Using Z-Specification Refinement and Proof, Jim Woodcock and Jim Devies Prentice Hall, 1996
3. Z: An introduction to formal methods, Second Edition, Antoi Diller, Wiley, 1994

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9320	Embedded Software Development	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

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

Course Outcomes

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

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

Course Content

Unit I: EMBEDDED PROCESSORS **9 lecture hours**

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

Unit II: EMBEDDED COMPUTING PLATFORM **9 lecture hours**

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

Unit III: **EMBEDDED NETWORK ENIVIRONMENT** **9 lecture hours**

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

Unit IV : REAL-TIME CHARACTERISTICS **9 lecture hours**

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

Unit V: SYSTEM DESIGN TECHNIQUES **9 lecture hours**

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

Text Books

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013.
2. Andrew N Sloss, D. Symes, C. Wright, Arm system developers guide‖, Morgan Kauffman/Elsevier, 2006.
3. Arshdeep Bahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014.
4. C. M. Krishna and K. G. Shin, ―Real-Time Systems, McGraw-Hill, 1997.

Reference Books

1. Frank Vahid and Tony Givargis, ―Embedded System Design: A Unified Hardware/Software Introduction‖, John Wiley & Sons.
2. Jane.W.S. Liu, ―Real-Time systems‖, Pearson Education Asia.
3. Michael J. Pont, ―Embedded C‖, Pearson Education, 2007.
4. Muhammad Ali Mazidi, Sarmad Naimi, Sepehr Naimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C" Pearson Education, First edition, 2014.
5. Steve Heath, ―Embedded System Design, Elsevier, 2005.
6. Wayne Wolf, ―Computers as Components: Principles of Embedded Computer System Design‖, Elsevier, 2006.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9330	Social Network Analysis	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/2018**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the components of the social network.
2. To model and visualize the social network.
3. To mine the users in the social network.
4. To understand the evolution of the social network.
5. To know the applications in real time systems.

Course Outcomes

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

1. Work on the internals components of the social network.
2. Model and visualize the social network.
3. Mine the behaviour of the users in the social network.
4. Predict the possible next outcome of the social network.
5. Apply social network in real time applications.

Course Content

Unit I: INTRODUCTION **9 lecture hours**

Introduction to Web - Limitations of current Web – Development of Semantic Web – Emergence of the Social Web – Statistical Properties of Social Networks -Network analysis - Development of Social Network Analysis - Key concepts and measures in network analysis - Discussion networks - Blogs and online communities - Web-based networks.

Unit II: MODELING AND VISUALIZATION **9 lecture hours**

Visualizing Online Social Networks - A Taxonomy of Visualizations - Graph Representation - Centrality- Clustering - Node-Edge Diagrams - Visualizing Social Networks with Matrix Based Representations- Node-Link Diagrams - Hybrid Representations - Modelling and aggregating social network data – Random Walks and their Applications –Use of Hadoop and Map Reduce - Ontological representation of social individuals and relationships.

Unit III: **MINING COMMUNITIES** **9 lecture hours**

Aggregating and reasoning with social network data, Advanced Representations – Extracting evolution of Web Community from a Series of Web Archive - Detecting Communities in Social Networks - Evaluating Communities – Core Methods for Community Detection & Mining - Applications of Community Mining Algorithms - Node Classification in Social Networks.

Unit IV : EVOLUTION **9 lecture hours**

Evolution in Social Networks – Framework - Tracing Smoothly Evolving Communities - Models and Algorithms for Social Influence Analysis - Influence Related Statistics - Social Similarity and Influence - Influence Maximization in Viral Marketing - Algorithms and Systems for Expert Location in Social Networks - Expert Location without Graph Constraints - with Score Propagation – Expert Team Formation - Link Prediction in Social Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models..

Unit V: APPLICATIONS **9 lecture hours**

A Learning Based Approach for Real Time Emotion Classification of Tweets, A New Linguistic Approach to Assess the Opinion of Users in Social Network Environments, Explaining Scientific and Technical Emergence Forecasting, Social Network Analysis for Biometric Template Protection.

Text Books

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, ―Computational Social Network Analysis: Trends, Tools and Research Advances, Springer, 2012
2. Borko Furht, ―Handbook of Social Network Technologies and Applications, Springer, 1st edition, 2011.
3. Charu C. Aggarwal, ―Social Network Data Analytics, Springer; 2014.

Reference Books

1. Giles, Mark Smith, John Yen, ―Advances in Social Network Mining and Analysis, Springer, 2010.
2. Guandong Xu , Yanchun Zhang and Lin Li, ―Web Mining and Social Networking – Techniques and applications, Springer, 1st edition, 2012.
3. Peter Mika, ―Social Networks and the Semantic Web, Springer, 1st edition, 2007.
4. Przemyslaw Kazienko, Nitesh Chawla, Applications of Social Media and Social Network Analysis, Springer,2015.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9340	Bio Inspired Computing	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To learn bio-inspired theorem and algorithms.
2. To Understand random walk and simulated annealing.
3. To learn genetic algorithm and differential evolution.
4. To learn swarm optimization and ant colony for feature selection.
5. To understand bio-inspired application in image processing.

Course Outcomes

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

1. Implement and apply bio-inspired algorithms.
2. Explain random walk and simulated annealing.
3. Implement and apply genetic algorithms.
4. Explain swarm intelligence and ant colony for feature selection.
5. Apply bio-inspired techniques in image processing.

Course Content

Unit I: INTRODUCTION **9 lecture hours**

Introduction to algorithm - Newton' s method - optimization algorithm - No-Free-Lunch Theorems - Nature-Inspired Mataheuristics -Analysis of Algorithms -Nature Inspires Algorithms -Parameter tuning and parameter control.

Unit II: RANDOM WALK AND ANEALING **9 lecture hours**

Random variables - Isotropic random walks - Levy distribution and flights - Markov chains - step sizes and search efficiency - Modality and intermittent search strategy - importance of randomization- Eagle strategy-Annealing and Boltzmann Distribution - parameters -SA algorithm - Stochastic Tunneling..

Unit III: **GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION 9 lecture hours**

Introduction to genetic algorithms and - role of genetic operators - choice of parameters - GA varients - schema theorem - convergence analysis - introduction to differential evolution - varients - choice of parameters - convergence analysis - implementation..

Unit IV : SWARM OPTIMIZATION AND FIREFLY ALGORITHM **9 lecture hours**

Swarm intelligence - PSO algorithm - accelerated PSO - implementation - convergence analysis - binary PSO - The Firefly algorithm - algorithm analysis - implementation - varientsAnt colony optimization toward feature selection.

Unit V: APPLICATION IN IMAGE PROCESSING **9 lecture hours**

Bio-Inspired Computation and its Applications in Image Processing: An Overview – Fine Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search.

Text Books

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013.
3. Xin-She Yang , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016.

Reference Books

1. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014.
2. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9410	Data Visualization Techniques	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To develop skills to both design and critique visualizations.
2. To introduce visual perception and core skills for visual analysis.
3. To understand visualization for time-series analysis.
4. To understand visualization for ranking analysis.
5. To understand visualization for deviation analysis.
6. To understand visualization for distribution analysis.
7. To understand visualization for correlation analysis.
8. To understand visualization for multivariate analysis.
9. To understand issues and best practices in information dashboard design.

Course Outcomes

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

1. Explain principles of visual perception.
2. Apply core skills for visual analysis.
3. Apply visualization techniques for various data analysis tasks.
4. Design information dashboard.

Course Content

Unit I: CORE SKILLS FOR VISUAL ANALYSIS 9 lecture hours

Information visualization – effective data analysis – traits of meaningful data – visual perception – making abstract data visible – building blocks of information visualization – analytical interaction – analytical navigation – optimal quantitative scales – reference lines and regions – trellises and crosstabs – multiple concurrent views – focus and context – details on demand – over-plotting reduction – analytical patterns – pattern examples.

Unit II: TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9 lecture hours

Time-series analysis – time-series patterns – time-series displays – time-series best practices – part-to-whole and ranking patterns – part-to-whole and ranking displays – best practices – deviation analysis – deviation analysis displays – deviation analysis best practices.

Unit III: **DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9 lecture hours**

Distribution analysis – describing distributions – distribution patterns – distribution displays – distribution analysis best practices – correlation analysis – describing correlations – correlation patterns – correlation displays – correlation analysis techniques and best practices – multivariate analysis – multivariate patterns – multivariate displays – multivariate analysis techniques and best practices.

Unit IV : INFORMATION DASHBOARD DESIGN 9 lecture hours

Information dashboard – Introduction– dashboard design issues and assessment of needs – Considerations for designing dashboard-visual perception – Achieving eloquence.

Unit V: INFORMATION DASHBOARD DESIGN 9 lecture hours

Advantages of Graphics _Library of Graphs – Designing Bullet Graphs – Designing Sparklines – Dashboard Display Media –Critical Design Practices – Putting it all together Unveiling the dashboard.

Text Books

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.

Reference Books

1. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
2. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
3. Stephen Few, "Now you see it: Simple Visualization techniques for quantitative analysis", Analytics Press, 2009.
4. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9420	Reconfigurable Computing	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the need for reconfigurable computing.
2. To expose the students to various device architectures.
3. To examine the various reconfigurable computing systems.
4. To understand the different types of compute models for programming reconfigurable architectures.
5. To expose the students to HDL programming and familiarize with the development environment.
6. To expose the students to the various placement and routing protocols.
7. To develop applications with FPGAs.

Course Outcomes

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

1. Identify the need for reconfigurable architectures.
2. Discuss the architecture of FPGAs.
3. Point out the salient features of different reconfigurable architectures.
4. Build basic modules using any HDL.
5. Develop applications using any HDL and appropriate tools.
6. Design and build an SoPC for a particular application.

Course Content

Unit I: DEVICE ARCHITECTURE **9 lecture hours**

General Purpose Computing Vs Reconfigurable Computing – Simple Programmable Logic Devices – Complex Programmable Logic Devices – FPGAs – Device Architecture - Case Studies.

Unit II: RECONFIGURABLE COMPUTING ARCHITECTURES AND SYSTEMS
9 lecture hours

Reconfigurable Processing Fabric Architectures – RPF Integration into Traditional Computing Systems – Reconfigurable Computing Systems – Case Studies – Reconfiguration Management.

Unit III: **PROGRAMMING RECONFIGURABLE SYSTEMS** **9 lecture hours**

Compute Models - Programming FPGA Applications in HDL – Compiling C for Spatial Computing – Operating System Support for Reconfigurable Computing.

Unit IV : MAPPING DESIGNS TO RECONFIGURABLE PLATFORMS **9 lecture hours**

The Design Flow - Technology Mapping – FPGA Placement and Routing – Configuration Bitstream Generation – Case Studies with Appropriate Tools..

Unit V: APPLICATION DEVELOPMENT WITH FPGAS **9 lecture hours**

Case Studies of FPGA Applications – System on a Programmable Chip (SoPC) Designs.

Text Books

1. Christophe Bobda, ―Introduction to Reconfigurable Computing – Architectures, Algorithms and Applications‖, Springer, 2010.
2. Maya B. Gokhale and Paul S. Graham, ―Reconfigurable Computing: Accelerating Computation with Field-Programmable Gate Arrays‖, Springer, 2005.
3. FPGA Frontiers: New Applications in Reconfigurable Computing, 2017, Nicole Hemsoth, Timothy Prickett Morgan, Next Platform.

Reference Books

1. Reconfigurable Computing: From FPGAs to Hardware/Software Codesign 2011 Edition by Joao Cardoso (Editor), Michael Hübne, Springer.
2. Scott Hauck and Andre Dehon (Eds.), ―Reconfigurable Computing – The Theory and Practice of FPGA-Based Computation‖, Elsevier / Morgan Kaufmann, 2008.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code: MCSE9430	Mobile Application Development	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. Understand system requirements for mobile applications.
2. Generate suitable design using specific mobile development frameworks.
3. Generate mobile application design.
4. Implement the design using specific mobile development frameworks.
5. Deploy the mobile applications in marketplace for distribution.

Course Outcomes

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

1. Describe the requirements for mobile applications.
2. Explain the challenges in mobile application design and development.
3. Develop design for mobile applications for specific requirements.
4. Implement the design using Android SDK.
5. Implement the design using Objective C and iOS.
6. Deploy mobile applications in Android and iPhone marketplace for distribution.

Course Content

Unit I: INTRODUCTION **9 lecture hours**

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

Unit II: BASIC DESIGN **9 lecture hours**

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

Unit III: **ADVANCED DESIGN** **9 lecture hours**

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

Unit IV : ANDROID **9 lecture hours**

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

Unit V: IOS **9 lecture hours**

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

Text Books

1. Charlie Collins, Michael Galpin and Matthias Kappler, ―Android in Practice‖, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, ―Beginning iOS 6 Development: Exploring the iOS SDK‖, Apress, 2013.
3. http://developer.android.com/develop/index.html.

Reference Books

1. James Dovey and Ash Furrow, ―Beginning Objective C‖, Apress, 2012.
2. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
3. Reto Meier, ―Professional android Development‖, Wiley-India Edition, 2012

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100

Course Code:MCSE9440	Information Storage Management	L	T	P	C
Version No. 1.0	**Date of Approval: 19/06/18**	3	0	0	3
Prerequisite/Exposure					
Co-requisites					

Course Objectives

1. To understand the storage architecture and available technologies.
2. To learn to establish & manage data center.
3. To learn security aspects of storage & data center.

Course Outcomes

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

1. Select from various storage technologies to suit for required application.
2. Apply security measures to safeguard storage & farm.
3. Analyse QoS on Storage.

Course Content

Unit I: STORAGE TECHNOLOGY **9 lecture hours**

Review data creation and the amount of data being created and understand the value of data to a business, challenges in data storage and data management, Solutions available for data storage, Core elements of a data center infrastructure, role of each element in supporting business activities.

Unit II: STORAGE SYSTEMS ARCHITECTURE **9 lecture hours**

Hardware and software components of the host environment, Key protocols and concepts used by each component ,Physical and logical components of a connectivity environment ,Major physical components of a disk drive and their function, logical constructs of a physical disk, access characteristics, and performance Implications, Concept of RAID and its components, Different RAID levels and their suitability for different application environments: RAID 0, RAID 1, RAID 3, RAID 4, RAID 5, RAID 0+1, RAID 1+0, RAID 6, Compare and contrast integrated and modular storage systems ,Iligh-level architecture and working of an intelligent storage system.

Unit III: **INTRODUCTION TO NETWORKED STORAGE** **9 lecture hours**

Evolution of networked storage, Architecture, components, and topologies of FC-SAN, NAS, and IP-SAN, Benefits of the different networked storage options, understand the need for long-term archiving solutions and describe how CAS full fill the need, understand the appropriateness of the different networked storage options for different application environments.

Unit IV: INFORMATION AVAILABILITY, MONITORING & MANAGING DATACENTERS **9 lecture hours**

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

Unit V: SECURING STORAGE AND STORAGE VIRTUALIZATION **9 lecture hours**

Information security, Critical security attributes for information systems, Storage security domains, List and analyzes the common threats in each domain, Virtualization technologies, block-level and file-level virtualization technologies and processes.

Text Books

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010.
2. Marc Farley, ―Building Storage Networks‖, Tata McGraw Hill ,Osborne, 2001.

Reference Books

1. Robert Spalding, ―Storage Networks: The Complete Reference―, Tata McGraw Hill , Osborne, 2003.

Continuous Assessment Pattern

Internal Assessment (IA)	Mid Term Test (MTE)	End Term Test (ETE)	Total Marks
20	30	50	100