



**VIT<sup>®</sup>**  
**Vellore Institute of Technology**  
(Deemed to be University under section 3 of UGC Act, 1956)

## **School of Computer Science and Engineering**

# **CURRICULUM AND SYLLABI (2024-2025)**

**M.Tech (CSE) – (Big Data Analytics)**



# School of Computer Science and Engineering

## M.Tech (CSE) – (Big Data Analytics)

### CREDIT STRUCTURE

#### Category-wise Credit distribution

S.no	Catagory	Credits
1	Discipline Core	24
2	Specialization Elective	12
3	Projects and Internship	26
4	Open Elective	3
5	Skill Enhancement	5
Total Credits		70



### Specialization Elective

14	MCSE620P	Analytics for Internet of Things Lab	Lab Only	1.0	0	0	2	0	1.0
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### Projects and Internship

sl.no	Course Code	Course Title	Course Type	Ver sio n	L	T	P	J	Credits
1	MCSE698J	Internship I/ Dissertation I	Project	1.0	0	0	0	0	10.0
2	MCSE699J	Internship II/ Dissertation II	Project	1.0	0	0	0	0	12.0
3	MSET695J	Project Work	Project	1.0	0	0	0	0	4.0

### Open Elective

sl.no	Course Code	Course Title	Course Type	Ver sio n	L	T	P	J	Credits
1	MFRE501L	Francais Fonctionnel	Theory Only	1.0	3	0	0	0	3.0
2	MGER501L	Deutsch fuer Anfaenger	Theory Only	1.0	3	0	0	0	3.0

### Skill Enhancement

sl.no	Course Code	Course Title	Course Type	Ver sio n	L	T	P	J	Credits
1	MENG501P	Technical Report Writing	Lab Only	1.0	0	0	4	0	2.0
2	MSTS501P	Qualitative Skills Practice	Soft Skill	1.0	0	0	3	0	1.5
3	MSTS502P	Quantitative Skills Practice	Soft Skill	1.0	0	0	3	0	1.5

Course code	Course title	L	T	P	C
MCSE501L	Data Structures and Algorithms	3	0	0	3
Pre-requisite	NIL			Syllabus version	v. 1.0
<b>Course Objectives</b>					
<ol style="list-style-type: none"> <li>1. To familiarize the concepts of data structures and algorithms focusing on space and time complexity.</li> <li>2. To provide a deeper insight into the basic and advanced data structures.</li> <li>3. To develop the knowledge for the application of advanced trees and graphs in real-world scenarios.</li> </ol>					
<b>Course Outcomes</b>					
After completion of this course, the student shall be able to:					
<ol style="list-style-type: none"> <li>1. Understand and analyze the space and time complexity of the algorithms.</li> <li>2. Identification of suitable data structure for a given problem.</li> <li>3. Implementation of graph algorithms in various real-life applications.</li> <li>4. Implementation of heaps and trees for querying and searching.</li> <li>5. Use of basic data structures in advanced data structure operations.</li> <li>6. Use of searching and sorting in various real-life applications.</li> </ol>					
<b>Module:1</b>	<b>Growth of Functions</b>	<b>3 hours</b>			
Overview and importance of algorithms and data structures- Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction.					
<b>Module:2</b>	<b>Elementary Data Structures</b>	<b>6 hours</b>			
Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures					
<b>Module:3</b>	<b>Sorting and Searching</b>	<b>7 hours</b>			
Insertion sort, merge sort, sorting in linear Time-Lower bounds for sorting, Radix sort, Bitonic sort, Cocktail sort, Medians and Order Statistics-Minimum and maximum, Selection in expected linear time, Selection in worst-case linear time, linear search, Interpolation search, Exponential search.					
<b>Module:4</b>	<b>Trees</b>	<b>6 hours</b>			
Binary trees- Properties of Binary trees, B-tree, B-Tree definition- Operations on B-Tree: Searching a B-tree, Creating, Splitting, Inserting and Deleting, B+-tree.					
<b>Module:5</b>	<b>Advanced Trees</b>	<b>8 hours</b>			
Threaded binary trees, Leftist trees, Tournament trees, 2-3 tree, Splay tree, Red-black trees, Range trees.					
<b>Module:6</b>	<b>Graphs</b>	<b>7 hours</b>			
Representation of graphs, Topological sorting, Shortest path algorithms- Dijkstra's algorithm, Floyd-Warshall algorithm, Minimum spanning trees - Reverse delete algorithm, Boruvka's algorithm.					
<b>Module:7</b>	<b>Heap and Hashing</b>	<b>6 hours</b>			
Heaps as priority queues, Binary heaps, binomial and Fibonacci heaps, Heaps in Huffman coding, Extendible hashing.					
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>2 hours</b>			
	<b>Total Lecture hours:</b>	<b>45 hours</b>			

<b>Text Book(s)</b>	
1.	Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022.
<b>Reference Books</b>	
1. Skiena, Steven S. "The Algorithm Design Manual (Texts in Computer Science)." 3rd edition, 2020, Springer.	
2.	Brass, Peter. Advanced data structures. Vol. 193. Cambridge: Cambridge University Press, 2008.
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council	No. 67
	Date 08-08-2022

Course code	Course title	L	T	P	C
MCSE501P	Data Structures and Algorithms LAB	0	0	2	1
Pre-requisite	NIL			Syllabus version	
				v. 1.0	

### Course Objectives

1. To familiarize the concepts of data structures and algorithm focusing on space and time complexity.
2. To provide a deeper insight on the basic and advanced data structures.
3. To develop the knowledge for application of the advanced trees and graphs in real world scenarios.

### Course Outcome

After completion of this course, the student shall be able to:

1. Understand and analyze the space and time complexity of the algorithms.
2. Identification of suitable data structure for a given problem.
3. Implementation of graph algorithms in various real-life applications.
4. Implementation of heaps and trees for querying and searching.
5. Use of basic data structures in advanced data structure operations.
6. Use of searching and sorting in various real-life applications.

### Indicative Experiments

1. Analyzing the complexity of iterative and recursive algorithms
2. Implement Linear data structures (Stacks, Queues, Linked Lists)
3. Linear time sorting techniques
4. Interpolation search & Exponential search
5. Binary tree & Tree traversals
6. B-trees & B+ trees
7. Advanced Trees: 2-3 tree, splay tree, red black tree etc.
8. Advanced Trees: Threaded Binary trees, tournament trees
9. Graph traversals (BFS, DFS, Topological sorting)
10. Determining the Shortest path between pair of nodes in the given graph
11. Minimum Spanning trees- reverse delete & Boruvka's algorithm
12. Heaps & Hashing

Total Laboratory Hours | 30 hours

### Text Book(s)

1. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022.

### Reference Books

1. Skiena, Steven S. "The Algorithm Design Manual (Texts in Computer Science)." 3rd edition, 2020, Springer.
2. Brass, Peter. Advanced data structures. Vol. 193. Cambridge: Cambridge University Press, 2008.

Mode of Evaluation: CAT / Mid-Term Lab/ FAT

Recommended by Board of Studies | 26-07-2022

Approved by Academic Council | No. 67 | Date | 08-08-2022

<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE502L</b>	<b>Design and Analysis of Algorithms</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>				<b>Syllabus version</b>
					v. 1.0

### **Course Objectives**

1. To provide a mathematical framework for the design and analysis of algorithms.
2. To disseminate knowledge on how to create strategies for dealing with real-world problems.
3. To develop efficient algorithms for use in a variety of engineering design settings.

### **Course Outcomes**

On completion of this course, student should be able to:

1. Apply knowledge of computing and mathematics to algorithm design.
2. Apply various algorithm paradigms to solve scientific and real-life problems.
3. Demonstrate the string matching and network flow algorithms relating to real-life problems.
4. Understand and apply geometric algorithms.
5. Apply linear optimization techniques to various real-world linear optimization problems.
6. Explain the hardness of real-world problems with respect to algorithmic design.

#### **Module:1 Greedy, Divide and Conquer Techniques Introduction 6 hours**

Overview and Importance of Algorithms - Stages of algorithm development: Describing the problem, Identifying a suitable technique, Design of an algorithm, Illustration of Design Stages - Greedy techniques: Graph Coloring Problem, Job Sequencing Problem with Deadlines- Divide and Conquer: Karatsuba's fast multiplication method, the Strassen algorithm for matrix multiplication

#### **Module:2 Dynamic Programming, Backtracking and Branch & Bound Techniques 9 hours**

Dynamic programming: Matrix Chain Multiplication, Longest Common Subsequence. Backtracking: N-Queens problem, Subset Sum, Graph Coloring- Branch & Bound: A-Star, LIFO-BB and FIFO BB methods.

#### **Module:3 Amortized analysis and String Matching Algorithms 6 hours**

Stack operation and Incrementing Binary counter -The aggregate method, the accounting method, the potential method, and Dynamic tables. Naïve String matching Algorithms, KMP algorithm, Rabin-Karp Algorithm, String matching with Finite Automata.

#### **Module:4 Network Flow Algorithms 6 hours**

Flow Networks, Maximum Flows: Ford-Fulkerson, Edmond-Karp, Push relabel Algorithm, The relabel-to-front algorithm, Minimum Cost flows – Cycle Cancelling Algorithm.

#### **Module:5 Computational Geometry 5 hours**

Line Segments – properties, intersection; Convex Hull finding algorithms- Graham's Scan, Jarvis's March Algorithm.

#### **Module:6 Linear Optimization and Randomized algorithms 5 hours**

Linear Programming problem - Simplex Method-Big M Method, LP Duality- The hiring problem, Finding the global Minimum Cut.

#### **Module:7 NP Completeness and Approximation Algorithms 6 hours**

The Class P - The Class NP - Reducibility and NP-completeness - Circuit Satisfiability problem-SAT 3CNF, Independent Set, Clique, Approximation Algorithm: Vertex Cover, Set Cover and Travelling salesman.

#### **Module:8 Contemporary Issues 2 hours**

	<b>Total Lecture hours:</b>	<b>45 hours</b>
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<b>Text Book(s)</b>	
1.	Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022.
<b>Reference Books</b>	
1. Rajeev Motwani, Prabhakar Raghavan; “Randomized Algorithms, Cambridge University Press, 1995 (Online Print — 2013).	
2.	Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications, 1st Edition, Pearson Education, 2014.
3.	Jon Kleinberg and EvaTardos, Algorithm Design, Pearson Education, 1“Edition, 2014.
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council	No. 67
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	08-08-2022

<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE502P</b>	<b>Design and Analysis of Algorithms Lab</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Pre-requisite</b>	<b>NIL</b>			<b>Syllabus version</b>	
				v. 1.0	

### **Course Objectives**

1. To provide a mathematical framework for the design and analysis of algorithms.
2. To disseminate knowledge on how to create strategies for dealing with real-world problems.
3. To develop efficient algorithms for use in a variety of engineering design settings.

### **Course Outcome**

On completion of this course, student should be able to:

1. Apply knowledge of computing and mathematics to algorithm design.
2. Apply various algorithm paradigms to solve scientific and real-life problems.
3. Demonstrate the string matching and network flow algorithms relating to real-life problems.
4. Understand and apply geometric algorithms.
5. Apply linear optimization techniques to various real-world linear optimization problems.
6. Explain the hardness of real-world problems with respect to algorithmic design.

### **Indicative Experiments**

1. Greedy Strategy : Graph Coloring Problem, Job Sequencing Problem with Deadlines
2. Divide and Conquer : Karatsuba's fast multiplication method, the Strassen algorithm for matrix multiplication
3. Dynamic Programming: Matrix Chain Multiplication, Longest Common Subsequence, 0-1 Knapsack
4. Backtracking: N-queens, Subset sum
5. Branch and Bound: Job selection
6. String Matching Algorithms: Rabin Karp Algorithm, KMP Algorithm
7. Network Flows : Ford -Fulkerson and Edmond – Karp, Cycle cancelling algorithm
8. Minimum Cost flows – Cycle Cancelling Algorithm
9. Linear programming: Simplex method
10. Randomized Algorithms: Las Vegas and Monte carlo
11. Polynomial time algorithm for verification of NPC problems
12. Approximation Algorithm: Vertex cover ,Set cover and TSP

Total Laboratory Hours | 30 hours

### **Text Book(s)**

1. Cormen, Thomas H., Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein. Introduction to algorithms. MIT press, 2022.

### **Reference Books**

1. Rajeev Motwani, Prabhakar Raghavan; Randomized Algorithms, Cambridge University Press, 1995 (Online Print — 2013).
2. Ravindra K. Ahuja, Thomas L. Magnanti, and James B. Orlin, Network Flows: Theory, Algorithms, and Applications, 1<sup>st</sup> Edition, Pearson Education, 2014.
3. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1“Edition, 2014.

Mode of Evaluation: CAT / Mid-Term Lab/ FAT

Recommended by Board of Studies | 26-07-2022

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<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE503L</b>	<b>Computer Architecture and Organization</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Pre-requisite</b>	<b>NIL</b>				<b>Syllabus version</b>
					v. 1.0

### **Course Objectives**

1. To provide knowledge on the basics of computer architectures and organization that lays the foundation to study high-performance architectures
2. To design and develop parallel programs using parallel computing platforms such as OpenMP, CUDA
3. To evaluate the performance using profiling tools and optimize parallel codes using various optimization techniques

### **Course Outcomes**

After completion of this course, the student shall be able to:

1. Outline the developments in the evolution of computer architectures and parallel programming paradigms
2. Comprehend the various programming languages and libraries for parallel computing platforms
3. Use of profiling tools to analyze the performance of applications by interpreting the given data
4. Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel application design
5. Develop parallel programs using OpenMP and CUDA and analyze performance parameters such as speed-up, and efficiency for parallel programs against serial programs

<b>Module:1</b>	<b>Computer Evolution And Performance</b>	5 hours
Defining Computer Architecture and Organization, Overview of Computer Components, Von Neumann architecture, Harvard Architecture CISC & RISC, Flynn's Classification of Computers, Moore's Law, Multi-threading, Comparisons of Single Core, Multi Processors, and Multi-Core architectures, Metrics for Performance Measurement		
<b>Module:2</b>	<b>Memory Hierarchy</b>	8 hours
Key Characteristics of Memory systems, Memory Hierarchy, Cache Design policies, Cache Performance, Cache Coherence, Snoopy Protocols, Cache coherence protocols, MSI, MESI, MOESI		
<b>Module:3</b>	<b>Parallel Computers</b>	8 hours
Instruction Level Parallelism(ILP), Compiler Techniques for ILP & Branch Prediction, Thread Level Parallelism (TLP), Threading Concepts, Shared Memory, Message Passing, Vectorization		
<b>Module:4</b>	<b>Multithreaded Programming using OpenMP</b>	7 hours
Introduction to OpenMP, Parallel constructs, Runtime Library routines, Work-sharing constructs, Scheduling clauses, Data environment clauses, atomic, master Nowait Clause, Barrier Construct		
<b>Module:5</b>	<b>Programming for GPU</b>	6 hours
Introduction to GPU Computing, CUDA Concepts, CUDA Programming Model, Program Structure of CUDA & Execution, Methods for operations on Device Memory, Thread Organization, Examples		
<b>Module:6</b>	<b>Performance Analyzers</b>	6 hours
Performance Evaluation, performance bottlenecks, Profiling categories; Profiling tools: Trace analyzer and collector (ITAC), VTune Amplifier XE, Energy Efficient Performance, Integrated Performance Primitives (IPP)		

<b>Module:7</b>	<b>Energy Efficient Architectures</b>	5 hours
Overview of power issues, CMOS Device-level Power dissipation basics, Sources of energy Consumption, Strategies to save power or Energy, Low power designs, Power management techniques		
<b>Module:8</b>	<b>Contemporary Issues</b>	1 hours
	<b>Total Lecture hours:</b>	45 hours
<b>Text Book(s)</b>		
1.	William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 2022, 11 <sup>th</sup> Edition, Pearson	
2	Gerassimos Barlas, Multicore and GPU Programming: An Integrated Approach, 2022, 2 <sup>nd</sup> edition, Morgan Kaufmann	
<b>Reference Books</b>		
1.	J.L. Hennessy and D.A. Patterson. Computer Architecture: A Quantitative Approach. 5th Edition, 2012, Morgan Kauffmann Publishers.	
2.	Shameem Akhter, Jason Roberts, Multi-core Programming: Increasing Performance Through Software Multi-threading, 2010, Intel Press, BPB Publications	
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT		
Recommended by Board of Studies	26-07-2022	
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Course code	Course title	L	T	P	C
MCSE503P	Computer Architecture and Organization LAB	0	0	2	1
Pre-requisite	NIL			Syllabus version	
				v. 1.0	

### Course Objectives

1. To provide knowledge on basics of computer architectures and organization that lays foundation to study high performance architectures
2. To design and develop parallel programs using parallel computing platforms such as OpenMP, CUDA
3. To evaluate the performance using profiling tools and optimize parallel codes using various optimization techniques

### Course Outcome

After completion of this course, the student shall be able to:

1. Outline the developments in the evolution of computer architectures and parallel programming paradigms
2. Comprehend the various programming languages and libraries for parallel computing platforms
3. Use of profiling tools to analyze the performance of applications by interpreting the given data
4. Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel Application design.
5. Develop parallel programs using OpenMP and CUDA and analyze performance parameters such as speed-up, efficiency for parallel programs against serial programs

### Indicative Experiments

1.	Set-up an environment for OpenMP Programming: Activities: create a Project using Visual Studio, Writing Sample OpenMp Program, Setting up properties, compile & Execute OpenMP program, OpenMP manual study, Creation of Login credential on Intel for Intel Parallel Studio
2.	OpenMP program using following construct and describe scenario for the need of construct Use of Parallel Construct, Determine the Number of processors in a parallel Region, Find the thread ID of each processor
3.	Computation of Execution Time Using OpenMP clock, Using windows clock
4.	OpenMP Program using various Environment Routines to access the processor run-time information and write interesting observations by comparing various routines
5.	OpenMP program using following Worksharing Constructs and describe scenario for the need of construct loop construct, sections construct, single construct
6.	OpenMP program using following schedule clauses and describe scenario for the need of clause Static, Dynamic, Guided
7.	Develop parallel programs for given serial programs and profile the program using Vtune Analysis tool Matrix-Matrix multiplication, Matrix-Vector multiplication
8.	Develop parallel programs for given serial programs and profile the program using Vtune Analysis tool Quicksort, Minimum Spanning Tree
9.	CUDA-platform setup on NVIDIA / Google Colab
10.	Write a CUDA C/C++ program that add two array of elements and store the result in third array
11.	Write a CUDA C/C++ program that Reverses Single Block in an Array; CUDA C/C++
12.	Write a CUDA C program for Matrix addition and Multiplication using Shared memory

**Total Laboratory Hours | 30 hours**

<b>Text Book(s)</b>	
1.	Gerassimos Barlas, Multicore and GPU Programming: An Integrated Approach, 2022, 2 <sup>nd</sup> edition, Morgan Kaufmann
<b>Reference Books</b>	
1.	Shameem Akhter, Jason Roberts, Multi-core Programming: Increasing Performance Through Software Multi-threading, 2010, Intel Press, BPB Publications
Mode of Evaluation: CAT / Mid-Term Lab/ FAT	
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<b>Text Book(s)</b>	
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 2018, 10 <sup>th</sup> Edition, Wiley, United States.
<b>Reference Books</b>	
1. Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C, "Operating Systems: Three easy pieces, 2018, 1 <sup>st</sup> Edition, Boston: Arpaci-Dusseau Books LLC.	
2.	Kamal, R, Embedded Systems: Architecture, Programming and Design, 2011, 1 <sup>st</sup> Edition, Tata McGraw-Hill Education.
3.	Portnoy, M, "Virtualization Essentials", 2012, 2 <sup>nd</sup> Edition, John Wiley & Sons, New Jersey, USA.
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT	
Recommended by Board of Studies	26-07-2022
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	08-08-2022

<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE504P</b>	<b>OPERATING SYSTEMS LAB</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Pre-requisite</b>	<b>Nil</b>			<b>Syllabus version</b>	
				v. 1.0	

### **Course Objectives**

1. To encompass process management, synchronization strategies, memory management, file systems, device management, and virtualization.
2. To introduce the concepts and features of real-time operating systems as well as virtualization.

### **Course Outcome**

After completion of this course, the student shall be able to:

1. Implement scheduling, devising and addressing synchronization issues.
2. Gain an understanding of memory management tasks.
3. Develop real-time working prototypes of different small-scale and medium-scale embedded systems.
4. Comprehend the basics of virtualization and differentiate types of virtualization.

### **Indicative Experiments**

1. Investigate the fundamental Unix/Linux commands.
2. Obtaining the OS system data file and its associated information.
3. Shell Programming.
4. Create utility programs that use I/O system calls to simulate operations such as ls, cp, grep, and others.
5. Create child, Orphan and Zombie processes using suitable system calls such as fork(), exec(), wait(), kill(), sleep() and exit() system calls.
6. Create a program that mimics the CPU Scheduling algorithms including multi-level queue scheduling algorithm. Ex: Assume that all processes in the system are divided into two categories: system processes and user processes. System processes are to be given higher priority than user processes. Use FCFS scheduling for the processes in each queue.
7. Implement the deadlock-free solution to Dining Philosophers problem using Semaphore.
8. Simulation of Bankers algorithm to check whether the given system is in safe state or not. Also check whether addition resource requested can be granted immediately.
9. Parallel Thread management using Pthreads library. Implement a data parallelism using multi-threading. Ex: An application should have a thread created with synchronization and thread termination. Every thread in the sub-program must return the value and must be synchronized with the main function. Final consolidation should be done by the main (main function).
10. Dynamic memory allocation algorithms – First-fit, Best-fit, Worst-fit algorithms.
11. Page Replacement Algorithms FIFO, LRU and Optimal
12. Implement a file locking mechanism.
13. RTOS Based Parameter Monitoring and Controlling System – Monitoring: Collecting data from sensors and interface display devices/actuators using a microcontroller. Controlling: Provide an alert when the received data reaches a certain threshold value.
14. Virtualization Setup: Type-1, Type-2 Hypervisor (Detailed Study Report).

**Total Laboratory Hours | 30 hours**

<b>Text Book(s)</b>	
1.	Vijay Mukhi, “The C Odyssey: UNIX: v. 3”, 2004, 3 <sup>rd</sup> Edition, BPB Publications, New Delhi, India.
<b>Reference Books</b>	
1. Stevens, W. R., & Rago, S. A. (2013). Advanced Programming in the UNIX Environment: Advanc Progra UNIX Envir_p3. Addison-Wesley.	
2.	Love, Robert, “Linux System Programming: talking directly to the kernel and C library”, 2013, 2 <sup>nd</sup> Edition, O'Reilly Media, Inc, United States.
Mode of Evaluation: CAT / Mid-Term Lab/ FAT	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council	No. 67
	Date 08-08-2022



<b>Text Book(s)</b>	
1.	James F. Kurose, Keith W. Ross, "Computer Networking: A Top-Down Approach", 2022, 8 <sup>th</sup> Edition (Paperback), Pearson, United Kingdom.
<b>Reference Books</b>	
1.	Larry Peterson and Bruce Davie, "Computer Networks: A Systems Approach", 2019, 6 <sup>th</sup> Edition, Morgan Kaufmann, United States of America.
2.	Andrew S. Tanenbaum, "Computer Networks", 2013, 6 <sup>th</sup> Edition, Pearson, Singapore.
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council	No. 67
	Date      08-08-2022

<b>Course code</b>	<b>Course title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE505P</b>	<b>Computer Networks Lab</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>
<b>Pre-requisite</b>	<b>NIL</b>			<b>Syllabus version</b>	
				v. 1.0	

### **Course Objectives**

1. To introduce the computer network concepts and provide skills required to trouble shoot the network devices.
2. To describe the basic knowledge of VLAN.
3. To develop the knowledge for application of software defined networks.

### **Course Outcome**

After completion of this course, the student shall be able to:

1. Understand the types of network cables and practical implementation of cross-wired and straight through cable.
2. Design and implementation of VLAN.
3. Analyze and apply network address translation using packet tracer and network simulators.
4. Design and develop software defined networks.

### **Indicative Experiments**

1.	Hardware Demo(Demo session of all networking hardware and Functionalities) OS Commands(Network configuration commands )
2.	Error detection and correction mechanisms Flow control mechanisms
3.	IP addressing Classless addressing
4.	Network Packet Analysis using Wireshark <ol style="list-style-type: none"> <li>i. Packet Capture Using Wire shark</li> <li>ii. Starting Wire shark</li> <li>iii. Viewing Captured Traffic</li> <li>iv. Analysis and Statistics &amp; Filters.</li> </ol>
5.	Socket programming(TCP and UDP) Multi client chatting
6.	Networking Simulation Tool –Wired and Wireless
7.	SDN Applications and Use Cases
8.	Security in Network- Use cases
9	Performance evaluation of routing protocols using simulation tools.

### **Reference Books**

1. James F. Kuross, Keith W. Ross, "Computer Networking, A Top-Down Approach", 8<sup>th</sup> Edition (Paperback), Pearson Education, 2022.

Mode of Evaluation: CAT / Mid-Term Lab/ FAT

Recommended by Board of Studies	26-07-2022
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Approved by Academic Council	No. 67	Date	08-08-2022
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<b>Text Book(s)</b>			
1	Abraham Silberschatz, Henry F. Korth, and S. Sudharsan, “Database System Concepts”, 7 <sup>th</sup> Edition, McGraw Hill, 2019.		
2	R. Elmasri and S. Navathe, Fundamentals of Database Systems, 7 <sup>th</sup> Edition, Addison-Wesley, 2016		
<b>Reference Books</b>			
1	Fawcett, Joe, Danny Ayers, and Liam RE Quin. “Beginning XML”, Wiley India Private Ltd., 5 <sup>th</sup> Edition, 2012		
2	Rigaux, Ph, Michel Scholl, and Agnes Voisard. “Spatial databases: with application to GIS”. Morgan Kaufmann, 2002.		
3	Dunckley L. Multimedia databases: An object relational approach. Addison-Wesley Longman Publishing Co., Inc.; 2003 Jan 1.		
Mode of Evaluation: CAT / Written Assignment / Quiz / FAT			
Recommended by Board of Studies	26-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

Course code	Course title	L	T	P	C
MCSE506P	DATABASE SYSTEMS LAB	0	0	2	1
Pre-requisite	Nil			Syllabus version	
				v. 1.0	

### Course Objectives

1. To understand the underlying principles of Relational Database Management System.
2. To focus on the modeling and design of secure databases and usage of advanced data models.
3. To implement and maintain the structured, semi structured and unstructured data.

### Course Outcome

After completion of this course, the student shall be able to:

1. Construct database queries using Structured Query Language (SQL)
2. Design and implement applications that make use of distributed fault-tolerant databases.
3. Apply Spatial and Multimedia Database concepts to solve real-world problems.
4. Implement applications that work with structured, semi-structured, and unstructured databases
5. Create applications that use cloud storage technologies and relevant distributed file systems

### Indicative Experiments

1.	Study of Basic SQL Commands. Model any given scenario into ER/EER Model
2.	Table creation with constraints, alter schema, insert values, aggregate functions, simple and complex queries with joins, Views, Subqueries.
3.	PL/SQL-Procedures, Cursors, Functions, Triggers
4.	Partition a given database based on the type of query and compares the execution speed of the query with/without parallelism.
5.	Create a distributed database scenario, insert values, fragment and replicate the database Query the distributed database
6.	Consider a schema that contains the following table with the key underlined:  Employee ( <u>Eno</u> , Ename, Desg, Dno). Assume that we horizontally fragment the table as follows:  Employee1(Eno; Ename; Desg; Dno), where 1<= Dno <=10 Employee2(Eno; Ename; Desg; Dno), where 11 <= Dno <=20 Employee3(Eno; Ename; Desg; Dno), where 21 <= Dno <=30  In addition, assume we have 4 sites that contain the following fragments: <ul style="list-style-type: none"> <li>• Site1 has Employee1</li> <li>• Site2 has Employee2</li> <li>• Site3 has Employee2 and Employee3</li> <li>• Site4 has Employee1</li> </ul> Implement at least 5 suitable queries on Employee fragments. Add relations to the database as per your requirements.
7.	Plot points, lines, and polygons using Spatial Databases such as Oracle Spatial, PostgreSQL, Microsoft SQL Server etc
8.	<ul style="list-style-type: none"> <li>• Use Spatial Databases to store data using Latitude and Longitude, find the distance between two spatial objects, find the area of a polygon</li> <li>• Store and retrieve images from a multimedia database</li> </ul>
9.	Create an XML document and validate it against an XML Schema/DTD. Use XQuery to query and view the contents of the database
10.	Execute XPATH expressions on a database.

11.	Perform the following using a MongoDB Database <ul style="list-style-type: none"> <li>• Create an Employee Collection and insert a few documents ( sample document given below for reference)</li> </ul> <pre>{ "name" : "Satish", "salary" : 30000, "address" : "Vellore", "school" : "SCOPE" }</pre> <ul style="list-style-type: none"> <li>• Display all employees whose address is vellore and salary is greater than 30000</li> <li>• Update the salary for an employee by name ‘Ram’ as 40000</li> <li>• Display only name and salary for all employees in the collection</li> <li>• Display all employees who are not from ‘SCOPE’ school</li> <li>• Display only documents that contains the address property</li> </ul>		
12.	Create an application that interacts with a cloud database.		
Total Laboratory Hours   30 hours			
<b>Text Book(s)</b>			
1.	D Abraham Silberschatz, Henry F. Korth, S. Sudarshan “Database System Concepts” 7th Edition McGraw Hill, 2021		
<b>Reference Books</b>			
1.	Elmasri and Navathe “Fundamentals of Database Systems”, 7th Edition Addison Wesley, 2014		
2.	Thomas Connolly, Carolyn Begg “Database Systems: A Practical Approach to Design, Implementation and Management” 6 <sup>th</sup> Edition, Pearson India, 2015		
3.	Mishra, Sanjay, and Alan Beaulieu. Mastering Oracle SQL: Putting Oracle SQL to Work. O'Reilly Media, Inc., 2004.		
Mode of Evaluation: CAT / Mid-Term Lab/ FAT			
Recommended by Board of Studies	26-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022

<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>				
MCSE614L	Big Data Frameworks and Technologies	2	0	0	2				
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>		<b>1.0</b>					
<b>Course Objectives</b>									
<ol style="list-style-type: none"> <li>1. To understand the need of a framework to store and process the big data.</li> <li>2. To have knowledge on the Big Data Technologies for processing the Different types of Data.</li> <li>3. To understand the advanced frame work for faster accessing and processing of Big Data.</li> </ol>									
<b>Course Outcomes</b>									
Upon completion of the course the student will be able to									
<ol style="list-style-type: none"> <li>1. Understand the need of new frame work to deal with huge amounts of Data.</li> <li>2. Demonstrate the Hadoop framework Hadoop Distributed File System and MapReduce.</li> <li>3. Demonstrate the Pig architecture and evaluation of pig scripts.</li> <li>4. Describe the Hive architecture and execute SQL queries on sample data sets.</li> <li>5. Demonstrate spark programming with different programming languages and graph algorithms.</li> </ol>									
<b>Module:1</b>	<b>Big Data</b>	<b>3 hours</b>							
Understanding Big Data: Concepts and terminology, Big Data Characteristics, Different types of Data, Identifying Data Characteristics - Big Data Architecture - Big Data Storage: File system and Distributed File System, NoSQL, Sharding, Replication, Sharding and Replication, ACID and BASE Properties.									
<b>Module:2</b>	<b>Hadoop Framework</b>	<b>5 hours</b>							
Hadoop Architecture - Hadoop Distributed File System (HDFS) –YARN – Hadoop I/O – Map Reduce: Developing a map-reduce application – Map-reduce working procedure – Types and Formats - Features of Map reduce: sorting and joins- Pipelining MapReduce jobs.									
<b>Module:3</b>	<b>Hadoop Technologies-PIG</b>	<b>4 hours</b>							
Introduction, Parallel processing using Pig, Pig Architecture, Grunt, Pig Data Model-scalar and complex types. Pig Latin- Input and output, Relational operators, User defined functions -Working with scripts. Hadoop Operations.									
<b>Module:4</b>	<b>Hive</b>	<b>4 hours</b>							
Introduction-Hive modules, Data types and file formats, Hive QL-Data Definition and Data Manipulation-Hive QL queries, Hive QL views- reduce query complexity. Hive scripts. Hive QL Indexes- Aggregate functions- Bucketing vs Partitioning.									
<b>Module:5</b>	<b>Spark</b>	<b>5 hours</b>							
Overview of Spark – Hadoop Overview of Spark – Hadoop vs. Spark – Cluster Design – Cluster Management – performance, Application Programming interface (API): Spark Context, Resilient Distributed Datasets, Creating RDD, RDD Operations, and Saving RDD - Lazy Operation – Spark Jobs.									
<b>Module:6</b>	<b>Data Analysis with Spark Shell</b>	<b>4 hours</b>							
Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution									
<b>Module:7</b>	<b>Spark SQL and GraphX</b>	<b>4 hours</b>							
SQL Context – Importing and Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms.									
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>							
	<b>Total Lecture hours:</b>	<b>30 hours</b>							

<b>Text Book(s)</b>	
1.	Thomas Erl, Wajid Khattak, and Paul Buhler, Big Data Fundamentals: Concepts, Drivers &Techniques, Pearson India Education Service Pvt. Ltd., First Edition, 2016.
2.	Tom White, Hadoop: The Definitive Guide, O'Reilly Media, Inc., Fourth Edition, 2015.
<b>Reference Books</b>	
1.	Alan Gates, Programming Pig Dataflow Scripting with Hadoop, O'Reilly Media, Inc, 2011.
2.	Jason Rutherford, Dean Wampler, Edward Caprialo, Programming Hive, O'ReillyMedia Inc,2012
3.	Mike Frampton, "Mastering Apache Spark", Packt Publishing, 2015.
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council	No. 67
	Date 08-08-2022

Course Code	Course Title	L	T	P	C				
MCSE614P	Big Data Frameworks and Technologies Lab	0	0	2	1				
Pre-requisite	Nil	Syllabus version 1.0							
<b>Course Objectives</b>									
<ol style="list-style-type: none"> <li>To understand the need of a framework to store and process the big data.</li> <li>To have knowledge on the Big Data Technologies for processing the Different types of Data.</li> <li>To understand the advanced frame work for faster accessing and processing of Big Data.</li> </ol>									
<b>Course Outcome</b>									
<ol style="list-style-type: none"> <li>Implement and evaluate the data manipulation procedures using pig, hive and spark on Hadoop frame work.</li> </ol>									
<b>Indicative Experiments</b>									
<ol style="list-style-type: none"> <li>Installing and configuring the Hadoop frame work. HDFS Commands,</li> <li>Map Reduce Program to show the need of combiner</li> <li>Map Reduce I/O Formats – Text, Key – Value</li> <li>Map Reduce I/O Formats – NLine – Multiline</li> <li>Installing and Configuring Apache PIG and HIVE</li> <li>Sequence File Input / Output Formats</li> <li>Distributed Cache &amp; Map side Join, Reduce Side Join</li> <li>Building and Running Spark Application</li> <li>Word count in Hadoop and Spark</li> <li>Manipulation RDD</li> <li>Spark Implementation of Matrix algorithms in Spark Spark Sql programming, Building Spark Streaming application</li> </ol>									
<b>Total Laboratory Hours</b> <b>30 hours</b>									
<b>Reference Books</b>									
<ol style="list-style-type: none"> <li>Mike Frampton "Mastering Apache Spark" – Pract Publishing 2015</li> <li>Tom White, "Hadoop – The Definitive Guide", O'Reilly 4<sup>th</sup> Edition 2015</li> <li>Nick Pentreath, "Machine Learning with Spark" Pract Publishing 2015</li> <li>Mohammed Gulle , "Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis" – Apress 2015</li> <li>Adam Shook and Donald Mine, "MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems" - O'Reilly 2012</li> </ol>									
Mode of Assessment: Continuous Assessment / FAT / Oral examination and others									
Recommended by Board of Studies	26-07-2022								
Approved by Academic Council	No. 67	Date	08-08-2022						

<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>				
MCSE615L	Data Analytics	2	0	0	2				
<b>Pre-requisite</b>	Nil	<b>Syllabus version</b>		1.0					
<b>Course Objectives</b>									
<ol style="list-style-type: none"> <li>1. Explicate how to design, construct, and quality check a dataset before using it to a build prediction model.</li> <li>2. Understanding the importance about feature selection in data models.</li> <li>3. Understanding how information theory, similarity score and Probability theory can be used to build prediction models.</li> </ol>									
<b>Course Outcomes</b>									
Upon completion of the course the student will be able to									
<ol style="list-style-type: none"> <li>1. Students will understand the basic concept of data mining and life cycles of data analytics.</li> <li>2. Analyze and Apply the different data preprocessing techniques.</li> <li>3. Analyze the characteristics of the data and its important feature.</li> <li>4. Apply the prediction model for decision making for a given set of problems.</li> <li>5. Students will understand the concept of distributed machine learning.</li> </ol>									
<b>Module:1</b>	<b>Introduction to Data Mining</b>	<b>4 hours</b>							
Introduction to Data Mining, Challenges in Data Mining, Data Mining Tasks, Machine Learning, Predictive Data Analytics Lifecycle, Predictive Data Analytics Tools									
<b>Module:2</b>	<b>Exploring Data</b>	<b>5 hours</b>							
Different types of data, Normal Distribution, Identifying Data Quality Issues, Missing Values, Irregular Cardinality, Outlier, Advanced Data Exploration, Visualizing Relationships Between Features, Measuring Covariance and Correlation, Data Preparation, Normalization, Binning, Sampling									
<b>Module:3</b>	<b>Feature Selection</b>	<b>3 hours</b>							
Feature Reduction- Feature Selection, Statistics for Feature Selection, Chi-Squared Test for Feature Selection, ANOVA F-test for Feature Selection, RFE feature selection, Dimensionality Reduction and PCA									
<b>Module:4</b>	<b>Decision Tree and Similarity-based Learning</b>	<b>5 hours</b>							
Decision Trees, Shannon's Entropy Model, Information Gain, Standard Approach: The ID3 Algorithm, Feature Space, Measuring Similarity Using Distance Metrics, Standard Approach: The Nearest Neighbor Algorithm, Extensions and Variations, Handling Noisy Data, Efficient Memory Search, Data Normalization, Predicting Continuous Targets									
<b>Module:5</b>	<b>Probability-based Learning</b>	<b>3 hours</b>							
Fundamentals, Bayes' Theorem, Bayesian Prediction, Conditional Independence and Factorization, Standard Approach: The Naive Bayes Model									
<b>Module:6</b>	<b>Error-based Learning</b>	<b>4 hours</b>							
Simple Linear Regression, Measuring Error, Error Surfaces, Standard Approach: Multivariable Linear Regression with Gradient Descent, Multivariable Linear Regression, Gradient Descent, Choosing Learning Rates and Initial Weights.									
<b>Module:7</b>	<b>Distributed Machine Learning</b>	<b>5 hours</b>							
Data Parallelism - Splitting Input Data, Parameter Server and All-Reduce - Building a Data Parallel Training and Serving Pipeline-Model Parallelism - Splitting the Model-Pipeline Input and Layer Split- Implementing Model Parallel Training and Serving Workflows - Federated Learning and Edge Devices									
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>							
		<b>Total Lecture hours</b>	<b>30 hours</b>						
<b>Text Book(s)</b>									
1.	John D. Kelleher, Brian Mac Namee, Aoife D'Arcy -Fundamentals of Machine Learning								

	for Predictive Data Analytics: Algorithms, Worked Examples, MIT Press 2020 , 2nd Edition.
2.	Jason Brownlee -Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python, First Edition, 2020.
<b>Reference Books</b>	
1.	Pang-Ning Tan; Michael Steinbach; Anuj Karpatne; Vipin Kumar -Introduction to Data Mining. By: Publisher: Pearson, Edition: 2 <sup>nd</sup> , 2019.
2.	Guanhua Wang-Distributed Machine Learning with Python, Packt Publishing, 2022.
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar	
Recommended by Board of Studies	26-07-2022
Approved by Academic Council	No. 67 Date 08-08-2022



<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>						
MCSE616L	Data Visualization	2	0	0	2						
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>		<b>1.0</b>							
<b>Course Objectives</b>											
<ol style="list-style-type: none"> <li>1. To understand the various types of data, apply and evaluate the principles of data visualization.</li> <li>2. Acquire skills to apply visualization techniques to a problem and its associated dataset.</li> <li>3. To apply structured approach to create effective visualizations from the massive dataset using various visualization tools.</li> </ol>											
<b>Course Outcomes</b>											
Upon completion of the course the student will be able to											
<ol style="list-style-type: none"> <li>1. Analyze the different data types, visualization types to bring out the insight.</li> <li>2. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on large dataset.</li> <li>3. Design visualization dashboard to support the decision making on large scale data.</li> <li>4. Demonstrate the analysis of large dataset using various visualization techniques and tools.</li> </ol>											
<b>Module:1</b>	<b>Introduction to Data Visualization</b>	<b>4 hours</b>									
Overview of data visualization - Data Abstraction - Task Abstraction - Dimensions and Measures - Analysis: Four Levels for Validation. Statistical charts (Bar Chart - stacked bar chart – Line Chart - Histogram - Pie chart - Frequency Polygon - Box plot - Scatter plot - Regression curves.)											
<b>Module:2</b>	<b>Visualization Techniques</b>	<b>4 hours</b>									
Introduction to various data visualization tools - Scalar and point techniques - vector visualization techniques - multidimensional techniques - visualizing cluster analysis – K-means and Hierarchical Cluster techniques.											
<b>Module:3</b>	<b>Spatio-temporal Data Visualization</b>	<b>4 hours</b>									
Time Series data visualization – Text data visualization – Spatial Data Visualization											
<b>Module:4</b>	<b>Visual Analytics</b>	<b>3 hours</b>									
Networks and Trees - Heat Map – Tree Map - Map Color and Other Channels Manipulate View - Visual Attributes											
<b>Module:5</b>	<b>Multivariate Data Visualization</b>	<b>5 hours</b>									
Multivariate data visualization – Geometric projection techniques - Icon-based techniques - Pixel-oriented techniques - Hierarchical techniques - Scatterplot matrix - Hyper box - Trellis display - Parallel coordinates											
<b>Module:6</b>	<b>Data Visualization Tools</b>	<b>5 hours</b>									
Tableau functions and logics: Marks and Channels-Arrange Tables- Arrange Spatial Data-Facets into multiple views											
<b>Module:7</b>	<b>Visualization Dashboard Creations</b>	<b>4 hours</b>									
Data Dashboard- Taxonomies- User Interaction- Organizational Functions-Dashboard Design – Worksheets - Workbooks – Workbook Optimization - Protection and common mistakes. Dashboard creation using visualization tool use cases: Finance-marketing-insurance-healthcare.											
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>									
	<b>Total Lecture hours:</b>	<b>30 hours</b>									
<b>Text Book(s)</b>											
1.	Tamara Munzer, Visualization Analysis and Design, 1st edition, CRC Press, United										

	States, 2015.		
2	Michael Fry, Jeffrey Ohlmann, Jeffrey Camm, James Cochran, Data Visualization: Exploring and Explaining with Data, South-Western College Publishing, 2021		
<b>Reference Books</b>			
1. Dr. Chun-hauh Chen, W. K. Hardle, A. Unwin, Handbook of Data Visualization, 1st edition, Springer publication, Germany, 2008.			
2. Ben Fry, Visualizing Data, 1st edition, O'Reilly Media, United States, 2008.			
3. Avril Coghlan, A little book of R for multivariate analysis, 1st edition, Wellcome Trust Sanger Institute, United Kingdom, 2013.			
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	26-07-2022		
Approved by Academic Council	No. 67	Date	08-08-2022



Course Code	Course Title	L	T	P	C				
MCSE617L	Domain Specific Predictive Analytics	2	0	0	2				
Pre-requisite	NIL	<b>Syllabus vision</b>		<b>1.0</b>					
<b>Course Objectives</b>									
<ol style="list-style-type: none"> <li>1. To introduce the fundamental concepts of predictive analytics.</li> <li>2. To impart the knowledge on various steps that are necessary before constructing the predictive model.</li> <li>3. To gain knowledge on the assessment of predictive models for decision making.</li> </ol>									
<b>Course Outcomes</b>									
Upon completion of the course the student will be able to									
<ol style="list-style-type: none"> <li>1. Understand the fundamental concepts of predictive analytics.</li> <li>2. Define the problem and prepare the data for analysis.</li> <li>3. Construct different predictive models for decision making.</li> <li>4. Apply descriptive modeling techniques for the given data.</li> <li>5. Assess and interpret different predictive models.</li> <li>6. Understand and apply appropriate algorithms for analyzing the data in healthcare domain.</li> </ol>									
<b>Module:1</b>	<b>Overview of Predictive Analytics</b>	<b>4 hours</b>							
Introduction to Analytics – Predictive Analytics – Parametric vs. Non-Parametric Models -Business Intelligence – Predictive Analytics vs. Business Intelligence – Predictive Analytics vs. Statistics – Predictive Analytics vs. Data Mining – Challenges in using Predictive Analytics - Obstacles with Data - Obstacles with Modeling									
<b>Module:2</b>	<b>Problem Setting, Data understanding and Preparation</b>	<b>4 hours</b>							
Defining Data for Predictive Modeling – Defining Target Variable – Defining Measures of Success for Predictive Models - Single Variable and Multiple Variable Summaries – Data Visualization – Variable Cleaning – Feature Creation - Case study: Fraud Detection									
<b>Module:3</b>	<b>Predictive Modeling</b>	<b>4 hours</b>							
Parameter Settings – Measures of Interesting Rules – Deploying Association Rules – Building Classification Rules from Association Rules – Neural Networks - Decision Trees – Linear Regression - Logistic Regression – K-Nearest Neighbor Classifier									
<b>Module:4</b>	<b>Descriptive Modeling</b>	<b>4 hours</b>							
Data Preparation Issues with Descriptive Modeling - Principal Component Analysis (PCA) Algorithm - Applying PCA to New Data - PCA for Data Interpretation - Clustering Algorithms - The K-Means Algorithm - The Kohonen SOM Algorithm - Visualizing Kohonen Maps									
<b>Module:5</b>	<b>Model Ensembles and Assessing Predictive Models</b>	<b>4 hours</b>							
Model Ensembles - The Wisdom of Crowds - Bias Variance Tradeoff - Bagging - Boosting - Random Forests - Stochastic Gradient Boosting - Heterogeneous Ensembles - Interpreting Model Ensembles - Batch Approach to Model Assessment - Percent Correct Classification - Rank-Ordered Approach to Model Assessment - Assessing Regression Models.									
<b>Module:6</b>	<b>Healthcare Analytics(T2:Ch1&amp;11)</b>								
Introduction - Healthcare Data Sources and Basic Analytics - Electronic Health									

Records - Clinical Prediction Models - Privacy-Preserving Data Publishing - Temporal Data Mining for Healthcare Data - Association Analysis - Classical Methods - Temporal Methods - Temporal Pattern Mining - Sequential Pattern Mining - Time-Interval Pattern Mining - Medical Applications - Sensor Data Analysis - Convolutional Event Pattern Discovery - Patient Prognostic via Case-Based Reasoning - Disease Progression Modeling

<b>Module:7</b>	<b>Visual Analytics for Healthcare Data</b>	<b>5 hours</b>
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Visual Analytics and Medical Data Visualization - Clinical Data Types - Standard Techniques to Visualize Medical Data - High-Dimensional Data Visualization - Visualization of Imaging Data - Visual Analytics in Healthcare - Visual Analytics in Public Health and Population Research - Geospatial Analysis- Visual Analytics for Clinical Workflow - Visual Analytics for Clinicians - Patient Progress and Guidelines - Visual Analytics for Patients - Assisting Comprehension

<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>
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	<b>Total Lecture hours:</b>	<b>30 hours</b>
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<b>Text Book(s)</b>
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1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the professional Data Analyst, John Wiley & Sons Inc. Publishers, First edition, 2014.
2. Chandan K. Reddy, Charu C. Aggarwal, Healthcare Data Analytics, Chapman & Hall/CRC, Data Mining and Knowledge Discovery Series, 2015.

<b>Reference Books</b>
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1. Klimberg, Ron and B.D. McCullough, Fundamentals of Predictive Analytics with JMP®, Cary, NC: SAS Institute Inc., Second Edition, 2016.
2. Eric Siegel, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, John Wiley & Sons Inc. Publishers, Second edition, 2016.
3. Hui Yang, Eva K. Lee, Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, John Wiley & Sons Inc. Publishers, 2016.

Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar
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Recommended by Board of Studies	18-11-2022
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Approved by Academic Council	No. 68	Date	19-12-2022
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Course code	Course Title	L	T	P	C									
MCSE617P	Domain Specific Predictive Analytics Lab	0	0	2	1									
Pre-requisite	NIL	Syllabus version		1.0										
<b>Course Objectives</b>														
<ol style="list-style-type: none"> <li>1. To introduce the fundamental concepts of predictive analytics.</li> <li>2. To impart the knowledge on various steps that are necessary for constructing the predictive model.</li> <li>3. To gain knowledge on the assessment of predictive models for decision making.</li> </ol>														
<b>Course Outcome</b>														
Upon completion of the course the student will be able to														
<ol style="list-style-type: none"> <li>1. Understand the fundamental concepts of predictive analytics.</li> <li>2. Define the problem and prepare the data for analysis.</li> <li>3. Construct different predictive models for decision making.</li> <li>4. Apply descriptive modeling techniques for the given data.</li> <li>5. Assess and interpret different predictive models.</li> <li>6. Understand and apply appropriate algorithms for analyzing the data in healthcare domain.</li> </ol>														
<b>Indicative Experiments</b>														
Experiments can be implemented using R/Python.														
1.	Clustering based data analytics using R/Python. (K-Means, SOM algorithms)													
2.	Demonstrate the statistics for a sample data like mean, standard deviation, normal/uniform distribution, variance and correlation.													
3.	Demonstrate missing value analysis, fixing missing values and outlier analysis using Healthcare domain datasets.													
4.	Demonstrate data visualization, histograms and multiple variable summaries.													
5.	Demonstrate transformation, scaling, binning, fixing skewed values and sampling.													
6.	Demonstration of Apriori algorithm on transaction dataset to find association rules.													
7.	Demonstration of Linear and Logistic regression using various domain datasets.													
8.	Demonstration of predictive models such as Decision Tree, Neural network and K-Nearest Neighbor using various domain datasets.													
9.	Demonstration of Temporal Mining Techniques													
10.	Demonstration of predictive analytics using healthcare data and microarray data.													
<b>Total Laboratory Hours   30 hours</b>														
<b>Text Book(s)</b>														
<ol style="list-style-type: none"> <li>1. Dean Abbott, Applied Predictive Analytics: Principles and Techniques for the professional Data Analyst, John Wiley &amp; Sons Inc. Publishers, First edition, 2014.</li> </ol>														

2. Chandan K. Reddy, Charu C. Aggarwal, Healthcare Data Analytics, Chapman & Hall/CRC, Data Mining and Knowledge Discovery Series, 2015.
<b>Reference Books</b>
1. Manohar Swamynathan, Mastering Machine Learning with Python in Six Steps, Apress Publishers, First edition, 2017.
Mode of Assessment: Continuous Assessment / FAT
Recommended by Board of Studies      18-11-2022
Approved by Academic Council      No. 68      Date      19-12-2022

<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE618L</b>	<b>Social Network Analytics</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>NIL</b>			<b>Syllabus version</b>	
				<b>1.0</b>	
<b>Course Objectives</b>					
<ol style="list-style-type: none"> <li>1. Understand the components and entities of the social network</li> <li>2. Analyze social media data to comprehend user sentiments and recommend the essential information appropriately.</li> <li>3. Model and visualize the social network</li> </ol>					
<b>Course Outcomes</b>					
<ol style="list-style-type: none"> <li>1. Illustrate the basic concepts of social network.</li> <li>2. Analyse the networks to find prominent actors and relate social network models.</li> <li>3. Develop social network applications using tools and techniques.</li> <li>4. Detect and analyze the communities in social networks.</li> <li>5. Design a system to assimilate information available on the web to model and build Social Network Application.</li> </ol>					
<b>Module:1</b>	<b>Fundamentals of Social Network Analysis</b>	<b>4 hours</b>			
Social Network Perspective, Fundamentals concepts in Network Analysis: Sociogram, Sociometry. Social Network Data: Types of Networks: One-Mode, Two-Mode, Affiliation, Ego-centered and Special Dyadic Networks, Network Data, Measurement and Collection, Notations for Social Network Data: Graphs, Directed, Singed, Valued graphs, Multigraph, Relations and Matrices.					
<b>Module:2</b>	<b>Centrality and Prestige</b>	<b>4 hours</b>			
Prominence: Actor-Centrality, Prestige, Group-Centrality, Prestige, Non directional Relations-Degree, Closeness, Betweenness, Eigen Vector Centrality, Directional Relations-Centrality, Prestige.					
<b>Module:3</b>	<b>Structural Balance and Transitivity</b>	<b>3 hours</b>			
Structural Balance: Signed Non directional, Signed Directional Relations, Checking for Balance, Index for Balance, Clusterability-Theorems, Clustering Coefficient and Transitivity.					
<b>Module:4</b>	<b>Cohesive Subgroups</b>	<b>5 hours</b>			
Social Group and Subgroup-Notation, Subgroups Based on Complete Mutuality: Clique, Reachability and Diameter: n-cliques, n-clans and n-clubs, Subgroups Based on Nodal Degree: k-plexes, k-cores, Measures of Subgroup Cohesion, Community detection using Subgroups and Betweenness.					
<b>Module:5</b>	<b>Structural Equivalence</b>	<b>4 hours</b>			
Definition, Social Roles and , Positional Analysis, Measuring Structural Equivalence, Representation of Network Positions, Block Models: Introduction, Network Positions and roles-Introduction					
<b>Module:6</b>	<b>Dyadic and Triadic Methods</b>	<b>4 hours</b>			
Dyads: Definitions, Dyad Census, Index, Simple Distributions, Triads: Random Models and Substantive Hypotheses, Triad Census, Distribution of a Triad Census-Mean and Variance, Testing Structural Hypotheses.					
<b>Module:7</b>	<b>Models in Social Network</b>	<b>5 hours</b>			

Small world network- Watt Strogatz networks - statistical models for social networks - network evaluation model - Preferential attachment - power law - Random Model : Erdos -Renyi model - Barabasi Albert model - Epidemic model - Case study: Text and opinion Analysis		
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>
	<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Text Book(s)</b>		
1.	Wasserman Stanley, and Katherine Faust, Social Network Analysis: Methods and Applications, Structural Analysis in the Social Sciences. Cambridge University Press, 2012 Online Edition.	
2.	Albert-László Barabási, Network Science, Cambridge University Press, 1st edition, 2016.	
<b>Reference Books</b>		
1.	John Scott, "Social Network Analysis", Sage Publications Ltd., Fourth Edition, 2017.	
2.	David Knoke & Song Yang, "Social Network Analysis", Sage Publishing, Third Edition, 2020.	
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	18-11-2022	
Approved by Academic Council	No. 68	Date 19-12-2022

<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>		
<b>MCSE618P</b>	<b>Social Network Analytics Lab</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>1</b>		
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>		<b>1.0</b>			
<b>Course Objectives</b>							
<ol style="list-style-type: none"> <li>1. Understand the components of the social network</li> <li>2. Analyze social media data to understand user sentiment and recommend the requisite information accordingly.</li> <li>3. Model and visualize the social network</li> </ol>							
<b>Course Outcome</b>							
Upon completion of the course the student will be able to							
<ol style="list-style-type: none"> <li>1. Demonstrate the basic properties of social network</li> <li>2. Demonstrate of analysis of social networks to find prominent actors and apply social network models.</li> <li>3. Develop social network applications using visualization tools.</li> <li>4. Detect and analyze the communities in social networks.</li> <li>5. Design a system to harvest information available on the web to model and build Social Network Application.</li> </ol>							
<b>Indicative Experiments</b>							
<ol style="list-style-type: none"> <li>1. Study and demonstrate to find the basic properties of a Graph/Social Network.</li> <li>2. Demonstrate the calculation of Centrality measures.</li> <li>3. Demonstrate the ranking of web pages in a web graph.</li> <li>4. Find divisions in a Social Network.</li> <li>5. Implement Community Detection algorithms on a Social Network.</li> <li>6. Demonstrate modelling of Social Networks.</li> <li>7. Visualize multidimensional Social Network.</li> <li>8. Applications of Classification and Clustering on a Social Network.</li> <li>9. Design and implement a Sentiment Analyzer.</li> <li>10. Design and implement a Social Network.</li> </ol>							
<b>Total Laboratory Hours</b> <b>30 hours</b>							
<b>Text Book(s)</b>							
<ol style="list-style-type: none"> <li>1. Wasserman Stanley, and Katherine Faust, Social Network Analysis: Methods and Applications, Structural Analysis in the Social Sciences. Cambridge University Press, 2012 Online Edition.</li> <li>2. Albert-László Barabási, Network Science, Cambridge University Press, 1st edition, 2016.</li> </ol>							
<b>Reference Books</b>							
<ol style="list-style-type: none"> <li>1. John Scott, "Social Network Analysis", Sage Publications Ltd., Fourth Edition, 2017.</li> <li>2. David Knoke &amp; Song Yang, "Social Network Analysis", Sage Publishing, Third Edition, 2020.</li> </ol>							
Mode of Assessment: Continuous Assessment / FAT							
Recommended by Board of Studies	18-11-2022						
Approved by Academic Council	No. 68	Date	19-12-2022				

<b>Course code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
<b>MCSE619L</b>	<b>Text and Speech Analytics</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Pre-requisite</b>	<b>NIL</b>				<b>Syllabus version</b>
					<b>1.0</b>
<b>Course Objectives</b>					
<ol style="list-style-type: none"> <li>1. To introduce the tools and techniques for performing text and speech analytics in diverse contexts.</li> <li>2. To understand the tools and technologies involved in developing text and speech applications.</li> <li>3. To demonstrate the use of computing for building applications in text and speech processing.</li> </ol>					
<b>Course Outcomes</b>					
Upon completion of the course the student will be able to					
<ol style="list-style-type: none"> <li>1. Develop tools to analyse the syntax and semantics of a statement written in a natural language.</li> <li>2. Apply machine learning and deep learning techniques to natural language processing.</li> <li>3. Use signal processing techniques to analyze/represent speech.</li> <li>4. Execute trials of speech systems.</li> <li>5. Evaluate the performance of NLP &amp; Speech systems.</li> </ol>					
<b>Module:1</b>	<b>Introduction to Text Processing and Language Modeling</b>	<b>5 hours</b>			
Introduction to Natural Language Processing (NLP) and Levels of NLP - Regular Expression - Basic Text processing- Text normalization - Vector Semantics and embedding : Lexical Semantics , Vector Semantics , Words and Vectors - Pointwise Mutual Information, N-gram Language Models : N-grams, Smoothing.					
<b>Module:2</b>	<b>Parts of speech and Named entities</b>	<b>4 hours</b>			
Parts of Speech Tagging - Hidden Markov Model - Conditional Random Fields. Constituency Grammars: Constituency, Context Free Grammars, Dependency Parsing: Dependency Relations, Dependency Formalism, Neural Dependency Parser.					
<b>Module:3</b>	<b>Logical Representations of Sentence Meaning</b>	<b>4 hours</b>			
Logical Representations of Sentence Meaning, Word Sense and Word Net, Word Sense Disambiguation, Word Sense Induction.					
<b>Module:4</b>	<b>Applications of Text and NLP</b>	<b>4 hours</b>			
Naive Bayes and Sentiment Analysis: Naive Bayes for text classification, Information Extraction - Relation extraction. Learning Architectures for Sequence Processing: Recurrent Neural Networks for text classification- Long Short-Term Memory (LSTM).					

<b>Module:5</b>	<b>Phonetics</b>	<b>3 hours</b>
Speech Sounds and Phonetic Transcription, Articulatory Phonetics – Prosody - Acoustic Phonetics and Signals - Phonetic Resources.		
<b>Module:6</b>	<b>Automatic Speech Recognition</b>	<b>4 hours</b>
Automatic Speech Recognition (ASR) Task - Feature Extraction: Log Mel Spectrum - Speech Recognition Architecture – Introduction: Gaussian Mixture Model - Connectionist Temporal Classification (CTC) - ASR Evaluation: Word Error Rate.		
<b>Module:7</b>	<b>Text-To-Speech</b>	<b>5 hours</b>
Text-To-Speech (TTS) Preprocessing: Text normalization – TTS: Spectrogram Prediction – TTS: Vocoding - TTS Evaluation.		
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>
	<b>Total Lecture hours:</b>	<b>30 hours</b>
<b>Text Book(s)</b>		
1.	Jurafsky, D. and J. H. Martin, Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (3rd Draft), 2021.	
<b>Reference Books</b>		
1.	John Atkinson-Abutridy, Text Analytics: An Introduction to the Science and Applications of Unstructured Information Analysis, CRC Press, 2022.	
2.	Introduction to Voice Computing in Python, Jim Schwoebel, NeuroLex, 2018	
3.	Theory and Applications of Digital Speech Processing, Lawrence R. Rabiner, Ronald W. Schafe, 1st Edn. Pearson, 2010.	
4.	Srinivasa-Desikan, Bhargav. Natural Language Processing and Computational Linguistics: A practical guide to text analysis with Python, Gensim, spaCy, and Keras. Packt Publishing Ltd, 2018.	
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar		
Recommended by Board of Studies	18-11-2022	
Approved by Academic Council	No. 68	Date 19-12-2022

Course Code	Course Title	L	T	P	C									
MCSE619P	Text and Speech Analytics Lab	0	0	2	1									
Pre-requisite	NIL	Syllabus version		1.0										
<b>Course Objectives</b>														
<ol style="list-style-type: none"> <li>1. To introduce the tools and techniques for performing text and speech analytics in diverse contexts.</li> <li>2. To understand the tools and technologies involved in developing text and speech applications.</li> <li>3. To demonstrate the use of computing for building applications in text and speech processing.</li> </ol>														
<b>Course Outcomes</b>														
Upon completion of the course the student will be able to														
<ol style="list-style-type: none"> <li>1. Develop tools to analyse the syntax and semantics of a statement written in a natural language.</li> <li>2. Apply machine learning and deep learning techniques to natural language processing.</li> <li>3. Use signal processing techniques to analyze/represent speech.</li> <li>4. Execute trials of speech systems.</li> <li>5. Evaluate the performance of NLP &amp; Speech systems.</li> </ol>														
<b>Indicative Experiments</b>														
1.	Introduction to text processing packages in Python.													
2.	Demonstration of Genism for Vectorizing Text, Transformations and n-grams.													
3.	Demonstration of Part-of-Speech tagging using spaCy.													
4.	Demonstration of text parsing, topic modeling, text clustering and text classification.													
5.	Demonstration of Deep learning techniques for text classification and for designing a chatbot.													
6.	Analyze Speech signal - Fast Fourier Transform (FFT), spectrogram, Linear predictive coding, Mel-frequency Cepstral Coefficients (MFCC) features.													
7.	Demonstration of Hidden Markov Model based Isolated word recognition.													
8.	Demonstration of Continuous speech recognition using CTC.													
9.	Demonstration of Alexa speech enabled application development system.													
10	Demonstration of Google voice API based speech transcription system.													
<b>Total Laboratory Hours</b> <b>30 hours</b>														
<b>Text Book(s)</b>														
1. Jurafsky, D. and J. H. Martin, Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition (3rd Draft), 2021.														

2. Srinivasa-Desikan, Bhargav. Natural Language Processing and Computational Linguistics: A practical guide to text analysis with Python, Gensim, spaCy, and Keras. Packt Publishing Ltd, 2018.

**Reference Books**

1. John Atkinson-Abutridy, Text Analytics: An Introduction to the Science and Applications of Unstructured Information Analysis, CRC Press, 2022.
2. Introduction to Voice Computing in Python, Jim Schwoebel, NeuroLex, 2018
3. Theory and Applications of Digital Speech Processing, Lawrence R. Rabiner, Ronald W. Schafer, 1st Edn. Pearson, 2010.

Mode of Assessment: Continuous Assessment / FAT

Recommended by Board of Studies	18-11-2022
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Approved by Academic Council	No. 68	Date	19-12-2022
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<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>				
<b>MCSE620L</b>	<b>Analytics for Internet of Things</b>	<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>				
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>		<b>1.0</b>					
<b>Course Objectives</b>									
<ol style="list-style-type: none"> <li>To introduce the fundamentals of IoT data analytics and major challenges in IoT data analytics.</li> <li>To provide knowledge on IoT network architecture and design.</li> <li>To understand smart objects and IoT networking protocols.</li> </ol>									
<b>Course Outcomes</b>									
Upon completion of the course the student will be able to <ol style="list-style-type: none"> <li>Understand the specific challenges in applying data analytics techniques over IoT data.</li> <li>Will know IoT network architecture and design.</li> <li>Smart objects and connecting smart objects</li> <li>Analyze various IoT networking protocols.</li> <li>Apply IoT analytics for cloud and data science for IoT analytics.</li> </ol>									
<b>Module:1</b>	<b>IoT Analytics and Challenges</b>	<b>3 hours</b>							
Defining IoT analytics: Defining Analytics, Defining Internet of Things, The concepts of constrained - IoT analytics challenges: the Data volume, Problem with time and space, Data quality, Analytics Challenges - Business value concerns.									
<b>Module:2</b>	<b>IoT Network Architecture and Design</b>	<b>5 hours</b>							
Drivers behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.									
<b>Module:3</b>	<b>Smart Objects: The Things in IoT</b>	<b>3 hours</b>							
Sensors, Actuators, and Smart Objects, Sensor Networks									
<b>Module:4</b>	<b>Connecting Smart Objects</b>	<b>6 hours</b>							
Communications Criteria, Range, Frequency Bands, Power Consumption, Topology, Constrained Devices, Constrained-Node Networks, IoT Access Technologies, IEEE 802.15.4, IEEE 802.15.4g and 802.15.4e, LoRaWAN.									
<b>Module:5</b>	<b>IoT Networking Protocols</b>	<b>3 hours</b>							
IoT networking data messaging protocols, Message Queue Telemetry Transport (MQTT), Hyper-Text Transport Protocol (HTTP), Constrained Application Protocol (CoAP), Data Distribution Service (DDS).									
<b>Module:6</b>	<b>IoT Analytics for the Cloud</b>	<b>4 hours</b>							
Building elastic analytics, Elastic analytics concepts, designing for scale, Cloud security and analytics, The AWS overview, Microsoft Azure overview.									
<b>Module:7</b>	<b>Data Science for IoT Analytics</b>	<b>5 hours</b>							

Machine learning (ML), Feature engineering with IoT data, Validation methods, Understanding the bias-variance tradeoff, Comparing different models to find the best fit using R, Random forest models using R, Anomaly detection using R.			
<b>Module:8</b>	<b>Contemporary Issues</b>	<b>1 hour</b>	
	<b>Total Lecture hours:</b>	<b>30 hours</b>	
<b>Text Book(s)</b>			
1. Andrew Minteer , Analytics for the Internet of things, Packt publishing 2017.			
2. David Hanes, Gonzalo Salgueiro, Patrick Grosssetete, Rob Barton and Jerome Henry, IoT Fundamentals:Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.			
<b>Reference Books</b>			
1. Pethuru Raj, Anupama C. Raman, The Internet of Things, Enabling Technologies, Platforms, and Use Cases, CRC Press, 2017.			
2. Rajkumar Buyya, Amir Vahid Dastjerdi, Internet of Things Principles and Paradigms, Morgan Kaufmann, 1st edition, 2016.			
3. Marco Schwartz, Internet of Things with Arduino Cookbook, Packt Publishing,2016			
4. Adeel Javed, "Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications", 1st Edition, Apress, 2016.			
Mode of Evaluation: CAT / written assignment / Quiz / FAT / Project / Seminar			
Recommended by Board of Studies	18-11-2022		
Approved by Academic Council	No. 68	Date	19-12-2022



3.	Marco Schwartz, Internet of Things with Arduino Cookbook, Packt Publishing, 2016		
4.	Adeel Javed, "Building Arduino Projects for the Internet of Things: Experiments with Real-World Applications", 1st Edition, Apress, 2016.		
<b>Mode of Assessment:</b> Continuous Assessment / FAT			
Recommended by Board of Studies		18-11-2022	
Approved by Academic Council	No. 68	Date	19-12-2022

Course Code	Course Title	L	T	P	C				
MCSE698J	Internship I/ Dissertation I				10				
Pre-requisite	NIL	<b>Syllabus version</b>							
		<b>1.0</b>							
<b>Course Objectives:</b>									
To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field and also to give research orientation.									
<b>Course Outcome:</b>									
<ol style="list-style-type: none"> <li>1. Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.</li> <li>2. The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues.</li> <li>3. A consciousness of the ethical aspects of research and development work.</li> <li>4. Publications in the peer reviewed journals / International Conferences will be an added advantage.</li> </ol>									
<b>Module Content</b>		<b>(Project duration: one semester)</b>							
<ol style="list-style-type: none"> <li>1. Dissertation may be a theoretical analysis, modeling &amp; simulation, experimentation &amp; analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.</li> <li>2. Dissertation should be individual work.</li> <li>3. Carried out inside or outside the university, in any relevant industry or research institution.</li> <li>4. Publications in the peer reviewed journals / International Conferences will be an added advantage.</li> </ol>									
<b>Mode of Evaluation:</b> Assessment on the project - Dissertation report to be submitted, presentation, project reviews and Final Oral Viva Examination.									
Recommended by Board of Studies	26-07-2022								
Approved by Academic Council	No. 67	Date	08-08-2022						

Course Code	Course Title	L	T	P	C				
MCSE699J	Internship II/ Dissertation II				12				
Pre-requisite	Syllabus version								
	1.0								
<b>Course Objectives:</b>									
To provide sufficient hands-on learning experience related to the design, development and analysis of suitable product / process so as to enhance the technical skill sets in the chosen field.									
<b>Course Outcome:</b>									
Upon successful completion of this course students will be able to									
<ol style="list-style-type: none"> <li>1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints.</li> <li>2. Perform literature search and / or patent search in the area of interest.</li> <li>3. Conduct experiments / Design and Analysis / solution iterations and document the results.</li> <li>4. Perform error analysis / benchmarking / costing.</li> <li>5. Synthesize the results and arrive at scientific conclusions / products / solution.</li> <li>6. Document the results in the form of technical report / presentation.</li> </ol>									
<b>Module Content</b>		<b>(Project duration: one semester)</b>							
<ol style="list-style-type: none"> <li>1. Dissertation may be a theoretical analysis, modeling &amp; simulation, experimentation &amp; analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities.</li> <li>2. Dissertation should be individual work.</li> <li>3. Carried out inside or outside the university, in any relevant industry or research institution.</li> <li>4. Publications in the peer reviewed journals / International Conferences will be an added advantage.</li> </ol>									
<b>Mode of Evaluation:</b> Assessment on the project - Dissertation report to be submitted, presentation, project reviews and Final Oral Viva Examination.									
Recommended by Board of Studies		26-07-2022							
Approved by Academic Council		No. 67	Date	08-08-2022					

<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>								
<b>MSET695J</b>	<b>Project Work</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>								
<b>Pre-requisite</b>	<b>NIL</b>	<b>Syllabus version</b>											
		<b>1.0</b>											
<b>Course Objectives:</b>													
<ol style="list-style-type: none"> <li>1. Use insight and creativity for better understanding of the domain of interest, scrutinize technical literature and identify research gaps</li> <li>2. Conduct experiments / Design and Analysis / solution iterations and document the results</li> <li>3. Synthesize the results and arrive at scientific conclusions / products / solution.</li> <li>4. Disseminate the advancement in the technology, new product / process development</li> </ol>													
<b>Course Outcomes:</b>													
<p>At the end of the course student will be able to</p> <ol style="list-style-type: none"> <li>1. Retrieve, analyze, and interpret published literature/books providing information related to niche areas/focused domains</li> <li>2. Formulate specific problem statements for well-defined problems with reasonable assumptions and constraints</li> <li>3. Perform experimental work, analyze, simulate and validate the findings</li> <li>4. Synthesize novel information and use the insights for further advancement in the domain</li> <li>5. Publish the findings in the peer reviewed Journals / National / International Conferences and file patent</li> </ol>													
<b>Module Contents</b>	<b>Project Duration: Two Semester</b>												
<p>This is oriented towards reading published literature or books related to niche areas or focused domains, design and conduct experiments, analyze, interpret and validate the data under the guidance of a faculty. Design and development of new process and product. Project can be for one or two semesters based on the completion of the work and achieving a tangible outcome in the form of a published or accepted Journal paper / reputed conference proceedings / filing a patent. Can be individual work or a group project, with a maximum of 3 students.</p>													

**Mode of Evaluation:** Tangible outcome (Published / accepted Journal Paper or published paper in a reputed conference proceedings or patent filed) is the primary factor for award of final marks / grade. In the absence of any of the above mentioned outcome, then the marks scored in the periodic reviews (one review on the progress of the work, per semester organized by the HoD / Project Coordinator) and the presentation in the International Conference on Science, Engineering Technology organized at VIT along with a project report will be considered for award of mark / grade.

Recommended by Board of Studies	28-02-2024		
Approved by Academic Council	No. 73	Date	14-03-2024



<b>leur idées)</b>		
Décrivez La Famille -La Maison -L'université -Les Loisirs-La Vie quotidienne- La ville natale- Un personnage célèbre		
<b>Module:7</b>	<b>Comment écrire un dialogue</b>	<b>5 hours</b>
Dialogue a) Réserver un billet de train b) Entre deux amis qui se rencontrent au café c) Parmi les membres de la famille d) Entre le patient et le médecin e) Entre le professeur et l'étudiant(e)		
<b>Module:8</b>	<b>Contemporary Topics</b>	<b>2 hours</b>
		<b>Total Lecture hours:</b>
		<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Adomania 1, Méthode de français, CelineHimber, Corina Brillant, Sophie Erlich. Publisher HACHETTE, February 2016.	
2.	Enchanté 1 !, Méthode de français, Rachana Sagar Private Limited, Jan 2017.	
<b>Reference Books</b>		
1.	Le français pour vous 1, Méthode de français, VinodSikri, Anna Gabriel Koshy, Prozopublishing, Jan 2019.	
2.	Accueil 1, Méthode de français, Rachana Sagar Private Limited, January 2016	
3.	Apprenons le français 1 Méthode de français, Mahitha Ranjit & Monica Singh, Jan 2019	
Modeof Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test		
Recommended by Board of Studies	19-05-2022	
Approved by Academic Council	No. 66	Date 16-06-2022



<b>Grammatik – Wortschatz – Übung</b>		
<b>Module:8</b>	<b>Trainierung den Sprachfähigkeiten</b>	<b>2 hours</b>
	<b>Total Lecture hours:</b>	<b>45 hours</b>
<b>Text Book(s)</b>		
1.	Netzwerk A1, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Ernst Klett Sprachen GmbH, Stuttgart, 2017	
<b>Reference Books</b>		
1.	Studio d A1 Deutsch als Fremdsprache, Hermann Funk, Christina Kuhn, Silke Demme: Heuber Verlag, Muenchen, 2012.	
2.	Lagune ,Hartmut Aufderstrasse, Jutta Müller, Thomas Storz,.. Muenchen, 2012	
3.	Deutsche Sprachlehre für Ausländer, Heinz Griesbach, Dora Schulz, 2011, Berlin	
4.	Themen Aktuell 1, Hartmurt Aufderstrasse, Heiko Bock, Mechthild Gerdes, Jutta Müller und Helmut Müller, 2010, Muenchen.	
	<a href="http://www.goethe.de">www.goethe.de</a> wirtschaftsdeutsch.de hueber.de, klett-sprachen.de <a href="http://www.deutschtraining.org">www.deutschtraining.org</a>	
Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test		
Recommended by Board of Studies	19-05-2022	
Approved by Academic Council	No.66	Date 16-06-2022

<b>Course code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>
MENG501P	Technical Report Writing	0	0	4	2
<b>Pre-requisite</b>	<b>Nil</b>			<b>Syllabus version</b>	
				1.0	
<b>Course Objectives</b>					
1. To develop writing skills for preparing technical reports. 2. To analyze and evaluate general and complex technical information. 3. To enable proficiency in drafting and presenting reports.					
<b>Course Outcome</b>					
At the end of the course, the student will be able to 1. Construct error free sentences using appropriate grammar, vocabulary and style. 2. Apply the advanced rules of grammar for proofreading reports. 3. Interpret information and concepts in preparing reports. 4. Demonstrate the structure and function of technical reports. 5. Improve the ability of presenting technical reports.					
<b>Indicative Experiments</b>					
1.	<b>Basics of Technical Communication</b> General and Technical communication, Process of communication, Levels of communication				
2.	<b>Vocabulary &amp; Editing</b> Word usage: confusing words, Phrasal verbs Punctuation and Proof reading				
3.	<b>Advanced Grammar</b> Shifts: Voice, Tense, Person, Number Clarity: Pronoun reference, Misplace and unclear modifiers				
4.	<b>Elements of Technical writing</b> Developing paragraphs, Eliminating unnecessary words, Avoiding clichés and slang Sentence clarity and combining				
5.	<b>The Art of condensation</b> Steps to effective precis writing, Paraphrasing and summarizing				
6.	<b>Technical Reports:</b> Meaning, Objectives, Characteristics and Categories				
7.	<b>Formats of reports and Prewriting:</b> purpose, audience, sources of information, organizing the material				
8.	<b>Data Visualization</b> Interpreting Data - Graphs - Tables - Charts - Imagery - Info graphics				
9.	<b>Systematization of Information:</b> Preparing Questionnaire Techniques to Converge Objective-Oriented data in Diverse Technical Reports				
10.	<b>Research and Analyses:</b> Writing introduction and literature review, Reference styles, Synchronize Technical Details from Magazines, Articles and e-content				
11..	<b>Structure of Reports</b> Title – Preface – Acknowledgement - Abstract/Summary – Introduction - Materials and Methods – Results – Discussion - Conclusion - Suggestions/Recommendations				
12.	<b>Writing the Report:</b> First draft, Revising, Thesis statement, Developing unity and coherence				
13.	<b>Writing scientific abstracts:</b> Parts of the abstract, Revising the abstract Avoiding Plagiarism, Best practices for writers				
14.	<b>Supplementary Texts</b> Appendix – Index – Glossary – References – Bibliography - Notes				
15	<b>Presentation</b>				

	Presenting Technical Reports Planning, creating and digital presentation of reports	<b>Total Laboratory hours :</b>	<b>60 hours</b>
<b>Text Book(s)</b>			
1. Raman, Meenakshi and Sangeeta Sharma, (2015).Technical Communication: Principles and Practice, Third edition, Oxford University Press, New Delhi.			
<b>Reference Books</b>			
1. Aruna, Koneru, (2020). English Language Skills for Engineers. McGraw Hill Education, Noida.			
2. Rizvi,M. Ashraf (2018)Effective Technical Communication Second Edition. McGraw Hill Education, Chennai.			
3. Kumar, Sanjay and Pushpalatha, (2018). English Language and Communication Skills for Engineers, Oxford University Press.			
4. Elizabeth Tebeaux and Sam Dragga, (2020).The Essentials of Technical Communication, Fifth Edition, Oxford University Press.			
Mode of Evaluation : Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test			
Recommended by Board of Studies	19-05-2022		
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<b>Course Code</b>	<b>Course Title</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>C</b>			
<b>MSTS501P</b>	<b>Qualitative Skills Practice</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>1.5</b>			
<b>Pre-requisite</b>	<b>Nil</b>	<b>Syllabus version</b>						
					<b>1.0</b>			
<b>Course Objectives:</b>								
<p>1. To develop the quantitative ability for solving basic level problems.</p> <p>2. To improve the verbal and professional communication skills.</p>								
<b>Course Outcome:</b>								
<p>At the end of the course, the student will be able to</p> <ol style="list-style-type: none"> <li>1. Execute appropriate analytical skills.</li> <li>2. Solve problems pertaining to quantitative and reasoning ability.</li> <li>3. Learn better vocabulary for workplace communication.</li> <li>4. Demonstrate appropriate behavior in an organized environment.</li> </ol>								
<b>Module:1</b>	<b>Business Etiquette: Social and Cultural Etiquette; Writing Company Blogs; Internal Communications and Planning: Writing press release and meeting notes</b>	<b>9 hours</b>						
Value, Manners- Netiquette, Customs, Language, Tradition, Building a blog, Developing brand message, FAQs', Assessing Competition, Open and objective Communication, Two way dialogue, Understanding the audience, Identifying, Gathering Information,, Analysis, Determining, Selecting plan, Progress check, Types of planning, Write a short, catchy headline, Get to the Point –summarize your subject in the first paragraph., Body– Make it relevant to your audience.								
<b>Module:2</b>	<b>Time management skills</b>	<b>3 hours</b>						
Prioritization, Procrastination, Scheduling, Multitasking, Monitoring, Working under pressure and adhering to deadlines								
<b>Module:3</b>	<b>Presentation skills – Preparing presentation; Organizing materials; Maintaining and preparing visual aids; Dealing with questions</b>	<b>7 hours</b>						
10 Tips to prepare PowerPoint presentation, Outlining the content, Passing the Elevator Test, Blue sky thinking, Introduction , body and conclusion, Use of Font, Use of Color, Strategic presentation, Importance and types of visual aids, Animation to captivate your audience, Design of posters, Setting out the ground rules, Dealing with interruptions, Staying in control of the questions, Handling difficult questions.								
<b>Module:4</b>	<b>QuantitativeAbility-L1–Numberproperties; Averages; Progressions; Percentages; Ratios</b>	<b>11 hours</b>						
Number of factors, Factorials, Remainder Theorem, Unit digit position, Tens digit position, Averages, Weighted Average, Arithmetic Progression, Geometric Progression, Harmonic Progression, increase and Decrease or Successive increase, Types of ratios and proportions.								
<b>Module:5</b>	<b>Reasoning Ability - L1 – Analytical Reasoning</b>	<b>8 hours</b>						
Data Arrangement (Linear and circular & Cross Variable Relationship), Blood Relations, Ordering / ranking / grouping, Puzzle test, Selection Decision table.								
<b>Module:6</b>	<b>Verbal Ability -L1 – Vocabulary Building</b>	<b>7 hours</b>						

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies.

	<b>Total Lecture hours:</b>	<b>45 hours</b>
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**Reference Books**

1. Kerry Patterson, Joseph Grenny, Ron McMillan and Al Switzler, (2017).2<sup>nd</sup> Edition, Crucial Conversations: Tools for Talking when Stakesare High .McGraw-Hill Contemporary, Bangalore.
2. Dale Carnegie,(2016).How to Win Friends and Influence People. Gallery Books, New York.
3. Scott Peck. M, (2003). Road Less Travelled. Bantam Press, New York City.
4. SMART, (2018). Place Mentor, 1<sup>st</sup> edition. Oxford University Press, Chennai.
5. FACE, (2016). Aptipedia Aptitude Encyclopedia. Wiley publications, Delhi.
6. ETHNUS, (2013). Aptimithra. McGraw – Hill Education Pvt .Ltd, Bangalore.

**Websites:**

1. [www.chalkstreet.com](http://www.chalkstreet.com)
2. [www.skillsyouneed.com](http://www.skillsyouneed.com)
3. [www.mindtools.com](http://www.mindtools.com)
4. [www.thebalance.com](http://www.thebalance.com)
5. [www.egeguru.ooo](http://www.egeguru.ooo)

Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test

Recommended by Board of Studies	19-05-2022
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Approved by Academic Council	No.66	Date	16-06-2022
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Course Code	Course Title	L	T	P	C
MSTS502P	Quantitative Skills Practice	0	0	3	1.5
Pre-requisite	Nil			Syllabus version	
				1.0	

**Course Objectives:**

1. To develop the students' advanced problem solving skills.
2. To enhance critical thinking and innovative skills.

**Course Outcome:**

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

1. Create positive impression during official conversations and interviews.
2. Demonstrate comprehending skills of various texts.
3. Improve advanced level thinking ability in general aptitude.
4. Develop emotional stability to tackle difficult circumstances.

<b>Module:1</b>	<b>Resume skills – Resume Template; Use of power verbs; Types of resume; Customizing resume</b>	<b>2 hours</b>
Structure of a standard resume, Content, color, font, Introduction to Power verbs and Write up, Quiz on types of resume, Frequent mistakes in customizing resume, Layout-Understanding different company's requirement, Digitizing career portfolio.		
<b>Module:2</b>	<b>Interview skills – Types of interview; Techniques to face remote interviews and Mock Interview</b>	<b>3 hours</b>
Structured and unstructured interview orientation, Closed questions and hypothetical questions, Interviewers' perspective, Questions to ask/not ask during an interview, Video interview, Recorded feedback, Phone interview preparation, Tips to customize preparation for personal interview, Practice rounds.		
<b>Module:3</b>	<b>Emotional Intelligence - L1 – Transactional Analysis; Brain storming; Psychometric Analysis; SWOT analysis</b>	<b>12 hours</b>
Introduction, Contracting, ego states, Life positions, Individual Brainstorming, Group Brainstorming, Stepladder Technique, Brain writing, Crawford's Slip writing approach, Reverse brainstorming, Star bursting, Charlette procedure ,Round robin brainstorming, Skill Test, Personality Test, More than one answer, Unique ways, SWOT analysis.		
<b>Module:4</b>	<b>Quantitative Ability - L3–Permutation - Combinations; Probability; Geometry and menstruation; Trigonometry; Logarithms; Functions; Quadratic Equations; Set Theory</b>	<b>14 hours</b>
Counting, Grouping, Linear Arrangement, Circular Arrangements, Conditional Probability, Independent and Dependent Events, Properties of Polygon, 2D & 3D Figures, Area & Volumes, Heights and distances, Simple trigonometric functions, Introduction to logarithms, Basic rules of logarithms, Introduction to functions, Basic rules of functions, Understanding Quadratic Equations, Rules & probabilities of Quadratic Equations, Basic concepts of Venn Diagram.		
<b>Module:5</b>	<b>Reasoning ability - L3 – Logical reasoning; Data Analysis and Interpretation</b>	<b>7 hours</b>

Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data Interpretation-Advanced, Interpretation tables, pie charts & bar charts.		
<b>Module:6</b>	<b>Verbal Ability - L3 – Comprehension and Critical reasoning</b>	<b>7 hours</b>
Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption & Inference, (c) Strengthening & Weakening an Argument.		
<b>Total Lecture hours:</b>		<b>45 hours</b>
<b>Reference Books</b>		
1.	Michael Farra and JIST Editors,(2011).Quick Resume & Cover Letter Book: Write and Use an Effective Resume in Just One Day. Jist Works, Saint Paul, Minnesota.	
2.	Flage Daniel E, (2003).The Art of Questioning: An Introduction to Critical Thinking. Pearson, London.	
3.	David Allen, (2015).Getting Things done: The Art of Stress-Free productivity. Penguin Books, New York City.	
4.	SMART, (2018). Place Mentor 1 <sup>st</sup> edition. Oxford University Press, Chennai.	
5.	FACE, (2016).Aptipedia Aptitude Encyclopedia. Wileypublications, Delhi.	
6.	ETHNUS, (2013).Aptimithra. McGraw-Hill Education Pvt Ltd, Bangalore.	
<b>Websites:</b>		
1.	<a href="http://www.chalkstreet.com">www.chalkstreet.com</a>	
2.	<a href="http://www.skillsyouneed.com">www.skillsyouneed.com</a>	
3.	<a href="http://www.mindtools.com">www.mindtools.com</a>	
4.	<a href="http://www.thebalance.com">www.thebalance.com</a>	
5.	<a href="http://www.eguru.ooo">www.eguru.ooo</a>	
Mode of Evaluation: Continuous Assessment Tests, Quizzes, Assignment, Final Assessment Test		
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