



VIT[®]

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Computer Science and Engineering

CURRICULUM AND SYLLABI

(2022-2023)

M.Tech (CSE) – (Big Data Analytics)



VISION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

Transforming life through excellence in education and research.

MISSION STATEMENT OF VELLORE INSTITUTE OF TECHNOLOGY

World class Education: Excellence in education, grounded in ethics and critical thinking, for improvement of life.

Cutting edge Research: An innovation ecosystem to extend knowledge and solve critical problems.

Impactful People: Happy, accountable, caring and effective workforce and students.

Rewarding Co-creations: Active collaboration with national & international industries & universities for productivity and economic development.

Service to Society: Service to the region and world through knowledge and compassion.

VISION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

To be a world-renowned centre of education, research and service in computing and allied domains.

MISSION STATEMENT OF THE SCHOOL OF COMPUTER SCIENCE AND ENGINEERING

- To offer computing education programs with the goal that the students become technically competent and develop lifelong learning skill.
- To undertake path-breaking research that creates new computing technologies and solutions for industry and society at large.
- To foster vibrant outreach programs for industry, research organizations, academia and society.



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School of Computer Science and Engineering

M.Tech (CSE) – (Big Data Analytics)

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

1. Graduates will be engineering professionals who will engage in technology development and deployment with social awareness and responsibility.
2. Graduates will function as successful practicing engineer / researcher / teacher / entrepreneur in the chosen domain of study.
3. Graduates will have holistic approach addressing technological, societal, economic and sustainability dimensions of problems and contribute to economic growth of the country.



M. Tech Computer Science and Engineering (Big Data Analytics)

PROGRAMME OUTCOMES (POs)

PO_01: Having an ability to apply mathematics and science in engineering applications.

PO_03: Having an ability to design a component or a product applying all the relevant standards and with realistic constraints, including public health, safety, culture, society and environment

PO_04: Having an ability to design and conduct experiments, as well as to analyze and interpret data, and synthesis of information

PO_05: Having an ability to use techniques, skills, resources and modern engineering and IT tools necessary for engineering practice

PO_06: Having problem solving ability- to assess social issues (societal, health, safety, legal and cultural) and engineering problems

PO_07: Having adaptive thinking and adaptability in relation to environmental context and sustainable development

PO_08: Having a clear understanding of professional and ethical responsibility

PO_11: Having a good cognitive load management skills related to project management and finance



M. Tech Computer Science and Engineering (Big Data Analytics)

ADDITIONAL PROGRAMME OUTCOMES (APOs)

APO_02: Having Sense-Making Skills of creating unique insights in what is being seen or observed (Higher level thinking skills which cannot be codified)

APO_03: Having design thinking capability

APO_04: Having computational thinking (Ability to translate vast data in to abstract concepts and to understand database reasoning)

APO_07: Having critical thinking and innovative skills

APO_08: Having a good digital footprint



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School of Computer Science and Engineering

M.Tech (CSE) – (Big Data Analytics)

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. Ability to design and develop computer programs/computer-based systems in the advanced level of areas including algorithms design and analysis, networking, operating systems design, etc.
2. Ability to apply the advanced concepts of Big Data that pave the way to create a platform to gain analytical skills which impacts business decisions and strategies.
3. Ability to bring out the capabilities for research and development in contemporary issues and to exhibit the outcomes as technical report.



M. Tech Computer Science and Engineering (Big Data Analytics)

CREDIT STRUCTURE

Category-wise Credit distribution

S.no	Category	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

Discipline Core

sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	MCSE501L	Data Structures and Algorithms	Theory Only	1.0	3	0	0	0	3.0
2	MCSE501P	Data Structures and Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
3	MCSE502L	Design and Analysis of Algorithms	Theory Only	1.0	3	0	0	0	3.0
4	MCSE502P	Design and Analysis of Algorithms Lab	Lab Only	1.0	0	0	2	0	1.0
5	MCSE503L	Computer Architecture and Organisation	Theory Only	1.0	3	0	0	0	3.0
6	MCSE503P	Computer Architecture and Organisation Lab	Lab Only	1.0	0	0	2	0	1.0
7	MCSE504L	Operating Systems	Theory Only	1.0	3	0	0	0	3.0
8	MCSE504P	Operating Systems Lab	Lab Only	1.0	0	0	2	0	1.0
9	MCSE505L	Computer Networks	Theory Only	1.0	3	0	0	0	3.0
10	MCSE505P	Computer Networks Lab	Lab Only	1.0	0	0	2	0	1.0
11	MCSE506L	Database Systems	Theory Only	1.0	3	0	0	0	3.0
12	MCSE506P	Database Systems Lab	Lab Only	1.0	0	0	2	0	1.0

Specialization Elective

sl.no	Course Code	Course Title	Course Type	Version	L	T	P	J	Credits
1	MCSE614L	Big Data Frameworks and Technologies	Theory Only	1.0	2	0	0	0	2.0
2	MCSE614P	Big Data Frameworks and Technologies Lab	Lab Only	1.0	0	0	2	0	1.0
3	MCSE615L	Data Analytics	Theory Only	1.0	2	0	0	0	2.0
4	MCSE615P	Data Analytics Lab	Lab Only	1.0	0	0	2	0	1.0
5	MCSE616L	Data Visualization	Theory Only	1.0	2	0	0	0	2.0
6	MCSE616P	Data Visualization Lab	Lab Only	1.0	0	0	2	0	1.0
7	MCSE617L	Domain Specific Predictive Analytics	Theory Only	1.0	2	0	0	0	2.0
8	MCSE617P	Domain Specific Predictive Analytics Lab	Lab Only	1.0	0	0	2	0	1.0
9	MCSE618L	Social Network Analytics	Theory Only	1.0	2	0	0	0	2.0
10	MCSE618P	Social Network Analytics Lab	Lab Only	1.0	0	0	2	0	1.0
11	MCSE619L	Text and Speech Analytics	Theory Only	1.0	2	0	0	0	2.0
12	MCSE619P	Text and Speech Analytics Lab	Lab Only	1.0	0	0	2	0	1.0
13	MCSE620L	Analytics for Internet of Things	Theory Only	1.0	2	0	0	0	2.0

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	MCSE696J	Study Oriented Project	Project	1.0	0	0	0	0	2.0
2	MCSE697J	Design Project	Project	1.0	0	0	0	0	2.0
3	MCSE698J	Internship I/ Dissertation I	Project	1.0	0	0	0	0	10.0
4	MCSE699J	Internship II/ Dissertation II	Project	1.0	0	0	0	0	12.0

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			
Course Objectives					
<ol style="list-style-type: none"> 1. To familiarize the concepts of data structures and algorithms focusing on space and time complexity. 2. To provide a deeper insight into the basic and advanced data structures. 3. To develop the knowledge for the application of advanced trees and graphs in real- world scenarios. 					
Course Outcomes					
After completion of this course, the student shall be able to: <ol style="list-style-type: none"> 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. 					
Module:1	Growth of Functions	3 hours			
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.					
Module:2	Elementary Data Structures	6 hours			
Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures					
Module:3	Sorting and Searching	7 hours			
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.					
Module:4	Trees	6 hours			
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.					
Module:5	Advanced Trees	8 hours			
Threaded binary trees, Leftist trees, Tournament trees, 2-3 tree, Splay tree, Red-black trees, Range trees.					
Module:6	Graphs	7 hours			
Representation of graphs, Topological sorting, Shortest path algorithms- Dijkstra's algorithm, Floyd-Warshall algorithm, Minimum spanning trees - Reverse delete algorithm, Boruvka's algorithm.					
Module:7	Heap and Hashing	6 hours			
Heaps as priority queues, Binary heaps, binomial and Fibonacci heaps, Heaps in Huffman coding, Extendible hashing.					
Module:8	Contemporary Issues	2 hours			
Total Lecture hours:					45 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 / 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							
<ol style="list-style-type: none"> To familiarize the concepts of data structures and algorithm focusing on space and time complexity. To provide a deeper insight on the basic and advanced data structures. 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: <ol style="list-style-type: none"> Understand and analyze the space and time complexity of the algorithms. Identification of suitable data structure for a given problem. Implementation of graph algorithms in various real-life applications. Implementation of heaps and trees for querying and searching. Use of basic data structures in advanced data structure operations. 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	

Course code	Course title	L	T	P	C
MCSE502L	Design and Analysis of Algorithms	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> To provide a mathematical framework for the design and analysis of algorithms. To disseminate knowledge on how to create strategies for dealing with real-world problems. 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:					
<ol style="list-style-type: none"> Apply knowledge of computing and mathematics to algorithm design. Apply various algorithm paradigms to solve scientific and real-life problems. Demonstrate the string matching and network flow algorithms relating to real-life problems. Understand and apply geometric algorithms. Apply linear optimization techniques to various real-world linear optimization problems. 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			
Total Lecture hours:					45 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, 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	Date 08-08-2022

Course code	Course title	L	T	P	C
MCSE502P	Design and Analysis of Algorithms Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> 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					
<p>On completion of this course, student should be able to:</p> <ol style="list-style-type: none"> 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 st Edition, Pearson Education, 2014.				
3.	Jon Kleinberg and EvaTardos, Algorithm Design, Pearson Education, 1 st Edition, 2014.				
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	

Course code	Course title	L	T	P	C
MCSE503L	Computer Architecture and Organization	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> To provide knowledge on the basics of computer architectures and organization that lays the foundation to study high-performance architectures To design and develop parallel programs using parallel computing platforms such as OpenMP, CUDA 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: <ol style="list-style-type: none"> Outline the developments in the evolution of computer architectures and parallel programming paradigms Comprehend the various programming languages and libraries for parallel computing platforms Use of profiling tools to analyze the performance of applications by interpreting the given data Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel application design Develop parallel programs using OpenMP and CUDA and analyze performance parameters such as speed-up, and efficiency for parallel programs against serial programs 					
Module:1	Computer Evolution And Performance	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					
Module:2	Memory Hierarchy	8 hours			
Key Characteristics of Memory systems, Memory Hierarchy, Cache Design policies, Cache Performance, Cache Coherence, Snoopy Protocols, Cache coherence protocols, MSI, MESI, MOESI					
Module:3	Parallel Computers	8 hours			
Instruction Level Parallelism(ILP), Compiler Techniques for ILP & Branch Prediction, Thread Level Parallelism (TLP), Threading Concepts, Shared Memory, Message Passing, Vectorization					
Module:4	Multithreaded Programming using OpenMP	7 hours			
Introduction to OpenMP, Parallel constructs, Runtime Library routines, Work-sharing constructs, Scheduling clauses, Data environment clauses, atomic, master Nowait Clause, Barrier Construct					
Module:5	Programming for GPU	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					
Module:6	Performance Analyzers	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)					

Module:7	Energy Efficient Architectures	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			
Module:8	Contemporary Issues	1 hours	
Total Lecture hours:			45 hours
Text Book(s)			
1.	William Stallings, Computer Organization and Architecture: Designing for Performance, Pearson, 2022, 11 th Edition, Pearson		
2	Gerassimos Barlas, Multicore and GPU Programming: An Integrated Approach, 2022, 2 nd edition, Morgan Kaufmann		
Reference Books			
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	
Approved by Academic Council		No. 67	Date 08-08-2022

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					
<ol style="list-style-type: none"> To provide knowledge on basics of computer architectures and organization that lays foundation to study high performance architectures To design and develop parallel programs using parallel computing platforms such as OpenMP, CUDA 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:					
<ol style="list-style-type: none"> Outline the developments in the evolution of computer architectures and parallel programming paradigms Comprehend the various programming languages and libraries for parallel computing platforms Use of profiling tools to analyze the performance of applications by interpreting the given data Evaluate efficiency trade-offs among alternative parallel computing architectures for an efficient parallel Application design. Develop parallel programs using OpenMP and CUDA and analyze performance parameters such as speed-up, efficiency for parallel programs against serial programs 					
Indicative Experiments					
<ol style="list-style-type: none"> 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 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 Computation of Execution Time Using OpenMP clock, Using windows clock OpenMP Program using various Environment Routines to access the processor run-time information and write interesting observations by comparing various routines OpenMP program using following Worksharing Constructs and describe scenario for the need of construct loop construct, sections construct, single construct OpenMP program using following schedule clauses and describe scenario for the need of clause Static, Dynamic, Guided Develop parallel programs for given serial programs and profile the program using Vtune Analysis tool Matrix-Matrix multiplication, Matrix-Vector multiplication Develop parallel programs for given serial programs and profile the program using Vtune Analysis tool Quicksort, Minimum Spanning Tree CUDA-platform setup on NVIDIA / Google Colab Write a CUDA C/C++ program that add two array of elements and store the result in third array Write a CUDA C/C++ program that Reverses Single Block in an Array; CUDA C/C++ Write a CUDA C program for Matrix addition and Multiplication using Shared memory 					
Total Laboratory Hours					30 hours

Text Book(s)			
1.	Gerassimos Barlas, Multicore and GPU Programming: An Integrated Approach, 2022, 2 nd edition, Morgan Kaufmann		
Reference Books			
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			
Recommended by Board of Studies		26-07-2022	
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Course code	Course title	L	T	P	C
MCSE504L	OPERATING SYSTEMS	3	0	0	3
Pre-requisite	Nil	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To focus the core functionalities required to develop and manage operating systems. 2. To encompass process management, synchronization strategies, memory management, file systems, device management, and virtualization. 3. To introduce the concepts and features of real-time operating systems as well as virtualization. 					
Course Outcomes					
After completion of this course, the student shall be able to:					
<ol style="list-style-type: none"> 1. Understand the fundamental operating system abstractions, including processes, threads, semaphores, and file systems. 2. Implement scheduling, devising and addressing synchronization issues. 3. Gain an understanding of memory management tasks. 4. Develop real-time working prototypes of different small-scale and medium-scale embedded systems. 5. Comprehend the basics of virtualization and differentiate types of virtualization. 					
Module:1	Introduction to Operating Systems	4 hours			
Computer Organization and Architecture - OS definition – OS history – OS Operations – OS design issues - Operating systems structures - Library files - Systems calls – Interrupts - Kernel approaches – Building and booting an OS.					
Module:2	Process and Scheduling	6 hours			
Process states – State transitions with suspend and resume - Process control block - Context-switching - Processes operations - Process scheduling - CPU scheduling: Non-preemptive, preemptive - Multi-queue scheduling - Multi-level feedback queue scheduling.					
Module:3	Synchronization	9 hours			
IPC: Shred memory, message passing - Race condition – Critical section problem - Peterson's solution – Bakery Algorithm - Mutex locks - Semaphores – Classical synchronization problems – Monitors - Thread synchronization – Multi-threading Models, Deadlocks – Resource allocation graphs – Deadlock: prevention, avoidance, detection and recovery.					
Module:4	Memory Management	5 hours			
Address binding – Fragmentation - Pinning Memory – Paging – Structure of the page table – Swapping - Segmentation - Demand Paging – Copy-on-write - Replacement – Thrashing – Working set – Memory compression – Allocating kernel memory.					
Module:5	Managing Devices, Files, Security and Protection	9 hours			
I/O Management – DMA - Delayed write - Disk scheduling algorithms: Seek-time and rotational latency based - File control block – Inode – Access method – Directory structure - Directory implementation – File allocation methods - Free space management – Program and network threats – Cryptography as a security tool – Domains of protection – Access matrix – Capability based systems					
Module:6	Real-time Operating Systems	5 hours			
RTOS Internals - Real-Time Scheduling - Task Specifications - Performance Metrics of RTOS - Schedulability Analysis – RTOS Programming Tools.					
Module:7	Virtualization	5 hours			
Need for virtualization - Virtual machines and architectures – Hypervisors - Virtualization Technologies: Para Virtualization, Full Virtualization - Virtualization types: Server virtualization, Application virtualization, Storage virtualization.					
Module:8	Contemporary Issues	2 hours			
Total Lecture hours:					45 hours

Text Book(s)			
1.	Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts", 2018, 10 th Edition, Wiley, United States.		
Reference Books			
1.	Arpaci-Dusseau, R. H., & Arpaci-Dusseau, A. C, "Operating Systems: Three easy pieces, 2018, 1 st Edition, Boston: Arpaci-Dusseau Books LLC.		
2.	Kamal, R, Embedded Systems: Architecture, Programming and Design, 2011, 1 st Edition, Tata McGraw-Hill Education.		
3.	Portnoy, M, "Virtualization Essentials", 2012, 2 nd Edition, John Wiley & Sons, New Jersey, USA.		
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
MCSE504P	OPERATING SYSTEMS LAB	0	0	2	1
Pre-requisite	Nil	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> To encompass process management, synchronization strategies, memory management, file systems, device management, and virtualization. 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:					
<ol style="list-style-type: none"> Implement scheduling, devising and addressing synchronization issues. Gain an understanding of memory management tasks. Develop real-time working prototypes of different small-scale and medium-scale embedded systems. 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	

Text Book(s)			
1.	Vijay Mukhi, “The C Odyssey: UNIX: v. 3”, 2004, 3 rd Edition, BPB Publications, New Delhi, India.		
Reference Books			
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 nd 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

Course code	Course title	L	T	P	C
MCSE505L	Computer Networks	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> To learn various network models, layers and their protocols. To gain a fundamental understanding of routing algorithms. To comprehend the basics of wireless as well as mobile networks and their characteristics. 					
Course Outcomes					
After completion of this course, the student shall be able to:					
<ol style="list-style-type: none"> Explore the basics of Computer Networks and various performance metrics. Interpret the application layer services and their protocols. Evaluate the requirements for reliable services and implications of congestion at the transport layer services. Analyse various functionalities required in the control and data plane at network layer services. Infer the characteristics of wireless as well as mobile networks and their security standards. 					
Module:1	Computer Networks and the Internet	7 hours			
Internet: A Nuts-and-Bolts Description - Network Protocols - The Network Edge: Access Networks and Physical Media - The Network Core: Packet Switching, Circuit Switching - Network of Networks - Delay, Loss and Throughput in Packet-Switched Networks - Protocol Layers and Their Service Models					
Module:2	Application Layer	5 hours			
Principles of Network Applications: Architectures, Processes and Transport Services - The Web and HTTP - Electronic Mail in the Internet - DNS—The Internet's Directory Service - Peer-to-Peer File Distribution - Socket Programming: Creating Network Applications					
Module:3	Transport Layer	7 hours			
Relationship Between Transport and Network Layers - Overview of the Transport Layer in the Internet - Multiplexing and Demultiplexing - Connectionless Transport: UDP - Reliable Data Transfer: Go-Back-N (GBN) and Selective Repeat (SR) - Connection-Oriented Transport: TCP, Flow Control and Congestion Control					
Module:4	Network Layer: Data Plane	5 hours			
Network Layer – Router - The Internet Protocol (IP): IPv4, Addressing and IPv6 - Generalized Forwarding and SDN					
Module:5	Network Layer: Control Plane	5 hours			
Control Plane: Per-router control and logically centralized control - Routing Algorithms - Link-State (LS) Routing Algorithm, Distance-Vector (DV) Routing Algorithm, Intra-AS Routing in the Internet: OSPF and Routing Among the ISPs: BGP - SDN Control Plane					
Module:6	Link Layer and LANs	8 hours			
Overview of Link Layer Services - Error-Detection and -Correction Techniques: Parity Checks, Checksum and CRC - Multiple Access Links and Protocols: Channel Partitioning Protocols and Random-Access Protocols - Switched Local Area Networks: Link-Layer Addressing and ARP - Virtual Local Area Networks					
Module:7	Wireless and Mobile Networks-Security	6 hours			
Elements of a wireless network - Wireless Links and Network Characteristics - WiFi: 802.11 Wireless LANs - Mobility Management: Principles - Wireless and Mobility: Impact on Higher-Layer Protocol-Security in Computer Network- Message Integrity and Digital Signatures - Network-Layer Security: IPsec and Virtual Private Networks					
Module:8	Contemporary Issues	2 hours			
		Total Lecture hours:			45 hours

Text Book(s)			
1.	James F. Kurose, Keith W. Ross, “Computer Networking: A Top-Down Approach”, 2022, 8 th Edition (Paperback), Pearson, United Kingdom.		
Reference Books			
1.	Larry Peterson and Bruce Davie, “Computer Networks: A Systems Approach”, 2019, 6 th Edition, Morgan Kaufmann, United States of America.		
2.	Andrew S. Tanenbaum, “Computer Networks”, 2013, 6 th 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

Course code	Course title			L	T	P	C
MCSE505P	Computer Networks Lab			0	0	2	1
Pre-requisite	NIL			Syllabus version			
				v. 1.0			
Course Objectives							
<ol style="list-style-type: none"> To introduce the computer network concepts and provide skills required to trouble shoot the network devices. To describe the basic knowledge of VLAN. To develop the knowledge for application of software defined networks. 							
Course Outcome							
After completion of this course, the student shall be able to:							
<ol style="list-style-type: none"> Understand the types of network cables and practical implementation of cross-wired and straight through cable. Design and implementation of VLAN. Analyze and apply network address translation using packet tracer and network simulators. 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"> Packet Capture Using Wire shark Starting Wire shark Viewing Captured Traffic Analysis and Statistics & Filters. 						
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 th Edition (Paperback), Pearson Education, 2022.						
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	

Course code	Course title	L	T	P	C
MCSE506L	DATABASE SYSTEMS	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		v. 1.0			
Course Objectives					
<ol style="list-style-type: none"> To understand the underlying principles of Relational Database Management Systems To focus on the modeling and design of secured databases and usage of advanced data models To implement and maintain the structured, semi-structured, and unstructured data in an efficient database system using emerging trends 					
Course Outcomes					
<p>On completion of this course, students must be able to</p> <ol style="list-style-type: none"> Design and implement a database depending on the business requirements, considering various design issues Understand the concepts of Indexing, Query optimization, transaction management, concurrency control, and recovery mechanisms Learn to apply parallel and distributed databases in Real-time scenarios Categorize and design the structured, semi-structured, and unstructured databases Characterize the database threats and their countermeasures 					
Module:1	Design and Implementation of Relational Model	6 hours			
Database System Concepts and Architecture, Entity-Relationship (ER) Modelling, Relational Model-Keys, and Integrity Constraints, Mapping ER model to Relational Schema, Normalization, Boyce Codd Normal Form, Multi-valued dependency and Fourth Normal form					
Module:2	Query Processing and Transaction Management	6 hours			
Storage and File Structure, Indexing, Query processing, and Query Optimization, Transaction Management, Concurrency Control, Recovery					
Module:3	Parallel Databases and Distributed Databases	8 hours			
Parallel Database Architecture, Data partitioning strategy, Inter-Query, and Intra-Query Parallelism, Distributed Database Features, Distributed Database Architecture, Fragmentation, Replication, Distributed Query Processing, Distributed Transactions Processing					
Module:4	Spatial and Multimedia Databases	6 hours			
Spatial database concepts, Spatial data types, and models, Spatial operators and queries, Indexing in spatial databases, Multimedia database concepts, Automatic Analysis of Images, Object Recognition in Images, Semantic Tagging of Images					
Module:5	Semi-Structured Databases	6 hours			
Semi Structured databases- XML Schema-DTD- XPath- XQuery, Semantic Web, RDF, RDFS					
Module:6	Cloud and NoSQL Databases	6 hours			
Cloud databases- Data Storage Systems on the Cloud, Data Representation, Partitioning and Retrieving Data, Challenges with Cloud-Based Databases- NoSQL Data model: Aggregate Models, Document Data Model, Key-Value Data Model, Columnar Data Model, Graph-Based Data Model					
Module:7	Database Security	5 hours			
Database Security Issues, Security Models, Different threats to databases, Challenges to maintaining database security					
Module:8	Contemporary Issues	2 hours			
Total Lecture hours:					45 hours

Text Book(s)			
1	Abraham Silberschatz, Henry F. Korth, and S. Sudharsan, "Database System Concepts", 7 th Edition, McGraw Hill, 2019.		
2	R. Elmasri and S. Navathe, Fundamentals of Database Systems, 7 th Edition, Addison-Wesley, 2016		
Reference Books			
1	Fawcett, Joe, Danny Ayers, and Liam RE Quin. "Beginning XML", Wiley India Private Ltd., 5 th 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					
<ol style="list-style-type: none"> To understand the underlying principles of Relational Database Management System. To focus on the modeling and design of secure databases and usage of advanced data models. To implement and maintain the structured, semi structured and unstructured data. 					
Course Outcome					
<p>After completion of this course, the student shall be able to:</p> <ol style="list-style-type: none"> Construct database queries using Structured Query Language (SQL) Design and implement applications that make use of distributed fault-tolerant databases. Apply Spatial and Multimedia Database concepts to solve real-world problems. Implement applications that work with structured, semi-structured, and unstructured databases 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.	<p>Consider a schema that contains the following table with the key underlined:</p> <p>Employee (<u>Eno</u>, Ename, Desg, Dno). Assume that we horizontally fragment the table as follows:</p> <p>Employee1(Eno; Ename; Desg; Dno), where $1 \leq Dno \leq 10$ Employee2(Eno; Ename; Desg; Dno), where $11 \leq Dno \leq 20$ Employee3(Eno; Ename; Desg; Dno), where $21 \leq Dno \leq 30$</p> <p>In addition, assume we have 4 sites that contain the following fragments:</p> <ul style="list-style-type: none"> Site1 has Employee1 Site2 has Employee2 Site3 has Employee2 and Employee3 Site4 has Employee1 <p>Implement at least 5 suitable queries on Employee fragments. Add relations to the database as per your requirements.</p>				
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"> Use Spatial Databases to store data using Latitude and Longitude, find the distance between two spatial objects, find the area of a polygon Store and retrieve images from a multimedia database 				
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"> • Create an Employee Collection and insert a few documents (sample document given below for reference) { "name" : "Satish", "salary" : 30000, "address" : "Vellore", "school" : "SCOPE" } • Display all employees whose address is vellore and salary is greater than 30000 • Update the salary for an employee by name 'Ram' as 40000 • Display only name and salary for all employees in the collection • Display all employees who are not from 'SCOPE' school • Display only documents that contains the address property 	
12.	Create an application that interacts with a cloud database.	
Total Laboratory Hours		30 hours
Text Book(s)		
1.	D Abraham Silberschatz, Henry F. Korth, S. Sudarshan "Database System Concepts" 7th Edition McGraw Hill, 2021	
Reference Books		
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 th 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

Course Code	Course Title	L	T	P	C
MCSE614L	Big Data Frameworks and Technologies	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To understand the need of a framework to store and process the big data. To have knowledge on the Big Data Technologies for processing the Different types of Data. To understand the advanced frame work for faster accessing and processing of Big Data. 					
Course Outcomes					
<p>Upon completion of the course the student will be able to</p> <ol style="list-style-type: none"> Understand the need of new frame work to deal with huge amounts of Data. Demonstrate the Hadoop framework Hadoop Distributed File System and MapReduce. Demonstrate the Pig architecture and evaluation of pig scripts. Describe the Hive architecture and execute SQL queries on sample data sets. Demonstrate spark programming with different programming languages and graph algorithms. 					
Module:1	Big Data	3 hours			
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.					
Module:2	Hadoop Framework	5 hours			
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.					
Module:3	Hadoop Technologies-PIG	4 hours			
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.					
Module:4	Hive	4 hours			
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.					
Module:5	Spark	5 hours			
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.					
Module:6	Data Analysis with Spark Shell	4 hours			
Writing Spark Application - Spark Programming in Scala, Python, R, Java - Application Execution					
Module:7	Spark SQL and GraphX	4 hours			
SQL Context – Importing and Saving data – Data frames – using SQL – GraphX overview – Creating Graph – Graph Algorithms.					
Module:8	Contemporary Issues	1 hour			
Total Lecture hours:					30 hours

Text Book(s)			
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.		
Reference Books			
1.	Alan Gates, Programming Pig Dataflow Scripting with Hadoop, O'Reilly Media, Inc, 2011.		
2.	Jason Rutherglen, Dean Wampler, Edward Capriolo, 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			
Course Objectives					
<ol style="list-style-type: none"> To understand the need of a framework to store and process the big data. To have knowledge on the Big Data Technologies for processing the Different types of Data. To understand the advanced frame work for faster accessing and processing of Big Data. 					
Course Outcome					
<ol style="list-style-type: none"> Implement and evaluate the data manipulation procedures using pig, hive and spark on Hadoop frame work. 					
Indicative Experiments					
1.	Installing and configuring the Hadoop frame work. HDFS Commands,				
2.	Map Reduce Program to show the need of combiner				
3.	Map Reduce I/O Formats – Text, Key – Value				
4.	Map Reduce I/O Formats – NLine – Multiline				
5.	Installing and Configuring Apache PIG and HIVE				
6.	Sequence File Input / Output Formats				
7.	Distributed Cache & Map side Join, Reduce Side Join				
8.	Building and Running Spark Application				
9.	Word count in Hadoop and Spark				
10.	Manipulation RDD				
11.	Spark Implementation of Matrix algorithms in Spark Spark Sql programming, Building Spark Streaming application				
Total Laboratory Hours					30 hours
Reference Books					
1. Mike Frampton “Mastering Apache Spark” – Pract Publishing 2015					
2. Tom White, “Hadoop – The Definitive Guide”, O’Relly 4 th Edition 2015					
3. Nick Pentreath, “Machine Learning with Spark” Pract Publishing 2015					
4. Mohammed Gulle , “Big Data Analytics with Spark: A Practitioner's Guide to Using Spark for Large Scale Data Analysis” – Apress 2015					
5. Adam Shook and Donald Mine, “MapReduce Design Patterns: Building Effective Algorithms and Analytics for Hadoop and Other Systems” - O’Relly 2012					
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	

Course Code	Course Title	L	T	P	C
MCSE615L	Data Analytics	2	0	0	2
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Explicate how to design, construct, and quality check a dataset before using it to a build prediction model. 2. Understanding the importance about feature selection in data models. 3. Understanding how information theory, similarity score and Probability theory can be used to build prediction models. 					
Course Outcomes					
<p>Upon completion of the course the student will be able to</p> <ol style="list-style-type: none"> 1. Students will understand the basic concept of data mining and life cycles of data analytics. 2. Analyze and Apply the different data preprocessing techniques. 3. Analyze the characteristics of the data and its important feature. 4. Apply the prediction model for decision making for a given set of problems. 5. Students will understand the concept of distributed machine learning. 					
Module:1	Introduction to Data Mining	4 hours			
Introduction to Data Mining, Challenges in Data Mining, Data Mining Tasks, Machine Learning, Predictive Data Analytics Lifecycle, Predictive Data Analytics Tools					
Module:2	Exploring Data	5 hours			
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					
Module:3	Feature Selection	3 hours			
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					
Module:4	Decision Tree and Similarity-based Learning	5 hours			
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					
Module:5	Probability-based Learning	3 hours			
Fundamentals, Bayes' Theorem, Bayesian Prediction, Conditional Independence and Factorization, Standard Approach: The Naive Bayes Model					
Module:6	Error-based Learning	4 hours			
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.					
Module:7	Distributed Machine Learning	5 hours			
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					
Module:8	Contemporary Issues	1 hour			
		Total Lecture hours		30 hours	
Text Book(s)					
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.
Reference Books	
1.	Pang-Ning Tan; Michael Steinbach; Anuj Karpatne; Vipin Kumar -Introduction to Data Mining. By: Publisher: Pearson, Edition: 2 nd , 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

Course Code	Course Title	L	T	P	C
MCSE615P	Data Analytics Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. Understand and analyze how information theory, similarity score and Probability theory can be used to build prediction models.					
Course Outcome					
Upon completion of the course the student will be able to					
1. Analyze the different data preprocessing techniques.					
2. Apply the prediction model for decision making for a given set of problems.					
3. Apply regression algorithms for finding relationships between data variables					
Indicative Experiments					
1.	Find the statistical measures of central tendency and dispersion such as min(), max(), mean(), meadian(), quantile(), sd() ,var() and summary() for real world datasets.				
2.	Demonstrate the different data visualization techniques. (Scatter Plot, Horizontal Bar Chart, Histogram, Visualization of Time Series data (Line Graphs) for applications such as weather analysis.				
3.	Perform the chi-square test and ANOVA F-test on datasets.				
4.	Implement the PCA method for dimensionality reduction on datasets.				
5.	Implement the RFE method and show the importance of features				
6.	Implement the Decision Tree for given datasets and compute the accuracy of model.				
7.	Implement the K-Nearest Neighbor Algorithm for given datasets and analyze the results.				
8.	Implement the Naïve Bayes method.				
9.	Implement simple linear regression program to predict the future values and analyze the goodness of fit.				
10.	Implement multivariate linear regression program to predict the future values analyze the goodness of fit.				
11.	Implementation of Distributed Decision Trees				
				Total Laboratory Hours	30 hours
Text Book(s)					
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.					
Reference Books					
1. Jason Brownlee -Data Preparation for Machine Learning: Data Cleaning, Feature Selection, and Data Transforms in Python, First Edition, 2020.					
2. Guanhua Wang-Distributed Machine Learning with Python, Packt Publishing, 2022.					
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	

Course Code	Course Title	L	T	P	C
MCSE616L	Data Visualization	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> To understand the various types of data, apply and evaluate the principles of data visualization. Acquire skills to apply visualization techniques to a problem and its associated dataset. To apply structured approach to create effective visualizations from the massive dataset using various visualization tools. 					
Course Outcomes					
Upon completion of the course the student will be able to					
<ol style="list-style-type: none"> Analyze the different data types, visualization types to bring out the insight. Relate the visualization towards the problem based on the dataset to analyze and bring out valuable insight on large dataset. Design visualization dashboard to support the decision making on large scale data. Demonstrate the analysis of large dataset using various visualization techniques and tools. 					
Module:1	Introduction to Data Visualization	4 hours			
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.)					
Module:2	Visualization Techniques	4 hours			
Introduction to various data visualization tools - Scalar and point techniques - vector visualization techniques - multidimensional techniques - visualizing cluster analysis – K-means and Hierarchical Cluster techniques.					
Module:3	Spatio-temporal Data Visualization	4 hours			
Time Series data visualization – Text data visualization – Spatial Data Visualization					
Module:4	Visual Analytics	3 hours			
Networks and Trees - Heat Map – Tree Map - Map Color and Other Channels Manipulate View - Visual Attributes					
Module:5	Multivariate Data Visualization	5 hours			
Multivariate data visualization – Geometric projection techniques - Icon-based techniques - Pixel-oriented techniques - Hierarchical techniques - Scatterplot matrix - Hyper box - Trellis display - Parallel coordinates					
Module:6	Data Visualization Tools	5 hours			
Tableau functions and logics: Marks and Channels-Arrange Tables- Arrange Spatial Data-Facets into multiple views					
Module:7	Visualization Dashboard Creations	4 hours			
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.					
Module:8	Contemporary Issues	1 hour			
		Total Lecture hours:		30 hours	
Text Book(s)					
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		
Reference Books			
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, Welcome 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
MCSE616P	Data Visualization Lab	0	0	2	1
Pre-requisite	NIL	Syllabus Version			
		1.0			
Course Objectives					
1. Analyze and solve real time data visualization scenarios using Python/R integrating with Tableau.					
Course Outcome					
Upon completion of the course the student will be able to					
1. Integrate with Tableau for various data visualization scenarios.					
2. Design visualization dashboard to support the decision making on large scale data.					
3. Demonstrate the analysis of large dataset using various visualization techniques and tools.					
Indicative Experiments					
1.	Acquiring and plotting data				
2.	Statistical Analysis				
3.	K-means and Hierarchical Cluster techniques				
4.	Multivariate Analysis, Correlation, regression and analysis of variance.				
5.	Financial analysis Clustering, Histogram and Heat Map.				
6.	Time-series analysis Stock Market.				
7.	Visualization of various massive dataset Healthcare, Census, Geospatial.				
8.	Visualization on Streaming dataset Stock market, weather forecasting.				
9.	Market-Basket Data analysis-visualization				
10.	Text visualization using web analytics				
Total Laboratory Hours					30 hours
Text Book(s)					
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					
Reference Books					
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, A little book of R for multivariate analysis, 1st edition, Welcome Trust Sanger Institute, United Kingdom, 2013.					
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	

Course Code	Course Title	L	T	P	C
MCSE617L	Domain Specific Predictive Analytics	2	0	0	2
Pre-requisite	NIL	Syllabus vision			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the fundamental concepts of predictive analytics. 2. To impart the knowledge on various steps that are necessary before constructing the predictive model. 3. To gain knowledge on the assessment of predictive models for decision making. 					
Course Outcomes					
<p>Upon completion of the course the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the fundamental concepts of predictive analytics. 2. Define the problem and prepare the data for analysis. 3. Construct different predictive models for decision making. 4. Apply descriptive modeling techniques for the given data. 5. Assess and interpret different predictive models. 6. Understand and apply appropriate algorithms for analyzing the data in healthcare domain. 					
Module:1	Overview of Predictive Analytics	4 hours			
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					
Module:2	Problem Setting, Data understanding and Preparation	4 hours			
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					
Module:3	Predictive Modeling	4 hours			
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					
Module:4	Descriptive Modeling	4 hours			
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					
Module:5	Model Ensembles and Assessing Predictive Models	4 hours			
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.					
Module:6	Healthcare Analytics(T2:Ch1&11)				
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			
Module:7	Visual Analytics for Healthcare Data		5 hours
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			
Module:8	Contemporary Issues		1 hour
			Total Lecture hours: 30 hours
Text Book(s)			
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.		
Reference Books			
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			
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
MCSE617P	Domain Specific Predictive Analytics Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the fundamental concepts of predictive analytics. 2. To impart the knowledge on various steps that are necessary for constructing the predictive model. 3. To gain knowledge on the assessment of predictive models for decision making. 					
Course Outcome					
Upon completion of the course the student will be able to					
<ol style="list-style-type: none"> 1. Understand the fundamental concepts of predictive analytics. 2. Define the problem and prepare the data for analysis. 3. Construct different predictive models for decision making. 4. Apply descriptive modeling techniques for the given data. 5. Assess and interpret different predictive models. 6. Understand and apply appropriate algorithms for analyzing the data in healthcare domain. 					
Indicative Experiments					
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.				
Total Laboratory Hours					30 hours
Text Book(s)					
<ol style="list-style-type: none"> 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.			
Reference Books			
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

Course Code	Course Title	L	T	P	C
MCSE618L	Social Network Analytics	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Understand the components and entities of the social network 2. Analyze social media data to comprehend user sentiments and recommend the essential information appropriately. 3. Model and visualize the social network 					
Course Outcomes					
<ol style="list-style-type: none"> 1. Illustrate the basic concepts of social network. 2. Analyse the networks to find prominent actors and relate social network models. 3. Develop social network applications using tools and techniques. 4. Detect and analyze the communities in social networks. 5. Design a system to assimilate information available on the web to model and build Social Network Application. 					
Module:1	Fundamentals of Social Network Analysis	4 hours			
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.					
Module:2	Centrality and Prestige	4 hours			
Prominence: Actor-Centrality, Prestige, Group-Centrality, Prestige, Non directional Relations-Degree, Closeness, Betweenness, Eigen Vector Centrality, Directional Relations-Centrality, Prestige.					
Module:3	Structural Balance and Transitivity	3 hours			
Structural Balance: Signed Non directional, Signed Directional Relations, Checking for Balance, Index for Balance, Clusterability-Theorems, Clustering Coefficient and Transitivity.					
Module:4	Cohesive Subgroups	5 hours			
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.					
Module:5	Structural Equivalence	4 hours			
Definition, Social Roles and , Positional Analysis, Measuring Structural Equivalence, Representation of Network Positions, Block Models: Introduction, Network Positions and roles-Introduction					
Module:6	Dyadic and Triadic Methods	4 hours			
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.					
Module:7	Models in Social Network	5 hours			

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			
Module:8	Contemporary Issues		1 hour
Total Lecture hours:			30 hours
Text Book(s)			
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.		
Reference Books			
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

Course Code	Course Title	L	T	P	C
MCSE618P	Social Network Analytics Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Understand the components of the social network 2. Analyze social media data to understand user sentiment and recommend the requisite information accordingly. 3. Model and visualize the social network 					
Course Outcome					
<p>Upon completion of the course the student will be able to</p> <ol style="list-style-type: none"> 1. Demonstrate the basic properties of social network 2. Demonstrate of analysis of social networks to find prominent actors and apply social network models. 3. Develop social network applications using visualization tools. 4. Detect and analyze the communities in social networks. 5. Design a system to harvest information available on the web to model and build Social Network Application. 					
Indicative Experiments					
1.	Study and demonstrate to find the basic properties of a Graph/Social Network.				
2.	Demonstrate the calculation of Centrality measures.				
3.	Demonstrate the ranking of web pages in a web graph.				
4.	Find divisions in a Social Network.				
5.	Implement Community Detection algorithms on a Social Network.				
6.	Demonstrate modelling of Social Networks.				
7.	Visualize multidimensional Social Network.				
8.	Applications of Classification and Clustering on a Social Network.				
9.	Design and implement a Sentiment Analyzer.				
10.	Design and implement a Social Network.				
Total Laboratory Hours					30 hours
Text Book(s)					
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.				
Reference Books					
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 Assessment: 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
MCSE619L	Text and Speech Analytics	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the tools and techniques for performing text and speech analytics in diverse contexts. 2. To understand the tools and technologies involved in developing text and speech applications. 3. To demonstrate the use of computing for building applications in text and speech processing. 					
Course Outcomes					
Upon completion of the course the student will be able to					
<ol style="list-style-type: none"> 1. Develop tools to analyse the syntax and semantics of a statement written in a natural language. 2. Apply machine learning and deep learning techniques to natural language processing. 3. Use signal processing techniques to analyze/represent speech. 4. Execute trials of speech systems. 5. Evaluate the performance of NLP & Speech systems. 					
Module:1	Introduction to Text Processing and Language Modeling	5 hours			
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.					
Module:2	Parts of speech and Named entities	4 hours			
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.					
Module:3	Logical Representations of Sentence Meaning	4 hours			
Logical Representations of Sentence Meaning, Word Sense and Word Net, Word Sense Disambiguation, Word Sense Induction.					
Module:4	Applications of Text and NLP	4 hours			
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).					

Module:5	Phonetics	3 hours	
Speech Sounds and Phonetic Transcription, Articulatory Phonetics – Prosody - Acoustic Phonetics and Signals - Phonetic Resources.			
Module:6	Automatic Speech Recognition	4 hours	
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.			
Module:7	Text-To-Speech	5 hours	
Text-To-Speech (TTS) Preprocessing: Text normalization – TTS: Spectrogram Prediction – TTS: Vocoding - TTS Evaluation.			
Module:8	Contemporary Issues	1 hour	
Total Lecture hours:			30 hours
Text Book(s)			
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.		
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. 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			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the tools and techniques for performing text and speech analytics in diverse contexts. 2. To understand the tools and technologies involved in developing text and speech applications. 3. To demonstrate the use of computing for building applications in text and speech processing. 					
Course Outcomes					
Upon completion of the course the student will be able to					
<ol style="list-style-type: none"> 1. Develop tools to analyse the syntax and semantics of a statement written in a natural language. 2. Apply machine learning and deep learning techniques to natural language processing. 3. Use signal processing techniques to analyze/represent speech. 4. Execute trials of speech systems. 5. Evaluate the performance of NLP & Speech systems. 					
Indicative Experiments					
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.				
Total Laboratory Hours					30 hours
Text Book(s)					
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. Schafe, 1st Edn. Pearson, 2010.			
Mode of Assessment: 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
MCSE620L	Analytics for Internet of Things	2	0	0	2
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the fundamentals of IoT data analytics and major challenges in IoT data analytics. 2. To provide knowledge on IoT network architecture and design. 3. To understand smart objects and IoT networking protocols. 					
Course Outcomes					
<p>Upon completion of the course the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the specific challenges in applying data analytics techniques over IoT data. 2. Will know IoT network architecture and design. 3. Smart objects and connecting smart objects 4. Analyze various IoT networking protocols. 5. Apply IoT analytics for cloud and data science for IoT analytics. 					
Module:1	IoT Analytics and Challenges	3 hours			
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.					
Module:2	IoT Network Architecture and Design	5 hours			
Drivers behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.					
Module:3	Smart Objects: The Things in IoT	3 hours			
Sensors, Actuators, and Smart Objects, Sensor Networks					
Module:4	Connecting Smart Objects	6 hours			
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.					
Module:5	IoT Networking Protocols	3 hours			
IoT networking data messaging protocols, Message Queue Telemetry Transport (MQTT), Hyper-Text Transport Protocol (HTTP), Constrained Application Protocol (CoAP), Data Distribution Service (DDS).					
Module:6	IoT Analytics for the Cloud	4 hours			
Building elastic analytics, Elastic analytics concepts, designing for scale, Cloud security and analytics, The AWS overview, Microsoft Azure overview.					
Module:7	Data Science for IoT Analytics	5 hours			

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.			
Module:8	Contemporary Issues		1 hour
		Total Lecture hours:	30 hours
Text Book(s)			
1.	Andrew Minter , Analytics for the Internet of things, Packt publishing 2017.		
2.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals:Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.		
Reference Books			
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

Course Code	Course Title	L	T	P	C
MCSE620P	Analytics for Internet of Things Lab	0	0	2	1
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. To introduce the fundamentals of IoT data analytics and major challenges in IoT data analytics. 2. To provide knowledge on IoT network architecture and design. 3. To understand smart objects and IoT networking protocols. 					
Course Outcome					
<p>Upon completion of the course the student will be able to</p> <ol style="list-style-type: none"> 1. Understand the specific challenges in applying data analytics techniques over IoT data. 2. Will know IoT network architecture and design. 3. Smart objects and connecting smart objects 4. Analyze various IoT networking protocols. 5. Apply IoT analytics for cloud and data science for IoT analytics. 					
Indicative Experiments					
1.	Study different sensors, actuators, and their applications.				
2.	Write a program using Arduino IDE for Blink LED.				
3.	Write a program to interface the DHT11 sensor with Arduino/Raspberry to print temperature and humidity readings.				
4.	Write an application to read temperature from the environment. If the temperature crosses the threshold value then it notifies with a buzzer.				
5.	Study and implement MQTT protocol using Arduino.				
6.	Study and implement COAP protocol using Arduino.				
7.	Write a program on Arduino/Raspberry Pi to upload temperature and humidity data to the ThingSpeak cloud.				
8.	Write an application to send Light Sensor Values to the ThingSpeak cloud				
9.	Write an application to send Temperature and Humidity Values to the ThingSpeak cloud				
10.	Implementation of Machine learning approaches over IoT data.				
Total Laboratory Hours					30 hours
Text Book(s)					
1.	Andrew Minter , Analytics for the Internet of things, Packt publishing 2017.				
2.	David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Rob Barton and Jerome Henry, IoT Fundamentals: Networking Technologies, Protocols and Use Cases for Internet of Things, Cisco Press, 2017.				
Reference Books					
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 Assessment: 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
MCSE696J	Study Oriented Project				02
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 1. The student will be able to analyse and interpret published literature for information pertaining to niche areas. 2. Scrutinize technical literature and arrive at conclusions. 3. Use insight and creativity for a better understanding of the domain of interest. 					
Course Outcome:					
<ol style="list-style-type: none"> 1. Retrieve, analyse, and interpret published literature/books providing information related to niche areas/focused domains. 2. Examine technical literature, resolve ambiguity, and develop conclusions. 3. Synthesize knowledge and use insight and creativity to better understand the domain of interest. 4. Publish the findings in the peer reviewed journals / National / International Conferences. 					
Module Content		(Project duration: One semester)			
This is oriented towards reading published literature or books related to niche areas or focussed domains under the guidance of a faculty.					
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Report to be submitted, presentation and project reviews – Presentation in the National / International Conference on Science, Engineering Technology.					
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
MCSE697J	Design Project				02
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> 1. Students will be able to design a prototype or process or experiments. 2. Describe and demonstrate the techniques and skills necessary for the project. 3. Acquire knowledge and better understanding of design systems. 					
Course Outcome:					
<ol style="list-style-type: none"> 1. Develop new skills and demonstrate the ability to upgrade a prototype to a design prototype or working model or process or experiments. 2. Utilize the techniques, skills, and modern tools necessary for the project. 3. Synthesize knowledge and use insight and creativity to better understand and improve design systems. 4. Publish the findings in the peer reviewed journals / National / International Conferences. 					
Module Content		(Project duration: One semester)			
Students are expected to develop new skills and demonstrate the ability to develop prototypes to design prototype or working models related to an engineering product or a process.					
Mode of Evaluation: Evaluation involves periodic reviews by the faculty with whom the student has registered. Assessment on the project – Report to be submitted, presentation and project reviews – Presentation in the National / International Conference on Science, Engineering Technology.					
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
MCSE698J	Internship I/ Dissertation I				10
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives:					
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.					
Course Outcome:					
<ol style="list-style-type: none"> 1. Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work. 2. The capability to use a holistic view to critically, independently and creatively identify, formulate and deal with complex issues. 3. A consciousness of the ethical aspects of research and development work. 4. Publications in the peer reviewed journals / International Conferences will be an added advantage. 					
Module Content					(Project duration: one semester)
<ol style="list-style-type: none"> 1. Dissertation may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities. 2. Dissertation should be individual work. 3. Carried out inside or outside the university, in any relevant industry or research institution. 4. Publications in the peer reviewed journals / International Conferences will be an added advantage. 					
Mode of Evaluation: 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	NIL	Syllabus version			
		1.0			
Course Objectives:					
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.					
Course Outcome:					
Upon successful completion of this course students will be able to					
<ol style="list-style-type: none"> 1. Formulate specific problem statements for ill-defined real life problems with reasonable assumptions and constraints. 2. Perform literature search and / or patent search in the area of interest. 3. Conduct experiments / Design and Analysis / solution iterations and document the results. 4. Perform error analysis / benchmarking / costing. 5. Synthesize the results and arrive at scientific conclusions / products / solution. 6. Document the results in the form of technical report / presentation. 					
Module Content			(Project duration: one semester)		
<ol style="list-style-type: none"> 1. Dissertation may be a theoretical analysis, modeling & simulation, experimentation & analysis, prototype design, fabrication of new equipment, correlation and analysis of data, software development, applied research and any other related activities. 2. Dissertation should be individual work. 3. Carried out inside or outside the university, in any relevant industry or research institution. 4. Publications in the peer reviewed journals / International Conferences will be an added advantage. 					
Mode of Evaluation: 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
MFRE501L	Français Fonctionnel	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
1. Demonstrate competence in reading, writing, and speaking basic French, including knowledge of vocabulary (related to profession, emotions, food, workplace, sports/hobbies, classroom and family). 2. Achieve proficiency in French culture oriented view point.					
Course Outcome					
At the end of the course, the student will be able to 1. Remember the daily life communicative situations via personal pronouns, emphatic pronouns, salutations, negations, interrogations etc. 2. Create communicative skill effectively in French language via regular / irregular verbs. 3. Demonstrate comprehension of the spoken / written language in translating simple sentences. 4. Understand and demonstrate the comprehension of some particular new range of unseen written materials. 5. Demonstrate a clear understanding of the French culture through the language studied.					
Module:1	Saluer, Se présenter, Etablir des contacts. Compétences en lecture - consulter un dictionnaire, appliquer des stratégies de lecture, lire pour comprendre.	9 hours			
Les nombres cardinaux- Les 7 jours de la semaine-Les 12 mois de l'année- La date-Les saisons-Les Pronoms personnels sujets-Les Pronoms Toniques- La conjugaison des verbes réguliers- er / - ir /-re verbes (Le présent)- La conjugaison des verbes irréguliers- avoir /être / aller / venir / faire /vouloir /pouvoir etc. <i>Savoir-faire pour:</i> saluer, et se présenter – épeler en français – communiquer en classe – utiliser des stratégies pour comprendre un texte en français.					
Module:2	Présenter quelqu'un, Chercher un(e) correspondant(e), Demander des nouvelles d'une personne.	7 hours			
La conjugaison des verbes Pronominaux (s'appeler/ s'amuser/ se promener)- La Négation- L'interrogation avec 'Est-ce que ou sans Est-ce que'- Répondez négativement.					
Module:3	Situer un objet ou un lieu, Poser des questions	6 hours			
Les articles (défini/ indéfini)- Les prépositions (à/en/au/aux/sur/dans/avec etc.)- L'article contracté- L'heure- La Nationalité du Pays- Les professions- L'adjectif (La Couleur, l'adjectif possessif, l'adjectif démonstratif, l'adjectif interrogatif (quel/quelle/quels/quelles)- L'interrogation avec Comment/ Combien / Où etc., Pronoms relatifs simples (qui/que/dont/où).					
Module:4	Comprendre et traduire un texte court, Demander et indiquer le chemin.	5 hours			
La traduction simple d'un texte/ dialogue :(français-anglais / anglais –français)					
Module:5	Trouver les questions, Répondre aux questions générales en français, Écouter des vidéos (site internet, YouTube) qui aident à améliorer leur prononciation/ vocabulaire et leurs compétences orales	6 hours			
L'article Partitif (du/ de la / de l'/ des) -Faites une phrase avec les mots donnés- Mettez les phrases en ordre, masculin/féminin ; singulier/pluriel- Associez les phrases- les adverbes de temps (ensuite/hier/puis....)					
Module:6	Comment écrire un passage - développer des compétences rédactionnelles. Discussion de groupe (donnez un sujet et demandez aux élèves de partager	5 hours			

	leurs idées)	
Décrivez La Famille -La Maison -L'université -Les Loisirs-La Vie quotidienne- La ville natale- Un personnage célèbre		
Module:7	Comment écrire un dialogue	5 hours
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)		
Module:8	Contemporary Topics	2 hours
	Total Lecture hours:	45 hours
Text Book(s)		
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.	
Reference Books		
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	
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

Course code	Course Title	L	T	P	C
MGER501L	Deutsch für Anfänger	3	0	0	3
Pre-requisite	NIL	Syllabus version			
		1.0			
Course Objectives					
<ol style="list-style-type: none"> 1. Demonstrate competency in reading, writing and speaking in Basic German. 2. Achieve proficiency in German culture oriented view point. 3. Develop basic vocabulary in the technical field. 					
Course Outcome					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> 1. Communicate in German language in their daily life communicative situations. 2. Apply the German language skill in writing corresponding letters, E-Mailsetc. 3. Create the talent of translating passages from English-German and vice versa and to frame simple dialogues based on given situations. 4. Understand and demonstrate the comprehension of some particular new range of unseen written materials. 5. Develop a general understanding of German culture and society. 					
Module:1	Die erste Begegnung	6 hours			
Einleitung, Begrüßungs formen, Länder und Sprachen, Alphabet, Buchstabieren, Personalpronomen, Zahlen (1-100), Telefonnummer und E-Mail Adressenennen W-fragen, Aussagesätze, Nomen – Singular und Plural und Artikel					
Lernziel: Verständnisvon Deutsch, Genus- Artikelwörter					
Module:2	Hobbys und Berufe	6 hours			
Über Hobbyssprechen, Wochentage, Jahreszeiten, und Monatenennen, Uhrzeitensagen, über Arbeit, Berufe und Arbeitszeitensprechen, Zahlen (Hundertbiseine Million) Aritel (bestimmter, unbestimmter), Plural der Substantive, Konjugation der Verben (regelmässig /unregelmässig), Ja-/Nein- Frage, Imperativmit Sie.					
Lernziel : Sätzeschreiben, überHobbyserzählen, über Berufesprechenusw.					
Module:3	Alltag und Familie	7 hours			
Über die Familiesprechen, eineWohnungbeschreiben, Tagesablaufschreiben, Mahlzeiten, Lebensmittel, Getränke Possessivpronomen, Negation, Kasus- Akkusativ und Dativ (bestimmter, unbestimmterArtikel), trennnbareverben, Modalverben, Adjektive, Präpositionen					
Lernziel : Sätzemit Modalverben, Verwendung von Artikel, über Familiesprechen, eine Wohnungbeschreiben.					
Module:4	Situations gespräche	6 hours			
Dialoge:					
a) Gespräche mit Familienmitgliedern, am Bahnhof,					
b) Gespräche beim Einkaufen, in einem Supermarkt, in einer Buchhandlung					
c) Gespräche in einem Hotel/ in einem Restaurant, Treffen im Café, Termin beim Arzt.					
Module:5	Korrespondenz	6 hours			
Leseverständnis, Mindmapmachen, Korrespondenz- Briefe, Postkarten, E-Mail					
Lernziel : Wortschatzbildung und aktiverSprachgebrauch					
Module:6	Aufsatzschreiben	6 hours			
Aufsätze : Meine Universität, Das Essen, mein Freund odermeine Freundin, meine Familie, einFest in Deutschlandusw.					
Module:7	Übersetzungen	6 hours			
Übersetzungen : (Deutsch – Englisch / Englisch –Deutsch)					
Lernziel :					

Grammatik – Wortschatz – Übung			
Module:8	Trainierung den Sprachfähigkeiten		2 hours
		Total Lecture hours:	45 hours
Text Book(s)			
1.	Netzwerk A1, Stefanie Dengler, Paul Rusch, Helen Schmitz, Tanja Sieber, Ernst Klett Sprachen GmbH, Stuttgart, 2017		
Reference Books			
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 SprachlehrefürAusländer, Heinz Griesbach, Dora Schulz, 2011, Berlin		
4.	Themen Aktuell 1, Hartmurt Aufderstrasse, Heiko Bock, MechthildGerdes, Jutta Müller und Helmut Müller, 2010, Muenchen.		
	www.goethe.de wirtschaftsdeutsch.de hueber.de, klett-sprachen.de www.deutschtraning.org		
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

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

	Presenting Technical Reports Planning, creating and digital presentation of reports		
Total Laboratory hours :			60 hours
Text Book(s)			
1.	Raman, Meenakshi and Sangeeta Sharma, (2015). Technical Communication: Principles and Practice, Third edition, Oxford University Press, New Delhi.		
Reference Books			
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	
Approved by Academic Council		No. 66	Date 16-06-2022

Course Code	Course Title	L	T	P	C
MSTS501P	Qualitative Skills Practice	0	0	3	1.5
Pre-requisite	Nil	Syllabus version			
		1.0			
Course Objectives:					
<ol style="list-style-type: none"> To develop the quantitative ability for solving basic level problems. To improve the verbal and professional communication skills. 					
Course Outcome:					
At the end of the course, the student will be able to					
<ol style="list-style-type: none"> Execute appropriate analytical skills. Solve problems pertaining to quantitative and reasoning ability. Learn better vocabulary for workplace communication. Demonstrate appropriate behavior in an organized environment. 					
Module:1	Business Etiquette: Social and Cultural Etiquette; Writing Company Blogs; Internal Communications and Planning: Writing press release and meeting notes	9 hours			
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.					
Module:2	Time management skills	3 hours			
Prioritization, Procrastination, Scheduling, Multitasking, Monitoring, Working under pressure and adhering to deadlines					
Module:3	Presentation skills – Preparing presentation; Organizing materials; Maintaining and preparing visual aids; Dealing with questions	7 hours			
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.					
Module:4	Quantitative Ability-L1–Number properties; Averages; Progressions; Percentages; Ratios	11 hours			
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.					
Module:5	Reasoning Ability - L1 – Analytical Reasoning	8 hours			
Data Arrangement (Linear and circular & Cross Variable Relationship), Blood Relations, Ordering / ranking / grouping, Puzzle test, Selection Decision table.					
Module:6	Verbal Ability -L1 – Vocabulary Building	7 hours			

Synonyms & Antonyms, One word substitutes, Word Pairs, Spellings, Idioms, Sentence completion, Analogies.			
		Total Lecture hours:	45 hours
Reference Books			
1.	Kerry Patterson, Joseph Grenny, Ron McMillan and Al Switzler, (2017).2 nd Edition, Crucial Conversations: Tools for Talking when Stakes are 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 st 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		
2.	www.skillsyouneed.com		
3.	www.mindtools.com		
4.	www.thebalance.com		
5.	www.eguru.ooo		
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

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:					
<ol style="list-style-type: none"> 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					
<ol style="list-style-type: none"> 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. 					
Module:1	Resume skills – Resume Template; Use of power verbs; Types of resume; Customizing resume	2 hours			
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.					
Module:2	Interview skills – Types of interview; Techniques to face remote interviews and Mock Interview	3 hours			
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.					
Module:3	Emotional Intelligence - L1 – Transactional Analysis; Brain storming; Psychometric Analysis; SWOT analysis	12 hours			
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.					
Module:4	Quantitative Ability - L3–Permutation - Combinations; Probability; Geometry and menstruation; Trigonometry; Logarithms; Functions; Quadratic Equations; Set Theory	14 hours			
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.					
Module:5	Reasoning ability - L3 – Logical reasoning; Data Analysis and Interpretation	7 hours			

Syllogisms, Binary logic, Sequential output tracing, Crypto arithmetic, Data Sufficiency, Data Interpretation-Advanced, Interpretation tables, pie charts & bar charts.			
Module:6	Verbal Ability - L3 – Comprehension and Critical reasoning		7 hours
Reading comprehension, Para Jumbles, Critical Reasoning (a) Premise and Conclusion, (b) Assumption & Inference, (c) Strengthening & Weakening an Argument.			
Total Lecture hours:			45 hours
Reference Books			
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 st edition. Oxford University Press, Chennai.		
5.	FACE, (2016).Aptipedia Aptitude Encyclopedia. Wileypublications, Delhi.		
6.	ETHNUS, (2013).Aptimithra. McGraw-Hill Education Pvt Ltd, Bangalore.		
Websites:			
1.	www.chalkstreet.com		
2.	www.skillsyouneed.com		
3.	www.mindtools.com		
4.	www.thebalance.com		
5.	www.eguru.ooo		
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