KONGU ENGINEERING COLLEGE
PERUNDURAI ERODE – 638 060
(Autonomous)

VISION

To be a centre of excellence for development and dissemination of knowledge in Applied Sciences, Technology, Engineering and Management for the Nation and beyond.

MISSION

We are committed to value based Education, Research and Consultancy in Engineering and Management and to bring out technically competent, ethically strong and quality professionals to keep our Nation ahead in the competitive knowledge intensive world.

QUALITY POLICY

We are committed to

- Provide value based quality education for the development of students as competent and responsible citizens
- Contribute to the nation and beyond through research and development
- Continuously improve our services

DEPARTMENT OF CSE

VISION

To be a centre of excellence for nurturing competent computer professionals of high calibre and quality for catering to the ever-changing needs of the industry and society.

MISSION

Department of CSE is committed to:

MS1: Develop innovative, competent and ethically strong computer engineers to meet global challenges.

MS2: Foster consultancy and basic as well as applied research activities to solve real world problems.

MS3: Endeavour for constant upgradation of technical expertise to cater to the needs of the industry and society.

2018 REGULATIONS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Post Graduates of Computer Science and Engineering will

PEO1: Adapt new computing technologies for attaining professional excellence and contribute to the advancement of computer science

PEO2: Achieve peer recognition as an individual or in a team through demonstration of good analytical research, design and implementation skills

PEO3: Thrive to pursue lifelong reflective learning to fulfill their goals

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3
MS1	3	2	2
MS2	2	3	2
MS3	2	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

PROGRAM OUTCOMES (POs)

Engineering Post Graduates will be able to:

PO1: Apply mathematical foundations, algorithmic principles, and computer science theory in the modelling and design of computer based systems of varying complexity

PO2: Critically analyze existing literature in an area of specialization and develop innovative and research oriented methodologies to tackle gaps identified

PO3: Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, ethical, health and safety, and sustainability in the field of computer engineering

PO4: Apply latest techniques and tools necessary for computing practice and demonstrate advanced knowledge of a selected area within the computer science discipline

PO5: Function effectively to accomplish a common goal and communicate with a range of audiences and prepare technical documents and make oral presentations

PO6: Demonstrate an ability to engage in lifelong learning for professional development

MAPPING OF PEOs WITH POs

PEO\PO	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	3	2	2	3	1	1
PEO2			1		3	3
PEO3	2	2	1	1		3

1 – Slight, 2 – Moderate, 3 – Substantial

CURRICULUM BREAKDOWN STRUCTURE UNDER REGULATION 2018

Curriculum Breakdown Structure(CBS)	Curriculum Content (% of total number of credits of the program)	Total number of contact hours	Total number of credits
Program Core(PC)	40.3%	41	29
Program Electives(PE)	25%	24	18
Humanities and Social Sciences and Management Studies(HSMS)	5.5%	5	4
Project(s)/Internships(PR)/Others	29.2%	40	21
Total			**72**

KEC R2018: SCHEDULING OF COURSES – ME (CSE)

Semester	Theory/ Theory cum Practical / Practical						Internship & Projects	Special Courses	Credits
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	9
I	18AMT11 Advanced Mathematics for computing (PC-3-1-0-4)	18MST11 Multicore Architecture (PC-3-1-0-4)	18MST12 Modern Operating System (PC-3-0-0-3)	18MST13 Advanced Software Engineering (PC-3-0-0-3)	18MSC11 Data Structures and Analysis of Algorithms (PC-3-0-2-4)	18MIC11 Advanced Database Technology (PC-3-0-2-4)			22
II	18MSC21 Machine Learning Techniques (PC-3-0-2-4)	18MSC22 Network design and technologies (PC-3-0-2-4)	18MST21 Security in computing (PC-3-1-0-4)	Professional Elective I (PE-3-0-0-3)	Professional Elective II (PE-3-0-0-3)	Professional Elective III (PE-3-0-0-3)	18MSP21 Mini Project (PR-0-0-4-2)		23
III	Professional Elective IV (PE-3-0-0-3)	Professional Elective V (PE-3-0-0-3)	Professional Elective VI (PE-3-0-0-3)				18MSP31 Project Work Phase I (PR-0-0-12-6)		15
IV							18MSP41 Project Work Phase II (PR-0-0-24-12)		12

Total Credits: 72

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M.E. DEGREE IN COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2018-19 onwards)

SEMESTER – I

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	Theory/Theory with Practical								
18AMT11	Advanced Mathematics for Computing	3	1	0	4	50	50	100	PC
18MST11	Multicore Architectures	3	1	0	4	50	50	100	PC
18MST12	Modern Operating System	3	0	0	3	50	50	100	PC
18MST13	Advanced Software Engineering	3	0	0	3	50	50	100	PC
18MSC11	Data Structures and Analysis of Algorithms	3	0	2	4	50	50	100	PC
18MIC11	Advanced Database Technology	3	0	2	4	50	50	100	PC
	Total				**22**				

CA – Continuous Assessment, ESE – End Semester Examination, CBS – Curriculum Breakdown Structure

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M.E. DEGREE IN COMPUTER SCIENCE AND ENGINEERING

CURRICULUM

(For the candidates admitted from academic year 2018-19 onwards)

SEMESTER - II

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	Theory/Theory with Practical								
18MSC21	Machine Learning Techniques	3	0	2	4	50	50	100	PC
18MSC22	Network Design and Technologies	3	0	2	4	50	50	100	PC
18MST21	Security in Computing	3	1	0	4	50	50	100	PC
	Elective - I	3	0	0	3	50	50	100	PC
	Elective - II	3	0	0	3	50	50	100	PC
	Elective - III	3	0	0	3	50	50	100	PC
	Practical								
18MSP21	Mini Project	0	0	4	2	100	0	100	PR
	Total				**23**				

CA – Continuous Assessment, ESE – End Semester Examination, CBS – Curriculum Breakdown Structure

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M.E. DEGREE IN COMPUTER SCIENCE AND ENGINEERING

CURRICULUM
(For the candidates admitted from academic year 2018-19 onwards)

SEMESTER – III

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	Theory/Theory with Practical								
	Elective - IV	3	0	0	3	50	50	100	PE
	Elective - V	3	0	0	3	50	50	100	PE
	Elective - VI	3	0	0	3	50	50	100	PE
	Practical								
18MSP31	Project Work Phase I	0	0	12	6	50	50	100	PR
	Total				**15**				

CA – Continuous Assessment, ESE – End Semester Examination, CBS – Curriculum Breakdown Structure

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M.E. DEGREE IN COMPUTER SCIENCE AND ENGINEERING

CURRICULUM
(For the candidates admitted from academic year 2018-19 onwards)

SEMESTER – IV

Course Code	Course Title	Hours / Week			Credit	Maximum Marks			CBS
		L	T	P		CA	ESE	Total	
	Practical								
18MSP41	Project Work Phase II	0	0	24	12	50	50	100	PR
	Total				**12**				

CA – Continuous Assessment, ESE – End Semester Examination, CBS – Curriculum Breakdown Structure

Total Credits: 72

LIST OF PROFESSIONAL ELECTIVES						
Course Code	Course Title	Hours/Week			Credit	CBS
		L	T	P		
SEMESTER II						
18COT21	Wireless Sensor Networks	3	1	0	4	PE
18MIE02	Data Visualization Techniques	3	0	0	3	PE
18MSE01	Business Intelligence	3	0	0	3	PE
18MSE02	Cloud Computing	3	0	0	3	PE
18MSE03	Compiler Design Techniques	2	0	2	3	PE
18MSE04	Data mining Techniques	3	0	0	3	PE
18MSE05	Blockchain Technologies	3	0	0	3	PE
18MSE06	Virtualization Techniques	3	0	0	3	PE
18MSE07	Big Data Analytics	3	0	2	4	PE
SEMESTER III						
18MIC12	Internet of Things	3	0	2	4	PE
18MIT11	Modern Information Retrieval Techniques	3	0	0	3	PE
18MIE09	Social Network Analysis	3	0	2	4	PE
18VLE12	Nature Inspired Optimization Techniques	3	0	0	3	PE
18MSE08	Software Defined Networking	3	0	0	3	PE
18MSE09	Information Storage Management	3	0	0	3	PE
18MSE10	Randomized Algorithms	2	1	0	3	PE
18MSE11	User Interface design	2	0	2	3	PE
18MSE12	Deep Learning Techniques	3	0	2	4	PE
18MSE13	Advanced Parallel Architecture and Programming	2	0	2	3	PE
18MSE14	Speech and Natural Language Processing	3	0	0	3	PE
18MSE15	Intelligent System Design	3	0	0	3	PE
18MSE16	Mobile and Pervasive Computing	3	0	0	3	PE

18AMT11 ADVANCED MATHEMATICS FOR COMPUTING

(Common to Computer Science and Engineering & Information Technology Branches)

L	T	P	Credit
3	1	0	4

Preamble	This course emphasizes the students to identify basic mathematical tools and techniques for designing various concepts in computing, storage methods, concepts in digital principles, managing databases, artificial intelligence, compiler and design, DBMS, design of Software etc.
Prerequisites	Basic concepts of probability and counting principles.

UNIT – I **9**

Estimation Theory: Point Estimation - Characteristics of estimators - Unbiased estimators - Methods or Estimation: Method of Maximum Likelihood Estimation - Method of Moments - Correlation - Regression.

UNIT – II **9**

Testing of Hypothesis: Sampling Distributions - Large sample tests - Testing the significance of single proportion - Difference of proportions - Single mean - Difference of means - Small sample tests - Testing the significance of means (student‘s t-test) - Testing the significance of Variances (F-test) - Testing the significance of goodness of fit - Independence of attributes (χ^2-test).

UNIT – III **9**

Combinatorics: Permutations and Combinations - Pigeonhole principle - Principle of inclusion and exclusion - Mathematical Induction - Recurrence relations - Solution of recurrence relations - Generating Functions - Solving recurrence relation by generating functions.

UNIT – IV **9**

Number Theory: Divisibility - Prime numbers - Fundamental theorem of arithmetic - Fermat‘s Little theorem - GCD - Euclid‘s algorithm - Congruence - Solution of Congruences - Chinese remainder theorem.

UNIT – V **9**

Automata Theory: Formal Languages: Introduction - Phrase structure grammar - Types of Grammar - Finite state machine - Finite state automata - Deterministic and Non-deterministic FSA - Equivalence of DFA to NFA - Push down automata - Languages accepted by PDA - Equivalence of Pushdown Automata and Context Free Languages - Turing Machine.

Lecture:45, Tutorial:15, Total: 60

REFERENCES:

1. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", 11th Edition, Sultan and Sons, 2018.
2. Victor Shoup, "A Computational Introduction to Number Theory and Algebra", 2nd Edition, Cambridge University Press, 2011.
3. Kenneth H. Rosen, "Discrete Mathematics and Its Applications", Tata McGraw Hill, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	use a sample to compute point estimate	Applying (K3)
CO2:	apply statistical tests in testing hypotheses on data	Analyzing (K4)
CO3:	use combinatorial concepts in analysis of algorithms	Evaluating (K5)
CO4:	handle network security related problems using number theory concepts	Applying (K3)
CO5:	model different kinds of machines using finite state machines	Creating (K6)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1			
CO2	1	1	1			
CO3	2	1	2			
CO4	2	1	2			
CO5	3	1	3			

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MST11 MULTICORE ARCHITECTURES

(Common to Computer Science and Engineering & Information Technology Branches)

L	T	P	Credit
3	1	0	4

Preamble	This course will introduce the students to the world of multi-core computer architectures and focuses on delivering an in-depth exposure in memory-subsystems and interconnects and few introductory sessions on advanced superscalar processors.
Prerequisites	Computer Architecture and Organization

UNIT – I **9**

Fundamentals of Quantitative Design and Analysis: Classes of Computers - Trends in Technology, Power, Energy and Cost - Dependability - Measuring, Reporting and Summarizing Performance - Quantitative Principles of Computer Design - Classes of Parallelism - ILP, DLP, TLP and RLP - Multi Threading - SMT and CMP Architectures - Limitations of Single Core Processors - The MultiCore era - Case Studies of Multi Core Architectures.

UNIT – II **9**

Memory Hierarchy Design: Introduction - Optimizations of Cache Performance - Memory Technology and Optimizations - Protection: Virtual Memory and Virtual Machines - Design of Memory Hierarchies - Case Studies

UNIT – III **9**

DLP in Vector, SIMD and GPU Architectures: Vector Architectures - SIMD Instruction Set Extensions for Multimedia - Graphics Processing Units - Detecting and Enhancing Loop Level Parallelism - Case Studies.

UNIT – IV **9**

TLP and Multiprocessors: Symmetric and Distributed Shared Memory Architectures - Cache Coherence Issues - Performance Issues - Synchronization Issues - Models of Memory Consistency - Inter Connection Networks - Buses, Crossbar and Multi-stage Interconnection Networks.

UNIT – V **9**

RLP and DLP in Warehouse Scale Architectures: Programming Models and Workloads for Warehouse scale Computers - Architecture for Warehouse scale computing - Domain Specific Architectures: Introduction - Guidelines for DSAs- Example Domain: Deep Neural Network - Google's Tensor Processing Unit - An interface Data Center Accelerator.

Lecture:45, Tutorial:15, Total: 60

REFERENCES:

1. John L. Hennessey and David A. Patterson, "Computer Architecture – A Quantitative Approach", 6th Edition, Morgan Kaufmann, Elsevier, 2017.
2. Kai Hwang, "Advanced Computer Architecture", Tata McGraw-Hill Education, 2003.
3. Richard Y. Kain, "Advanced Computer Architecture: A Systems Design Approach", Prentice Hall, 2011.
4. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/ Software Approach", Morgan Kaufmann, Elsevier, 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	investigate the limitations of ILP and the need for multi core architectures	Analyzing (K4)
CO2:	describe the hierarchical memory system	Understanding (K2)
CO3:	summarize the salient features of different multi core architectures and how they exploit parallelism	Understanding (K2)
CO4:	critically analyze the different types of inter connection networks	Analyzing (K4)
CO5:	compare the architectures of GPUs, Warehouse scale computers and Domain specific architecture	Analyzing (K4)

Mapping of COs with POs

PEOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1			
CO2	1	3	2			
CO3	1	3	1			
CO4	1	3	1			
CO5	3	3	2	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy

18MST12 MODERN OPERATING SYSTEM

L	T	P	Credit
3	0	0	3

Preamble	The concepts of operating system to distributed environment like cloud computing, mobile computing etc.
Prerequisites	Operating systems

UNIT – I **9**

Process Synchronization: Introduction - Functions of OS - Design Approaches - Types of advanced OS, Synchronization mechanisms - Critical Section Problem - Process Deadlocks: Models of Deadlock - Models of Resources.

UNIT – II **9**

Distributed Operating Systems: Issues in Distributed Operating System - Architecture - Communication Primitives - Lamport‘s Logical clocks - Causal Ordering of Messages - Distributed Mutual Exclusion Algorithms - Centralized and Distributed Deadlock Detection Algorithms - Agreement Protocols.

UNIT – III **9**

Distributed Resource Management: Distributed File Systems **-** Design Issues - Distributed Shared Memory - Algorithms for Implementing Distributed Shared memory - Issues in Load Distributing - Load Distributing Algorithms - Synchronous and Asynchronous Check Pointing and Recovery.

UNIT – IV **9**

Fault Tolerance and Security: Fault Tolerance - Two-Phase Commit Protocol - Non-blocking Commit Protocol - Security and Protection. **Multiprocessor Operating Systems:** Structures - Design Issues - Threads - Process Synchronization - Processor Scheduling - Memory Management - Reliability / Fault Tolerance.

UNIT – V **9**

Database Operating Systems: Introduction - Concurrency Control - Distributed Database Systems - Concurrency Control Algorithms. **Real Time and Mobile Operating Systems:** Basic Model of Real Time Systems – Characteristics - Applications of Real Time Systems - Real Time Task Scheduling - Overview of Mobile Operating Systems.

Total: 45

REFERENCES:

1. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2014.
2. Rajib Mall, “Real-Time Systems: Theory and Practice”, Pearson Education India, 2006.
3. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, “Operating System Concepts”, 7th Edition, John Wiley & Sons, 2004.
4. Andrew S. Tanenbaum, “Modern Operating Systems”, 2nd Edition, Addison Wesley, 2001.
5. Daniel P. Bovet and Marco Cesati, “Understanding the Linux kernel”, 3rd Edition, O‘Reilly, 2005.
6. Neil Smyth, “iPhone iOS 4 Development Essentials – Xcode”, 4th Edition, Payload Media, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	elaborate the synchronization mechanism, various models and functions of an operating system	Understanding (K2)
CO2:	examine the issues - Mutual exclusion, Deadlock detection and Agreement protocols of Distributed Operating System	Analyzing (K4)
CO3:	interpret the file system and load distribution mechanisms in Distributed Operating System	Applying (K3)
CO4:	compare various fault tolerant protocols and security issues	Understanding (K2)
CO5:	summarize the characteristics of multiprocessor and illustrate different features of real time and mobile operating systems	Applying (K3)

Mapping of COs with POs

PEOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1				
CO2	3	3				
CO3	3	2	1			
CO4	2	1				
CO5	3	1				

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MST13 ADVANCED SOFTWARE ENGINEERING

L	T	P	Credit
3	0	0	3

Preamble	This course takes into account of the emerging needs of industry underpinned by theory and software engineering practices.
Prerequisites	Software Engineering

UNIT – I **9**

Introduction to Software Engineering: Introduction - Software processes - Agile software development - Agile methods - plan-driven and agile development - Extreme programming - Agile project management - scaling agile methods - Requirements engineering.

UNIT – II **9**

Modeling and Design: System modeling - Types of models and model driven engineering - Architectural design - Design and implementation - Object-oriented design using the UML - Design patterns - Implementation issues - Open source development - Software testing - Development testing - Test-driven development - Release testing - User testing

UNIT – III **9**

Advanced Software Engineering: Software reuse - Component-based software engineering - Distributed software engineering - Service-oriented architecture - Embedded software - Aspect-oriented software engineering.

UNIT – IV **9**

Software Management: Project management - Project planning - Software pricing - Plan-driven development - Project scheduling - Agile planning - Estimation techniques - Quality management - Configuration management.

UNIT – V **9**

DEVOPS: Motivation - Cloud as a platform - Operations - Deployment Pipeline: Overall Architecture - Building and Testing – Deployment - Case study: Migrating to Microservices.

Total: 45

REFERENCES:

1. Roger S. Pressman, “Software Engineering - A Practioner’s Approach”, 7th Edition, MCGraw Hill, 2009.
2. Ian Sommerville, “Software Engineering”, 9th Edition, Addison Wesley, 2011.
3. Heineman G.T., and Councill W.T., “Component-Based Software Engineering: Putting the Pieces Together”, Pearson Higher Education/Addison Wesley, 2001.
4. Len Bass, Ingo Weber and Liming Zhu, “DevOps: A Software Architect‘s Perspective”, Pearson Education, 2016.
5. Martin R.C., “Agile Software Development: Principles, Patterns, and Practices”, Pearson Education Publisher, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	summarize the core concepts in software engineering	Understanding (K2)
CO2:	apply general principles of software development in the development of complex software	Applying (K3)
CO3:	discuss the methods and techniques for advanced software development and apply these in various development situations	Applying (K3)
CO4:	apply the different project management features to solve the world senarios	Applying (K3)
CO5:	apply the DevOps practices for different cases	Applying (K3)

Mapping of COs with POs

PEOs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2		1			
CO2	3	2				
CO3	3	1	1	2		
CO4						1
CO5	3		1	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy

18MSC11 DATA STRUCTURES AND ANALYSIS OF ALGORITHMS

(Common to Computer Science and Engineering, Information Technology & Information Technology(ICW) Branches)

L	T	P	Credit
3	0	2	4

Preamble	Provides insight into the intrinsic nature of the problem as well as possible solution techniques, independent of programming language / programming paradigm/computer hardware/ implementation aspect.
Prerequisites	Nil

UNIT – I **9**

Data Structures: The Role of Algorithms in Computing- Growth of Functions - Analysis of Recursive and Non-recursive Functions – Lists - Heap Sort – Quick Sort – Sorting in Linear Time

UNIT – II **9**

Advanced Data Structures: Binary Search Trees-Red-Black Trees-Augmenting Data Structures - B- Tress – Binomial Heaps - Fibonacci Heaps

UNIT – III **9**

Algorithm Design Techniques: Overview of Basic Design Techniques: Divide and Conquer(Strassen‘s Matrix Multiplication) – Dynamic Programming(Rod Cutting) - Greedy Algorithms(Huffman Codes) - String Matching: Naïve Algorithm - Rabin Karp Algorithm - String matching with finite automata - Knuth-Morris-Pratt Algorithm - Computational Geometry: Line Segment Properties - Determining segments intersection – Convex Hull – Closest pair of points.

UNIT – IV **9**

Graph Algorithms: Elementary Graph Algorithms - Minimum Spanning Trees - Single Source Shortest Paths - All Pairs Shortest Paths - Maximum Flow

UNIT – V **9**

NP and Approximation Algorithm: NP-Completeness: Polynomial Time verification, NP Completeness and Reducibility - NP Completeness Proofs - NP Complete Problems - Approximation Algorithms: Traveling Salesman Problem - Sum of Subset Problem - Vertex Cover Problem

List of Exercises / Experiments :

1. Implement any two sorting algorithm
2. Apply Binary Search Trees ,Red-Black trees ,Binomial Heap and Fibonacci heaps algorithms
3. Strassen‘s matrix multiplication algorithm, Huffman code using Algorithm Design Techniques
4. Implement String Matching and Graph algorithms
5. Solve NP Problems sum of Subset Problem and Travelling sales person problem

Lecture:45, Practical:30, Total: 75

REFERENCES / MANUALS / SOFTWARES:

1. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, “Introduction to Algorithms”, 3rd Edition, MIT Press, USA, 2009.
2. Levitin A., “Introduction to The Design and Analysis of Algorithms”, 2nd Edition, Addison Wesley, New York, 2007.
3. Weiss Mark Allen, “Data Structures and Algorithm Analysis in C++”, 3rd Edition, Pearson Education, New Delhi, 2007.
4. Aho Alfred V., Hopcroft John E., and Ulllman Jeffrey D., “Data Structures and Algorithms”, Pearson Education, New Delhi, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	analyze algorithms and prove their correctness for searching and sorting	Analyzing (K4)
CO2:	choose appropriate data structure as applicable to specified problem definition	Applying (K3)
CO3:	design algorithms using different Algorithm Design Techniques and apply them to real world problem	Applying (K3)
CO4:	summarize the major graph algorithms and apply on standard problems	Applying (K3)
CO5:	outline the significance of NP-completeness and Approximation algorithm	Understanding (K2)
CO6:	identify the appropriate data structure for solving the given problem	Applying (K3), Precision (S3)
CO7:	choose and employ appropriate data structure to represent complex data structure	Applying (K3), Precision (S3)
CO8:	synthesize operations like searching, insertion, deletion and traversing on various data structures	Applying (K3), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3		3		1
CO2	3	2		3		
CO3	3	2		3		
CO4	3	2		3		
CO5	2	1		2		
CO6	3	2		3		
CO7	3	2		3		
CO8	3	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MIC11 ADVANCED DATABASE TECHNOLOGY

(Common to Information Technology & Computer Science and Engineering Branches)

L	T	P	Credit
3	0	2	4

Preamble	To acquire knowledge on advanced databases like parallel and distributed database, object oriented database, active database, temporal database, spatial database, mobile database, multimedia database, XML database and cloud database to effectively store the data for real time applications.
Prerequisites	Fundamentals of Database Management Systems

UNIT – I **9**

Parallel and Distributed Databases: Database System Architectures: Centralized and Client-Server Architectures - Server System Architectures - Parallel Systems - Distributed Systems - Parallel Databases: I/O Parallelism - Inter and Intra Query Parallelism - Inter and Intra operation Parallelism - Design of Parallel Systems - Distributed Database Concepts - Distributed Data Storage - Distributed Transactions - Commit Protocols - Concurrency Control - Distributed Query Processing - Case Studies.

UNIT – II **9**

Object Oriented Databases: Object Oriented Databases - Introduction - Weakness of RDBMS - Object Oriented Concepts - Storing Objects in Relational Databases - Next Generation - Database Systems - Object Oriented Data models - OODBMS Perspectives - Persistence - Issues in OODBMS - Object Oriented Database Management System Manifesto - Advantages and Disadvantages of OODBMS - Object Oriented Database Design - OODBMS Standards and Systems - Object Management Group - Object Database Standard ODMG - Object Relational DBMS - Postgres - Comparison of ORDBMS and OODBMS.

UNIT – III **9**

Intelligent Databases: Active Databases: Syntax and Semantics (Starburst, Oracle, DB2) – Taxonomy – Applications - Design Principles for Active Rules - Temporal Databases: Overview of Temporal Databases-TSQL2 - Deductive Databases: Logic of Query Languages - Datalog - Recursive Rules-Syntax and Semantics of Datalog Languages - Implementation of Rules and Recursion - Recursive Queries in SQL - Spatial Databases - Spatial Data Types - Spatial Relationships - Spatial Data Structures - Spatial Access Methods - Spatial DB Implementation.

UNIT – IV **9**

Advanced Data Models: Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols - Multimedia Databases - Information Retrieval - Data Warehousing - Data Mining - Text Mining.

UNIT – V **9**

Emerging Technologies: XML Databases: XML Data Model - DTD - XML Schema - XML Querying - Web Databases - Geographic Information Systems - Biological Data Management - Cloud Based Databases: Data Storage Systems on the Cloud - Cloud Storage Architectures - Cloud Data Models - Query Languages - Introduction to Big Data - Storage - Analysis.

List of Exercises / Experiments :

1. Distributed Database for Bookstore
2. Deadlock Detection Algorithm for distributed database using wait- for graph
3. Object Oriented Database – Extended Entity Relationship (EER)
4. Parallel Database – University Counselling for Engineering colleges
5. Parallel Database – Implementation of Parallel Join & Parallel Sort

6. Active Database – Implementation of Triggers & Assertions for Bank Database
7. Deductive Database – Constructing Knowledge Database for Kinship Domain (Family Relations)
8. Study and Working of WEKA Tool
9. Query Processing – Implementation of an Efficient Query Optimizer
10. Designing XML Schema for Company Database
Lecture:45, Practical:30, Total: 75

REFERENCES / MANUALS / SOFTWARES:

1. Elmasri R., Navathe S.B., "Fundamentals of Database Systems", 5th Edition, Pearson Education/Addison Wesley, 2010.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", 3rd Edition, Pearson Education, 2007.
3. Henry F. Korth, Abraham Silberschatz S., Sudharshan, "Database System Concepts", 5th Edition, McGraw Hill, 2011.
4. Date C.J., Kannan A., and Swamynathan S., "An Introduction to Database Systems", 8th Edition, Pearson Education, 2006.
5. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", 3rd Edition, McGraw Hill, 2004.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	select the appropriate high performance database like parallel and distributed database	Applying (K3)
CO2:	model and represent the real world data using object oriented database	Evaluating (K4)
CO3:	design a semantic based database to meaningful data access	Evaluating (K4)
CO4:	embed the rule set in the database to implement intelligent databases	Evaluating (K4)
CO5:	represent the data using XML database for better interoperability	Evaluating (K4)
CO6:	design an effective query processing for parallel and distributed database	Applying (K3), Precision (S3)
CO7:	design an online system for various applications	Applying (K3), Precision (S3)
CO8:	design an application using advanced data models	Applying (K3), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3		3		1
CO2	3	2		3		
CO3	3	2		3		
CO4	3	2		3		
CO5	2	1		2		
CO6	3	2		3		
CO7	3	2		3		
CO8	3	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

18MSC21 MACHINE LEARNING TECHNIQUES

(Common to Computer Science and Engineering, Information Technology, Information Technology (Information Cyber Warfare) & Control and Instrumentation Engineering branches)

L	T	P	Credit
3	0	2	4

Preamble	Provides a concise introduction to the fundamental concepts of machine learning and popular machine learning algorithms.
Prerequisites	Nil

UNIT – I **9**

Supervised Learning: Definition of Machine Learning - Examples of Machine Learning Applications. Supervised Learning:Learning a Class from Examples - VC Dimension - PAC Learning - Noise - Learning Multiple Classes - Regression - Model Selection and Generalization - Dimensions of a Supervised Machine Learning Algorithm. Dimensionality Reduction: Introduction - Subset Selection – Principal Component Analysis- Feature Embedding - Factor Analysis.

UNIT – II **9**

Tree And Probabilistic Models: Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Different ways to Combine Classifiers – Boosting – Bagging –– Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithm.

UNIT – III **9**

Multilayer Perceptrons: Introduction - The Perceptron - Training a Perceptron - Learning Boolean Functions - Multilayer Perceptrons - MLP as a Universal Approximator - Backpropagation Algorithm - Training Procedures - Tuning the Network Size - Dimensionality Reduction - Learning Time

UNIT – IV **9**

Kernel Machines: Introduction - Optimal Separating Hyperplane - Soft Margin Hyperplane - v-SVM - Kernal Trick - Vectorial Kernels - Defining Kernels - Multiple Kernel Learning - Multiclass Kernel Machines - One class Kernel Machines - Kernel Dimensionality Reduction.

UNIT – V **9**

Reinforcement Learning: Introduction - Single State Case-Elements of Reinforcement Learning - Model-Based Learning - Temporal Difference Learning - Generalization - Partially Observable States. Design of Machine Learning Experiments: Introduction - Factors, Response, and Strategy of Experimentation - Response Surface Design - Randomization, Replication, and Blocking - Guidelines for Machine Learning Experiments.

List of Exercises / Experiments :

1. Implementation of linear regression
2. Implementation of Decision tree
3. Implementation of k-means clustering
4. Implementation of k-NN
5. Implementation of Backpropagation algorithm
6. Comparison of linear regression and decision tree algorithm for the given dataset
7. Comparison of kernel functions of Support Vector Machine for the given dataset

Lecture:45, Practical:30, Total: 75

REFERENCES / MANUALS / SOFTWARES:

1. Ethem Alpaydin, “Introduction to Machine Learning”, 3rd Edition, Prentice Hall of India, 2014.
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, 2nd Edition, Springer, 2011.
3. Willi Richert, Luis Pedro Coelho, “Building Machine Learning Systems with Python”, 2nd Edition, Packt Publishing Ltd., 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	illustrate the foundations of machine learning and apply suitable dimensionality reduction techniques for an application	Applying (K3)
CO2:	make use of supervised methods to solve the given problem	Applying (K3)
CO3:	apply neural networks to solve real world problems	Applying (K3)
CO4:	solve real world problems using kernel machines	Applying (K3)
CO5:	summarize the concepts of reinforcement learning and design machine learning experiments	Analyzing (K4)
CO6:	implement various supervised algorithms and evaluate the performance	Analyzing (K4), Precision (S3)
CO7:	implement the unsupervised algorithms and evaluate the performance	Analyzing (K4), Precision (S3)
CO8:	implement and compare the performance of different algorithms	Analyzing (K4), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3		2			
CO2	3		2			1
CO3	3			2		1
CO4	3			2		1
CO5	2		3			1
CO6	3		2			
CO7	3		2			
CO8	3		2			

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy

18MSC22 NETWORK DESIGN AND TECHNOLOGIES

(Common to Computer Science and Engineering & Information Technology branches)

L	T	P	Credit
3	0	2	4

Preamble	This course provides insight into Network design, tools for monitoring the network and advanced topics in Networks such as Wireless network protocols, 4G and 5G networks, Software-Defined Networks.
Prerequisites	Computer Networks

UNIT – I **9**

Network Design Fundamentals: Introduction -Cooperative communications -The OSI model -The TCP/IP model -The Internet protocols-Networking hardware-Physical connectivity-Virtual connectivity.

UNIT – II **9**

Network monitoring and Analysis: An effective network monitoring LAN and WAN - Monitoring your network -The dedicated monitoring server – monitoring various network parameters - characteristics of monitoring tools - Types of monitoring tools-Spot check tools-Log analysers-Trending tools-Realtime tools-Benchmarking-Interpret the traffic graph - Monitoring RAM and CPU usage.

UNIT – III **9**

Wireless Networks: IEEE802.16 and WiMAX – Security – Advanced 802.16 Functionalities – Mobile WiMAX - 802.16e – Network Infrastructure – WLAN – Configuration – Management Operation – Security – IEEE 802.11e and WMM – QoS – Comparison of WLAN and UMTS.

UNIT – IV **9**

4G and 5G Networks: LTE – Network Architecture and Interfaces – FDD Air Interface and Radio Networks –Scheduling – Mobility Management and Power Optimization – LTE Security Architecture – Interconnection with UMTS and GSM – LTE Advanced (3GPPP Release 10)- 4G Networks and Composite Radio Environment – Protocol Boosters – Hybrid 4G Wireless Networks Protocols – Green Wireless Networks – Physical Layer and Multiple Access – Introduction to 5G.

UNIT – V **9**

Software Defined Networks: Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – Data centre concepts and constructs : Introduction- The Multitenant Data Center - The Virtualized Multitenant Data Center- Orchestration - Connecting a Tenant to the Internet:VPN - Virtual Machine Migration and Elasticity - SDN Solutions for the Data Center Network – VLANs - Network Topology – Building an SDN Framework :The Juniper SDN Framework.

List of Exercises / Experiments :

1. Switches configuration – Managed and Unmanaged switches.
2. Establishing a Local Area Network (LAN).
3. VLAN Creation, adding resources and configuration.
4. DHCP Server Configuration.
5. Connecting two LANs using multi-router topology with static routes.
6. Defining access control lists and integrating centralized authentication server.
7. Firewall configuration.
8. Installing and configuring open source based packet analyzer and network management tools.

9. Monitoring the network and locate source of the problem with Spot check tools
10. Collecting network activity data, analyzing and reporting it with Trending tools
11. Monitoring a network with Realtime tools
Lecture: 45, Practical: 30, Total: 75

REFERENCES / MANUALS / SOFTWARES:

1.	Martin Sauter, "From GSM to LTE, An Introduciton to Mobile Networks and Mobile Broadband", 1st Edition, Wiley, 2014.
2.	Thoman D. Nadeau, and Ken Gray, "SDN - Software Defined Networks", 1st Edition, O'Reilly Publishers, 2013.
3.	Flickenger R., Belcher M., Canessa E., Zennaro M., "How To Accelerate Your Internet A Practical Guide to Bandwidth Management and Optimisation using Open Source Software", 1st Edition, BMO Book Sprint Team, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	identify the components required for designing a network	Applying (K3)
CO2:	apply different tools for network monitoring	Applying (K3)
CO3:	analyze various wireless network technologies	Analyzing (K4)
CO4:	summarize the features of LTE, 4G and 5G networks	Understanding (K2)
CO5:	experiment with software defined networks	Understanding (K2)
CO6:	configure LAN, VLAN, DHCP server and firewalls	Applying (K3), Precision (S3)
CO7:	identify, install and configure open source based packet analyzer and network management tools	Applying (K3), Precision (S3)
CO8:	analyze network activity with spot check, trending and real time tools	Analyzing (K4), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3		
CO2	2	2	1	3		
CO3	1	2				
CO4	1	3				
CO5	1	2				
CO6	2	3	3	2		
CO7	2	2	3	3		
CO8	3	3	3	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MST21 SECURITY IN COMPUTING					
		L	**T**	**P**	**Credit**
		3	**1**	**0**	**4**
Preamble	Able to learn the basic concepts in computer security including software vulnerability analysis and defense, networking and wireless security, applied cryptography, as well as ethical, legal, social and economic facets of security.				
Prerequisites	Computer Networks				
UNIT – I					**9**
Introduction to Mathematical Foundations of Cryptography: Integer arithmetic, Modular arithmetic, Congruence and Matrices– Probability and Information theory, Algebraic foundations– Introduction to Number theory.					
UNIT – II					**9**
Symmetric Encryption Techniques and Key Management: Substitution Ciphers – Transposition Ciphers – Classical Ciphers – DES – AES – Modes of operation - Key Channel Establishment for symmetric Cryptosystems.					
UNIT – III					**9**
Asymmetric Cryptosystems: The Diffie-Hellman Key Exchange Protocol - Discrete Logarithm Problem- - Public-key Cryptosystems: RSA Cryptosystem and cryptanalysis - Elliptic curve cryptography - ElGamal Cryptosystem -Need for Stronger Security notions for Public-key Cryptosystems. Combination of Asymmetric and Symmetric Cryptography. Key Channel Establishment for Public key Cryptosystems.					
UNIT – IV					**9**
Authentication: Authentication Protocols Principles – Authentication protocols for Internet Security – SSH Remote login protocol – Kerberos Protocol – SSL and TLS – Authentication frame for public key Cryptography- Hash Functions – Security of Hash Functions and MACs – MD5 Message Digest Algorithm - Secure Hash Algorithm - Digital Signature Standard.					
UNIT – V					**9**
Legal and Ethical issues in Security: Protecting Programs and Data – Information and the Law – Rights of Employees and Employers – Software Failures – Computer Crime – Privacy – Ethical Issues in Computer Security. **Need for security**: The security SDLC - Business needs, threats, attacks - NSTISSC security model, ISO, NIST and VISA models.					
Lecture:45, Tutorial:15, Total: 60					
REFERENCES:					
1.	Mao W., "Modern Cryptography – Theory and Practice", 1st Edition, Pearson Education, 2004.				
2.	Stallings William, "Cryptography and Network Security: Principles and Practices", 7th Edition, Pearson Education, 2016.				
3.	Charles P. Pfleeger, Shari Lawrence Pfleeger, "Security in Computing", 5th Edition, Prentice Hall, 2018.				

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	apply the mathematical foundations in security principles	Applying (K3)
CO2:	analyze various symmetric encryption and key management techniques	Analyzing (K4)
CO3:	evaluate the different asymmetric encryption techniques	Evaluating (K5)
CO4:	outline various authentication protocols	Understanding (K2)
CO5:	express the legal and ethical issues of security and need for security practices as well as models	Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2		3		
CO2	3	3	1	3		
CO3	3	3	2	3		
CO4	2	1		2		
CO5	2	1		2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18COT21 WIRELESS SENSOR NETWORKS

(Common to Communication Systems, Control and Instrumentation Engineering, Computer Science and Engineering & Information Technology branches)

L	T	P	Credit
3	1	0	4

Preamble	This course will cover the most recent research topics in wireless sensor networks and IPV6 transition. Topics such as MAC layer and PHY layer functionalities, 6LoWPAN fundamentals, routing, mobility and other advanced topics are precisely covered.
Prerequisites	Wireless Networks

UNIT – I — **9**

IEEE 802.15.4 PHY Layer: WSN Introduction, WPAN, network topologies, superframe structure, data transfer model, frame structure, slotted CSMA, IEEE 802.15.4 PHY: frequency range, channel assignments, minimum LIFS and SIFS periods, O-QPSK PPDU format, modulation and spreading. Simulation of data transfer model using Cooja simulator.

UNIT – II — **9**

IEEE 802.15.4 MAC Layer: MAC functional description, MAC frame formats and MAC command frames, Simulation of WSN traffic model using Cooja simulator.

UNIT – III — **9**

6LoWPAN Fundamentals: 6LoWPAN-Introduction, protocol stack, addressing, L2 forwarding, L3 routing, Header Compression, Fragmentation and Reassembly, Commissioning, Neighbor Discovery. Analyzing of sensor data exchange using Wireshark.

UNIT – IV — **9**

6LoWPAN Mobility and Routing: Mobility: types, Mobile IPv6, Proxy MIPv6, NEMO, Routing: Overview, ROLL, border routing, RPL, MRPL, Edge Router Integration (Cooja simulation).

UNIT – V — **9**

IPv6 Transition and Application Protocols: IPv4 Interconnectivity: IPv6 transition, IPv6-in-IPv4 tunneling, application protocols: design issues, MQTT-S, ZigBee CAP.

Lecture:45, Tutorial:15, Total: 60

REFERENCES:

1. "IEEE Standard for Local and metropolitan area networks, Part 15.4: Low-Rate Wireless Personal Area Networks (LR-WPANs)", IEEE Computer Society, New York, 5 September 2011.
2. Shelby and Zach, "6LoWPAN : The Wireless Embedded Internet", 1st Edition, John Wiley & Sons Inc., Hoboken, New Jersey, 2009, ISBN 978-0-470-74799-5.
3. Holger Karl and Andreas Willig, "Protocols and architectures for wireless sensor networks", John Wiley & Sons Inc., Hoboken, New Jersey, 2005, ISBN 978-0-470-09510-2.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	interpret the physical layer functionalities of IEEE 802.15.4 sensor devices	Understanding (K2)
CO2:	analyze MAC frame modeling of IEEE 802.15.4 sensor devices	Analyzing (K4)
CO3:	analyze 6LoWPAN architecture	Analyzing (K4)
CO4:	validate the routing protocol performance of 6LoWPAN devices	Evaluating (K5)
CO5:	apply IPV6 protocols for IoT applications	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1				3		
CO2	3	3				
CO3	3	3			3	
CO4		3				
CO5					3	

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MIE02 DATA VISUALIZATION TECHNIQUES

(Common to Information Technology & Computer Science and Engineering branches)

L	T	P	Credit
3	0	0	3

Preamble	Data visualization techniques are used to communicate complex information in a way that is easier to interpret by turning information into visually engaging images and stories. Data visualization is a key to clear-cut reports and dashboards.
Prerequisites	Database Management Systems and Data Mining Concepts

UNIT – I **9**

Core Skills for Visual Analysis: Information visualization - Uses – History – Effective Analysis – Traits of meaningful data – Visual Perception – Making Abstract Data Visible – Building blocks of information visualization.

UNIT – II **9**

Analytical Skills: Analytical Interaction: Interaction and Navigation – Analytical Techniques And Practices: Optimal Quantitative Scales – Reference Lines and Regions – Trellises And Crosstabs – Multiple Concurrent Views – Focus And Context – Over-Plotting Reduction – Analytical Patterns – Guidelines And Pattern Examples.

UNIT – III **9**

Time-Series, Ranking and Deviation Analysis: Time-Series Analysis: Patterns –Displays – Techniques and Best Practices – Part-To-Whole And Ranking Analysis: Patterns – Displays – Techniques and Best Practices – Deviation Analysis: Displays – Techniques and Best Practices.

UNIT – IV **9**

Distribution, Correlation and Multivariate Analysis: Distribution Analysis : Describing Distributions – Patterns – Displays – Techniques and Best Practices – Correlation Analysis: Describing Correlations – Patterns –Displays –Techniques and Best Practices – Multivariate Analysis: Patterns – Displays –Techniques And Best Practices.

UNIT – V **9**

Information Dashboard Design: Dashboard Design – Categorizing Dashboards – Typical Dashboard Data – Common Mistakes – Visual Perception – Limits Of Short-Term Memory – Visually Encoding Data – Gestalt Principles – Principles Of Visual Perception.

Total: 45

REFERENCES:

1. Stephen Few, “Now you see it: Simple Visualization Techniques for Quantitative Analysis”, 1st Edition, Analytics Press, 2009.
2. Stephen Few, “Information Dashboard Design: The Effective Visual Communication of Data”, 1st Edition, O'Reilly, 2006.
3. Edward R. Tufte, “The Visual Display of Quantitative Information”, 2nd Edition, Graphics Press, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe the core skills for visual analysis and discuss the importance of data visualization	Understanding (K2)
CO2:	outline the general techniques and practices that enhance visual analysis	Understanding (K2)
CO3:	apply time-series, ranking, and deviation analysis techniques and design practices for data visualization	Applying (K3)
CO4:	apply the various techniques of distribution, correlation and multivariate analysis in data visualization	Applying (K3)
CO5:	examine the fundamental concept of how to design the information dashboards	Analyzing (K4)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1				
CO2	2	1				
CO3	2	2				
CO4	2	2				
CO5	2	2	2			

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy

18MSE01 BUSINESS INTELLIGENCE

L	T	P	Credit
3	0	0	3

Preamble	Improved application development and high scale deployment.
Prerequisites	Database , SQL Queries

UNIT – I **9**

Introduction to Business Intelligence: Introduction to Digital Data and its Types – Structured, Semi-structured and Unstructured Data - Introduction to OLTP and OLAP – Architectures – Data Models – Role of OLAP in BI – OLAP Operations – Business Intelligence - BI Definition and Evolution – BI Concepts - BI Component Framework – BI Process, Users, Applications – BI Roles – BI Best Practices– Popular BI Tools.

UNIT – II **9**

Data Integration: Need for Data Warehouse – Definition of Data Warehouse – Data Mart – Ralph Kimball's Approach vs. W.H.Inmon's Approach – Goals of Data Warehouse – ETL Process – Data Integration Technologies – Data Quality – Data Profiling – Case Study from Healthcare domain – Kettle Software: Introduction to ETL using Pentaho Data Integration.

UNIT – III **9**

Multidimensional Data Modeling: Basics of Data Modeling – Types of Data Model – Data Modeling Techniques – Fact Table – Dimension Table – Dimensional Models- Dimensional Modeling Life Cycle – Designing the Dimensional Model - Measures, Metrics, KPIs and Performance Management – Understanding Measures and Performance – Measurement System - Role of metrics – KPIS - Analyze Data using MS Excel 2010.

UNIT – IV **9**

Basics of Enterprise Reporting: Reporting Perspectives - Report Standardization and Presentation Practices– Enterprise Reporting Characteristics - Balanced Scorecard - Dashboards - Creating Dashboards- Scorecards Vs Dashboards - Analysis - Enterprise Reporting using MS Access / MS Excel.

UNIT – V **9**

BI Applications and Case Studies: Understanding Business Intelligence and Mobility – Business Intelligence and Cloud Computing – Business Intelligence for ERP Systems – Social CRM and Business Intelligence - Case Studies : Good Life HealthCare Group, Good Food Restaurants Inc., Ten To Ten Retail Stores.

Total: 45

REFERENCES / MANUALS / SOFTWARES:

1. Prasad N., Seema Acharya, "Fundamentals of Business Analytics", 2nd Edition, Wiley-India Publication, 2016.
2. Efraim Turban, Ramesh Sharda, Dursun Delen, David King, "Business Intelligence: A Managerial Approach", 2nd Edition, Pearson Education, 2014.
3. David Loshin, "Business Intelligence", 5th Edition, Morgan Kaufmann Publishers, San Francisco, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	apply the key elements of data warehouse and business intelligence in BI tools	Applying (K3)
CO2:	apply the concepts and technology of BI space in any domain	Applying (K3)
CO3:	explain about analysis, integration and reporting services	Understanding (K2)
CO4:	summarize the functionalities of key performance indicators	Understanding (K2)
CO5:	apply BI to mobile, cloud, ERP and social CRM systems	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1			
CO2	2	3	1	2		
CO3	2	2	2	2		
CO4	3	2	2	2		
CO5			1	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE02 CLOUD COMPUTING

L	T	P	Credit
3	0	0	3

Preamble	Cloud computing is a scalable services consumption and delivery platform that provides on-demand computing service for shared pool of resources, namely servers, storage, networking, software, database, applications etc., over the Internet.
Prerequisites	Nil

UNIT – I **9**

Cloud Computing Basics: Defining Cloud computing – Cloud Types - Characteristics of Cloud computing-Cloud Architecture - Cloud Computing Stack - Infrastructure as a service- Platform as a Service - Software as a Service – Identity as a Service - Compliance as a Service.

UNIT – II **9**

Platforms and Cloud based Services: Abstraction and Virtualization – Load Balancing and Virtualization – Hypervisors – Machine Imaging – Porting Applications – Capacity Planning – Google Web Services-Amazon Web Services- Microsoft Cloud Services.

UNIT – III **9**

Managing and Securing the Cloud: Administrating the cloud – Cloud Management Products – Cloud Management Standards - Securing the cloud – Securing Data – Establishing Identity and Presence.

UNIT – IV **9**

Cloud Based Storage: Digital Universe- Provisioning Cloud Storage – Cloud Backup Solutions – Cloud Storage Interoperability. Mobile Cloud: Mobile Market – Smartphones with the cloud – Mobile web services – Service types – Service Discovery.

UNIT – V **9**

Cloud Computing Tool: Openstack – Overview of services - Conceptual architecture - Controller - Compute - Block Storage - Object Storage – Networking - Environment – Security - Identity service - Image service - Installation.

Total: 45

REFERENCES:

1. Barrie Sosinsky, “Cloud Computing Bible”, 1st Edition, Wiley Publishing, 2015.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, “Distributed and Cloud Computing, From Parallel Processing to the Internet of Things”, 1st Edition, Morgan Kaufmann Publishers, 2012.
3. www.openstack.org

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	describe the main concepts, key technologies, strengths and limitations of cloud computing	Understanding (K2)
CO2:	outline the underlying principle of abstraction, virtualization, load balancing, capacity planning and cloud based services	Understanding (K2)
CO3:	identify the core issues in cloud security and apply remedial measures	Applying (K3)
CO4:	identify the various interoperability and storage issues in modern cloud	Applying (K3)
CO5:	use appropriate open stack components to set up a private cloud environment	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1		1	2			
CO2				2		
CO3		1				
CO4			2	2		
CO5				3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE03 COMPILER DESIGN TECHNIQUES

L	T	P	Credit
2	0	2	3

Preamble	The course is intended to make the students learn the basic techniques that underlie the practice of Compiler Construction and to introduce the theory and tools that can be used to perform syntax-directed translation of a high-level programming language into an executable code with optimization techniques.
Prerequisites	Programming Languages

UNIT – I **6**

Introduction: Language Processors - Structure of a compiler – Evolution of Programming Languages- Applications of Compiler Technology Programming Language Basics - The Lexical Analyzer Generator - Parser Generator- Compiler Tools: Lex and YACC. Intermediate Code Generation techniques: Variants of Syntax trees-Three Address Code.

UNIT – II **6**

Optimization: Introduction - Early Optimizations: Constant-Expression Evaluation - Scalar Replacement of Aggregates-Algebraic Simplifications and Reassociation -Value Numbering - Copy Propagation-Sparse Conditional Constant Propagation. Redundancy Elimination: Common Subexpression Elimination - Invariant Code Motion- Partial-Redundancy Elimination- Redundancy Elimination and Reassociation- Code Hoisting. Loop Optimizations: Induction Variable Optimizations - Unnecessary Bounds Checking Elimination.

UNIT – III **6**

Instruction Level Parallelism: Processor Architectures - Code-Scheduling Constraints - Basic-Block Scheduling -Global Code Scheduling -Software Pipelining.

UNIT – IV **6**

Optimizing for Parallelism and Locality: Basic Concepts- Matrix-Multiply-An Example - Iteration Spaces - Affine Array Indexes - Data Reuse -Array data dependence Analysis- Application: Finding Synchronization - Free Parallelism- Pipelining.

UNIT – V **6**

Interprocedural Analysis and Register Allocation: Basic Concepts – Need for Inter procedural Analysis – A Logical Representation of Data Flow – A Simple Pointer-Analysis Algorithm. Register Allocation: Register allocation and Assignment-Local Methods-Graph Coloring.

List of Exercises / Experiments :

1. Implementation of Scanner using LEX
2. Implementation of Parser (Top down and Bottom up)
3. Generation of Intermediate code
4. Convert the BNF rules into YACC form and write code to generate abstract syntax tree.
5. Write program to generate machine code from the abstract syntax tree generated by the parser

Lecture: 30, Practical: 30, Total: 60

REFERENCES / MANUALS / SOFTWARES:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers: Principles, Techniques and Tools", 2nd Edition, Pearson Education, 2013.
2. Steven S. Muchnick, "Advanced Compiler Design Implementation", 1st Edition, Morgan Kaufman Publishers, Elsevier Science, India, 2008.
3. Richard Y. Kain, "Advanced Computer Architecture: A Systems Design Approach", 1st Edition, Prentice Hall, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe different phases of compiler and design a simple scanner and parser by using its pattern	Applying (K3)
CO2:	survey various code optimization techniques to improve the performance of a program in terms of speed and space	Analyzing (K4)
CO3:	study the architectural design of the system for compilation	Understanding (K2)
CO4:	apply optimization techniques to optimize programs in real time	Applying (K3)
CO5:	optimize functions and demonstrate how to store data and access from registers	Analyzing (K4)
CO6:	apply the knowledge of LEX tool and YACC tool to develop a scanner and parser	Applying (K3), Precision (S3)
CO7:	develop programs with new code optimization techniques to optimize the performance of a program interms of speed and space	Analyzing (K4), Precision (S3)
CO8:	analyze modern programming languages and write programs for generating target language	Analyzing (K4), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1		2		
CO2	2	2		2		
CO3	2	1	1			
CO4	2	1	1	3		
CO5	1	2	2	2		
CO6	3	2	2	1		
CO7	3	2	2	2		
CO8	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE04 DATA MINING TECHNIQUES

L	T	P	Credit
3	0	0	3

Preamble	This course provides students with an overview of the data mining process and techniques for preprocessing. It also make the students to gain knowledge of various data mining techniques and also prepare them for taking research in the area of data mining and its applications.
Prerequisites	Database Management Systems

UNIT – I **9**

Introduction: Data Mining - Steps in Knowledge Discovery Process- Kinds of Data and Patterns – Technologies used-Targeted applications - Major issues in Data Mining - Data objects and attribute types - Statistical descriptions of data - Data Visualization- Measuring data similarity and dissimilarity.

UNIT – II **9**

Data Preprocessing: Data Cleaning, Integration, Reduction, Transformation and Discretization, Mining Frequent Patterns - Frequent Itemset Mining Methods.

UNIT – III **9**

Classification: Decision Tree Induction-Bayesian Classification - Rule based Classification - classification by Back Propagation – Support Vector Machines – Lazy Learners – Model Evaluation and Selection - Techniques to improve Classification Accuracy - k-Nearest Neighbor Classifier.

UNIT – IV **9**

Clusters Analysis: Partitioning Methods – Hierarchical Methods – Density based Methods - Grid based Methods - Evaluation of Clustering – Outliers and Outlier analysis - Outlier detection Methods - Statistical Approaches.

UNIT – V **9**

Applications: Mining Complex data types - Statistical Data Mining - Data Mining foundations - Visual and Audio Data Mining – Applications - Ubiquitous and invisible Data Mining - Social impacts of Data Mining.

Total: 45

REFERENCES / MANUALS / SOFTWARES:

1. Han Jiawei and Kamber Micheline, "Data Mining: Concepts and Techniques", 3rd Edition, Morgan Kaufmann Publishers, 2012.
2. Berson Alex, and Smith Stephen J., "Data Warehousing, Data Mining and OLAP", 13th Reprint, Tata McGraw Hill, New Delhi, 2013.
3. Gupta G.K., "Introduction to Data Mining with Case Studies", 2nd Edition, Prentice Hall India, New Delhi, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe the different data mining techniques and identify different types of data	Applying (K3)
CO2:	apply data preprocessing and frequent itemset mining methods for the given problem	Applying (K3)
CO3:	summarize the characteristics of classification methods and use them for solving a problem	Applying (K3)
CO4:	summarize and demonstrate the working of different clustering and outlier methods	Applying (K3)
CO5:	comprehend the role of data mining in various applications	Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3			2		1
CO2	3		2			1
CO3	3			2		1
CO4			3			2
CO5			3			2
1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy						

18MSE05 BLOCKCHAIN TECHNOLOGIES

L	T	P	Credit
3	0	0	3

Preamble	The widespread popularity of digital cryptocurrencies has led the foundation of Blockchain. This course covers both the conceptual as well as application aspects of Blockchain. This includes the fundamental design and architectural primitives of Blockchain, the system and the security aspects, along with various use cases from different application domains.
Prerequisites	Basics of Cryptography and Distributed systems

UNIT – I **9**

Introduction to Blockchain: Financial transaction – Ledger – trustless system – Elements of blockchain – types – Byzantine General Problems – benefits – challenges – Components and structure of blockchain: blocks – chain – hashing – digital signatures – example – miners – validators – smart contracts - speed – decentralization Vs distributed systems

UNIT – II **9**

Cryptography behind Blockchain: principles – historical perspectives – classical cryptography- types – symmetric – asymmetric – signatures – hashing. **Bitcoin:** History – Why bitcoin – keys and addresses – transactions – blocks – bitcoin network – wallets

UNIT – III **9**

Consensus: Practical Byzantine fault tolerance algorithm – Proof of Work - Proof of Stake - Proof of Authority - Proof of Elapsed time Cryptocurrency Wallets: Introduction to cryptocurrency wallets - Transactions - Types of cryptocurrency wallets – Tenancy - Alternate Blockchains

UNIT – IV **9**

Hyperledger and Enterprise Blockchains: History - Hyperledger projects - Hyperledger Burrow - Hyperledger Sawtooth - Hyperledger Fabric - Hyperledger Iroha - Hyperledger Indy - Tools in Hyperledger – Deploy a simple application on IBM cloud

UNIT – V **9**

Ethereum: Introducing Ethereum - Components of Ethereum - Ethereum accounts - Ethereum network - Ethereum clients - Ethereum gas - Ethereum virtual machine - Ethereum block – Ether - Basics of Solidity - Ethereum Development

Total: 45

REFERENCES:

1. Brenn Hill, Samanyu Chopra, Paul Valencourt, “Blockchain Quick Reference: A guide to exploring decentralized blockchain application development”, 1st Edition, Packt Publishing, 2018.
2. Andreas Antonopoulos, “Mastering Bitcoin: Programming the open blockchain”, 2nd Edition, O’Reilly Media, 2017.
3. Melanie Swan, “Blockchain: Blueprint for a New Economy”, 1st Edition, O’Reilly Media, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	discuss the elements, structure and architecture of a blockchain	Understanding (K2)
CO2:	describe blockchain cryptography and history of bitcoin	Understanding (K2)
CO3:	explain consensus and cryptocurrency wallet	Understanding (K2)
CO4:	deploy a simple application using Hyperledger on IBM cloud	Applying (K3)
CO5:	develop and analyze a distributed application using Ethereum and Solidity	Evaluating (K4)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1			1		
CO2	2	1		2		
CO3	2	1		2		
CO4	3	2	1	3		
CO5	3	3	2	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE06 VIRTUALIZATION TECHNIQUES

L	T	P	Credit
3	0	0	3

Preamble	Virtual machine allows the creation of an environment that is not logically tied to the underlying hardware. The cloud is essentially a virtual environment that arises from the combination of multiple virtual machines into one powerful entity. Therefore, the process of virtualization is a key element in the creation of cloud platforms and infrastructure.
Prerequisites	Operating system, Networking concepts

UNIT – I **9**

Overview of Virtualization: Basics of Virtualization - Virtualization Types – Desktop Virtualization – Network Virtualization – Server and Machine Virtualization – Storage Virtualization – System-level or Operating Virtualization – Application Virtualization-Virtualization Advantages – Virtual Machine Basics – Taxonomy of Virtual machines - Process Virtual Machines – System Virtual Machines – Hypervisor - Key Concepts.

UNIT – II **9**

Server Consolidation: Hardware Virtualization – Virtual Hardware Overview - Server Virtualization – Physical and Logical Partitioning - Types of Server Virtualization – Business cases for Sever Virtualization – Uses of Virtual server Consolidation – Planning for Development – Selecting server Virtualization Platform.

UNIT – III **9**

Network Virtualization: Design of Scalable Enterprise Networks - Virtualizing the Campus WAN Design – WAN Architecture- WAN Virtualization - Virtual Enterprise Transport Virtualization–VLANs and Scalability - Theory Network Device Virtualization Layer 2 - VLANs Layer 3 VRF Instances Layer 2 - VFIs Virtual Firewall Contexts Network Device Virtualization - Data- Path Virtualization Layer 2: 802.1q - Trunking Generic Routing Encapsulation – IPsec-L2TPv3 Label Switched Paths - Control-Plane Virtualization.

UNIT – IV **9**

Virtualizing Storage: SCSI- Speaking SCSI- Using SCSI buses – Fiber Channel – Fiber Channel Cables – Fiber Channel Hardware Devices – iSCSI Architecture – Securing iSCSI – SAN backup and recovery techniques – RAID – SNIA Shared Storage Model – Classical Storage Model – SNIA Shared Storage Model – Host based Architecture – Storage based architecture – Network based Architecture – Fault tolerance to SAN – Performing Backups – Virtual tape libraries.

UNIT – V **9**

Virtual Machines Products: Xen Virtual machine monitors- Xen API – VMware – VMware products – VMware Features – Microsoft Virtual Server – Features of Microsoft Virtual Server.

Total: 45

REFERENCES:

1. William von Hagen, "Professional Xen Virtualization", 1st Edition, Wrox Publications, January, 2008.
2. Chris Wolf, Erick M. Halter, "Virtualization: From the Desktop to the Enterprise", Illustrated Edition, APress 2005.
3. Kumar Reddy, Victor Moreno, "Network virtualization", 1st Edition, Cisco Press, July, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	demonstrate the various virtual machine products	Applying (K3)
CO2:	create a virtual machine and to extend it to a virtual network	Creating (K6)
CO3:	analyse the intricacies of server, storage and network virtualizations	Analyzing (K4)
CO4:	compile all types of virtualization techniques	Creating (K6)
CO5:	design and develop applications on virtual machine platforms	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1			
CO2	2	2	1	2		
CO3	1	2	1	2		
CO4	1	3	2	1		
CO5		2	1	2		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE07 BIG DATA ANALYTICS

(Common to Computer Science and Engineering, Information Technology & Information Technology (ICW) branches)

L	T	P	Credit
3	0	2	4

Preamble	Provides basic knowledge about Big data, its framework and storage in databases and prepares the students to perform various analytical operations and visualize the results
Prerequisites	Database Management Systems

UNIT – I **9**

Big Data: Definition – Wholeness of big data: Understanding – Capturing –Benefits and management – Organizing and analyzing – Challenges – Big data architecture – Big data sources and applications: Big data sources – Machine to machine Communications- Big data Applications.

UNIT – II **9**

MapReduce Framework: Introducing Hadoop – Starting Hadoop – Components of Hadoop: Working with files in HDFS - Anatomy of a MapReduce program – Reading and writing - Writing basic MapReduce programs: Getting the patent data set-Constructing the basic template of a MapReduce program-Counting things-Adapting for Hadoop's API changes-Streaming in Hadoop- Improving performance with combiners – Hadoop Ecosystem.

UNIT – III **9**

NoSQL Database Systems: Introduction to NoSQL – CAP theorem - MongoDB : Data types – MongoDB Query Language – Cassandra: Features of Cassandra- Data types – CRUD- Collections Alter Commands – Import and Export- Querying system tables

UNIT – IV **9**

Mining Data Streams: Stream Data Model - Sampling Data in a Stream–Filtering Streams–Counting Distinct Elements in a Stream–Estimating Moments–Counting Ones in a Window–Decaying Window - Stream processing with SPARK and Kafka.

UNIT – IV **9**

Case Studies: Implement using open source frameworks/tools : Time Series Analysis - Text analysis – Social Network Analysis - Data streams

List of Exercises / Experiments :

1. Install, configure and run Hadoop and HDFS
2. Implement word count / frequency programs using MapReduce
3. Implement an application that stores big data in MongoDB / Cassandra
4. Data streaming using open source frameworks/tools
5. Text Analysis

Lecture:45, Practical:30, Total: 75

REFERENCES/MANUAL/SOFTWARE:

1. Anil Maheshwari, "Big Data". 1st Edition, McGraw Hill Education, 2017.
2. Chuck Lam, "Hadoop in Action", 2nd Edition, Manning Publications, 2011.
3. Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", 1st Edition, Wiley, 2015.
4. List of Softwares: Hadoop, R Package, Hbase, Pig, Hive

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	identify the need for big data analytics	Understanding (K2)
CO2:	develop simple programs using Hadoop framework	Understanding (K2)
CO3:	explore NoSQL database system for real world problems	Analyzing (K4)
CO4:	recognize the need for stream processing and discuss SPARK and Kafka architecture	Analyzing (K4)
CO5:	discuss big data use cases and implement using open source frameworks/tools	Applying (K3)
CO6:	demonstrate simple programs using MapReduce, Hadoop and HDFS	Applying (K3), Precision (S3)
CO7:	use MongoDB / Cassandra for storing big data in real world problems	Applying (K3) , Precision (S3)
CO8:	implement programs for data streaming and text analysis using open source frameworks/ tools	Applying (K3) , Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2					
CO2	2	2	2	2		
CO3	2	2	2	2		
CO4	1	1				
CO5	2	2	2	2	1	1
CO6	3	2				
CO7	3	2	1			
CO8	3	2	1		1	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy

18MIC12 INTERNET OF THINGS

(Common to Information Technology & Computer Science and Engineering Branches)

L	T	P	Credit
3	0	2	4

Preamble	This course is intended to give students a thorough understanding of IoT and its applications and to design, develop and analyze the various tools for building IoT applications also to develop IoT infrastructure for various real time applications.
Prerequisites	Microprocessors/Microcontrollers/Computer Organization/Networks

UNIT – I **9**

Introduction to Internet of Things and Design Methodology: Definition and Characteristics of IoT - Physical Design of IoT - IoT Protocols - IoT Communication Models - IoT Communication APIs - IoT enabled Technologies - IoT Levels and Templates - M2M - Difference between M2M and IoT - Software defined networks - Network function virtualization - IoT Platform design Methodologies.

UNIT – II **9**

IoT Architecture and Protocols: Four Pillars of IoT - DNA of IoT - Middleware for IoT: Overview - Communication middleware for IoT - LBS and Surveillance Middleware - Protocol Standardization for IoT - Efforts - M2M and WSN Protocols - SCADA and RFID Protocols - Unified Data Standards.

UNIT – III **9**

Introduction to Python and IoT Physical Devices: Language features of Python - Data types - Data structures - Control of flow – Functions – Modules – Packaging - File handling - Data/time operations – Classes - Exception handling Python packages - JSON, XML, HTTPLib, URLLib, SMTPLib - Introduction to Raspberry PI - Interfaces (serial, SPI, I2C)Programming - Python program with Raspberry PI with focus of interfacing external gadgets - Controlling output - Reading input from pins.

UNIT – IV **9**

Cloud Storage and Analysis: Various Real time applications of IoT - Connecting IoT to cloud - Cloud Storage for IoT - Data Analytics for IoT - Software and Management Tools for IoT

UNIT – V **9**

Cyber Security and Privacy in Internet of Things : Security and Privacy issues and challenges - Mitigating Security and Privacy Challenges - Security Assessment of an IoT Solution - Attacks and Countermeasures: Perception Layer - Network Layer - Transport Layer - Application Layer - IoT security requirements based on CIA Principles - Security in IoT Protocols.

List of Exercises / Experiments :

1. Working with Cooja Simulator
    - i. Creating an IoT scenario
    - ii. Sending data between an IoT client and server
    - iii. Launching an attack in RPL protocol LED Pi
2. Controlling things using Raspberry Pi via webpage/mobile app
3. Data communication using MQTT Protocol via Mosquitto simulator
4. Configure MQTT Mosquitto Server to secure MQTT
5. Sensing and Sending the sensor value via JSON/SMTP
6. Gather, Visualize and analyze the data in BLUEMIX
7. Perfom decision making with IOT data in Xively Cloud (Google Cloud)

Lecture:45, Practical:30, Total: 75

REFERENCES / MANUALS / SOFTWARES:

1.	ArshdeepBahga and Vijay Madisetti, "Internet of Things - A Hands-on Approach", Universities Press, 2015.
2.	Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", 1st Edition, CRC Press, 2012.
3.	https://www.isaca.org/Journal/archives/2015/Volume-4/Pages/security-and-privacy-challenges-of-iot-enabled-solutions.aspx
4.	*https://www.researchgate.net/270763270_Survey_of_Security_and_Privacy_Issues*
5.	http://slogix.in/

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe the physical and logical design of IoT and identify the appropriate IoT level and develop design methodologies for a given application	Applying (K3)
CO2:	explain the architecture, need for middleware and the role of different standardization protocols	Understanding (K2)
CO3:	recall the basic concepts and packages of Python related to IoT for interfacing with IoT devices	Applying (K3)
CO4:	develop simple real time applications, upload the data onto the cloud and perform data analytics	Applying (K3)
CO5:	identify the security threats against a given IoT system and suggest simple countermeasures	Understanding (K2)
CO6:	develop IoT applications using Cooja Simulator and Raspberry Pi	Applying (K3), Precision (S3)
CO7:	communicate to server via application layer protocols	Applying (K3), Precision (S3)
CO8:	analyse IoT data stored in cloud	Applying (K3), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1	1		
CO2	1	1	1	1		
CO3	2	1	2	2		
CO4	2	1	2	2		
CO5	3	1	3	3		
CO6	3	2	1	1		
CO7	3	2	1	1		
CO8	3	2	1	1		

1 – Slight, 2 – Moderate, 3 – Substantial, BT- Bloom's Taxonomy

18MIT11 MODERN INFORMATION RETRIEVAL TECHNIQUES

(Common to Information Technology & Computer Science and Engineering branches)

L	T	P	Credit
3	0	0	3

Preamble	Information Retrieval Techniques discusses about the basic concepts of IR, and various modeling techniques with different ways of indexing and searching mechanisms to build a text or multimedia based IR system.
Prerequisites	DBMS, DWDM, Web Technology

UNIT – I **9**

Introduction and Classic IR Models: Information Retrieval - The IR Problem - The IR System - Search Interfaces Today - Visualization in Search Interfaces - Modeling – Boolean Model – Term Weighting – TF-IDF Weighting – Vector Model – Set Theoretic Models – Algeraic Models – Latent Semantic Indexing Model – Neural Network Model - Probabilistic Models - Retrieval Evaluation – Retrieval Metrics.

UNIT – II **9**

Relevance Feedback, Languages and Query Properties: A Framework for feedback methods - Explicit Relevance feedback - Implicit feedback through local analysis - Global analysis - Documents: Metadata - Documents formats - Queries - Query Language – Query Properties.

UNIT – III **9**

Text Operations, Indexing and Searching: Text Properties - Document Preprocessing - Text Compression – Text Classification – Characterization of Text Classification – Unsupervised Algorithms – Supervised Algorithms – Decision Tree – K-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation Metrics – Accuracy and Error – Indexing and Searching – Inverted Indexes – Sequential Searching – Multidimensional Indexing.

UNIT – IV **9**

Web Retrieval and Web Crawling: The Web – Search Engine Architectures – Cluster Based Architecture – Distributed Architectures – Search Engine Ranking – User Interaction –Browsing – Web Crawling – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation.

UNIT – V **9**

Applications: Enterprise Search - Tasks - Architecture – Library Systems – Online Public Access Catalogues – IR System and Document Databases – Digital Libraries – Architecture and Fundamentals.

Total:45

REFERENCES:

1. Ricardo Baeza-Yate, Berthier Ribeiro-Neto, "Modern Information Retrieval", 2nd Edition, Pearson Education Asia, 2011.
2. Chowdhury G.G., "Introduction to Modern Information Retrieval", 2nd Edition, Neal-Schuman Publishers, 2003.
3. Daniel Jurafsky and James H. Martin, "Speech and Language Processing", 1st Edition, Pearson Education, 2000.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe the basic concepts of information retrieval	Understanding (K2)
CO2:	apply the various modeling techniques	Applying (K3)
CO3:	discuss the concepts of feedback, languages and query properties	Understanding (K2)
CO4:	create an IR application by using text-based indexing and searching mechanisms	Creating (K5)
CO5:	design a simple search engine	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1			
CO2	1	1	1			
CO3	2	1	2			
CO4	2	1	2			
CO5	3	1	3			

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom's Taxonomy

18MIE09 SOCIAL NETWORK ANALYSIS

(Common to Information Technology & Computer Science and Engineering branches)

L	T	P	Credit
3	0	2	4

Preamble	The study of graphs and revelation of their properties with their tools have been termed as Social Network Analysis. Some of the surprising and beautiful discoveries achieved with Social Network Analysis are 6 degrees of separation, the algorithm behind Google search, Link prediction, Viral marketing, etc.,
Prerequisites	Nil

UNIT – I **9**

Graph Theory and Social Networks: Graphs: Basic Definitions- Paths and Connectivity- Distance and Breadth First Search-Network Dataset: An overview. Strong and Weak Ties: Triadic Closure- The Strength of Weak Ties- Tie Strength and Network Structure in Large Scale Data- Tie Strength, Social Media, and Passive Engagement- Closure, Structural Holes, and Social Capital. Networks in their Surrounding Contexts: Homophily – Mechanism Underlying Homophily-Selection and Social Influence- Affiliation. Positive and Negative Relationships: Structural Balance- Characterizing the Structure of Balanced Networks – Application of Structural Balance – A Weaker Form of Structural Balance

UNIT – II **9**

Game Theory and Interaction in Networks: Games: What is Game?- Reasoning about Behavior in Game-Best Responses and Dominant Strategies- Nash Equilibrium- Multiple Equilibria- Coordination Games, The Hawk-Dove Game-Mixed Strategies-Examples and Empirical Analysis- Pareto Optimality and Social Optimality. Evolutionary Game Theory: Fitness as a Result of interaction- Evolutionarily Stable Strategies- A General Description of Evolutionarily Stable Strategies- Relationship between Evolutionarily and Nash Equilibria- Evolutionarily Stable Mixed Strategies. Modeling Network Traffic using Game Theory: Traffic at Equilibrium- Braess's Paradox. Matching Markets: Bipartite Graphs and Perfect Matchings-Valuations and Optimal Assignments.

UNIT – III **9**

Information Networks and the World Wide Web: The Structure of the Web: The World Wide Web-Information Networks, Hypertext, and Associative Memory- The Web as a Directed Graph- The Bow-Tie Structure of the Web. Link Analysis and Web Search: Searching the Web: The problem of Ranking- Link Analysis using Hubs and Authorities- Page Rank- Applying Link Analysis in Modern Web Search.

UNIT – IV **9**

Network Dynamics - Population Models: Information Cascades: Following the Crowd- A Simple Herding Experiment- Bayes Rule: A model of Decision Making-Making under Uncertainty- Baye's Rule in the Herding Experiment- A Simple, General Cascade Model- Sequential Decision Making and Cascades. Network Effects: The Economy Without Network Effects- The Economy with Network Effects- Stability, Instability and Tipping Points- A Dynamic View of the Market- Industries with Network Goods- Mixing Individual Effects with Population-Level Effects. Power Laws and Rich-Get-Richer Phenomena: Popularity as Network Phenomenon-Power Laws- Rich-Get-Richer Models-The Unpredictability of Rich-Get-Richer Model-The Long Tail-The Effect of Search Tools and Recommendation Systems.

UNIT – V		9

Network Dynamics – Structural Models: Cascading Behavior in Networks: Diffusion in Network- Modeling diffusion through a Network- Cascades and Clusters- Diffusion, Thresholds, and the Role of Weak Ties- Extensions of the Basic Cascade Model- Knowledge, Thresholds and Collective Action. The Small-World Phenomenon: Six Degrees of Separation- Structure and Randomness- Decentralized Search- Modeling the process of Decentralized Search- Empirical Analysis and Generalized Models- Core Periphery Structures and Difficulties in Decentralized Search. Epidemics: Diseases and the Networks that transmit them- Branching Processes- The SIR Epidemic Model- The SIS Epidemic Model- Synchronization- Transient Contacts and the Danger of Concurrency.

List of Exercises:

1. Exploring face book Graph API
2. Implementing access token using face book API
3. Implementing FQL(Face book Query Language)
4. Implementation using OpenGraph API
5. Use Dialogs API to implement login, posting on time line and sending request

Lecture: 45, Practical: 30, Total: 75

REFERENCES / MANUALS / SOFTWARE:

1. David Easley, Jon Klienberg, “Networks, Crowds, and Markets: Reasoning about a Highly Connected World”, Cambridge University Press, 2010.
2. Stanley Wasserman, Katherine Faust, “Social Networks Analysis: Methods and Applications”, Cambridge University Press, 2010.
3. Charles Kadushin, “Understanding Social Networks: Theories, Concepts, and Findings”, Oxford University Press, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	apply the concepts of graph theory for analysis of social networks distribution	Understanding (K2)
CO2:	utilize game theory for decision making in the context of social networking	Applying (K3)
CO3:	compare and contrast different link analysis and web search techniques	Understanding (K2)
CO4:	analyze network behavior based on population model	Applying (K3)
CO5:	investigate the aggregate behavior of the social networks based on structural model	Applying (K3)
CO6:	demonstrate APIs for different social networks	Applying (K3), Precision (S3)
CO7:	implement Face book Query Language	Applying (K3), Precision (S3)
CO8:	use Dialogs API to send posts online	Applying (K3), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1			
CO2	1	1	1			
CO3	2	1	2			
CO4	2	1	2			
CO5	3	1	3			
CO6			2		3	
CO7					2	
CO8				2	2	1

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy

18VLE12 NATURE INSPIRED OPTIMIZATION TECHNIQUES

(Common to VLSI Design , Communication Systems, Embedded Systems, Computer Science and Engineering & Mechatronics branches)

L	T	P	Credit
3	0	0	3

Preamble	To acquaint and familiarize with different types of optimization techniques, solving optimization problems, implementing computational techniques, abstracting mathematical results and proofs etc.
Prerequisites	Linear algebra and Calculus

UNIT – I **9**

Introduction to Algorithms: Newton's Method – Optimization - Search for Optimality - No-Free-Lunch Theorems - Nature-Inspired Metaheuristics - Brief History of Metaheuristics. **Analysis of Algorithms:** Introduction - Analysis of Optimization Algorithms - Nature-Inspired Algorithms - Parameter Tuning and Parameter Control.

UNIT – II **9**

Simulated Annealing: Annealing and Boltzmann Distribution - Parameters - SA Algorithm - Unconstrained Optimization - Basic Convergence Properties - SA Behavior in Practice - Stochastic Tunneling. **Genetic Algorithms** : Introduction - Genetic Algorithms - Role of Genetic Operators - Choice of Parameters - GA Variants - Schema Theorem - Convergence Analysis

UNIT – III **9**

Particle Swarm Optimization: Swarm Intelligence - PSO Algorithm - Accelerated PSO – Implementation - Convergence Analysis - Binary PSO – Problems. **Cat Swarm Optimization:** Natural Process of the Cat Swarm - Optimization Algorithm – Flowchart - Performance of the CSO Algorithm.

UNIT – IV **9**

TLBO Algorithm: Introduction **-** Mapping a Classroom into the Teaching-Learning-Based optimization – Flowchart- Problems. **Cuckoo Search:** Cuckoo Life Style - Details of COA – flowchart - Cuckoos' Initial Residence Locations - Cuckoos' Egg Laying Approach - Cuckoos Immigration - Capabilities of COA. **Bat Algorithms:** Echolocation of Bats - Bat Algorithms – Implementation - Binary Bat Algorithms - Variants of the Bat Algorithm - Convergence Analysis.

UNIT – V **9**

Other Algorithms: Ant Algorithms - Bee-Inspired Algorithms - Harmony Search - Hybrid Algorithms.

Total: 45

REFERENCES:

1. Xin-She Yang, "Nature-Inspired Optimization Algorithms", 1st Edition, Elsevier, 2014.
2. Omid Bozorg-Haddad, "Advanced Optimization by Nature-Inspired Algorithms" Springer Volume 720, 2018.
3. Srikanta Patnaik, Xin-She Yang, Kazumi Nakamatsu, "Nature-Inspired Computing and Optimization Theory and Applications", Springer Series, 2017.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	infer the basic concepts of optimization techniques	Understanding (K2)
CO2:	identify the parameter which is to be optimized for an application	Analyzing (K4)
CO3:	analyze and develop mathematical model of different optimization algorithms	Analyzing (K4)
CO4:	select suitable optimization algorithm for a real time application	Applying (K3)
CO5:	recommend solutions, analyses, and limitations of models	Analyzing (K4)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1		1			
CO2	1	1	1			
CO3	2	1	2			
CO4	2	1	2			
CO5	3	1	3			

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Bloom’s Taxonomy

18MSE08 SOFTWARE DEFINED NETWORKING					
		L	**T**	**P**	**Credit**
		3	**0**	**0**	**3**
Preamble	Provides insight on basics of software defined networking and how it is changing the way communications networks are managed, maintained, and secured.				
Prerequisites	Operating Systems, Data Structures and Algorithms, Computer Networks				
UNIT – I					**9**
Introduction to SDN: Traditional switch Architecture, Autonomous and Dynamic Forwarding Table, Why SDN?, The Genesis of SDN, How SDN works, The OpenFlow Specification , OpenFlow 1.0 and OpenFlow Basics, OpenFlow 1.1 and OpenFlow 1.3					
UNIT – II					**9**
SDN Application in Data Center: SDN in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center, SDN in other Environments, SDN Applications, SDN Open Source, Switch Implementation, Controller Implementation, SDN Futures					
UNIT – III					**9**
SDN Control Plane: Distributed Control plane, Centralized Control plane, OpenFlow, SDN Controllers, Network Programmability, Data Center concepts and constructs, The Virtualized Multitenant Data Center, SDN solution for Data Center Network					
UNIT – IV					**9**
SDN and NFV: Network Function Virtualization, Virtualization and Data plane I/O, Service Locations and Chaining, Network Topology and Topological Information Abstraction, Building an SDN Framework, IETF SDN Frameworks, Open Daylight Controller/Framework					
UNIT – V					**9**
SDN Usecases: Usecases for Bandwidth Scheduling, Manipulation and calendaring, Data Center Overlays, Big Data and Network Function Virtualization, Input Traffic Monitoring, Classification, and Triggered Actions.					
					Total: 45

REFERENCES :

1. Paul Goransson, Chuck Black, "Software Defined Networks: A Comprehensive Approach", 1st Edition, Morgan Kaufmann, June 2014.
2. Thomas D. Nadeau, Ken Gray, "SDN: Software Defined Networks, An Authoritative Review of Network Programmability Technologies", O'Reilly Media, August 2013.
3. Vivek Tiwari, "SDN and OpenFlow for Beginners", Amazon Digital Services Inc., 2013.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	employ openflow protocol to determine the operations of software defined network	Applying (K3)
CO2:	demonstrate the role of software defined network in different networking environment	Applying (K3)
CO3:	examine the data plane and control plane of software defined networks	Analyzing (K4)
CO4:	model software defined controller for various networking applications	Applying (K3)
CO5:	use software defined network to solve the given network problems	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1		2		
CO2	2	1		2		
CO3	3	3	2	3		
CO4	3	2		3		
CO5	2	1		2		2

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE09 INFORMATION STORAGE MANAGEMENT

L	T	P	Credit
3	0	0	3

Preamble	Information storage management offers essential details about various storage systems, storage networking technologies and business continuity solutions along with management techniques in order to store, manage, and protect digital information in classic, virtualized, and cloud environments
Prerequisites	Computer Networks and Database Management Systems

UNIT – I **9**

Storage Systems: Introduction to evolution of storage architecture, key data center elements, virtualization, and cloud computing. Components of storage system environments – Host (or computer), connectivity, storage, and application in both classic and virtual environments. RAID implementations, techniques and levels along with the impact of RAID on application performance. Components of intelligent storage provisioning and intelligent storage implementations.

UNIT – II **9**

Storage Networking Technologies: Fibre channel SAN components, connectivity options, and topologies including access protection mechanism —Zoning, FC protocol stack, addressing operations, SAN-based virtualization and VSAN technology, iSCS and FCIP protocols for storage access over IP network, Converged protocol FCoE and its components Network Attached Storage (NAS) – components, protocol and operations, File level storage virtualization. Object based storage and unified storage platform.

UNIT – III **9**

Backup, Archive and Replication: Business continuity terminologies, planning and solutions, clustering and multipathing architecture to avoid single points of failure, Backup and recovery – methods, targets and topologies, Data duplication and backup in virtualized environment, Fixed content and data archive, Local replication in classic and virtual environments, Remote replication in classic and virtual environment.

UNIT – IV **9**

Cloud Computing: Business drivers for Cloud computing, Definition of Cloud computing, Characteristics of cloud computing, Steps involved in transitioning from Classic data center to Cloud computing environment services and deployment models, Cloud infrastructure components, Cloud migration considerations.

UNIT – V **9**

Securing and Managing Storage Infrastructure: Security threats, and countermeasures in various domains security solutions for FC-SAN, IP-SAN and NS environments, Security in virtualized and cloud environment, Monitoring and managing various information infrastructure components in classic and virtual environments, Information lifecycle management (ILM) and storage tiering, Cloud service management activities.

Total: 45

REFERENCES:

1. EMC Corporation, "Information Storage and Management", 2nd Edition, Wiley, 2012.
2. Robert Spalding, "Storage Networks: The Complete Reference", Tata McGraw Hill, Osborne, 2003.
3. Marc Farley, "Building Storage Networks", 2nd Edition, Tata McGraw Hill, Osborne, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	explore the various storage systems and RAID implementations	Understanding (K2)
CO2:	identify various storage networking technologies and its components	Applying (K3)
CO3:	apply business continuity solutions – backup and replication, and archive for managing fixed content	Applying (K3)
CO4:	describe the fundamentals of cloud storage environment	Understanding (K2)
CO5:	explain the storage security framework and discuss the storage monitoring and management activities	Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1		2		
CO2		2	2	1		
CO3	1	1	2	3		
CO4		2		1		
CO5	2	2				

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE10 RANDOMIZED ALGORITHMS

L	T	P	Credit
2	1	0	3

Preamble	In this course, the probability tools required to design and analyze a randomized algorithm are studied. The emphasis will be on strengthening the analytical skills of the student so that he can independently design or analyze a randomized algorithm.
Prerequisites	Design and Analysis of Algorithms, Data Structures and Algorithms

UNIT – I **9**

Introduction: Min-Cut Algorithm, Binary Planar Partitions, **Game-theoretic techniques:** Game Tree Evaluation, The Minimax principle, Randomness and Non-uniformity. **Moments and deviations:** Occupancy Problems, Markov and Chebyshev Inequalities, Randomized Selection, Two-point Sampling, Stable Marriage Problem and Coupon Collector‘s Problem.

UNIT – II **9**

Tail Inequalities: Chernoff Bound, Routing in a parallel Computer, A wiring Problem, Martingales. **The probabilistic method:** Overview, Maximum Satisfiability, Expanding Graphs, Lovasz Local Lemma and Method of Conditional Probabilities.

UNIT – III **9**

Markov Chains and Random Walks: A 2-SAT Example, Markov Chains, Random Walks on Graphs, Electrical Networks, Cover Times, Graph Connectivity, Expanders and Rapidly Mixing Random Walks. **Algebraic techniques:** Fingerprinting and Freivalds Technique, verifying polynomial identities, perfect matchings in graphs, verifying equality of strings, pattern matching, Interactive proof systems.

UNIT – IV **9**

Data Structures: Fundamental Data-structuring problem, Random Treaps, Skip Lists, Hash Tables and Hashing. **Graph algorithms:** All-pairs Shortest Paths, Min-cut Problem, Minimum Spanning Trees.

UNIT – V **9**

Approximate Counting: Randomized Approximation Schemes, DNF Counting Problem, Volume Estimation. **Parallel and distributed algorithms:** PRAM model and its sorting, Maximal Independent Sets, Perfect Matching, Choice Coordination Problem, Byzantine Agreement.

Total: 45

REFERENCES:

1. Rajeev Motwani and Prabhakar Raghavan, “Randomized Algorithms”, 1st Edition, Cambridge University Press, Reprint 2010.
2. Michael Mitzenmacher and Eli Upfal, “Probability and Computing: Randomized Algorithms and Probabilistic Analysis”, Cambridge University Press, 2005.
3. Grimmett and Stirzaker, “Probability and Random Processes”, Oxford, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	outline the basic concepts in the design and analysis of randomized algorithms	Understanding (K2)
CO2:	illustrate tail inequalities and different probability that are frequently used in algorithmic application	Understanding (K2)
CO3:	determine the use of Markov chains and Random walks in the different practical applications	Applying (K3)
CO4:	discover the applications of data structures and graph algorithms	Analyzing (K4)
CO5:	examine the different appropriate counting schemes and parallel and distributed algorithms for various applications	Analyzing (K4)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1	2	2	1
CO2	2	1	1	2	2	1
CO3	3	2	1	3	3	2
CO4	3	3	2	3	3	3
CO5	3	3	2	3	3	3

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy

18MSE11 USER INTERFACE DESIGN

L	T	P	Credit
2	0	2	3

Preamble	UID deals with design of responsive web application using Full Stack Web Development – MEAN ie MongoDB, ExpressJS, AngularJS and NodeJS.
Prerequisites	HTML,CSS and Javascript

UNIT – I **9**

Introduction to NoSQL Database - MongoDB: What is NoSQL Database - Why to Use MongoDB - Difference between MongoDB & RDBMS - Download & Installation - Common Terms in MongoDB – Implementation of Basic CRUD Operations using MongoDB.

UNIT – II **9**

Introduction to Server-side JS Framework – Node.js: Introduction - What is Node JS – Architecture – Feature of Node JS - Installation and setup - Creating web servers with HTTP (Request and Response) – Event Handling - GET and POST implementation - Connect to NoSQL Database using Node JS – Implementation of CRUD operations.

UNIT – III **9**

Introduction to TypeScript: TypeScript : Introduction to TypeScript – Features of TypeScript – Installation setup – Variables – Datatypes – Enum – Array – Tuples – Functions – OOP concepts – Interfaces – Generics – Modules – Namespaces – Decorators – Compiler options – Project Configuration.

UNIT – IV **9**

Introduction to Client-side JS Framework – Basics of Angular: Introduction to Angular - Needs and Evolution – Features – Setup and Configuration – Components and Modules – Templates – Change Detection – Directives – Data Binding - Pipes – Nested Components.

UNIT – V **9**

Client-side JS Framework – Forms and Routing in Angular: Template Driven Forms - Model Driven Forms or Reactive Forms - Custom Validators - Dependency Injection - Services - RxJS Observables - HTTP - Routing.

List of Exercises / Experiments :

1. Implementation of Basic CRUD Operations using MongoDB
2. Create web server connection with HTTP Request and HTTP Response
3. Implementation of Event Handling using GET and POST Method
4. Establish Connection to NoSQL Database using NodeJS and implement CURD operations
5. Demonstrate Inheritance and Interfaces using Typescript
6. Design a web application using AngularJS

Lecture:45, Practical:15, Total: 60

REFERENCES / MANUALS / SOFTWARES:

1. Nathan Rozentals, “Mastering TypeScript”, 2nd Edition, Packt Publishing, 2017.
2. Nathan Murray, Ari Lerner, Felipe Coury, Carlos Taborda, “ng-book, The Complete Book on Angular 6”, Createspace Publisher, 2018.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	create NoSQL Database CURD operations using MongoDB	Creating (K6)
CO2:	develop server side applications using Node JS	Creating (K6)
CO3:	make use of Type Script to build web application	Applying (K3)
CO4:	summarize Angular features and create component based web pages	Understanding (K2)
CO5:	design a Full Stack web application	Creating (K6)
CO6:	design RWD to perform CURD operations with MongoDB	Creating (K6), Precision (S3)
CO7:	create web server connection with HTTP request and HTTP response	Applying (K3), Precision (S3)
CO8:	develop full stack application using angular for the given use case	Creating (K6), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3		
CO2	3	3	3	3		
CO3	3	2		3		
CO4	2	1		2		
CO5	3	3	3	3		
CO6	3	3	3	3		
CO7	3	2		3		
CO8	3	3	3	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE12 DEEP LEARNING TECHNIQUES

(Common to Computer Science and Engineering & Information Technology branches)

L	T	P	Credit
3	0	2	4

Preamble	Deep Learning is a subfield of machine learning concerned with algorithms inspired by the structure and function of the brain called artificial neural networks. This course explores the fundamentals concepts in the design of deep neural networks and its various architectures such as convolutional neural networks, recurrent neural networks etc.
Prerequisites	Fundamental concepts of Algorithms and computer programming

UNIT – I **9**

Foundations of Deep Learning: Introduction – Math behind machine learning – Linear Algebra – Statistics – How does Machine Learning works – Logistic regression – Evaluating Models – Neural Networks – Training Neural Networks – Activation functions – Loss functions – Hyper parameters.

UNIT – II **9**

Architectural Design: Defining Deep Learning – Common Architectural Principles of Deep Networks: Parameters – Layers - Activation functions - Loss functions - Optimization Algorithms – Hyper parameters. Building blocks of Deep Networks: RBMS-Auto encoders-Variational encoders.

UNIT – III **9**

Types of Deep Networks: Unsupervised pretrained Networks – Convolutional Neural Networks (CNNs) – Recurrent Neural Networks – Recursive Neural Networks – Applications.

UNIT – IV **9**

Convolutional Neural Networks: Pooling layers – Batch Normalization – padding and strides – Different types of initialization – implementing a convolutional auto encoder - 1D to CNN to text. **Recurrent Neural Networks**: Implementing a simple RNN – Adding LSTM – GRUs – Bidirectional RNNs – Character-level text generation.

UNIT – V **9**

Case Studies: Large scale deep learning – Computer vision – speech recognition – natural language processing – implementation.

List of Exercises:

1. Implementation of linear regression technique.
2. Program to create a multi-layer neural network.
3. Program to test the performance of multi-layer neural network with various activation and loss functions
4. Tuning the neural network performance with hyper parameters
5. Implementation of convolutional neural networks
6. Implementation of Recurrent neural networks
7. Implementation of Recursive neural networks
8. Developing a simple image recognition application
9. Developing a simple speech recognition application
10. Developing a Chatbot

Lecture: 45, Practical: 30, Total: 75

REFERENCES / MANUALS / SOFTWARES:

1.	Josh Patterson and Adam Gibson, "Deep Learning – A Practitioner's Approach", 1st Edition, O'Reilly Series, August 2017.
2.	Indra den Bakker, "Python Deep Learning Cookbook", 1st Edition, Packt Publishing, October 2017.
3.	Ian Goodfellow, Yoshua Bengio and Aaron Courville, "Deep Learning", 1st Edition, MIT Press, 2016.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	outline the basic concepts in the design of neural networks	Understanding (K2)
CO2:	demonstrate the significant functionalities of various components present in the deep networks	Understanding (K2)
CO3:	design and explore the architecture of various types of deep networks	Applying (K3)
CO4:	build different kinds of deep networks using Tensorflow/keras frameworks	Applying (K3)
CO5:	relate the use of deep networks in different practical applications	Analyzing (K4)
CO6:	implement the regression technique and variants of deep neural networks	Applying (K3), Precision (S3)
CO7:	analyze the performance of artificial neural network	Analyzing (K4), Precision (S3)
CO8:	develop the simple deep learning applications	Evaluating (K5), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	1	1			
CO2	2	1	1			
CO3	2	1	2			
CO4	2		2			
CO5	1	1	1	1		
CO6	2	3	3			
CO7	2	3	3			
CO8	2	3	3			

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE13 ADVANCED PARALLEL ARCHITECTURE AND PROGRAMMING

L	T	P	Credit
2	0	2	3

Preamble	This course provides an understanding of the fundamental principles and engineering trade-offs involved in designing modern parallel computing systems as well as to teach parallel programming techniques necessary to effectively utilize these machines. Because writing good parallel programs requires an understanding of key machine performance characteristics, this course covers both parallel hardware and software.
Prerequisites	Computer Architecture and Multicore Architecture

UNIT – I **6**

Parallel Architecture and Foundations of Parallel Programming: Parallel Architecture: Need, Convergence, Design issues – Parallel Application Case Studies – The von Neumann architecture - Processes, multitasking, and threads - Modifications to the von Neumann Model – Parallel Hardware and Software – Input and Output – Performance – Parallel Program Design – Writing and Running Parallel Programs

UNIT – II **6**

Message Passing Paradigm: Basic MPI programming – MPI_Init and MPI_Finalize – MPI communicators – SPMD programs – message passing – MPI_Send and MPI_Recv – message matching – MPI I/O – parallel I/O – collective communication – derived types – Performance evaluation of MPI programs – A Parallel Sorting Algorithm.

UNIT – III **6**

Shared Memory Paradigm PThreads: Basics of Pthreads – Execution, Error checking of threads – Matrix-Vector Multiplication – Critical sections – Busy waiting – Mutexes – Producer-Consumer Synchronization and Semaphores – Barriers and Condition variables – Read Write locks – Caches, Cache Coherence and False sharing – Thread-Safety – Pthreads case study.

UNIT – IV **6**

Shared Memory Paradigm OpenMP: Basic OpenMP constructs – The Trapezoidal Rule – Scope of Variables – Reduction Clause – Parallel for Directive – Loops in OpenMP – Scheduling loops – Synchronization in OpenMP – Case Study: Producer Consumer problem– Cache Issues – Threads safety in OpenMP.

UNIT – V **6**

OpenCL Language: Introduction to OpenCL – OpenCL example – Platforms, Contexts and Devices - OpenCL programming in C – Simple Programs.

List of Exercises:

1. Implementation of numerical methods using MPI and OpenMP
2. Parallelizing loops in OpenMP
3. Matrix vector multiplication using Pthreads
4. Producer-consumer synchronization and semaphores using Pthreads
5. Implementation of read/write locks using Pthreads
6. Vector operations with OpenCL

Lecture: 30, Practical: 30, Total: 60

REFERENCES / MANUALS / SOFTWARES:

1. David E. Culler, Jaswinder Pal Singh, "Parallel Computing Architecture: A Hardware/ Software Approach", Morgan Kaufmann, Elsevier, 2013.
2. Peter S. Pacheco, "An introduction to parallel programming", Morgan Kaufmann, 2011.
3. Munshi Aaftab, Gaster R. Benedict,"OpenCL Programming Guide", Addision-Wesley, 2011.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	investigate issues in Parallel Architecture and Programming	Analyzing (K4)
CO2:	develop message passing parallel programs using MPI framework	Applying (K3)
CO3:	implement shared memory parallel programs using Pthreads	Applying (K3)
CO4:	experiment with OpenMP for shared memory applications	Applying (K3)
CO5:	write simple parallel programs using OpenCL	Understanding (K2)
CO6:	develop parallel programs for numerical methods with MPI and OpenMP	Applying (K3), Precision (S3)
CO7:	develop parallel programs for different system tasks using Pthreads	Applying (K3), Precision (S3)
CO8:	perform different vector operations with OpenCL	Applying (K3), Precision (S3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	1	3		
CO2	3	2		3		
CO3	3	2		3		
CO4	3	2		3		
CO5	2	1		2		
CO6	3	2		3		
CO7	3	2		3		
CO8	3	2		3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE14 SPEECH AND NATURAL LANGUAGE PROCESSING

L	T	P	Credit
3	0	0	3

Preamble	The course provides the foundation knowledge on speech production and perception along with processing of speech signal and also deals with the basics of text processing and then it also covers some of the most interesting applications of text mining.
Prerequisites	Nil

UNIT – I **9**

Words and Morphology: Introduction - Models and Algorithms – Words – Morphology - Morphological Parsing using Finite State Transducers - FST Lexicon and Rules - Porter Stemmer - Spelling Errors - Error Pattern - Non-Word Error - Probabilistic Models - Applying Bayesian Methods to Spelling - Word Segmentation - N-grams - Smoothing – Backoff.

UNIT – II **9**

Tagging and Grammer: Part of Speech Tagging - Tagsets for English - Rule Based Tagging - Stochastic Part of Speech Tagging – Transformation-Based Tagging - CFG for English - Context Free Rule - Sentence-Level Constructions - Noun Phrase - Coordination-Agreement - Verb Phrase and Sub categorization -Auxiliaries – Parsing - Top Down Parsing - Bottom Up Parsing - Earley Algorithm.

UNIT – III **9**

Features and Unificataion: Features and Unification – Structures - Unification of Structure - Features and Structures in Grammar – Implementing Unification - Parsing with Unification Constraints - Probabilistic CFG - Probabilistic Lexicalize CFG – Dependency Grammar.

UNIT – IV **9**

Semantics: Semantic Analysis - Syntax Driven Semantic Analysis - Attachments for a Fragment of English - Integrating Semantic analysis into Earley Parser - Word Sense Disambiguation and Information Retrieval.

UNIT – V **9**

Advanced Topics: Computational Phonology - Speech Synthesis - Speech Recognition - HMM and Speech Recognition – Discourse - Dialogue and Conversation - Deep Learning and Natural Language Processing.

Total: 45

REFERENCES:

1. Daniel Jurafsky and James H. Martin, “Speech and Language Processing”, Pearson Education, 2009.
2. Christopher Manning and Hinrich Schuetze,” Foundations of Statistical Natural Language Processing”, MIT Press, 2000.
3. Xuedong Huang , Alex Acero and Hsiao - Wuen Hon, “Spoken Language Processing: A Guide to Theory, Algorithm and System Development“, Prentice Hall, 2001.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	analyze word structure using morphological analysis and Finite State Transducers	Analyzing (K4)
CO2:	apply Probabilistic approaches for Spelling and use N-grams for Language Modelling	Applying (K3)
CO3:	analyze Sentences using Parsing with CFG and Probabilistic Parsing	Analyzing (K4)
CO4:	apply Semantic in word sense disambiguation and Information Retrieval	Applying (K3)
CO5:	discuss Speech recognition and Text to Speech conversion using Computation Phonology and HMM	Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	3		
CO2	3	3	2	3		
CO3	3	3	2	3		
CO4	3	3	3	3		
CO5	3	3	3	3		

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom's Taxonomy

18MSE15 INTELLIGENT SYSTEM DESIGN		
	L T P Credit 3 0 0 3	
Preamble	This course deals with designing intelligent systems using various techniques like search and heuristics, making use of logic in knowledge representation and reasoning, and employing machine learning techniques with data sets. The role of fuzzy and neural systems in building intelligent systems will also be discussed.	
Prerequisites	Artificial Intelligence	
UNIT – I		**9**
Problem Solving and Searching: Evolution of Modern Computational Intelligence - Problem Solving by Search - Informed (Heuristic) Search - Iterative Search - Adversarial Search.		
UNIT – II		**9**
Logic and Knowledge Base Systems: Knowledge Representation and Reasoning - Rule-Based Expert Systems - Managing Uncertainty in Rule Based Expert Systems.		
UNIT – III		**9**
Fuzzy and Neural Systems: Fuzzy Expert Systems – Artificial Neural Networks - Advanced Artificial Neural Networks.		
UNIT – IV		**9**
Learning from Data: Machine Learning – Decision Trees Evolutionary Algorithms - Evolutionary Metaheuristics fS.		
UNIT – V		**9**
Bio-Inspired Intelligence: Swarm Intelligence - Hybrid Intelligent Systems.		
		Total: 45

REFERENCES:

1. Crina Grosan and Ajith Abraham, "Intelligent Systems – A Modern Approach", Springer – Verlag Berlin Heidelberg, 2011.
2. Robert J. Schalkoff, "Intelligent Systems Principles, Paradigms and Pragmatics", Jones and Bartlett Publishers, 2011.
3. Padhy N.P., "Artificial Intelligence and Intelligent Systems", Oxford University Press, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	apply search techniques and heuristics for solving problems	Applying (K3)
CO2:	make use of logic in knowledge representation and reasoning	Applying (K3)
CO3:	explain the role of fuzzy and neural systems in building intelligent systems	Understanding (K2)
CO4:	outline the machine learning techniques using datasets	Understanding (K2)
CO5:	employ bio-inspired algorithms and build hybrid intelligence systems	Applying (K3)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	2			
CO2	3	1	2			
CO3	3	2	3			
CO4	3	2	3	2		
CO5	2	2	3			

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy

18MSE16 MOBILE AND PERVASIVE COMPUTING

L	T	P	Credit
3	0	0	3

Preamble	This course provides an understanding of wireless and mobile communication concepts through various layers of mobile networking. It also helps to realize the pervasive and context aware computing architectures, systems and applications.
Prerequisites	Network design and Technologies

UNIT – I **9**

Introduction to Wireless Environment: Introduction to wireless communication-Wireless Transmission-Medium Access Control- Wireless MAC protocols –Comparison of 2G, 3G,4G looking ahead 5G systems.

UNIT – II **9**

Mobile Communication: GSM - Bluetooth - Mobile network layer-Mobile transport layer - File system support for mobility support - Mobile execution environments and applications.

UNIT – III **9**

Pervasive Communication: Pervasive computing principles - Characteristics of pervasive computing environments - Applications and case study - Pervasive Web Application architecture - Pervasive computing and web based applications - Voice enabling pervasive computing- PDA in pervasive computing- User interface issues in pervasive computing.

UNIT – IV **9**

Context Aware Computing: Structure and Elements of Context-aware Pervasive Systems: Abstract architecture – Infrastructures - Middleware and toolkits, Context-aware mobile services: Context for mobile device users – Location-based services- Ambient service- Enhancing Context-aware mobile services and Context aware artifacts.

UNIT – V **9**

Context-Aware Pervasive System: Context-aware sensor networks – A framework for Context aware sensors – Context-aware security systems – Constructing Context-aware pervasive system- Future of Content aware systems.

Total: 45

REFERENCES:

1. Schiller Jochen, "Mobile Communication", 2nd Edition, PHI/Pearson Education, 2009.
2. Burkhardt Jochen, Henn Horst and Hepper Stefan, Schaec Thomas and Rindtorff Klaus, "Pervasive Computing Technology and Architecture of Mobile Internet Applications", Addison Wesley Reading, 2007.
3. Seng Loke, "Context-Aware Pervasive Systems: Architectures for a New Breed of Applications", 1st Edition, Auerbach Publications, 2006.

COURSE OUTCOMES: On completion of the course, the students will be able to		BT Mapped (Highest Level)
CO1:	describe the operation and performance of wireless protocols	Understanding (K2)
CO2:	summarize the concepts and principles of various mobile communication technologies	Understanding (K2)
CO3:	demonstrate the working of protocols that support mobility	Understanding (K2)
CO4:	illustrate architecture of pervasive computing and identify the applicability of pervasive computing	Applying (K3)
CO5:	explain the concepts of context aware computing and pervasive system	Understanding (K2)

Mapping of COs with POs

COs/POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2				
CO2	2	2				
CO3	2	2				
CO4	2	2	1			
CO5	2	2	1			

1 – Slight, 2 – Moderate, 3 – Substantial, BT - Bloom’s Taxonomy