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.

DEPARTMENT OF INFORMATION TECHNOLOGY

VISION

To be a centre of excellence for development and dissemination of knowledge in Information Technology for the Nation and beyond.

MISSION

- To transform the students into innovative, competent and high quality IT professionals to meet the growing global challenges.
- To impart value-based IT education to the students and enrich their knowledge
- To endeavour for continuous upgradation of technical expertise of students to cater to the needs of the society
- To achieve an effective interaction with industry for mutual benefits

2018 REGULATIONS

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Post Graduates of Information Technology will

PEO1: Work on need based research in different domains relevant to Information Technology and carry out research projects of national and social relevance

PEO2: Provide problem solving capability through IT tools and techniques with adequate hands on experience to meet industry/ societal needs

PEO3: Create, apply and disseminate cognitive ideas related to IT field and advance in their profession

MAPPING OF MISSION STATEMENTS (MS) WITH PEOs

MS\PEO	PEO1	PEO2	PEO3	PEO4
MS1	3	2	3	2
MS2	2	3	2	3
MS3	2	2	3	2
MS4	1	3	3	2

1 – Slight, 2 – Moderate, 3 – Substantial

PROGRAM OUTCOMES (POs)

Engineering Post Graduates will be able to:

PO1 Carry out research /investigation and development work independently to solve real world problems in the field of information technology

PO2 Write and present a substantial technical report on their own research findings

PO3 Apply knowledge of mathematics, science, and computer science/technology to analyze, evaluate, model and integrate technologies for the upcoming issues in the field of Information and Communication Technologies

PO4 Transfer technology efficiently on engineering needs within engineering community and with society at large, by being able to comprehend and develop presentations and software tools

PO5 Identify contemporary issues in providing technology solutions for sustainable development considering impact on economic, social, political, and global issues and thereby contribute to the welfare of the society

PO6 Demonstrate independent learning and erudition by adopting research mission

MAPPING OF PEOs WITH POs

PEOs\POs	PO1	PO2	PO3	PO4	PO5	PO6
PEO1	3		2	3	3	
PEO2			2	2	3	1
PEO3	2	2	3	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)	47.2%	585	34
Program Electives(PE)	25.0%	270	18
Project(s)/Internships(PR)/Others	27.7%	600	20
Total			**72**

KEC R2018: SCHEDULING OF COURSES –MTech- Information Technology

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)**	18MSC11 Data Structures and Analysis of Algorithms **(PC-3-0-2-4)**	18MIT11 Modern Information Retrieval Techniques **(PC-3-0-0-3)**	18MIT12 Web Technologies **(PC-3-0-0-3)**	18MIC11 Advanced Database Technology **(PC-3-0-2-4)**	18MIC12 Internet of Things **(PC-3-0-2-4)**				22
II	18MSC21 Machine Learning Techniques **(PC-3-0-2-4)**	18MSE07 Big Data analytics **(PC-3-0-2-4)**	18MIT21 Cloud Architecture and security **(PC-3-0-0-3)**	Elective – I **(PE-3-0-0-3)**	Elective – II **(PE-3-0-0-3)**	Elective – III **(PE-3-0-0-3)**		18MIP21 Mini Project **(PR-0-0-4-2)**		22
III	Elective – IV **(PE-3-0-0-3)**	Elective –V **(PE-3-0-0-3)**	Elective – VI **(PE-3-0-0-3)**	18MIL31 Computing Lab **(PC-0-0-2-1)**				18MIP31 Project Work - Phase I **(PR-0-0-12-6)**		16
IV								18MIP41 Project Work - Phase II **(PR-0-0-24-12)**		12

Total Credits: 72

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 060
(Autonomous)

M.Tech. DEGREE IN INFORMATION TECHNOLOGY

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
18MSC11	Data Structures and Analysis of Algorithms	3	0	2	4	50	50	100	PC
18MIT11	Modern Information Retrieval Techniques	3	0	0	3	50	50	100	PC
18MIT12	Web Technologies	3	0	0	3	50	50	100	PC
18MIC11	Advanced Database Technology	3	0	2	4	50	50	100	PC
18MIC12	Internet of Things	3	0	2	4	50	50	100	PC
	Total				**22**				

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

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 060
(Autonomous)

M.Tech. DEGREE IN INFORMATION TECHNOLOGY

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
18MSE07	Big Data Analytics	3	0	2	4	50	50	100	PC
18MIT21	Cloud Architecture and Security	3	0	0	3	50	50	100	PC
	Elective - I	3	0	0	3	50	50	100	PE
	Elective - II	3	0	0	3	50	50	100	PE
	Elective - III	3	0	0	3	50	50	100	PE
	Practical								
18MIP21	Mini Project	0	0	4	2	100	0	100	PR
	Total				**22**				

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

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 060
(Autonomous)

M.Tech. DEGREE IN INFORMATION TECHNOLOGY

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								
18MIL31	Computing Laboratory	0	0	2	1	100	0	100	PC
18MIP31	Project Work Phase I	0	0	12	6	50	50	100	PR
	Total				**16**				

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

KONGU ENGINEERING COLLEGE, PERUNDURAI, ERODE – 638 060
(Autonomous)

M.Tech. DEGREE IN INFORMATION TECHNOLOGY

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								
18MIP41	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
18MSC22	Network Design and Technologies	3	0	2	4	PE
18MWC21	Ethical Hacking	3	0	2	4	PE
18MWE02	Information Theory and Coding	3	0	0	3	PE
18MWE03	Multimedia Compression Techniques	3	0	0	3	PE
18MIE01	Distributed Systems	3	0	0	3	PE
18MIE02	Data Visualization Techniques	3	0	0	3	PE
18MIE03	Web Analytics and Development	3	0	0	3	PE
18MIE04	Mobile and Wireless Security	3	0	0	3	PE
SEMESTER III						
18COE13	Digital Image Processing and Multi Resolution Analysis	3	0	0	3	PE
18MST11	Multicore Architectures	3	1	0	4	PE
18MSE12	Deep Learning Techniques	3	0	2	4	PE
18MIE05	Software Quality and Testing	3	0	0	3	PE
18MIE06	Modern High Speed Networking	3	0	0	3	PE
18MIE07	Forecasting and Optimization Techniques	3	0	0	3	PE
18MIE08	Quantum Computing	3	0	0	3	PE
18MIE09	Social Network Analysis	3	0	2	4	PE
18MIE10	Knowledge Engineering	3	0	0	3	PE
18MIE11	Data Sciences	3	0	0	3	PE
18MIE12	GPU Architecture and Programming	3	0	0	3	PE
18MIE13	Mobile Applications and Services	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

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	2	3		2		
CO2	3	3				
CO3	2	3	3			
CO4	1	3	1			
CO5	2		1			
CO6	3			3		
CO7	3			3		
CO8	3			3		

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			
CO2			3			
CO3			1			
CO4	2		3			
CO5	2		2	1	2	

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

18MIT12 WEB TECHNOLOGIES

L	T	P	Credit
3	0	0	3

Preamble	The basic understanding of how things work in the Web world from the technology point of view as well as to give the basic overview of the different technologies for the development of web-based applications.
Prerequisites	Nil

UNIT – I **9**

Design and Scripting: Introduction to HTML 5 Tags - Cascading Style Sheet - Responsive Web design: overview – grid – Navbar - Table - Images - Jumbotron – menu – form – layout - Tool tip – panel – popover – tabs – modal

UNIT – II **9**

Introduction to Java Scripting: Control Statements - Function - Objects - Document Object Model and Collections - Event Handling - Form handling and validations. Object-Oriented Techniques in JavaScript - Classes - Constructors and Prototyping (Sub classes and Super classes) - JSON - Introduction to AJAX

UNIT – III **9**

Introduction to NoSQL Database: MongoDB Environment - MongoDB : Introduction to MongoDB - RDBMS and MongoDB - Data Types in MongoDB - MongoDB CRUD Operations

UNIT – IV **9**

Introduction to Server-side JS Framework: Node JS - Needs of Node JS - Architecture - Blocking vs. Non-Blocking - Event-driven Programming - Event Loop - Installation and setup - Creating web servers with HTTP Request and Response - Node JS Callback Pattern - Event Emitter and Event Handling - GET and POST implementation - Modules - Implementation of CRUD operation using Node JS

UNIT – V **9**

Introduction to Client-side JS Framework: Challenges and Needs - Merits of Model View Controller (MVC) at Client-side over Server-side - Single Page Application (SPA) - Progressive Web Application (PWA) - Introduction to Angular - Setup and Configuration - Use of Components and Modules - Elements of Templates - Work of Change Detection in Components.

Total: 45

REFERENCES:

1. Deitel and Deitel, "Internet and World Wide Web - How to Program", 5th Edition, Pearson Education, India, 2012.
2. Fabio Cimo, "Bootstrap Programming Cookbook", Exelixis Media P.C., 2015.
3. https://www.mongodb.com/
4. Nate Murray, Felipe Coury, Ari Lerner and Carlos Taborda, "ng-book, The Complete Book on Angular 4" September 2016.
5. Krasimir Tsonev, "Node.js by Example", Packt Publishing, May 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	design web pages using html ,CSS and bootstrap framework	Understanding (K2)
CO2:	develop interactive web pages using Java Script	Understanding (K2)
CO3:	apply CRUD operation in NoSQL, MongoDB database	Applying (K3)
CO4:	demonstrate Web application using server side scripting Node JS	Applying (K3)
CO5:	develop Component based web design using Angular JS	Applying (K3)

Mapping of COs with POs

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

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	1	1	1	2	3	1
CO2	2		2	3	2	1
CO3	2	1	2	3	2	1
CO4	3		2	2	1	2
CO5	2	1	3	2	2	1
CO6	3	1	2	3	1	1
CO7	3	1	2	3	1	1
CO8	3	1	2	3	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	3	2	1	1		
CO2	2	1				
CO3	3	2	1	1		
CO4	3	2	1	1		
CO5	2	1				
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

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	2			
CO7	3	2	2			
CO8	3	2	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		2			1
CO2	3		2	3		
CO3	3		1		3	
CO4	2		2	3	2	
CO5	1		3	2		
CO6	3	2				
CO7	3	2	1			
CO8	3	2	1			1

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

18MIT21 CLOUD ARCHITECTURE AND SECURITY

(Common to Information Technology & Information Technology(Information Cyber Warfare) branches)

L	T	P	Credit
3	0	0	3

Preamble	Provides knowledge about basic concepts of cloud computing, types of cloud services, technologies and service providers and to understand the distinct basic cloud architecture models and advanced architecture models for complex environments and the security issues and threats in cloud environments.
Prerequisites	Nil

UNIT – I **9**

Cloud Computing Basics: Introduction to Cloud Computing – Cloud computing reference model- Essential Characteristics - Benefits and challenges of cloud computing- Roles and Boundaries-Cloud Delivery Models - Deployment models -Cloud computing vendors.

UNIT – II **9**

Cloud Enabling Technology: Data Center Technology-Remote operation and management-Facilities-Computing, Storage, Network Hardware- Virtualization Technology-Types of virtualization- OS based virtualization- Hardware based Virtualization- Virtualization Management-Web Technology- Multitenant Technology- Service Technology- Case Study.

UNIT – III **9**

Fundamental Cloud Architecture: Work load Distribution architecture- Resource Pooling Architecture-Dynamic Scalability-Elastic Resource Capacity-Service load balancing-Redundant Storage Architecture-Case Study.

UNIT – IV **9**

Advanced Cloud Architecture: Hypervisor clustering architecture- Cloud Balancing architecture- Resource Reservation- Dynamic failure detection and recovery architecture-Rapid provisioning- Storage workload management architecture-Multipath resource access architecture-Cross Storage device vertical tiering architecture

UNIT – V **9**

Security in Cloud: Cloud security fundamentals- Basic terms and concepts- Threat agents- Cloud Security Threats-Encryption- Hashing- Digital Signature-Public Key Infrastructure- Identity and Access Management-Single Sign on-Cloud Based Security Groups.

Total: 45

REFERENCES:

1. Thomas Erl, Zaigham Mahmood, Ricardo Puttini, "Cloud Computing: Concepts, Technology and Architecture", 1st Edition, Prentice Hall, 2013.
2. Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, "Cloud Computing: A Practical Approach", 1st Edition, McGraw-Hill, 2010.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud", 1st Edition, O'Reilly, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	articulate the main concepts, key technologies, strengths and limitations of cloud computing	Understanding (K2)
CO2:	illustrate the architecture, infrastructure and delivery models of cloud computing	Understanding (K2)
CO3:	analyze the different cloud technologies including virtualization and web based technologies	Analyzing (K3)
CO4:	categorize the appropriate cloud architecture for distinct functional areas.	Analyzing (K3)
CO5:	identify the core issues of cloud computing such as security, threats and privacy.	Understanding (K2)

Mapping of COs with POs

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

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

18MIL31 COMPUTING LABORATORY

(Common to Information Technology & Information Technology(Information Cyber Warfare) branches)

L	T	P	Credit
0	0	2	1

Preamble	This course aims to develop simple web applications in cloud, to design and development process involved in creating a cloud based application and to setup and configure web services and create web applications
Prerequisites	Web Technologies, Cloud Architecture

List of Experiments:

1. Install Virtual box/VMware Workstation with different operating systems.
2. Install and configure to launch virtual machine using trystack
3. Simulate a cloud scenario using CloudSim and implement a scheduling algorithm
4. Configure Google App Engine and create simple web applications using python/java.
5. Study experiment on configuring EC2 in Amazon Web Service
6. Design an online examination system using IaaS as service
7. Design an online book shopping cart system using server less computing

Total: 30

REFERENCES/MANUAL/SOFTWARES:

1. Cloudsim, Trystack, Python/Java/PHP, HTML/Javascript/XAMPP, Virtualbox / VMWare, GoogleApp
2. Laboratory Manual

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	configure various virtualization tools and simulate cloud environment and implement scheduling algorithms	Applying (K3), Precision (S3)
CO2:	configure various Web Services and launch virtual machine	Applying (K3), Precision (S3)
CO3:	develop and deploy web applications in cloud environment	Applying (K3), Precision (S3)

Mapping of COs with POs

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

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	Analyizing (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			
CO2			2	3		
CO3	2	3				
CO4	1		3			2
CO5					3	
CO6	2	3	3			2
CO7	2	2	3			3
CO8	3	3	3			2

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

18MWC21 ETHICAL HACKING

(Common to Information Technology (Information Cyber Warfare) & Information Technology branches)

L	T	P	Credit
3	0	2	4

Preamble	This subject provides the fundamental knowledge about security permissions in computer, internet and system and how to secure from the various vulnerabilities and provide countermeasures for real world applications.
Prerequisites	Nil

UNIT – I **9**

Casing the Establishment: What is foot printing? - Internet Foot printing- Scanning – Determining if the system is alive – Determining which services are running or Listening – Detecting the operating system – Processing and storing scan data - Enumeration - basic banner grabbing- Enumerating Common Network services- Case study- Network Security Monitoring.

UNIT – II **9**

System Hacking: Introduction – Cracking password – Password cracking websites – Password guessing Algorithms – Password Cracking Tools – Countermeasure – Escalating Privileges- Executing Applications – Key loggers and spywares.

UNIT – III **9**

Infrastructure and Hardware Hacking: Remote connectivity and VoIP Hacking - Preparing to dial up- War – Dialing - Brute-Force Scripting - PBX hacking - Voice mail hacking - VPN hacking – Hacking Hardware – Physical access –Hacking Devices – Default Configurations – Reverse Engineering Hardware.

UNIT – IV **9**

Wireless and Firewall Hacking: Wireless Equipment – Discovery and monitoring - Denial of Service Attacks – Common Dos Attack Techniques - DoS Countermeasures - Encryption attacks –Authentication attacks - Firewalls - Firewalls landscape - Firewall Identification - Scanning Through firewalls - Packet Filtering - Application Proxy Vulnerabilities.

UNIT – V **9**

Application Hacking and Countermeasures : Web and Database Hacking – Web Server Hacking - Web application Hacking - Common web application Vulnerabilities – Database Hacking – Mobile Hacking – Hacking android – iOS.

List of Exercises / Experiments :

1. Passive Information Gathering
2. Detecting Live Systems
3. Enumerating Systems
4. Defeating Malware
5. Securing Wireless Systems - Net Stumbler
6. Capture Wireless Traffic
7. Breaking into Database using SQL Injection
8. OS Hacking
9. E-mail Bombing
10. Hacking android phone

Lecture: 45, Practical: 30, Total: 75

REFERENCES / MANUAL / SOFTWARES:	
1.	Stuart McClure, Joel Scambray and Goerge Kurtz, "Hacking Exposed 7 : Network Security Secrets and Solutions", 7th Edition, Tata McGrawHill Publishers, 2012.
2.	EC- Council Press, "Ethical Hacking and Countermeasures: Threats and Defense Mechanisms", 1st Edition, Cengage Learning, 2009.
3.	EC- Council Press, "Ethical Hacking and Countermeasures: Attack Phases", 1st Edition, Cengage Learning, 2009.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain the basic vulnerabilities in any computing system	Applying (K3)
CO2:	determine the possible security attacks in complex real time systems and their effective countermeasures	Applying (K3)
CO3:	identify the security issues in hardware and software	Applying (K3)
CO4:	interpret the vulnerabilities in wireless environment and firewall systems	Applying (K3)
CO5:	formulate research problems in the computer security applications	Analyzing (K4)
CO6:	organize various information using passive information gathering, live system, enumeration and malware	Applying (K3), Precision (S3)
CO7:	utilize various tools to break the remote system hardware and software	Applying (K3), Precision (S3)
CO8:	examine various countermeasures for the vulnerabilities in real world applications	Analyzing (K4), Articulation (S4)

Mapping of COs with POs

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

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

18MWE02 INFORMATION THEORY AND CODING

(Common to Information Technology (Information Cyber Warfare), Information Technology & Communication Systems branches)

L	T	P	Credit
3	0	0	3

Preamble	Information Theory and Coding deals with concept of information and its efficient, error-free and secure delivery of information using binary data streams. It also provides a complete understanding of error-control coding techniques over noisy communication channel.
Prerequisites	Communication Networks/Systems

UNIT – I **9**

Source Coding: Introduction to Information theory – Uncertainty and Information – Entropy and Average Mutual Information – Information Measure for Continuous Random Variables – Source coding theorem – Huffman Coding – Shannon-Fano-Elias Coding – Arithmetic Coding – Lempel – Ziv Algorithm – Run Length Encoding and the PCX Format – Rate Distortion Function

UNIT – II **9**

Channel Capacity and Coding: Introduction – Channel Model – Channel Capacity – Channel Coding – Information Capacity Theorem – Error control coding: Introduction to Error Correction Codes – Basic Definitions – Matrix Description of Linear Block Codes – Equivalent Codes – Parity Check Matrix – Decoding of Linear Block Code – Syndrome Decoding – Error Probability after Coding – Perfect Codes – Hamming Codes – Low Density Parity Check (LDPC) Codes – Optimal Linear Codes – Maximum Distance Separable (MDS) Codes

UNIT – III **9**

Cyclic Codes: Introduction to the Cyclic Codes – Polynomials – Division Algorithm for Polynomials – A Method for Generating Cyclic Codes – Matrix Description of Cyclic Codes – Burst Error Correction – Fire Codes – Golay Codes – Cyclic Redundancy Check (CRC) Codes – Circuit Implementation of Cyclic Codes

UNIT – IV **9**

Bose-Chaudhuri Hocquenghem (BCH) Codes: Introduction to BCH Code – Primitive Elements – Minimal Polynomials – Generator Polynomials in Terms of Minimal Polynomials – Some Examples of BCH Codes – Decoding of BCH codes – Reed-Solomon Codes – Implementation of Reed –Solomon Encoders and Decoders – Performance of RS Codes Over Real Channels – Nested Codes

UNIT – V **9**

Convolutional Codes: Introduction to Convolutional Codes – Tree Codes and Trellis Codes – Polynomial Description of Convolution Codes – Distance Notions for Convolutional Codes – The Generating Function – Matrix Description of Convolutional Codes – Viterbi Decoding and Convolutional Codes – Distance Bounds for Convolutional Codes – Turbo Codes

Total: 45

REFERENCES:

1. Ranjan Bose, "Information Theory, Coding and Cryptography", 2nd Edition, Tata McGraw Hill, 2008.
2. Andrew J. Viterbi, Jim K. Omura, "Principles of Digital Communication and Coding", 4th Edition, Courier Corporation, 2018.
3. John G. Proakis, Masoud Salehi, "Digital Communications", 5th Edition, McGraw Hill, 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	outline the principles behind an efficient, correct and secure transmission of digital data stream	Understanding (K2)
CO2:	recognize the basics of error-coding techniques	Analyzing (K4)
CO3:	construct the knowledge about the encoding and decoding of digital data streams	Applying (K3)
CO4:	examine the performance requirements of various coding techniques	Analyzing (K4)
CO5:	take part in to conduct research in information theory by the professionals	Evaluating (K5)

Mapping of COs with POs

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

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

18MWE03 MULTIMEDIA COMPRESSION TECHNIQUES

(Common to Information Technology (Information and Cyber Warfare), Information Technology & Communication Systems branches)

L	T	P	Credit
3	0	0	3

Preamble	The aims of this course are to study methods for handling and compressing various kinds of data, such as text, images, audio and video data and understand data compression techniques for multimedia and other applications, in particular to the Internet.
Prerequisite	Computer Networks

UNIT – I **9**

Introduction: Special features of Multimedia – Graphics and Image Data Representations – Popular File formats – Fundamental Concepts in Video – Digital Audio – Storage requirements for multimedia applications –Need for Compression – Lossy & Lossless compression techniques– Overview of Source Models – Source coding – Scalar and Vector quantization

UNIT – II **9**

Text Compression: Compression techniques: Shannon- Fano coding –Huffman coding – Adaptive Huffman Coding – Arithmetic coding – Dictionary techniques: LZW algorithm

UNIT – III **9**

Audio Compression: Audio compression techniques – μ- Law and A-Law companding- Differential Encoding –DPCM- ADPCM – DM – Optimal Predictors and Optimal Quantization –Application to speech coding: G.722 – Application to audio coding : MPEG audio, Speech compression techniques : Formants and CELP Vocoders

UNIT – IV **9**

Image Compression : Transform Coding: JPEG Standard – Sub band coding algorithms – Design of Filter banks – Implementation using filters- Wavelet based compression: EZW- SPIHT coders – JPEG 2000 standards- JBIG- JBIG2 standards

UNIT – V **9**

Video Compression: Video compression Based on Motion Compensation – Search for Motion Vectors – H.261 – MPEG Video Coding I: MPEG – 1 and 2 – MPEG Video Coding II: MPEG – 4: Object Based Visual Coding –Synthetic Object Coding –Object types-Profiles and Levels – MPEG 7.

Total: 45

REFERENCES:

1. Morgan Kauffman, Khalid Sayood, "Introduction to Data Compression", 2nd Edition, Harcourt India, 2000.
2. David Salomon, "Data Compression – The Complete Reference", 2nd Edition, Springer Verlag New York Inc., 2001.
3. Mark S. Drew, Ze-Nian Li, "Fundamentals of Multimedia", 2nd Edition, PHI, 2005.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	summarize scalar and vector quantization theory and also to represent the multimedia data in different formats for various applications	Understanding (K2)
CO2:	make use of different coding techniques and apply various algorithms for text compression	Applying (K3)
CO3:	identify the various audio and speech compression techniques for practical applications	Applying (K3)
CO4:	take part in image compression techniques and also to implement the compression techniques in MATLAB	Analyzing (K4)
CO5:	compare various video compression algorithms for practical applications	Evaluating (K5)

Mapping of COs with POs

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

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

18MIE01 DISTRIBUTED SYSTEMS					
		L	**T**	**P**	**Credit**
		3	**0**	**0**	**3**
Preamble	Provide principles of distributed systems, including design and architecture, algorithms, locking, recovery, Replication and handling of failures in distributed environment.				
Prerequisites	Computer Networks				
UNIT – I					**9**
Introduction: Characteristics- Design goals- Types of distributed systems- **Architectures:** Architecture styles- Middleware organization- System architecture- Example architecture- the network file system.					
UNIT – II					**9**
Process: Threads- Virtualization- Clients- Servers- Code migration. **Communications:** Foundations- Remote procedure call- Message-oriented communication- multicast communication.					
UNIT – III					**9**
Naming: Names, identifiers, addresses- flat naming- Structured naming- attribute based naming. **Coordination:** Clock synchronization- Logical clocks- Mutual Exclusion- Election algorithms- Location systems.					
UNIT – IV					**9**
Consistency and Replication: Introduction -Data-centric consistency models- Client-centric consistency models- Replica management- Consistency Protocols					
UNIT – V					**9**
Fault Tolerance: Introduction- Process resilience- Reliable client-server communication- Reliable group communication- Distributed commit- Recovery					
					Total: 45
REFERENCES:					
1.	Maarten van Steen and Andrew S. Tanenbaum, "Distributed Systems", 2nd Edition, Pearson Education Inc., 2017.				
2.	Brendan Burns, "Designing Distributed Systems", 1st Edition, O'Reilly Media Inc., 2018.				

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	gain knowledge about the technologies in distributed environment	Understanding (K2)
CO2:	develop applications in the area of distributed systems (RMI, RPC)	Applying (K3)
CO3:	demonstrate various naming and coordination mechanisms	Evaluating (K5)
CO4:	demonstrate how consistency and replication are handled in distributed environment	Evaluating (K5)
CO5:	explain the concept of fault tolerance	Applying (K3)

Mapping of COs with POs

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

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			
CO2			2	3	1	
CO3			3	2	2	
CO4		2	3	3	3	
CO5			3		2	2

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

18MIE03 WEB ANALYTICS AND DEVELOPMENT				
	L	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Preamble	Explore the role of web data and analysis tools to perform web analysis to make efficient web search as well as for information retrieval.			
Prerequisites	Nil			
UNIT – I				**9**
Web Analytics: Introduction to Social media and network - Social Media: New Technologies of Collaboration - Social Network Analysis Measuring - Mapping - Modeling Collections of Connections - Search Engine Optimization.				
UNIT – II				**9**
NodeXL: Getting Started with NodeXL - Layout - Visual Design - Labeling - Calculating and Visualizing Network – Metrics.				
UNIT – III				**9**
Social Media Network Analysis: Email - Twitter: Nuts and Bolts - Networks - Acquiring Data - Discovery - Visualizing and Interpreting - Facebook - YouTube - Wiki Networks.				
UNIT – IV				**9**
Web Analytics 2.0: Introduction - Optimal Strategy: Steps to Predetermining Your Future Success - Click streamanalysis: Introduction- Metrics - Practical Solutions.				
UNIT – V				**9**
Competitive Intelligence Analysis: CI Data Sources, Types, and Secrets - Website Traffic Analysis .- Search and Keyword Analysis - Audience Identification and Segmentation Analysis - Emerging Analytics: Analyzing Offline Customer Experiences - Measuring the Success of Blogs - Optimal Solutions for Hidden Web Analytics.				
				Total: 45
REFERENCES:				
1.	Derek Hansen, Ben Shneiderman, Marc Smith, "Analyzing Social Media Networks with NodeXL: Insights from a Connected World", 1st Edition, Morgan Kaufmann, 2010,			
2.	Avinash Kaushik, "Web Analytics 2.0: The Art of Online Accountability", 1st Edition, Sybex, 2009.			

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	gain knowledge about web analytics	Understanding (K2)
CO2:	elaborate the process of node xl	Understanding(K2)
CO3:	demonstrate the social media analysis	Applying(K3)
CO4:	outline the fundamental conceptsof web analytics 2.0	Understanding(K2)
CO5:	apply the competitive intelligence techniques to perform web analysis	Applying(K3)

Mapping of COs with POs

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

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

18MIE04 MOBILE AND WIRELESS SECURITY

(Common to Information Technology &
Information Technology(Information Cyber Warfare) branches)

L	T	P	Credit
3	0	0	3

Preamble	The objective of this course is to have better knowledge on security issues, applications, attacks and security issues in wireless and mobile communications.
Prerequisites	Computer Networks

UNIT – I **9**

Introduction to Mobile and Wireless Networks: Cellular Networks, 1G through 3G, IEEE Networks - WLAN IEEE 802.11, WPAN IEEE 802.15, WMAN IEEE 802.16, IEEE 802.20, MIH IEEE 802.21, WRAN IEEE 802.22, Mobile Internet Networks – Macro and Micro mobility – Personal mobility – SIP – Identity based mobility, NEMO and MANETs – Vulnerabilities in wireless communications –security basics – symmetric and asymmetric cryptography, Hash functions – Electronic signatures – MAC – PKI and electronic certificate – IPSec – AAA protocol – Firewalls – Intrusion detection.

UNIT – II **9**

Wi-Fi Security Architectures: Hot Spot architecture – WIDS – Rogue AP detection – IEEE 802.11 geolocation techniques – Honeypots –Bluetooth Security – Protocol architecture – Radio physical layer – Device addressing – SCO and ACL logical transports – Security mode – Authentication and pairing – Attacks – BlueSmack – WiFi Security-Passive and Active attacks – DOS attacks – Trojan attack – Dictionary Attack.

UNIT – III **9**

IEEE 802.11 and WiMaX Security: Security in IEEE 802.11 – WEP – WEP2 – IV collisions – RC4 weakness – 802.1x authentication - 802.11i security architecture – policy negotiation – radio security policies – RADIUS – EAP – PKI – WiMAX security – TEK – KEK – IEEE 802.16e – PKMv2-RSA – Security Association – 3 way handshake – role of smart cards in WiMAX.

UNIT – IV **9**

Security in Adhoc Networks: Attacks to routing protocols – Security mechanisms – Auto-configuration – Key management – Self-managed PKI – Resurrecting Duckling – Group key management – Wireless Sensor Networks – Attacks – Preventive mechanisms – Intrusion tolerance – SNEP - μTELSA – TinySec – key management in WSNs.

UNIT – V **9**

Security in Mobile Telecommunication Networks: Signaling system 7 (SS7) – GSM security – GRPS security – UMTS infrastructure and security – H.323 – SIP – Megaco – VoIP security flaws and countermeasure – IMS architecture – security flaws – 4G security – Protection of interception – Security issues in Mobile IP – HIP – NetLMM.

Total: 45

REFERENCES:

1. Hakima Chaouchi and Maryline Laurent-Maknavicius, "Wireless and Mobile Network Security: Security basics, Security in On-the-shelf and Emerging Technologies", 2nd Edition, John Wiley & Sons, 2009.
2. Pallapa Venkataram and Sathish Babu, "Wireless and Mobile Network Security", 1st Edition, Tata McGraw Hill, 2010.
3. Amitabh Mishra, "Security and Quality of Service in Ad Hoc and Wireless Networks", 1st Edition, Cambridge University Press, 2008.

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)

Mapping of COs with POs

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

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

18COE13 DIGITAL IMAGE PROCESSING AND MULTI RESOLUTION ANALYSIS

(Common to Communication Systems, Mechatronics, Information Technology & Applied Electronics branches)

L	T	P	Credit
3	0	0	3

Preamble	To analyze the images in frequency domain and to perform various operations like enhancement, Restoration, Compression, Registration and Multi resolution analysis.
Prerequisites	Digital Signal Processing

UNIT – I **9**

Image Transforms: Orthogonal transforms – FT, DST, DCT, Hartley, Walsh hadamard, Haar, Radon, Slant Wavelet, KL, SVD and their properties.

UNIT – II **9**

Image Enhancement and Restoration: Image enhancement - Point operations - contrast stretching - clipping and thresholding - digital negative intensity level slicing - bit extraction. Histogram processing - histogram equalisation -modification. Spatial operations – smoothing spatial filters, sharpening spatial filters. Transform operations. Color image enhancement. Image Restoration – degradation model, Noise models, Unconstrained and Constrained restoration, Inverse filtering – removal of blur caused by uniform linear motion, Wiener filtering, Restoration by SVD and Homomorphic filtering

UNIT – III **9**

Image Compression: Image Compression – Need for data compression – Run length encoding – Huffman coding – Arithmetic coding – predictive coding- transform based compression, - vector quantization – block truncation coding. Image Segmentation: Point, Edge and line detection -thresholding-Region based approach Image Representation: boundary based – region based and intensity based description

UNIT – IV **9**

Registration and Multivalued Image Processing: Registration – geometric transformation – registration by mutual information Mutivalued image processing – colour image processing – colour image enhancement- satellite image processing- radiometric correction – other errors- multi spectral image enhancement- medical image processing – image fusion.

UNIT – V **9**

Wavelets and Multiresolution Processing: Image Pyramids – Subband coding – The Haar Transform – Multiresolution Expansion – Series Expansion – Scaling Function – Wavelet Function – Wavelet Transform in One Dimension- The Wavelet Series Expansion – The Discrete Wavelet Transform – The Continuous Wavelet Transform – The Fast Wavelet Transform – Wavelet transform in two dimensions– Applications in image denoising and compression.

Total: 45

REFERENCES:

1. Gonzalez Rafel C. and Woods Richard E., "Digital Image Processing", 4th Edition, Prentice Hall, New York, 2017.
2. Chanda B., Dutta Majumder D., "Digital Image Processing and Analysis", 2nd Edition, PHI Learning, 2011.
3. Abdeljalil Ouahabi, "Signal and Image Multiresolution Analysis", John Wiley & Sons, 2012.
4. Rosenfield Azriel and Kak Avinash C., "Digital Picture Processing", 2nd Edition, Academic Press Inc., New York, 1982.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	implement the image enhancement and image restoration techniques	Applying (K3)
CO2:	model the systems to enhance and restore the image optimally	Applying (K3)
CO3:	apply the coding technique to perform compression of images	Applying (K3
CO4:	apply the concepts of registration to fuse images of various modalities	Applying (K3)
CO5:	analyze the images in one dimension and two dimension simultaneously	Analyzing (K4)

Mapping of COs with POs

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

1 – Slight, 2 – Moderate, 3 – Substantial, BT – Blooms 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	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

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	1		1			
CO2	1	1	1			
CO3	2	1	2			
CO4	2	1	2			
CO5	3	1	3			
CO6	2	3	3			2
CO7	2	3	3			2
CO8	2	3	3			2

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

18MIE05 SOFTWARE QUALITY AND TESTING				
	L	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Preamble	Software Testing and Quality Assurance is predominant for the smartness of the Software system. Software testing is a critical element of software quality assurance and represents the ultimate review of specification, design and coding.			
Prerequisites	Software Engineering			
UNIT – I				**9**
Introduction: Basic concepts and Preliminaries – Theory of Program Testing– Unit Testing – Control Flow Testing –Data Flow Testing– System Integration Testing.				
UNIT – II				**9**
Software Testing Methodology: Software Test Plan–Components of Plan - Types of Technical Reviews - Static and Dynamic Testing- – Software Testing in Spiral Manner - Information Gathering - Test Planning - Test Coverage - Test Evaluation -Prepare for Next Spiral - Conduct System Test - Acceptance Test - Summarize Testing Results.				
UNIT – III				**9**
Emerging Specialized Areas in Testing: Test Process Assessment – Test Automation Assessment - Test Automation Framework – Nonfunctional Testing – SOA Testing – Agile Testing – Testing Center of Excellence – Onsite/Offshore Model - Modern Software Testing Tools – Software Testing Trends – Methodology to develop Software Testing Tool.				
UNIT – IV				**9**
Software Quality Models: Software quality –Verification versus Validation– Components of Quality Assurance – SQA Plan – Quality Standards – CMM – PCMM – CMMI – Malcolm Baldrige National Quality Award.				
UNIT – V				**9**
Quality through Continuous Improvement Process: Role of Statistical Methods in Software Quality – Transforming Requirements intoTest Cases – Deming's Quality Principles – Continuous Improvement through Plan Do Check Act (PDCA).				
				Total: 45

REFERENCES:

1. William E. Lewis, "Software Testing and Continuous Quality Improvement", 3rd Edition, Auerbach Publications, 2011.
2. Kshirasagar Naik and Priyadarshi Tripathy, "Software Testing and Quality Assurance Theory and Practice", 2nd Edition, John Wiley & Sons Publication, 2011.
3. Ron Patton, "Software Testing", 2nd Edition, Pearson Education, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	illustrate with various software testing strategies	Understanding (K2)
CO2:	discriminate the software testing techniques to cater to the needs of the project	Analyzing (K4)
CO3:	experiment the Emerging Specialized Areas in Testing	Applying (K3)
CO4:	classify the components of software quality assurance systems	Analyzing (K4)
CO5:	show the Quality through Continuous Improvement Process	Applying (K3)

Mapping of COs with POs

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

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

18MIE06 MODERN HIGH SPEED NETWORKING				
	L	**T**	**P**	**Credit**
	3	**0**	**0**	**3**

Preamble	Will gain a knowledge on traditional methods like packet switching and circuit switching techniques and its advancements that helps in achieving high speed network access, high speed LANs technologies, constraint based routing techniques, protocols for QoS support in fast networks and recent advancements in networks like SONET, SDN and WDM
Prerequisites	Basics of Networking

UNIT – I **9**

High Speed Networks: Frame Relay Networks – Asynchronous transfer mode – ATM Protocol Architecture, ATM logical Connection, ATM Cell – ATM Service Categories – AAL- High Speed LANs: Fast Ethernet, Gigabit Ethernet, Fibre Channel – Wireless LANs: applications, requirements – Architecture of 802.11

UNIT – II **9**

Integrated and Differentiated Services: Services- Integrated Services Architecture – Approach, Components, Services- Queuing Discipline, FQ, PS, BRFQ, GPS, WFQ , Differentiated Services

UNIT – III **9**

QOS Support and Optical Networks: Protocols for QoS Support : RSVP –Multiprotocol Label Switching – RTP, RTCP. Optical Networking: Synchronous Optical Networking (SONET), Wavelength Division Multiplexing (WDM)

UNIT – IV **9**

Software Defined Networks: SDN Approach, Standards, SDN Data plane and Open Flow, Control Plane and Application Plane, SDN Security

UNIT – V **9**

Virtualization in Networks: Virtualization: Network Function Virtualization Concepts and architecture, NFV Functionality, Network Virtualization, Quality of Experience, NFV Security

Total: 45

REFERENCES:

1. William Stallings, "High Speed Networks and Internet", 2nd Edition, Pearson Education, New Delhi, 2002.
2. William Stallings, "Foundations of Modern Networking", 1st Edition, Pearson Education, New Delhi, 2015.
3. Steven Shepard, "SONET/SDH Demystified", McGraw Hill Telecom, New York, 2002.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe the packet and switching techniques	Understanding (K2)
CO2:	make an analysis on High Speed LAN Technologies	Analyzing (K4)
CO3:	suggest a suitable architecture for constrain based routing in Networks	Analyzing (K4)
CO4:	describe the importance of QoS in high speed Networking	Understanding (K2)
CO5:	describe recent advancements in optical Networking	Understanding (K2)

Mapping of COs with POs

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

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

18MIE07 FORECASTING AND OPTIMIZATION TECHNIQUES

L	T	P	Credit
3	0	0	3

Preamble	Forecasting is a process used to predict future trend from past and present data. Optimization is used to select the best element that meets specified criteria from some set of available alternatives. This course provides a comprehensive introduction to forecasting methods and optimization techniques and help the students to build an optimized forecasting model
Prerequisites	Basic concepts of probability and statistics

UNIT – I **9**

Introduction to Forecasting: The Nature and Uses of Forecasts- The Forecasting Process- Resources for Forecasting- Types of Forecasting Techniques - Graphical Displays- Time Series Plots- Plotting Smoothed Data- Numerical Description of Time Series Data- Stationary Time Series- Auto covariance and Autocorrelation Functions- Use of Data Transformations and Adjustments- Transformations- Trend and Seasonal Adjustments- General Approach to Time Series Modeling and Forecasting- Evaluating and Monitoring Forecasting Model Performance- Forecasting Model Evaluation- Choosing between Competing Models- Monitoring a Forecasting Model

UNIT – II **9**

Regression Analysis and Forecasting: Least Squares Estimation in Linear Regression Models. Statistical Inference in Linear Regression. Test for Significance of Regression- Tests on Individual Regression Coefficients and Groups of Coefficients- Confidence Intervals on Individual Regression Coefficients. Confidence Intervals on the Mean Response. Prediction of New Observations. Model Adequacy Checking- Residual Plots- Scaled Residuals and PRESS. Measures of Leverage and Influence- Variable Selection Methods in Regression- Generalized and Weighted Least Squares. Generalized Least Squares. Weighted Least Squares- Discounted Least Squares. Regression Models for General Time Series Data- Detecting Autocorrelation: The Durbin-Watson Test- Outliers- Multicollinearity- Hetrosckedasticity- Autocorrelation and Structural Breaks- Estimating the Parameters in Time Series Regression Models

UNIT – III **9**

Autoregressive Integrated Moving Average (ARIMA) and Other Models: First Order Exponential Smoothing- Second Order Exponential Smoothing- Higher Order Exponential Smoothing- Exponential Smoothing for Seasonal Data- Linear Models for Stationary Time Series- Finite Order Moving Average (MA) Processes- Finite Order Autoregressive Processes- Mixed Autoregressive-Moving Average Processes- Nonstationary Processes- Time Series Model Building- Forecasting ARIMA Processes- Seasonal Processes- Exponential Smoothers and ARIMA Models- Multivariate Stationary Process- Vector ARIMA Models- Vector AR (VAR) Models- State Space Models- ARCH and GARCH Models- Direct Forecasting of Percentiles-Neural Networks and Forecasting

UNIT – IV **9**

Numerical Methods of Optimization: What is optimization? -Linear programming- Integer programming- Quadratic programming- Nonlinear programming- Stochastic programming- Dynamic programming- Combinatorial optimization- Infinite-dimensional optimization- Constraint satisfaction.

UNIT – V **9**

Advanced Optimization Techniques and Aspects of Optimization: Hill climbing- simulated annealing- genetic algorithm- Ant colony- Optimization of Fuzzy Systems- Neural-Network-Based Optimization- Reduction of Size of an Optimization Problem- Fast Reanalysis Techniques- Derivatives of Static Displacements and Stresses- Derivatives of Eigenvalues and Eigenvectors- Derivatives of Transient Response- Sensitivity of Optimum Solution to Problem Parameters- Multilevel Optimization- Parallel Processing- Multiobjective Optimization.

Total: 45

REFERENCES:

1. Hyndman, R.J. and Athanasopoulos, G. (2018) Forecasting: principles and practice, 2nd edition, OTexts: Melbourne, Australia. Online: www.OTexts.com/fpp2.
2. Gupta C. B., "Optimization Techniques in Operation Research", 2nd Edition, I.K. International Publishing House, Pvt Ltd., 2012.
3. Hamdy A. Taha, "Operations Research: An Introduction", 9th Edition, Pearson, 2010.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain forecasting methods used in time series modeling	Understanding (K2)
CO2:	apply regression analysis using different regression models	Applying (K3)
CO3:	distinguish the variants of autoregressive model	Analyzing (K4)
CO4:	illustrate the numerical methods of optimization	Understanding (K2)
CO5:	apply the concept of advanced optimization techniques using soft computing techniques to various problems	Applying (K3)

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		3	3	3	
CO4	3		3	3	3	
CO5	3	2	3	3	3	2

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

18MIE08 QUANTUM COMPUTING

L	T	P	Credit
3	0	0	3

Preamble	Provide an insight of basic of quantum physics from a computer scientist's perspective, and how it describes reality and understand the philosophical implications of quantum computing
Pre-requisites	Linear Algebra, Theory of Computation

UNIT – I **9**

Qubit and Quantum States: The Qubit- Vector Spaces - Linear Combination Of Vectors - Uniqueness of a spanning set - basis & dimensions - inner Products – orthonormality - gram-schmidt orthogonalization - bra-ket formalism - the Cauchy-schwarez and triangle Inequalities.

UNIT – II **9**

Matrices and Operators: Observables - The Pauli Operators - Outer Products - The Closure Relation - Representation of operators using matrices - outer products & matrix representation - matrix representation of operators in two dimensional spaces - Pauli Matrix - Hermitian unitary and normal operator - Eigen values and Eigen Vectors - Spectral Decomposition - Trace of an operator - importantproperties of Trace - Expectation Value of Operator - Projection Operator - Positive Operators.

UNIT – III **9**

Tensor Products: Representing Composite States in Quantum Mechanics - Computing inner products - Tensor products of column vectors - operators and tensor products of Matrices.

UNIT – IV **9**

Density Operator: Density Operator of Pure and Mix state - Key Properties - Characterizing Mixed State - Practical Trace and Reduce Density Operator - Density Operator and Bloch Vector.

UNIT – V **9**

Quantum Measurement Theory: Distinguishing Quantum states and Measures - Projective Measurements - Measurement on Composite systems - Generalized Measurements - Positive Operator-Valued Measures.

Total: 45

REFERENCES:

1. David McMahon, "Quantum Computing Explained", John Wiley & Sons Inc., 2008.
2. Zdzislaw Meglicki, "Quantum Computing Without Magic: Devices", The MIT Press, 2008.
3. Marco Lanzagorta, Jeffrey Uhlmann, "Quantum Computer Science", Morgan & Claypool Publishers, 2012.
4. Phillip Kaye, Raymond Laflamme, Michele Mosca , "An Introduction to Quantum Computing", Oxford University Press, 2007.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	explain qubit and quantum states	Understanding (K2)
CO2:	identify various operation that can be done using operators and matrices	Understanding (K2)
CO3:	apply Tensor product and density operator to various operation	Applying (K3)
CO4:	implement the principles of density operator for solving problems	Applying (K3)
CO5:	summarize quantum measurement theory	Understanding (K2)

Mapping of COs with POs

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

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	2		2	3		
CO2	2		2	3		
CO3	2		2	3		
CO4	2		2	3		
CO5			2	2		
CO6			2		3	
CO7					2	
CO8				2	2	1

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

18MIE10 KNOWLEDGE ENGINEERING				
	L	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Preamble	A comprehensive understanding of Artificial Intelligence and build intelligent behavior to show how this knowledge can be represented symbolically, and how automated reasoning procedures can make Intelligent Systems in the context of Knowledge Engineering.			
Prerequisites	Discrete Mathematics, Artificial Intelligence			

UNIT – I	**9**
Introduction: Intelligent Agents - Problem Solving - Solving Problems by Searching - Beyond Classical Search - Adversarial Search - Constraint Satisfaction Problems.	

UNIT – II	**9**
Knowledge and Reasoning: Logical Agents - First Order Logic - Inference in First Order Logic - Knowledge Representation.	

UNIT – III	**9**
Uncertain Knowledge and Reasoning: Quantifying Uncertainty-Probabilistic Reasoning - Probabilistic Reasoning over Time - Making Simple Decisions -Making Complex Decisions.	

UNIT – IV	**9**
Object Oriented Representation: Object-Oriented Representation - Frame Formalism - Structured Descriptions - Meaning and Entailment - Taxonomies and Classification - Inheritance	

UNIT – V	**9**
Actions and Planning: Actions - The Situation Calculus - Frame Problem - Complex Actions - Planning - The STRIPS Representation - Planning as a Reasoning Task - Hierarchical and Conditional Planning	
	Total: 45

REFERENCES:

1. Russell Stuart and Norvig Peter, "Artificial Intelligence: A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, New Delhi, 2009.
2. Ronald Brachman and Hector Levesque, "Knowledge Representation and Reasoning", 1st Edition, The Morgan Kaufmann Series in Artificial Intelligence, 2004.
3. Arthur B. Markman, "Knowledge Representation", 1st Edition, Lawrence Erlbaum Associates, Reprint 2008.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	provide a strong foundation of fundamental concepts in Artificial Intelligence	Understanding (K2)
CO2:	discover different search strategies for a problem	Understanding (K2)
CO3:	get familiar with the various applications of AI techniques in Intelligent Systems	Applying (K3)
CO4:	analyze different knowledge representation schemes for typical AI problems	Analyzing (K4)
CO5:	evaluate a typical AI problem to be solved using machine learning techniques	Evaluating (K5)

Mapping of COs with POs

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

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

18MIE11 DATA SCIENCES

L	T	P	Credit
3	0	0	3

Preamble	Give students a thorough understanding of data science, its lifecycle and applications and to enable them to design, develop and apply various techniques for analyzing big data in different scenarios
Pre-requisites	Nil

UNIT – I **9**

Introduction: Big Data Overview- Practice in Analytics – Key Roles of Big data Eco system – Examples – Data Analytics life cycle: Discovery – Data Preparation – Model Planning – Model Building – Communicate results – Operationalize – Case study: Global Innovation Network and Analysis.

UNIT – II **9**

Data Analytical Methods: Linear Regression: Use Cases – Model description – Diagnostics – Logistic Regression: Use Cases – Model description – Diagnostics – Reasons to choose and cautions – Additional regressional models – Case studies.

UNIT – III **9**

Big Data Technologies: Big data - Types of Data – Characteristics – Evolution – Definition – Challenges – Other Characteristics - Business Intelligence Vs Big Data – Big Data Analytics: Classification of Analytics – Top Challenges and importance – Data Science – Data Scientist - Terminologies used in Big data environments – Big data Technology landscape: NoSQL – Hadoop.

UNIT – IV **9**

Hadoop: Introduction – RDBMS Vs Hadoop – Distributed Computing Challenges – Hadoop History and Overview – Hadoop Distributed File System – Processing Data with Hadoop – Managing Resources and Applications with Hadoop - Interacting with Hadoop Ecosystem.

UNIT – V **9**

MongoDB and Cassandra: MongoDB : Introduction to MongoDB – RDBMS and MongoDB - Data Types in MongoDB – MongoDB Query Language. Cassandra: Introduction – Features of Cassandra – CQL Data Types – Operations – Collections – Alter Commands – Import and Export – Querying System Tables.

Total: 45

REFERENCES:

1. EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", John Wiley and Sons, 2015.
2. Seema Acharya and Subhashini Chellappan, "Big Data and Analytics", 1st Edition, Wiley, 2015.
3. Frank J. Ohlhorst, "Big Data Analytics: Turning Big Data into Big Money", Wiley and SAS Business Series, 2012.
4. Holden Kararu, Andy Konwinski, Padtrick Wendell and Matei Zaharia, "Learning Spark", O'Reilly Books, 2015.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	acquire basic knowledge of big data and data analytics lifecycle	Understanding (K2)
CO2:	apply analytical methods to manipulate data	Applying (K3)
CO3:	recall the concepts of big data technologies	Understanding (K2)
CO4:	demonstrate the application of Hadoop framework	Applying (K3)
CO5:	implement MongoDB and Cassandra to manage and retrieve data from data stores	Applying (K3)

Mapping of COs with POs

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

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

18MIE12 GPU ARCHITECTURE AND PROGRAMMING				
	L	**T**	**P**	**Credit**
	3	**0**	**0**	**3**
Preamble	Provide principles of GPU computer architecture with programming environments and architectural aspects of modern GPUs, with a special focus on their streaming parallel nature, writing programs on the GPU using high level languages like CUDA.			
Prerequisites	Computer Architecture, C Programming			
UNIT – I				**9**
Introduction: Overview of supercomputing - Understanding parallelism with GPUs - CUDA hardware overview- Setting up CUDA				
UNIT – II				**9**
Memory handling with CUDA: Introduction – caches - shared memory - Constant memory - Global memory - Texture Memory				
UNIT – III				**9**
CUDA in Practice: Introduction -Serial and Parallel code - Processing datasets – Profiling - An example using AES - Multi-CPU and Multi-GPU solutions				
UNIT – IV				**9**
Optimizing Application: Parallel/Serial GPU/CPU - Memory considerations –Transfers - Thread usage - Calculations and Divergence – Algorithms				
UNIT – V				**9**
Designing GPU-Based Systems: Introduction - CPU Processor - GPU Device - Mass storage - Power Consideration				
				Total: 45

REFERENCES:

1. Shane Cook, "CUDA Programming: A Developers guide to parallel computing with GPUs", Morgan Kaufmann, 2013.
2. John Cheng and Max Grossman and Ty McKercher, "Professional CUDA C Programming", John Wiley & Sons Inc., 2014.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	describe about the parallel programming with GPUs	Understanding (K2)
CO2:	explain about CUDA memory handling techniques	Applying (K3)
CO3:	write programs using CUDA	Applying (K3)
CO4:	implement the optimized application using CUDA	Applying (K3)
CO5:	explain the GPU based system and its issues and solutions	Understanding (K2)

Mapping of COs with POs

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

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

18MIE13 MOBILE APPLICATIONS AND SERVICES

L	T	P	Credit
3	0	0	3

Preamble	To understand system requirements for mobile applications and Generate suitable design using specific mobile development frameworks, mobile application design and to Implement the design using specific mobile development frameworks and deploy the mobile applications in marketplace for distribution.
Prerequisites	Mobile Computing

UNIT – I **9**

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

UNIT – II **9**

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

UNIT – III **9**

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

UNIT – IV **9**

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

UNIT – V **9**

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

Total: 45

REFERENCES:

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6 Development: Exploring the iOS SDK”, Apress, 2013.
3. http://developer.android.com/develop/index.html.
4. James Dovey and Ash Furrow, “Beginning Objective C”, Apress, 2012.
5. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012.
6. Reto Meier, “Professional android Development”, Wiley-India Edition, 2012.

COURSE OUTCOMES: On completion of the course, the students will be able to		**BT Mapped (Highest Level)**
CO1:	summarize the requirements for mobile applications	Remembering (K1)
CO2:	explain the challenges in mobile application design and development	Understanding (K2)
CO3:	develop design for mobile applications for specific requirements	Creating (K6)
CO4:	implement the design using Objective C and iOS	Applying (K3)
CO5:	deploy mobile applications in Android and iPhone marketplace for distribution	Creating (K6)

Mapping of COs with POs

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

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