KIT-Kalaignarkarunanidhi Institute of Technology
(An Autonomous Institution)
Coimbatore – 641 402.

Department of Computer Science and Engineering
PG – Computer Science and Engineering
Conceptual Frame work
(For Students admitted from the Academic Year 2019-20 and onwards)

Semester	Level of Course	Hours / Week	No of Courses	Range of Credits/ Courses	Total Credits
PART I					
A - Foundation Courses					
I	Foundation Courses **(FC)**	4	1	4	4
B - Professional Core Courses					
I to III	Professional Core **(PC)**	3	12	3-4	35
C - Elective Courses					
I to III	Professional Elective **(PE)**	3	4	3	12
D – Project Work					
III & IV	Project Work **(PW)**	12 -24	2	6 -12	18
Total Credit					**69**
PART II- Career Enhancement Courses (CEC)					
II	Article Writing and Seminar	2	1	1	1
Total Credit					**01**
Total Credit to be Earned					**70**

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Scheme of Instructions and Examinations

(For Students admitted from the Academic Year 2019-20 and onwards)

Semester I											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19MAT102	Applied Probability and Statistics	FC	4	4	0	0	3	40	60	100	4
M19CST101	Advanced Data Structures	PC	4	4	0	0	3	40	60	100	4
M19CST102	Advanced Computer Architecture	PC	3	3	0	0	3	40	60	100	3
M19CST103	Operating System Internals	PC	3	3	0	0	3	40	60	100	3
M19CST104	Machine Learning Techniques	PC	3	3	0	0	3	40	60	100	3
M19CST105	Advanced Software Engineering	PC	3	3	0	0	3	40	60	100	3
M19CSP101	Advanced Data Structures Laboratory	PC	4	0	4	0	3	40	60	100	2
Total Hrs/ Week			**24**	**20**	**4**	**0**	**Total Credits**				**22**

Semester II											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CST201	Network Design and Technologies	PC	3	3	0	0	3	40	60	100	3
M19CST202	Security Practices	PC	3	3	0	0	3	40	60	100	3
M19CST203	Internet of Things	PC	3	3	0	0	3	40	60	100	3
M19CST204	Big Data Analytics	PC	3	3	0	0	3	40	60	100	3
	Professional Elective I	PE	3	3	0	0	3	40	60	100	3
	Professional Elective II	PE	3	3	0	0	3	40	60	100	3
M19CSP201	Big Data Analytics Laboratory	PC	4	0	4	0	3	40	60	100	2
M19CSP202	Term Paper Writing and Seminar	CEC	2	0	2	0	3	40	60	100	1
Total Hrs/ Week			**24**	**18**	**4**	**0**	**Total Credits**				**21**

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Semester III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CST301	Research Methodology	PC	3	3	0	0	3	40	60	100	3
	Professional Elective III	PE	3	3	0	0	3	40	60	100	3
	Professional Elective IV	PE	3	3	0	0	3	40	60	100	3
M19CSP301	Project Phase I	PW	12	0	12	0	3	40	60	100	6
Total Hrs/ Week			**21**	**9**	**12**	**0**	**Total Credits**				**15**

Semester IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSP401	Project Phase II	PW	24	0	24	0	3	40	60	100	12
Total Hrs/ Week			**24**	**0**	**24**	**0**	**Total Credits**				**12**

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FOUNDATION COURSES (FC)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19MAT102	Applied Probability and Statistics	FC	4	3	0	1	3	40	60	100	4

PROFESSIONAL CORE (PC)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CST101	Advanced Data Structures	PC	3	3	0	0	3	40	60	100	3
M19CST102	Advanced Computer Architecture	PC	3	3	0	0	3	40	60	100	3
M19CST103	Operating System Internals	PC	3	3	0	0	3	40	60	100	3
M19CST104	Machine Learning Techniques	PC	3	3	0	0	3	40	60	100	3
M19CST105	Advanced Software Engineering	PC	3	3	0	0	3	40	60	100	3
M19CSP101	Advanced Data Structures Laboratory	PC	3	3	0	0	3	40	60	100	2
M19CST201	Network Design and Technologies	PC	3	3	0	0	3	40	60	100	3
M19CST202	Security Practices	PC	3	3	0	0	3	40	60	100	3
M19CST203	Internet of Things	PC	3	3	0	0	3	40	60	100	3
M19CST204	Big Data Analytics	PC	3	3	0	0	3	40	60	100	3
M19CSP201	Big Data Analytics Laboratory	PC	4	0	4	0	3	40	60	100	2

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PROFESSIONAL ELECTIVES (PE)

Semester – II

Elective – I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			t Period	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSE201	Advanced Databases	PE	3	3	0	0	3	40	60	100	3
M19CSE202	Principles of Programming Languages	PE	3	3	0	0	3	40	60	100	3
M19CSE203	Image Processing and Analysis	PE	3	3	0	0	3	40	60	100	3
M19CSE204	Web Engineering	PE	3	3	0	0	3	40	60	100	3
M19CSE205	Cloud Computing Technologies	PE	3	3	0	0	3	40	60	100	3

Semester – II

Elective – II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSE206	Real Time Systems	PE	3	3	0	0	3	40	60	100	3
M19CSE207	Mobile and Pervasive Computing	PE	3	3	0	0	3	40	60	100	3
M19CSE208	Parallel Programming Paradigms	PE	3	3	0	0	3	40	60	100	3
M19CSE209	Information Retrieval Techniques	PE	3	3	0	0	3	40	60	100	3
M19CSE210	Software Architectures and Design	PE	3	3	0	0	3	40	60	100	3

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Semester – III
Electives – III

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSE301	Security for Internet of Things.	PE	3	3	0	0	3	40	60	100	3
M19CSE302	Data Visualization Techniques	PE	3	3	0	0	3	40	60	100	3
M19CSE303	Block chain Technology	PE	3	3	0	0	3	40	60	100	3
M19CSE304	Product Design and Development	PE	3	3	0	0	3	40	60	100	3
M19CSE305	Embedded Software Development	PE	3	3	0	0	3	40	60	100	3

Semester - III
Electives – IV

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSE306	Bio Informatics	PE	3	3	0	0	3	40	60	100	3
M19CSE307	Information Storage Management	PE	3	3	0	0	3	40	60	100	3
M19CSE308	Bio-inspired Computing	PE	3	3	0	0	3	40	60	100	3
M19CSE309	Mobile Application Development	PE	3	3	0	0	3	40	60	100	3
M19CSE310	Social Network Analysis	PE	4	3	0	0	3	40	60	100	3

PROJECT WORK (PW)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSP301	Project Work - Phase I	PW	12	0	12	0	3	40	60	100	6
M19CSP401	Project Phase II	PW	24	0	24	0	3	40	60	100	12

CAREER ENHANCEMENT COURSE (CEC)

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19CSP202	Term Paper Writing and Seminar	CEC	2	0	2	0	3	100	-	100	1

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Semester - I

M.E.	M19MAT102 - APPLIED PROBABILITY AND STATISTICS	T	P	TU	C
		4	0	0	4

Course Objectives:

1. To understand the basic concepts of one dimensional random variables to introduce and some standard distributions applicable in engineering which can describe real life phenomenon.
2. To introduce the basic concepts of two dimensional random variables that apply in engineering problems.
3. This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling.
4. It is framed to address the issues and the principles of estimation theory, testing of hypothesis.
5. To introduce the concept of multivariate analysis in data sciences.

UNIT - I ONE DIMENSIONAL RANDOM VARIABLES 12

Random variables - Probability function - Moments - Moment generating functions and their properties - Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions

UNIT - II TWO DIMENSIONAL RANDOM VARIABLES 12

Joint distributions - Marginal and conditional distributions - Functions of two dimensional random variables - Regression curve - Correlation.

UNIT - III TESTING OF HYPOTHESIS 12

Sampling distributions - Type I and Type II errors - Large samples: Tests based on Normal (mean and proportion). Small samples: t test for mean, F test for variance, Chi square tests for independence of attributes and goodness of fit.

UNIT - IV ESTIMATION THEORY 12

Unbiased estimators - Method of moments - Maximum likelihood estimation - Curve fitting by principle of least squares - Regression lines.

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UNIT - V MULTIVARIATE ANALYSIS 12

Random vectors and matrices - Mean vectors and covariance matrices - Multivariate normal density and its properties - Principal components - Population principal components - Principal components from standardized variables

Total Instructional hours: 60

Course Outcomes:

Students will be able to

CO1: Identify Moments, MGF and solve different types of distribution problems.

CO2: Make use of two dimensional random variables in correlation and regression analysis.

CO3: Apply the concept of testing of hypothesis for small and large samples in real life problems.

CO4: Construct Unbiased Estimators, Moments and Regression lines.

CO5: Develop the concepts of multivariate normal distribution and principle components analysis.

Reference Books:

1. Devore, J. L., “Probability and Statistics for Engineering and the Sciences” (Cengage Learning), 8th Edition, 2014.
2. Joseph.F.Hair, “Applied Multivariate Methods for Data Analysis”, (Pearson New International Edition), 7th Edition, 2013.
3. Gupta S.C. and Kapoor V.K., “Fundamentals of Mathematical Statistics”, (Sultan and Sons), New Delhi, 2019.
4. Johnson, R.A., Miller, I and Freund J., "Miller and Freund„s Probability and Statistics for Engineers ", (Pearson Education, Asia), 8th Edition, 2015.
5. Richard A. Johnson and Dean W. Wichern, “Applied Multivariate Statistical Analysis”,(Pearson Education, Asia), 6th Edition 2018.

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M.E.	M19CST101 - ADVANCED DATA STRUCTURES AND ALGORITHMS	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To understand the usage of algorithms in computing.
2. To learn and use hierarchical data structures and its operations
3. To learn the usage of graphs and its applications.
4. To select and design data structures and algorithms that is appropriate for problems.
5. To study about NP Completeness of problems.

UNIT -I ROLE OF ALGORITHMS IN COMPUTING 9

Algorithms – Algorithms as a Technology- Insertion Sort – Analyzing Algorithms – Designing Algorithms- Growth of Functions: Asymptotic Notation – Standard Notations and Common Functions- Recurrences: The Substitution Method – The Recursion-Tree Method

UNIT -II HIERARCHICAL DATA STRUCTURES 9

Binary Search Trees: Basics – Querying a Binary search tree – Insertion and Deletion- Red-Black trees: Properties of Red-Black Trees – Rotations – Insertion – Deletion -B-Trees: Definition of B-trees – Basic operations on B-Trees – Deleting a key from a B-Tree- Fibonacci Heaps: structure – Mergeable-heap operations- Decreasing a key and deleting a node-Bounding the maximum degree.

UNIT -III GRAPHS 9

Elementary Graph Algorithms: Representations of Graphs – Breadth-First Search – Depth-First Search – Topological Sort – Strongly Connected Components- Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra_s Algorithm; All-Pairs Shortest Paths: Shortest Paths and Matrix Multiplication – The Floyd-Warshall Algorithm

UNIT -IV ALGORITHM DESIGN TECHNIQUES 9

Dynamic Programming: Matrix-Chain Multiplication – Elements of Dynamic Programming – Longest Common Subsequence- Greedy Algorithms: An Activity-Selection Problem – Elements of the Greedy Strategy- Huffman Codes.

UNIT -V NP COMPLETE AND NP HARD 9

NP-Completeness: Polynomial Time – Polynomial-Time Verification – NP- Completeness and Reducability – NP-Completeness Proofs – NP-Complete Problems

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Apply data structures and algorithms to solve computing problems

CO2: Apply Hierarchical structures to solve the problems using red black tree, B-tree and Heaps.

CO3: Build algorithms using graph structure and various string matching algorithms to solve real-life problems

CO4: Apply suitable design strategy for problem solving

CO5: Outline about NP Complete and NP hard

Reference Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms ‖, Pearson Education, Reprint 2006.
2. Robert Sedgewick and Kevin Wayne, ―ALGORITHMS‖, Fourth Edition, Pearson Education.
3. S.Sridhar, ―Design and Analysis of Algorithms‖, First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, ―Introduction to Algorithms‖, Third Edition, Prentice-Hall, 2011.

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M.E.	M19CST102 - ADVANCED COMPUTER ARCHITECTURE	T	P	TU	C
		3	0	0	3

Course Objective:

1. To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters
2. To learn the different multiprocessor issues.
3. To expose the different types of multicore architectures.
4. To understand the design of the memory hierarchy.

UNIT – I FUNDAMENTALS OF COMPUTER DESIGN AND ILP 9

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP – Multithreading

UNIT - II MEMORY HIERARCHY DESIGN 9

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

UNIT - III MULTIPROCESSOR ISSUES 9

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures –Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT - IV MULTICORE ARCHITECTURES 9

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers- Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT - V VECTOR, SIMD AND GPU ARCHITECTURES 9

Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism-Case Studies.

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Identify the limitations of ILP

CO2: Summarize the Optimization and memory Hierarchy design

CO3: Outline the issues related to multiprocessing and suggest solutions

CO4: Identify the salient features of different multicore architectures and how they exploit parallelism

CO5: Identify how data level parallelism is exploited in architectures

Reference Books:

1. Darryl Gove, ―Multicore Application Programming: For Windows, Linux, and Oracle Solaris‖, Pearson, 2011
2. David B. Kirk, Wen-mei W. Hwu,―Programming Massively Parallel Processors‖, Morgan Kauffman, 2010
3. David E. Culler, Jaswinder Pal Singh,‖Parallel computing architecture : A hardware/software approach‖ , Morgan Kaufmann /Elsevier Publishers, 1999
4. John L. Hennessey and David A. Patterson, ―Computer Architecture – A Quantitative Approach‖, Morgan Kaufmann / Elsevier, 5th edition, 2012.
5. Kai Hwang and Zhi.Wei Xu, ―Scalable Parallel Computing‖, Tata McGraw Hill, NewDelhi, 2003

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M.E.	M19CST103 - OPERATING SYSTEM INTERNALS	T	P	TU	C
		3	0	0	3

Course Objective:

1. To be able to read and understand sample open source programs and header files.
2. To learn how the processes are implemented in Linux.
3. To understand the implementation of the Linux file system.
4. To study Linux memory management data structures and algorithms.
5. To acquire the knowledge in the implementation of interprocess communication.
6. To understand how program execution happens in Linux.

UNIT -I INTRODUCTION 9

Basic Operating System Concepts - Overview of Unix File System - Files - Links - Types - Inodes -Access Rights - System Calls - Overview of Unix Kernels -Model - Implementation - Reentrant Kernels - Address Space - Synchronization - Interprocess Communication - Process Management - Memory Management - Device Drivers.

UNIT -II PROCESSES 9

Processes, Lightweight Processes, and Threads - Process Descriptor - State - Identifying a Process - Relationships among processes - Organization - Resource Limits - Creating Processes - - System Calls - Kernel Threads - Destroying Processes -Termination - Removal.

UNIT -III FILE SYSTEM 9

The Virtual File System (VFS) - Role - File Model -System Calls - Data Structures - Super Block, Inode, File, dentry Objects - dentry Cache - Files Associated with a Process - Filesystem Types - Special Filesystems - Filesytem Type Registration - Filesytem Handling - Namespaces - Mounting - Unmounting - Implementation of VFS System Calls.

UNIT –IV MEMORY MANAGEMENT 9

Page frame management -page descriptors - non-uniform memory access - memory zones - reserved page frames - zoned page frame allocator - kernel mappings - buddy system algorithm - page frame cache - zone allocator.

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UNIT -V PROCESS COMMUNICATION AND PROGRAM EXECUTION 9

Process Communication - Pipes -Usage - Data Structures - Creating and Destroying a Pipe - Reading From and Writing into a Pipe. Program Execution - Executable Files - Process Credentials - Command-Line Arguments and Shell Environment - Libraries - Program Segments and Process Memory Regions - Execution tracing - Executable Formats - Execution Domains - The exec Functions

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Explain the functionality of a large software system by reading its source.

CO2: Summarize how the processes are implemented in Linux

CO3: Outline the implementation of the Linux file system.

CO4: Summarize Linux memory management data structures and algorithms.

CO5: Illustrate the knowledge in the implementation of interprocess communication and understand how program execution happens in Linux.

Reference Books:

1. Daniel P. Bovet and Marco Cesati, "Understanding the Linux Kernel", 3rd Edition, O'Reilly Publications, 2005.
2. Harold Abelson, Gerald Jay Sussman and Julie Sussman, ―Structure and Interpretation of Computer Programs‖, Second Edition, Universities Press, 2013.
3. Maurice J. Bach, ―The Design of the Unix Operating System‖ 1st Edition Pearson Education, 2003.
4. Michael Beck, Harald Bohme, Mirko Dziadzka, Ulrich Kunitz, Robert Magnus, Dirk Verworner, ―Linux Kernel Internals‖, 2nd Edition, Addison-Wesley, 1998.
5. Robert Love, ―Linux Kernel Development‖, 3rd Edition, Addison-Wesley, 2010.

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M.E.	M19CST104 - MACHINE LEARNING TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objective:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To have a thorough understanding of the Supervised and Unsupervised learning techniques
3. To study the various probability based learning techniques
4. To understand graphical models of machine learning algorithms

UNIT -I INTRODUCTION 9

Learning – Types of Machine Learning – Supervised Learning – The Brain and the Neuron – Design a Learning System – Perspectives and Issues in Machine Learning – Concept Learning Task – Concept Learning as Search – Finding a Maximally Specific Hypothesis – Version Spaces and the Candidate Elimination Algorithm – Linear Discriminants – Perceptron – Linear Separability – Linear Regression.

UNIT -II LINEAR MODELS 9

Multi-layer Perceptron – Going Forwards – Going Backwards: Back Propagation Error – Multi-layer Perceptron in Practice – Examples of using the MLP – Overview – Deriving Back-Propagation – Radial Basis Functions and Splines – Concepts – RBF Network – Curse of Dimensionality – Interpolations and Basis Functions – Support Vector Machines.

UNIT -III TREE AND PROBABILISTIC MODELS 9

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

UNIT -IV DIMENSIONALITY REDUCTION AND EVOLUTIONARY MODELS 9

Dimensionality Reduction – Linear Discriminant Analysis – Principal Component Analysis – Factor Analysis – Independent Component Analysis – Locally Linear Embedding – Isomap – Least Squares Optimization – Evolutionary Learning – Genetic algorithms – Genetic

Offspring: - Genetic Operators – Using Genetic Algorithms – Reinforcement Learning – Overview – Getting Lost Example – Markov Decision Process

UNIT -V GRAPHICAL MODELS 9

Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Markov Chain Monte Carlo – Graphical Models – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Compare supervised, unsupervised and semi-supervised learning

CO2: Apply the appropriate machine learning strategy for any given problem

CO3: Develop supervised, unsupervised or semi-supervised learning algorithms for any given problem

CO4: Build systems that uses the appropriate graph models of machine learning

CO5: Make use of existing machine learning algorithms to improve classification efficiency

Reference Books:

1. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)‖, Third Edition, MIT Press, 2014
2. Jason Bell,‖Machine learning – Hands on for Developers and Technical Professionals‖, First Edition, Wiley, 2014.
3. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data‖, First Edition, Cambridge University Press, 2012.
4. Stephen Marsland, ―Machine Learning – An Algorithmic Perspective‖, Second Edition, Chapman and Hall/CRC Machine Learning and Pattern Recognition Series, 2014.
5. Tom M Mitchell, ―Machine Learning‖, First Edition, McGraw Hill Education, 2013.

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M.E.	M19CST105 - ADVANCED SOFTWARE ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objective:

1. To understand Software Engineering Lifecycle Models
2. To do project management and cost estimation
3. To gain knowledge of the System Analysis and Design concepts.
4. To understand software testing approaches
5. To be familiar with DevOps practices

UNIT -I INTRODUCTION 9

Software engineering concepts – Development activities – Software lifecycle models - Classical waterfall - Iterative waterfall – Prototyping – Evolutionary - Spiral – Software project management – Project planning – Estimation – Scheduling – Risk management – Software configuration management.

UNIT -II SOFTWARE REQUIREMENT SPECIFICATION 9

Requirement analysis and specification – Requirements gathering and analysis – Software Requirement Specification – Formal system specification – Finite State Machines – Petrinets – Object modelling using UML – Use case Model – Class diagrams – Interaction diagrams – Activity diagrams – State chart diagrams – Functional modelling – Data Flow Diagram.

UNIT -III ARCHITECTURE AND DESIGN 9

Software design – Design process – Design concepts – Coupling – Cohesion – Functional independence – Design patterns – Model-view-controller – Publish-subscribe – Adapter – Command – Strategy – Observer – Proxy – Facade – Architectural styles – Layered - Client-server - Tiered - Pipe and filter.- User interface design

UNIT -IV TESTING 9

Testing – Unit testing – Black box testing– White box testing – Integration and System testing– Regression testing – Debugging - Program analysis – Symbolic execution – Model Checking

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UNIT -V DEVOPS 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Outline the advantages of various Software Development Lifecycle Models

CO2: Summarize about the software requirement specification

CO3: Develop a design using architectural styles and design patterns

CO4: Summarize software testing approaches

CO5: Infer the advantages of DevOps practices

Reference Books:

1. Bernd Bruegge, Alan H Dutoit, ―Object-Oriented Software Engineering‖, 2nd edition, Pearso Education, 2004.
2. Carlo Ghezzi, Mehdi Jazayeri, Dino Mandrioli, ―Fundamentals of Software Engineering‖, 2nd edition, PHI Learning Pvt. Ltd., 2010.
3. Craig Larman, ―Applying UML and Patterns‖, 3rd ed, Pearson Education, 2005.
4. Len Bass, Ingo Weber and Liming Zhu, ―DevOps: A Software Architect_s Perspective‖, Pearson Education, 2016
5. Rajib Mall, ―Fundamentals of Software Engineering‖, 3rd edition, PHI Learning Pvt. Ltd., 2009.
6. Stephen Schach, ―Software Engineering‖, 7th ed, McGraw-Hill, 2007.

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M.E.	M19CSP101 - ADVANCED DATA STRUCTURES LABORATORY	T	P	TU	C
		0	4	0	2

Course Objective:

1. To acquire the knowledge of using advanced tree structures.
2. To learn the usage of heap structures.
3. To understand the usage of graph structures and spanning trees.

List of Experiments:

Expt. No.	Description of the Experiments
1.	Implementation of Merge Sort and Quick Sort-Analysis
2.	Implementation of a Binary Search Tree
3.	Red-Black Tree Implementation
4.	Heap Implementation
5.	Fibonacci Heap Implementation
6.	Graph Traversals
7.	Spanning Tree Implementation
8.	Shortest Path Algorithms (Dijkstra's algorithm, Bellmann Ford Algorithm)
9.	Implementation of Matrix Chain Multiplication
10.	Activity Selection and Huffman Coding Implementation.

Total Instructional hours: 30

Course Outcome

Students will be able to

CO1: Develop the sorting methods and analyze it

CO2: Apply Hierarchical structures to solve the problems using red black tree B-tree and Heaps.

CO3: Make use of Graph structure and traversal

CO4: Develop an application by using shortest path algorithms

CO5: Build the solution for NP hard abd NP complete problems

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Reference Books:

1. Alfred V. Aho, John E. Hopcroft, Jeffrey D. Ullman, ―Data Structures and Algorithms‖, Pearson Education, Reprint 2006
2. Robert Sedgewick and Kevin Wayne, ―ALGORITHMS‖, Fourth Edition, Pearson Education
3. S.Sridhar, ―Design and Analysis of Algorithms‖, First Edition, Oxford University Press. 2014
4. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, ―Introduction to Algorithms‖, Third Edition, Prentice-Hall, 2011.

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Semester - II

M.E.	M19CST201 - NETWORK DESIGN AND TECHNOLOGIES	T	P	TU	C
		3	0	0	3

Course Objective:

1. To understand the principles required for network design.
2. To explore various technologies in the wireless domain.
3. To study about 3G and 4G cellular networks.
4. To understand the paradigm of Software defined networks

UNIT- I NETWORK DESIGN 9

Advanced multiplexing – Code Division Multiplexing, DWDM and OFDM – Shared media networks – Switched networks – End to end semantics – Connectionless, Connection oriented, Wireless Scenarios –Applications, Quality of Service – End to end level and network level solutions. LAN cabling topologies – Ethernet Switches, Routers, Firewalls and L3 switches – Remote Access Technologies and Devices – Modems and DSLs – SLIP and PPP – Core networks, and distribution networks.

UNIT- II WIRELESS NETWORKS 9

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 – Bluetooth – Protocol Stack – Security – Profiles.

UNIT- III CELLULAR NETWORKS 9

GSM – Mobility Management and call control – GPRS – Network Elements – Radio Resource Management – Mobility Management and Session Management – Small Screen Web Browsing over GPRS and EDGE – MMS over GPRS – UMTS – Channel Structure on the Air Interface – UTRAN –Core and Radio Network Mobility Management – UMTS Security.

UNIT- IV 4G NETWORKS 9

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 – Channel Modelling for 4G – Introduction to 5G.

UNIT- V SOFTWARE DEFINED NETWORKS 9

Introduction – Centralized and Distributed Control and Data Planes – Open Flow – SDN Controllers – General Concepts – VLANs – NVGRE – Open Flow – Network Overlays – Types – Virtualization – Data Plane – I/O – Design of SDN Framework.

Total Instructional hours: 45

Course Outcome:

Students will be able to

CO1: Identify the components required for designing a network.

CO2: Infer the knowledge on wireless networks.

CO3: Explain the principles of cellular networks.

CO4: Infer the features of 4G and 5G networks.

CO5: Experiment with software defined networks.

Reference Books:

1. Erik Dahlman, Stefan Parkvall, Johan Skold, ―4G: LTE/LTE-Advanced for Mobile Broadband‖, Academic Press, 2013
2. Jonathan Rodriguez, ―Fundamentals of 5G Mobile Networks‖, Wiley, 2015.
3. Larry Peterson and Bruce Davie, ―Computer Networks: A Systems Approach‖, 5th edition, Morgan Kauffman, 2011
4. Martin Sauter, "From GSM to LTE, An Introduction to Mobile Networks and Mobile Broadband", Wiley, 2014
5. Martin Sauter, ―Beyond 3G - Bringing Networks, Terminals and the Web Together: LTE, WiMAX, IMS, 4G Devices and the Mobile Web 2.0‖, Wiley, 2009
6. Naveen Chilamkurti, Sherali Zeadally, Hakima Chaouchi, ―Next-Generation Wireless Technologies‖, Springer, 2013
7. Paul Goransson, Chuck Black, ―Software Defined Networks: A Comprehensive Approach‖, Morgan Kauffman, 2014
8. Savo G Glisic, ―Advanced Wireless Networks – 4G Technologies‖ John Wiley & Sons, 2007
9. Thomas D.Nadeau and Ken Gray, ―SDN – Software Defined Networks‖, O"Reilly Publishers, 2013
10. Ying Dar Lin, Ren-Hung Hwang and Fred Baker, ―Computer Networks: An Open Source Approach‖, McGraw Hill, 2011.

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M.E.	M19CST202- SECURITY PRACTICES	T	P	TU	C
		3	0	0	3

Course Objective:

1. To learn the core fundamentals of system and web security concepts.
2. To have through understanding in the security concepts related to networks.
3. To deploy the security essentials in IT Sector.
4. To be exposed to the concepts of Cyber Security and encryption Concepts.
5. To perform a detailed study of Privacy and Storage security and related Issues.

UNIT- I SYSTEM SECURITY 9

Building a secure organization- A Cryptography primer- detecting system Intrusion- Preventing system Intrusion- Fault tolerance and Resilience in cloud computing environments- Security web applications, services and servers.

UNIT- II NETWORK SECURITY 9

Internet Security - Botnet Problem- Intranet security- Local Area Network Security - Wireless Network Security - Wireless Sensor Network Security- Cellular Network Security- Optical Network Security- Optical wireless Security.

UNIT- III SECURITY MANEGEMENT 9

Information security essentials for IT Managers- Security Management System - Policy Driven System Management- IT Security - Online Identity and User Management System - Intrusion and Detection and Prevention System.

UNIT- IV CYBER SECURITY AND CRYPTOGRAPHY 9

Cyber Forensics- Cyber Forensics and Incidence Response - Security e-Discovery - Network Forensics - Data Encryption- Satellite Encryption - Password based authenticated Key establishment Protocols.

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UNIT- V PRIVACY AND STORAGE SECURITY 9

Privacy on the Internet - Privacy Enhancing Technologies - Personal privacy Policies - Detection of Conflicts in security policies- privacy and security in environment monitoring systems. Storage Area Network Security - Storage Area Network Security Devices - Risk management - Physical Security Essentials.

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the core fundamentals of system security

CO2: Apply the security concepts related to networks in wired and wireless scenario

CO3: Utilize and Manage the security essentials in IT Sector

CO4: Explain the concepts of Cyber Security and encryption Concepts

CO5: Infer the knowledge on Privacy and Storage security.

Reference Books:

1. John R.Vacca, ―Computer and Information Security Handbook‖, Second Edition, Elsevier 2013.
2. Michael E. Whitman, Herbert J. Mattord, ―Principal of Information Security‖, Fourth Edition, Cengage Learning, 2012.
3. Richard E.Smith, ―Elementary Information Security‖, Second Edition, Jones and Bartlett Learning, 2016

M.E.	M19CST203- INTERNET OF THINGS	T	P	TU	C
		3	0	0	3

Course Objective:

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

UNIT- I INTRODUCTION TO IoT 9

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

UNIT- II IoT ARCHITECTURE 9

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

UNIT- III IoT PROTOCOLS 9

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

UNIT- IV BUILDING IoT WITH RASPBERRY PI & ARDUINO 9

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

UNIT- V CASE STUDIES AND REAL-WORLD APPLICATIONS 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the basic concepts of IoT

CO2: Explain the architecture of IoT

CO3: Make use of various protocols for IoT.

CO4: Build applications using Raspberry Pi and Arduino.

CO5: Infer the applications of IoT in real time scenario.

Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, ―Internet of Things – A hands-on approach‖, Universities Press, 2015
2. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), ―Architecting the Internet of Things‖, Springer, 2011.
3. Honbo Zhou, ―The Internet of Things in the Cloud: A Middleware Perspective‖, CRC Press, 2012.
4. Jan Ho¨ ller, Vlasios Tsiatsis , Catherine Mulligan, Stamatis , Karnouskos, Stefan Avesand. David Boyle, "From Machine-to-Machine to the Internet of Things - Introduction to a New Age of Intelligence", Elsevier, 2014.
5. Olivier Hersent, David Boswarthick, Omar Elloumi , ―The Internet of Things – Key applications and Protocols‖, Wiley, 2012

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M.E.	M19CST204- BIG DATA ANALYTICS	T	P	TU	C
		3	0	0	3

Course Objective:

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

UNIT- I INTRODUCTION TO BIG DATA 7

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

UNIT- II HADOOP FRAMEWORK 9

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

UNIT- III DATA ANALYSIS 13

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

UNIT- IV MINING DATA STREAMS 7

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

UNIT- V BIG DATA FRAMEWORKS 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the basics of big data analytics.

CO2: Explain the concepts of distributed file systems and Hadoop.

CO3: Utilize various statistical and data mining approaches to analyze data.

CO4: Infer the concept of analytics on real-time streaming data.

CO5: Make use of the various NoSql alternative database models.

Reference Books:

1. Bill Franks, ―Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL‖, and Graph", 2013.
3. Michael Berthold, David J. Hand, ―Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis‖, O_Reilly Media, 2013.

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M.E.	M19CSP201- BIG DATA ANALYTICS LABORATORY	T	P	TU	C
		3	0	0	3

Course Objective:

1. To implement Map Reduce programs for processing big data.
2. To realize storage of big data using H base, Mongo DB.
3. To analyse big data using linear models.
4. To analyse big data using machine learning techniques such as SVM / Decision tree classification and clustering.

List of Experiments:

Expt. No.	Description of the Experiments
	Hadoop
1.	Install, configure and run Hadoop and HDFS
2.	Implement word count / frequency programs using MapReduce
3.	Implement an MR program that processes a weather dataset R
4.	Implement Linear and logistic Regression
5.	Implement SVM / Decision tree classification techniques
6.	Implement clustering techniques
7.	Visualize data using any plotting framework
8.	Implement an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R.

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Make use of Hadoop framework to process data.

CO2: Build and apply linear and logistic regression models

CO3: Make use of machine learning methods to perform data analysis

CO4: Utilize plotting framework to perform graphical data analysis

CO5: Build an application that stores big data in Hbase / MongoDB / Pig using Hadoop / R

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Reference Books:

1. Bill Franks,‖Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics‖, Wiley and SAS Business Series, 2012.
2. David Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
3. Michael Berthold, David J. Hand, —Intelligent Data Analysis‖, Springer, Second Edition, 2007.
4. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
5. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.
6. Richard Cotton, "Learning R – A Step-by-step Function Guide to Data Analysis‖, O_Reilly Media, 2013.

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PROFESSIONAL ELECTIVES (PE)

Semester – II (Elective – I)

M.E.	M19CSE201- ADVANCED DATABASES	T	P	TU	C
		3	0	0	3

Course Objective:

1. To understand the design of databases.
2. To acquire knowledge on parallel and distributed databases and its applications.
3. To study the usage and applications of Object Oriented and Intelligent databases.
4. To understand the emerging databases like Mobile, XML, Cloud and Big Data

UNIT- I PARALLEL AND DISTRIBUTED DATABASES 9

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 INTELLIGENT DATABASES 9

Active Databases: Syntax and Semantics (Starburst, Oracle, DB2)- TaxonomyApplications-Design Principles for Active Rules- Temporal Databases: Overview of Temporal Databases TSQL2- Deductive Databases-Recursive Queries in SQL- Spatial Databases- Spatial Data Types - Spatial Relationships- Spatial Data Structures-Spatial Access Methods- Spatial DB Implementation.

UNIT- III XML DATABASES 9

XML Databases: XML Data Model – DTD – XML Schema – XML Querying – Web Databases – Open Database Connectivity.

UNIT- IV MOBILE DATABASES 9

Mobile Databases: Location and Handoff Management - Effect of Mobility on Data Management - Location Dependent Data Distribution - Mobile Transaction Models - Concurrency Control - Transaction Commit Protocols.

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UNIT- V MULTIMEDIA DATABASES 9

Multidimensional Data Structures – Image Databases – Text / Document Databases – Video Databases – Audio Databases – Multimedia Database Design.

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the knowledge on database architecture.

CO2: Classify intelligent databases.

CO3: Interpret XML databases.

CO4: Infer the knowledge on mobile databases.

CO5: Summarize the concept of multimedia databases.

Reference Books:

1. C.J.Date, A.Kannan, S.Swamynathan, ―An Introduction to Database Systems‖, Eighth Edition, Pearson Education, 2006.
2. Carlo Zaniolo, Stefano Ceri, Christos Faloutsos, Richard T.Snodgrass, V.S.Subrahmanian, Roberto Zicari, ―Advanced Database Systems‖, Morgan Kaufmann publishers,2006.
3. Henry F Korth, Abraham Silberschatz, S. Sudharshan, ―Database System Concepts‖, Sixth Edition, McGraw Hill, 2011.
4. R. Elmasri, S.B. Navathe, ―Fundamentals of Database Systems‖, Sixth Edition, Pearson Education/Addison Wesley, 2010.
5. Vijay Kumar, ―Mobile Database Systems‖, John Wiley & Sons, 2006

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M.E.	M19CSE202- PRINCIPLES OF PROGRAMMING LANGUAGES	T	P	TU	C
		3	0	0	3

Course Objective:

1. To understand and describe syntax and semantics of programming languages.
2. To understand Data, Data types, and Bindings.
3. To learn the concepts of functional and logical programming.
4. To explore the knowledge about concurrent Programming paradigms

UNIT- I ELEMENTS OF PROGRAMMING LANGUAGES 9

Reasons for studying, concepts of programming languages, Language Evaluation Criteria, influences on Language design, Language categories. Programming Language Implementation – Compilation, Hybrid Implementation, Pure Interpretation and Virtual Machines. Describing Syntax and Semantics -Introduction - The General Problem of Describing Syntax-Formal Methods of Describing Syntax - Attribute Grammars - Describing the Meanings of Programs: Dynamic Semantics.

UNIT- II DATA TYPES-ABSTRACTION 9

Introduction - Primitive Data Types- Character String Types- User-Defined Ordinal Type- Array types- Associative Arrays-Record Types- Tuple Types-List Types -Union Types - Pointer and Reference Types -Type Checking- Strong Typing -Type Equivalence - Theory and Data Types-Variables-The Concept of Binding -Scope - Scope and Lifetime - Referencing Environments - Named Constants- The Concept of Abstraction- Parameterized Abstract Data Types- Encapsulation Constructs- Naming Encapsulations.

UNIT- III FUNCTIONAL PROGRAMMING 9

Introduction- Mathematical Functions- Fundamentals of Functional Programming Languages- The First Functional Programming Language: LISP- An Introduction to Scheme- Common LISP- Haskell-F# - ML : Implicit Types- Data Types- Exception Handling in ML. Functional Programming with Lists- Scheme, a Dialect of Lisp- The Structure of Lists- List Manipulation- A Motivating Example: Differentiation- Simplification of Expressions- Storage Allocation for Lists.

UNIT- IV LOGIC PROGRAMMING 9

Relational Logic Programming- Syntax- Basics- Facts- Rules- Syntax- Operational Semantics- Relational logic programs and SQL operations- Logic Programming- Syntax- Operational semantics- Data Structures-Meta-tools: Backtracking optimization (cuts); Unify; Meta-circular interpreters- The Origins of Prolog- Elements- of Prolog-Deficiencies of Prolog-Applications of Logic Programming.

UNIT- V CONCURRENT PROGRAMMING 9

Parallelism in Hardware- Streams: Implicit Synchronization-Concurrency as Interleaving- Liveness Properties- Safe Access to Shared Data- Concurrency in Ada- Synchronized Access to Shared Variables- Synthesized Attributes- Attribute Grammars- Natural Semantics- Denotational Semantics -A Calculator in Scheme-Lexically Scoped Lambda Expressions- An Interpreter-Recursive Functions.

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Explain syntax and semantics of programming languages.

CO2: Explain data, data types, and basic statements of programming languages.

CO3: Infer the knowledge on mathematical functions and functional programming.

CO4: Develop programs in LISP, ML, and Prolog.

CO5: Make use of logic programming.

CO6: Infer the knowledge on concurrent programming

Reference Books:

1. Ghezzi, —Programming Languages‖, 3rd Edition, John Wiley, 2008
2. John C. Mitchell, —Concepts in Programming Languages‖, Cambridge University Press, 2004.
3. Louden, —Programming Languages‖, 3rd Edition, 2012.
4. Ravi Sethi, —Programming Languages: Concepts and Constructs‖, 2nd Edition, Addison, Wesley, 1996.
5. Robert .W. Sebesta, —Concepts of Programming Languages‖, 10th Edition, Pearson Education, 2002.

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M.E.	M19CSE203- IMAGE PROCESSING AND ANALYSIS	T	P	TU	C
		3	0	0	3

Course Objective:

1. To understand the image processing concepts and analysis
2. To understand the image processing techniques
3. To familiarize the image processing environment and their applications.
4. To appreciate the use of image processing in various applications

UNIT- I IMAGE PROCESSING FUNDAMENTALS 9

Introduction – Elements of visual perception, Steps in Image Processing Systems – Digital Imaging System - Image Acquisition – Sampling and Quantization – Pixel Relationships – File Formats – colour images and models - Image Operations – Arithmetic, logical, statistical and spatial operations.

UNIT- II IMAGE ENHANCEMENT AND RESTORATION 9

Image Transforms -Discrete and Fast Fourier Transform and Discrete Cosine Transform ,Spatial Domain - Gray level Transformations Histogram Processing Spatial Filtering – Smoothing and Sharpening. Frequency Domain: Filtering in Frequency Domain – Smoothing and Sharpening filters – Homomorphic Filtering., Noise models, Constrained and Unconstrained restoration models.

UNIT- III IMAGE SEGMENTATION AND MORPHOLOGY 9

Detection of Discontinuities – Edge Operators – Edge Linking and Boundary Detection – Thresholding – Region Based Segmentation – Motion Segmentation, Image Morphology: Binary and Gray level morphology operations - Erosion, Dilation, Opening and Closing Operations Distance Transforms- Basic morphological Algorithms. Features – Textures - Boundary representations and Descriptions- Component Labeling – Regional descriptors and Feature Selection Techniques.

UNIT- IV IMAGE ANALYSIS AND CLASSIFICATION 9

Image segmentation- pixel based, edge based, region based segmentation. Active contour models and Level sets for medical image segmentation, Image representation and analysis, Feature extraction and representation, Statistical, Shape, Texture, feature and statistical image classification.

UNIT- V IMAGE REGISTRATION AND VISUALIZATION 9

Rigid body visualization, Principal axis registration, Interactive principal axis registration, Feature based registration, Elastic deformation based registration, Image visualization – 2D display methods, 3D display methods, virtual reality based interactive visualization.

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the basic concepts of image processing.

CO2: Explain the image enhancement and restoration methds.

CO3: Make use of image segmentation and morphology.

CO4: Experiment with the concepts of image analysis and classification.

CO5: Infer the concepts of image registration and visualization.

Reference Books:

1. Alasdair McAndrew, ―Introduction to Digital Image Processing with Matlab‖, Cengage Learning 2011,India.
2. Anil J Jain, ―Fundamentals of Digital Image Processing‖, PHI, 2006.
3. Kavyan Najarian and Robert Splerstor, ―Biomedical signals and Image processing CRC‖ –,Taylor and Francis, New York, 2006
4. Rafael C.Gonzalez and Richard E.Woods, ―Digital Image Processing‖, Third Edition,
5. Pearson Education, 2008, New Delhi
6. S.Sridhar, ―Digital Image Processing‖, Oxford University Press, 2011

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M.E.	M19CSE204- WEB ENGINEERING	T	P	TU	C
		3	0	0	3

Course Objective:

1. Understand the characteristics of web applications.
2. Learn to Model web applications
3. Be aware of Systematic design methods
4. Be familiar with the testing techniques for web applications

UNIT- I INTRODUCTION TO WEB ENGINEERING 9

Motivation, Categories of Web Applications, Characteristics of Web Applications. Requirements of Engineering in Web Applications- Web Engineering-Components of Web Engineering-Web Engineering Process-Communication-Planning.

UNIT- II WEB APPLICATION ARCHITECTURES & MODELLING WEB APPLICATIONS 9

Introduction- Categorizing Architectures- Specifics of Web Application Architectures, Components of a Generic Web Application Architecture- Layered Architectures, 2-Layer Architectures, N-Layer Architectures-Data-aspect Architectures, Database-centric Architectures- Architectures for Web Document Management- Architectures for Multimedia Data- Modeling Specifics in Web Engineering, Levels, Aspects, Phases Customization, Modeling Requirements, Hypertext Modeling, Hypertext Structure Modeling Concepts, Access Modeling Concepts, Relation to Content Modeling, Presentation Modeling, Relation to Hypertext Modeling, Customization Modeling, Modelling Framework-Modeling languages- Analysis Modeling for Web Apps-The Content Model-The Interaction Model-Configuration Model.

UNIT- III WEB APPLICATION DESIGN 9

Design for WebApps- Goals-Design Process-Interactive Design- Principles and Guidelines-Workflow-Preliminaries-Design Steps- Usability- Issues- Information Design- Information Architecture- structuring- Accessing Information-Navigation Design- Functional Design-Wep App Functionality- Design Process- Functional Architecture- Detailed Functional Design.

UNIT- IV TESTING WEB APPLICATIONS 9

Introduction-Fundamentals-Test Specifics in Web Engineering-Test Approaches-Conventional Approaches, Agile Approaches- Testing concepts- Testing Process -Test Scheme- Test Methods and Techniques- Link Testing- Browser Testing-Usability Testing-Load, Stress, and Continuous Testing, Testing Security, Test-driven Development, -Content Testing-User Interface testing-Usability Testing-Compatibility Testing-Component Level Testing-Navigation Testing-Configuration testing-Security and Performance Testing-Test Automation.

UNIT- V PROMOTING WEB APPLICATIONS AND WEB PROJECT MANAGEMENT 9

Introduction-challenges in launching the web Application-Promoting Web Application-Content Management-Usage Analysis-Web Project Management-Challenges in Web Project Management-Managing Web Team- Managing the Development Process of a Web Application- Risk, Developing a Schedule, Managing Quality, Managing Change, Tracking the Project. Introduction to node JS - web sockets.

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the concepts of web engineering.

CO2: Explain the architecture and modelling of web applications.

CO3: Make use of various web designing approaches.

CO4: Utilize various methods to perform web testing.

CO5: Explain the concept of promoting and managing web applications.

Reference Books:

1. Chris Bates, ―Web Programming: Building Internet Applications‖, Third Edition, Wiley India Edition, 2007.
1. Gerti Kappel, Birgit Proll, ―Web Engineering‖, John Wiley and Sons Ltd, 2006.
2. Guy W. Lecky-Thompson, ―Web Programming‖, Cengage Learning, 2008.
3. John Paul Mueller, ―Web Development with Microsoft Visual Studio 2005‖, Wiley Dream tech, 2006.
4. Roger S. Pressman, David Lowe, ―Web Engineering‖, Tata McGraw Hill Publication, 2007.

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M.E.	M19CSE205- CLOUD COMPUTING TECHNOLOGIES	T	P	TU	C
		3	0	0	3

Course Objective:

1. To understand the concepts of virtualization and virtual machines
2. To gain expertise in server, network and storage virtualization.
3. To understand and deploy practical virtualization solutions and enterprise solutions
4. To gain knowledge on the concept of virtualization that is fundamental to cloud computing
5. To understand the various issues in cloud computing
6. To be able to set up a private cloud
7. To understand the security issues in the grid and the cloud environment

UNIT- I VIRTUALIZATION 9

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

UNIT- II VIRTUALIZATION INFRASTRUCTURE 9

Comprehensive Analysis -Resource Pool – Testing Environment –Server Virtualization – Virtual Workloads – Provision Virtual Machines – Desktop Virtualization – Application Virtualization –Implementation levels of virtualization – virtualization structure – virtualization of CPU, Memory and I/O devices – virtual clusters and Resource Management – Virtualization for data center automation.

UNIT- III CLOUD PLATFORM ARCHITECTURE 9

Cloud deployment models: public, private, hybrid, community – Categories of cloud computing: Everything as a service: Infrastructure, platform, software- A Generic Cloud Architecture Design – Layered cloud Architectural Development – Virtualization Support and Disaster Recovery –Architectural Design Challenges - Public Cloud Platforms : GAE,AWS – Inter-cloud Resource Management

UNIT- IV PROGRAMMING MODEL 9

Introduction to Hadoop Framework - Mapreduce, Input splitting, map and reduce functions, specifying input and output parameters, configuring and running a job –Developing Map Reduce Applications - Design of Hadoop file system –Setting up Hadoop Cluster - Cloud Software Environments -Eucalyptus, Open Nebula, Open Stack, Nimbus

UNIT- V CLOUD SECURITY 9

Cloud Infrastructure security: network, host and application level – aspects of data security, provider data and its security, Identity and access management architecture, IAM practices in the cloud, SaaS, PaaS, IaaS availability in the cloud - Key privacy issues in the cloud – Cloud Security and Trust Management

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Apply the concepts of storage virtualization, network virtualization and its management

CO2: Infer the basics of virtualization infrastructure.

CO3: Identify the architecture, infrastructure and delivery models of cloud Computing.

CO4: Develop services using Hadoop and cloud software

CO5: Apply the security models in the cloud environment

Reference Books:

1. Danielle Ruest, Nelson Ruest, —Virtualization: A Beginner"s Guidell, McGraw-Hill Osborne Media, 2009.
1. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes",Elsevier/Morgan Kaufmann, 2005.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
5. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing,From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.

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6. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O_Reilly Media, Inc.,2009.
7. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
8. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

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PROFESSIONAL ELECTIVES (PE)

Semester – II (Elective – II)

M.E.	M19CSE206 - REAL TIME SYSTEMS	T	P	TU	C
		3	0	0	3

Course Objective:

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

UNIT-I REAL TIME SYSTEM AND SCHEDULING 9

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

UNIT-II SOFTWARE REQUIREMENTS ENGINEERING 9

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

UNIT-III INTERTASK COMMUNICATION AND MEMORY MANAGEMENT 9

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

.

UNIT-IV REAL TIME DATABASES 9

Real time Databases – Basic Definition, Real time Vs General Purpose Databases, Main Memory Databases, Transaction priorities, Transaction Aborts, Concurrency control issues,

Disk Scheduling Algorithms, Two– phase Approach to improve Predictability – Maintaining Serialization Consistency – Databases for Hard Real Time Systems.

UNIT-V EVALUATION TECHNIQUES AND CLOCK SYNCHRONIZATION 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Apply principles of real time system design techniques to develop real time Applications.

CO2:. Make use of architectures and behavior of real time operating systems

CO3: Infer the concept of inter task communication and memory management task

CO4: Apply the Real time databases

CO5: Summarize the Evaluation Techniques and clock Synchronization

References Books:

1. C.M. Krishna, Kang G. Shin,‖Real-Time Systems‖, McGraw-Hill International Editions,1997
2. Philip.A.Laplante, —Real Time System Design and Analysis‖, Prentice Hall of India, 3rd Edition, 2004
3. Rajib Mall, —Real-time systems: theory and practice‖, Pearson Education, 2009
4. R.J.A Buhur, D.L Bailey, —An Introduction to Real-Time Systems‖, Prentice Hall International, 1999
5. Stuart Bennett, —Real Time Computer Control-An Introduction‖, Prentice Hall of India, 1998
6. Allen Burns, Andy Wellings, —Real Time Systems and Programming Languages‖, Pearson Education, 2003.

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M.E.	M19CSE207- MOBILE AND PERVASIVE COMPUTING	T	P	TU	C
		3	0	0	3

Course Objective:

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

UNIT -I INTRODUCTION 9

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

UNIT -II OVERVIEW OF MODERN 4G TELECOMMUNICATIONS SYSTEM 9

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

UNIT -III PERVASIVE CONCEPTS AND ELEMENTS 9

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

UNIT -IV HCI IN PERVASIVE COMPUTING 9

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

UNIT -V PERVASIVE MOBILE TRANSACTIONS 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Illustrate the Basic architecture and concepts of till Third Generation Communication systems.

CO2: Explain the latest 4G Telecommunication System Principles

CO3: Demonstrate the pervasive concepts.

CO4: Make use of HCI in Pervasive environment.

CO5: Infer the pervasive concepts in mobile environment.

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References Books:

1. Alan Colman, Jun Han, and Muhammad Ashad Kabir, ―Pervasive Social Computing Socially-Aware Pervasive Systems and Mobile Applications‖, Springer, 2016.
1. J.Schiller, ―Mobile Communication‖, Addison Wesley, 2000.
2. Juha Korhonen, ―Introduction to 4G Mobile Communications‖ , Artech House Publishers, 2014
3. Kolomvatsos, Kostas,‖ Intelligent Technologies and Techniques for Pervasive Computing‖, IGI Global, 2013.
5. M. Bala Krishna, Jaime Lloret Mauri, ―Advances in Mobile Computing and Communications: Perspectives and Emerging Trends in 5G Networks‖, CRC 2016
6. Minyi Guo, Jingyu Zhou, Feilong Tang, Yao Shen, ―Pervasive Computing: Concepts, Technologies and Applications‖ CRC Press, 2016.

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M.E.	M19CSE208- PARALLEL PROGRAMMING PARADIGMS	T	P	TU	C
		3	0	0	3

Course Objective:

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

UNIT -I FOUNDATIONS OF PARALLEL PROGRAMMING 9

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

UNIT -II DISTRIBUTED MEMORY PROGRAMMING WITH MPI 9

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

UNIT -III SHARED MEMORY PARADIGM WITH PTHREADS 9

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

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UNIT -IV SHARED MEMORY PARADIGM: OPENMP 9

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

UNIT –V GRAPHICAL PROCESSING PARADIGMS: OPENCL AND INTRODUCTION TO CUDA 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Infer the basics of parallel programming.

CO2: Make use of distributed memory programs using MPI framework.

CO3: Develop the shared memory parallel programs using Pthreads.

CO4: Develop the shared memory parallel programs using OpenMP

CO5: Infer the principles of Graphical Processing OpenCL programs.

References Books:

1. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, ―OpenCL programming guide‖, Addison Wesley, 2011
2. M. J. Quinn, ―Parallel programming in C with MPI and OpenMP‖, Tata McGraw Hill, 2003.
3. Peter S. Pacheco, ―An introduction to parallel programming‖, Morgan Kaufmann, 2011.
4. Rob Farber, ―CUDA application design and development‖, Morgan Haufmann, 2011.
5. W. Gropp, E. Lusk, and A. Skjellum, ―Using MPI: Portable parallel programming with the message passing interface‖, Second Edition, MIT Press, 1999 OTHER WEB

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M.E.	M19CSE209- INFORMATION RETRIEVAL TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objective:

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

UNIT- I INTRODUCTION: MOTIVATION 9

Basic Concepts – Practical Issues - Retrieval Process – Architecture - Boolean Retrieval – Retrieval Evaluation – Open Source IR Systems–History of Web Search – Web Characteristics–

The impact of the web on IR —IR Versus Web Search–Components of a Search engine

UNIT -II MODELING 9

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

UNIT -III INDEXING 9

Static and Dynamic Inverted Indices – Index Construction and Index Compression. Searching -

Sequential Searching and Pattern Matching. Query Operations -Query Languages – Query Processing - Relevance Feedback and Query Expansion - Automatic Local and Global Analysis –Measuring Effectiveness and Efficiency

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UNIT –IV CLASSIFICATION AND CLUSTERING 9

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

UNIT -V SEARCHING THE WEB 9

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

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Build an Information Retrieval system using the available tools.

CO2: Identify and design the various components of an Information Retrieval system.

CO3: Relate the information retrieval with pertinence to modeling, query operations and indexing

CO4: Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval

CO5: construct an efficient search engine and analyze the Web content structure.

References Books:

1. Christopher D. Manning, Prabhakar Raghavan, Hinrich Schutze, ―Introduction to Information Retrieval‖, Cambridge University Press, First South Asian Edition, 2008.
2. ―Implementing and Evaluating Search Engines‖, The MIT Press, Cambridge, Massachusetts London, England, 2010
3. Ricardo Baeza – Yates, Berthier Ribeiro – Neto, ―Modern Information Retrieval: The concepts and Technology behind Search‖ (ACM Press Books), Second Edition, 2011.
4. Stefan Buttcher, Charles L. A. Clarke, Gordon V. Cormack, ―Information Retrieval‖

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M.E-CSE	**M19CSP202 – TERM PAPER WRITING**	T	P	TU	C
		0	2	0	1

Course Objectives:

In this course, students will develop their scientific and technical reading and writing skills that they need to understand and construct research articles. A term paper requires a student to obtain information from a variety of sources (i.e., Journals, dictionaries, reference books) and then place it in logically developed ideas. The work involves the following steps:

1. Selecting a subject, narrowing the subject into a topic
2. Stating an objective.
3. Collecting the relevant bibliography (at least 15 journal papers)
4. Preparing a working outline.
5. Studying the papers and understanding the authors contributions and critically analysing each paper.
6. Preparing a working outline
7. Linking the papers and preparing a draft of the paper.
8. Preparing conclusions based on the reading of all the papers.
9. Writing the Final Paper and giving final Presentation

Please keep a file where the work carried out by you is maintained.
Activities to be carried out:

Activity	**Instructions**	**Submission week**	**Evaluation**
Selection of area of interest Stating an objective	You are requested to select an area of interest, topic and state an objective	2nd week	3 % Based on clarity of thought, current relevance and clarity in writing
Collecting Information about your area & topic	1. List 1 Special Interest Groups or professional society. 2. List 2 journals. 3. List 2 conferences, symposia or workshops. 4. List 1 thesis title. 5. List 3 web presences. (mailing lists, forums, news sites) 6. List 3 authors who publish regularly in your area. 7. Attach a call for papers (CFP) from	3rd week	3% (the selected information must be area specific and of international and national standard)

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	your area		
Collection of Journal papers in the topic in the context of the objective – collect 20 & then filter	• You have to provide a complete list of references you will be using- Based on your objective -Search various digital libraries and Google Scholar • When picking papers to read - try to: • Pick papers that are related to each other in some ways and/or that are in the same field so that you can write a meaningful survey out of them, • Favour papers from well-known journals and conferences, • Favour —first or foundational papers in the field (as indicated in other people‘s survey paper), • Favour more recent papers, • Pick a recent survey of the field so you can quickly gain an overview, • Find relationships with respect to each other and to your topic area (classification scheme/categorization) • Mark in the hard copy of papers whether complete work or section/sections of the paper s Whether complete work or section/sections of the paper are being considered	4th week	6% (the list of standard papers and reason for selection)
Reading and notes for first 5 papers	Reading Paper Process • For each paper form a Table answering the following questions: • What is the main topic of the article? • What was/were the main issue(s) the author said they want to discuss? • Why did the author claim it was important? • How does the work build on other‘s work, in the author‘s opinion? • What simplifying assumptions does the author claim to be making? • What did the author do? • How did the author claim they were going to evaluate their work and compare it to others? • What did the author say were the	5th week	8% (the table given should indicate your understanding of the paper and the evaluation is based o n your conclusions about each paper)

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	limitations of their research? • What did the author say were the important directions for future research? Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next 5 papers	Repeat Reading Paper Process	6th week	8% (the table given should indicate your understanding of the paper and the evaluation is based On your conclusions about each paper)
Reading and notes for next 5 papers	Repeat Reading Paper Process	7th week	8% (the table given should indicate your understanding of the paper and the evaluation is based On your conclusions about each paper)
Draft outline 1 and Linking papers	Prepare a draft Outline, your survey goals, along with a classification / categorization diagram	8th week	8% (this component will be evaluated based on the linking and classification among the papers)
Abstract	Prepare a draft abstract and give a presentation	9th week	6% (Clarity, purpose and conclusion) 6% Presentation & Viva Voce
Introduction Background	Write an introduction and background sections	10th week	5% (clarity)
Sections of the paper	Write the sections of your paper based on the classification / categorization diagram in keeping with the goals of your survey	11th week	10% (this component will be evaluated based on the linking and classification among the papers)
Your	Write your conclusions and future work	12th week	5% (conclusions –

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conclusions			clarity and your ideas)
Final Draft	Complete the final draft of your paper	13th week	10% (formatting, English, Clarity and linking) 4% Plagiarism Check Report
Seminar	A brief 15 slides on your paper	14th & 15th Week	10% (based on presentation and Viva-voce)

Total Instructional hours: 30

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M.E.	M19CSE210- SOFTWARE ARCHITECTURES AND DESIGN	T	P	TU	C
		0	4	0	2

Course Objective:

1. To understand the need, design approaches for software architecture to bridge the dynamic requirements and implementation.
2. To learn the design principles and to apply for large scale systems
3. To design architectures for distributed heterogeneous systems ,environment through brokerage interaction
4. To build design knowledge on service oriented and model driven architectures and the aspect oriented architecture.
5. To develop appropriate architectures for various Case studies like semantic web services, supply chain cloud services.

UNIT -I INTRODUCTION 9

Introduction to Software Architecture-Bridging Requirements and Implementation, Design Guidelines, Software Quality attributes. Software Architecture Design Space. Agile Approach to Software Architecture Design, Models for Software Architecture Description Languages (ADL).

UNIT -II OBJECT ORIENTED PARADIGM 9

Object-Oriented Paradigm -Design Principles. Data-Centered Software Architecture: Repository Architecture, Blackboard Architecture. Hierarchical Architecture Main-Subroutine, Master-Slave, Layered, Virtual Machine. Interaction-Oriented Software Architectures: Model-View-Controller (MVC), Presentation-Abstraction-Control (PAC).

UNIT -III DISTRIBUTED ARCHITECTURE 9

Distributed Architecture: Client-Server, Middleware, Multi-tiers, Broker Architecture – MOM,CORBA Message Broker Architecture- Service-Oriented Architecture (SOA), SOAP, UDDI, SOA Implementation in Web Services, Grid/cloud Service Computing. Heterogeneous Architecture- Methodology of Architecture Decision, Quality Attributes.

UNIT -IV ARCHITECTURE OF USER INTERFACES 9

Architecture of User Interfaces containers, case study-web service. Product Line Architectures - methodologies, processes and tools. Software Reuse and Product Lines - Product Line Analysis, Design and implementation, configuration Models. Model Driven Architectures (MDA) –why MDAModel transformation and software architecture, SOA and MDA. Eclipse modeling framework.

UNIT -V ASPECT ORIENTED ARCHITECTURE 9

Aspect Oriented Architectures- AOP in UML,AOP tools, Architectural aspects and middleware Selection of Architectures, Evaluation of Architecture Designs, Case Study: Online Computer Vendor, order processing, manufacture &shipping –inventory, supply chain cloud service Management, semantic web services

Total Instructional hours: 45

Course Outcome

Students will be able to

CO1: Outline the need of software architecture for sustainable dynamic systems.

CO2: Apply design principles for large scale systems

CO3: Construct architectures for distributed heterogeneous systems

CO4: Classify service oriented and model driven architectures and the aspect oriented architecture

CO5: Develop appropriate architectures through various case studies.

References Books:

1. —Essentials of software Architecture‖, Ion Gorton, Second Edition, Springer-verlag, 2011
2. —Software Architecture Design Illuminated‖, Kai Qian Jones and Bartlett Publishers Canada, 2010

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M.E-CSE	M19CST301 - RESEARCH METHODOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To understand the basics of research formulation and design.
2. To learn the concept of data collection and analysis.
3. To understand the concept of soft computing.
4. To learn the concept of research ethics, IPR and scholarly publishing.
5. To study about interpretation and report writing.

UNIT I RESEARCH FORMULATION AND DESIGN 9

Motivation and objectives – Research methods vs Methodology. Types of research – Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical, concept of applied and basic research process, criteria of good research. Defining and formulating the research problem, selecting the problem, necessity of defining the problem, importance of literature review in defining a problem, literature review-primary and secondary sources, reviews, monograph, patents, research databases, web as a source, searching the web, critical literature review, identifying gap areas from literature and research database, development of working hypothesis.

UNIT II DATA COLLECTION AND ANALYSIS 9

Accepts of method validation, observation and collection of data, methods of data collection, sampling methods, data processing and analysis strategies and tools,data analysis with statically package (Sigma STAT,SPSS for student t-test, ANOVA, etc.), hypothesis testing.

UNIT III SOFT COMPUTING 9

Computer and its role in research, Use of statistical software SPSS, GRETL etcin research. Introduction to evolutionary algorithms - Fundamentals of Genetic algorithms, Simulated Annealing, Neural Network based optimization, Optimization of fuzzy systems.

UNIT IV RESEARCH ETHICS, IPR AND SCHOLARY PUBLISHING 9

Ethics-ethical issues, ethical committees (human & animal); IPR- intellectual property rights and patent law, commercialization, copy right, royalty, trade related aspects of intellectual

property rights (TRIPS); scholarly publishing- IMRAD concept and design of research paper, citation and acknowledgement, plagiarism, reproducibility and accountability.

UNIT V INTERPRETATION AND REPORT WRITING 9

Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Significance of Report Writing, Different Steps in Writing Report, Layout of the Research Report, Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports, Conclusions.

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Understand the concept of research formulation and design.

CO2: Understand the process of data collection and analysis.

CO3: Make use of the soft computing methods.

CO4: Illustrate the principles of research ethics publication and principles of interpretation and report writing.

CO5: Understand the basics of IPR and scholarly

Reference Books:

1. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R., 1990. Research Methodology: Methods and Techniques. New Age International. 418p.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.
4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270p.
5. Wadehra, B.L. 2000. Law relating to patents, trademarks, copyright designs and geographical indications. Universal Law Publishing.

Semester - III (Professional Elective III)

M.E-C.S.E	M19CSE301- SECURITY OF INTERNET OF THINGS	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To identify the security requirements in IoT
2. To know about cryptographic fundamentals for IoT
3. To understand the authentication credentials and access control.
4. To learn the various types Trust models.
5. To know the various services provided for Cloud Security.

UNIT I INTRODUCTION: SECURING THE INTERNET OF THINGS 9

Security Requirements in IoT Architecture - Security in Enabling Technologies - Security Concerns in IoT Applications. Security Architecture in the Internet of Things - Security Requirements in IoT - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT; Vulnerabilities – Secrecy and Secret-Key Capacity - Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

UNIT II CRYPTOGRAPHIC FUNDAMENTALS FOR IOT 9

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – IoT Node Authentication

UNIT III IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT 9

Identity lifecycle – authentication credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe schemes – access control

UNIT IV PRIVACY PRESERVATION AND TRUST MODELS FOR IOT 9

Concerns in data dissemination – Lightweight and robust schemes for Privacy protection – Trust and Trust models for IoT – self-organizing Things - Preventing unauthorized access.

UNIT V CLOUD SECURITY FOR IOT 9

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.

Total Instructional hours: 45

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Course Outcomes:

Students will be able to

CO1:Understand the IoT Security requirements

CO2: Learn about cryptographic fundamentals for IoT

CO3: Know the authentication credentials and access control

CO4: Explain the various types Trust models

CO5:Develop enterprise architecture with Cloud Security

Reference Books:

1. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren.
2. Securing the Internet of Things Elsevier.
3. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations.

Semester - III (Professional Elective III)

M.E-C.S.E	M19CSE302- DATA VISUALIZATION TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives:

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

UNIT I CORE SKILLS FOR VISUAL ANALYSIS 9

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

UNIT II TIME-SERIES, RANKING, AND DEVIATION ANALYSIS 9

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

UNIT III DISTRIBUTION, CORRELATION, AND MULTIVARIATE ANALYSIS 9

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

UNIT IV INFORMATION DASHBOARD DESIGN 9

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

UNIT V ADVANCED INFORMATION DASHBOARD DESIGN 9

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

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Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Explain principles of visual perception

CO2: Apply core skills for visual analysis

CO3: Apply visualization techniques for various data analysis tasks

CO4: Know information dashboard

CO5: Design information dashboard

Reference Books:

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008.
2. Edward R. Tufte, "The visual display of quantitative information", Second Edition, Graphics Press, 2001.
3. Evan Stubbs, "The value of business analytics: Identifying the path to profitability", Wiley, 2011.
4. Gert H. N. Laursen and Jesper Thorlund, "Business Analytics for Managers: Taking business intelligence beyond reporting", Wiley, 2010.
5. Nathan Yau, "Data Points: Visualization that means something", Wiley, 2013.
6. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013.
7. Tamara Munzner, Visualization Analysis and Design, AK Peters Visualization Series, CRC Press, Nov. 2014

Semester - III (Professional Elective III)

M.E-C.S.E	M19CSE303 - BLOCKCHAIN TECHNOLOGY	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To understand working of blockchain systems.
2. To interact with blockchain systems.
3. To design, build, and deploy smart contracts and distributed applications.
4. To integrate ideas from blockchain technology into their own projects.
5. To know about cryptocurrency.

UNIT I BASICS 9

Distributed Database - Two General Problem - Byzantine General problem and Fault Tolerance - Hadoop Distributed File System - Distributed Hash Table - ASIC resistance - Turing Complete. Cryptography: Hash function - Digital Signature – ECDSA - Memory Hard Algorithm - Zero Knowledge Proof.

UNIT II BLOCKCHAIN 9

Introduction - Advantage over conventional distributed database - Blockchain Network - Mining Mechanism - Distributed Consensus - Merkle Patricia Tree - Gas Limit - Transactions and Fee –Anonymity – Reward - Chain Policy - Life of Blockchain application - Soft & Hard Fork - Private and Public blockchain.

UNIT III DISTRIBUTED CONSENSUS 9

Nakamoto consensus - Proof of Work - Proof of Stake - Proof of Burn - Difficulty Level - Sybil Attack -Energy utilization and alternate.

UNIT IV CRYPTOCURRENCY 9

History - Distributed Ledger - Bitcoin protocols - Mining strategy and rewards - Ethereum – Construction – DAO - Smart Contract – GHOST – Vulnerability – Attacks – Sidechain - Namecoin .

UNIT V CRYPTOCURRENCY REGULATION 9

Stakeholders - Roots of Bit coin - Legal Aspects - Crypto currency Exchange - Black Market and Global Economy. Applications: Internet of Things - Medical Record Management System - Domain Name Service and future of Blockchain.

Total Instructional hours: 45

BoS Chairman

Course Outcomes:

Students will be able to

CO1: Explain distributed database with cryptographic algorithms

CO2: Explain the basics of blockchain

CO3: Contrast the differences between proof-of-work and proof-of-stake consensus

CO4: Experiment with a blockchain system by sending and reading transactions

CO5: Design, build, and deploy a distributed application

Reference Books:

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).
2. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies.
3. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System.
4. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,Yellow paper.2014.
5. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts.

Semester - III (Professional Elective III)

M.E-C.S.E	M19CSE304- PRODUCT DESIGN AND DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To understand the product design and development processes with its challenges.
2. To identify customer needs with product specification.
3. To understand the concept generation with industrial design.
4. To know about concept selection and theory of inventive problem solving.
5. To be familiar with the testing and Intellectual Property.

UNIT 1 INTRODUCTION 9

Significance of product design - product design and development process - sequential engineering design method - the challenges of product development; Product Planning and Project Selection: Identifying opportunities - evaluate and prioritize projects - allocation of resources.

UNIT 2 CUSTOMER NEEDS AND PRODUCT SPECIFICATIONS 9

Identifying Customer Needs: Interpret raw data in terms of customers need - organize needs in hierarchy and establish the relative importance of needs; Product Specifications: Establish target specifications- setting final specifications.

UNIT 3 CONCEPT GENERATION AND INDUSTRIAL DESIGN 9

Concept Generation: Activities of concept generation - clarifying problem - search both internally and externally - explore the output; Industrial Design: Assessing need for industrial design - industrial design process – management - assessing quality of industrial design.

UNIT 4 CONCEPT SELECTION AND TRIZ 9

Concept Selection: Overview - concept screening and concept scoring - methods of selection. Theory of inventive problem solving (TRIZ): Fundamentals - methods and techniques - General Theory of Innovation and TRIZ - Value engineering Applications in Product development and design - Model-based technology for generating innovative ideas

UNIT 5 CONCEPT TESTING AND INTELLECTUAL PROPERTY 9

Concept Testing: Elements of testing - qualitative and quantitative methods including survey - measurement of customers' response; Intellectual Property: Elements and outline -

patenting procedures - claim procedure; Design for Environment: Impact - regulations from government - ISO system.

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Show the product design and development processes

CO2: Interpret customer needs and product specification

CO3: Apply concept generation in industrial design

CO4: Explain concept selection and theory of inventive problem solving

CO5: Outline testing and elements of Intellectual Property

Reference Books:

1. Ulrich K. T, and Eppinger S.D, Product Design and Development, Tata McGraw Hill
2. Otto K, and Wood K, Product Design, Pearson
3. Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.
4. Inventive thinking through TRIZ: a practical guide, By Michael A. Orloff, Springer.
5. Systematic innovation: an introduction to TRIZ ; (theory of inventive Problem Solving), By John Terninko, AllaZusman, CRC Press.

Semester - III (Professional Elective III)

M.E. C.S.E	M19CS305 - EMBEDDED SOFTWARE DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives:

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

UNIT I EMBEDDED PROCESSORS 9

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

UNIT II EMBEDDED COMPUTING PLATFORM 9

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

UNIT III EMBEDDED NETWORK ENIVIRONMENT 9

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

UNIT IV REAL-TIME CHARACTERISTICS 9

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

UNIT V SYSTEM DESIGN TECHNIQUES 9

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

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Understand different architectures of embedded processor, microcontroller and peripheral devices.

CO2: Outline memory and peripherals with embedded systems.

CO3: Illustrate embedded network environment.

CO4: Classify challenges in Real time operating systems.

CO5: Design and analyze applications on embedded systems.

Reference Books:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things" Wiley Publication, First edition, 2013.
2. Andrew N Sloss, D. Symes, C. Wright, “Arm system developers guide”, Morgan Kauffman/Elsevier, 2006.
3. Arshdeep Bahga, Vijay Madisetti, " Internet of Things: A Hands-on-Approach" VPT First Edition, 2014.
4. C. M. Krishna and K. G. Shin, ”Real-Time Systems” , McGraw-Hill, 1997.
5. Frank Vahid and Tony Givargis, “Embedded System Design: A Unified Hardware/Software Introduction”, John Wiley & Sons.
6. Jane.W.S. Liu, “Real-Time systems”, Pearson Education Asia.
7. Michael J. Pont, “Embedded C”, Pearson Education , 2007.
8. Muhammad Ali Mazidi ,SarmadNaimi , SepehrNaimi, "The AVR Microcontroller and Embedded Systems: Using Assembly and C", Pearson Education, First edition, 2014
9. Steve Heath, “Embedded System Design”, Elsevier, 2005
10. Wayne Wolf, “Computers as Components: Principles of Embedded Computer System Design”, Elsevier, 2006.

BoS Chairman

Semester - III (Professional Elective IV)

M.E- C.S.E	M19CS306 - BIO INFORMATICS	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To get exposed to the fundamentals of bioinformatics.
2. To learn bio-informatics algorithm and phylogenetic concept.
3. To understand open problems and issues in replication and molecular clocks.
4. To learn assemble genomes and corresponding theorem.
5. To study and exposed to the domain of human genomics.

UNIT I INTRODUCTION AND FUNDAMENTALS 9

Fundamentals of genes,genomics, molecular evolution – genomic technologies –beginning of bioinformatics - genetic data –sequence data formats – secondary database – examples – data retrieval systems – genome browsers.

UNIT II BIOINFORMATICS ALGORITHM AND ANALYSIS 9

Sequence alignment and similarity searching in genomic databases: BLAST and FASTA – additional bioinformatics analysis involving nucleic acid sequences-additional bioinformatics analysis involving protein sequences – Phylogenetic Analysis.

UNIT III DNA REPLICATION AND MOLECULAR CLOCKS 9

Beginning of DNA replication – open problems – multiple replication and finding replication – computing probabilities of patterns in a string-the frequency array-converting patterns-solving problems- finding frequents words-Big-O notation –case study-The Tower of Hanoi problem.

UNIT IV ASSEMBLE GENOMES AND SEQUENCES 9

Methods of assemble genomes – string reconstruction – De Bruijn graph – Euler‘s theorem – assembling genomes –DNA sequencing technologies – sequence antibiotics – Brute Force Algorithm – Branch and Bound algorithm – open problems – comparing biological sequences- Case Study –Manhattan tourist Problem.

UNIT V HUMAN GENOME 9

Human and mouse genomes-random breakage model of chromosome evolution – sorting by reversals – greedy heuristic approach – break points- rearrangements in tumor and break point genomes-break point graps- synteny block construction -open problems and technologies.

Total Instructional hours: 45

BoS Chairman

Course Outcomes:

Students will be able to

CO1: Explain the basics of genomics.

CO2: Contrast efficient algorithm and issues.

CO3: Apply the replication and molecular clocks in bioinformatics.

CO4: Experiment with genomes and sequences

CO5: Illustrate the Microarray technologies for genome expression.

Reference Books:

1. Ion Mandoiu and Alexander Zelikovsky , “Computational Methods for Next Generation Sequencing Data Analysis” ,Wiley series 2016.
2. IstvanMiklos,RenyiInstitutue, “Introduction to algorithms in bioinformatics”,Springer 2016.
3. Philip Compeau and Pavelpevzner, “Bioinformatics Algorithms: An Active Learning Approach”,Second edition volume I , Cousera, 2015.
4. SupratimChoudhuri, “Bioinformatics for Beginners”, Elsevier, 2014.

Semester - III (Professional Elective IV)

M.E- C.S.E	M19CSE307 - INFORMATION STORAGE MANAGEMENT	T	P	TU	C
		3	0	0	3

Course Objectives:

1. To understand various storage technologies.
2. To understand the storage architectures.
3. To learn to establish & manage data center.
4. To learn network based storage techniques.
5. To learn security aspects of storage & data center.

UNIT I STORAGE TECHNOLOGY 9

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

UNIT II STORAGE SYSTEMS ARCHITECTURE 9

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

UNIT III INTRODUCTION TO NETWORKED STORAGE 9

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

UNIT IV INFORMATION AVAILABILITY & MANAGING DATACENTERS 9

List reasons for planned/unplanned outages and the impact of downtime, Impact of downtime -Business continuity (BC) and disaster recovery (DR) ,RTO and RPO, Identify single points of failure in a storage infrastructure and list solutions to mitigate these failures, architecture of backup/recovery and the different backup/ recovery topologies, replication

technologies and their role in ensuring information availability and business continuity, Remote replication technologies and their role in providing disaster recovery and business continuity capabilities. Identify key areas to monitor in a data center, Industry standards for data center monitoring and management, Key metrics to monitor for different components in a storage infrastructure, Key management tasks in a data center.

UNIT V SECURING STORAGE AND STORAGE VIRTUALIZATION 9

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

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Select from various storage technologies to suit for required application.

CO2: Explain different storage architectures

CO3: Classify various network storage techniques

CO4: Organize available information and disaster recovery system for data center

CO5: Apply security measures to safeguard storage & farm.

Reference Books:

1. EMC Corporation, "Information Storage and Management: Storing, Managing, and Protecting Digital Information", Wiley, India, 2010
2. Marc Farley, “Building Storage Networks”, Tata McGraw Hill, Osborne, 2001.
3. Robert Spalding, “Storage Networks: The Complete Reference”, Tata McGraw Hill, Osborne, 2003.

Semester - III (Professional Elective IV)

M.E- C.S.E	M19CSE308-BIO-INSPIRED COMPUTING	T	P	TU	C
		3	0	0	3

Course Objectives:

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

UNIT- I INTRODUCTION 9

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

UNIT- II RANDOM WALK AND ANEALING 9

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

UNIT- III GENETIC ALOGORITHMS AND DIFFERENTIAL EVOLUTION 9

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

UNIT- IV SWARM OPTIMIZATION AND FIREFLY ALGORITHM 9

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

UNIT- V APPLICATION IN IMAGE PROCESSING 9

Bio-Inspired Computation and its Applications in Image Processing: An Overview - Fine-Tuning Enhanced Probabilistic Neural Networks Using Meta-heuristic-driven Optimization - Fine-Tuning Deep Belief Networks using Cuckoo Search - Improved Weighted Thresholded Histogram Equalization Algorithm for Digital Image Contrast Enhancement Using Bat

Algorithm - Ground Glass Opacity Nodules Detection and Segmentation using Snake Model - Mobile Object Tracking Using Cuckoo Search

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Develop and apply bio-inspired algorithms

CO2: Explain the random walk and simulated annealing

CO3: Identify and apply genetic algorithms

CO4: Explain swarm intelligence and ant colony for feature selection

CO5: Apply bio-inspired techniques in image processing.

Reference Books:

1. Eiben,A.E.,Smith,James E, "Introduction to Evolutionary Computing", Springer 2015.
2. Helio J.C. Barbosa, "Ant Colony Optimization - Techniques and Applications", Intech 2013
3. Xin-She Yang , Joao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing", Elsevier 2016
4. Xin-She Yang, "Nature Inspired Optimization Algorithm", Elsevier First Edition 2014

Semester - III (Professional Elective IV)

M.E- C.S.E	M19CSE309- MOBILE APPLICATION DEVELOPMENT	T	P	TU	C
		3	0	0	3

Course Objectives:

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

UNIT- I INTRODUCTION 9

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

UNIT- II BASIC DESIGN 9

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

UNIT- III ADVANCED DESIGN 9

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

UNIT- IV ANDROID 9

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

UNIT- V IOS 9

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 Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Show the requirements for mobile applications.

CO2: Explain the challenges in mobile application design and development.

CO3: Develop design for mobile applications for specific requirements.

CO4: Build applications using Android SDK.

CO5: Build applications using Objective C and iOS

Reference Books:

1. Charlie Collins, Michael Galpin and Matthias Kappler, “Android in Practice”, DreamTech, 2012.
2. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS 6
3. Development: Exploring the iOS SDK”, Apress, 2013.
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.

Semester - III (Professional Elective IV)

M.E- C.S.E	M19CSE310- SOCIAL NETWORK ANALYSIS	T	P	TU	C
		3	0	0	3

Course Objectives:

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

UNIT- I INTRODUCTION 9

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

UNIT- II MODELING AND VISUALIZATION 9

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

UNIT- III MINING COMMUNITIES 9

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

UNIT- IV EVOLUTION 9

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

Networks - Feature based Link Prediction – Bayesian Probabilistic Models - Probabilistic Relational Models.

UNIT- V APPLICATIONS 9

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

Total Instructional hours: 45

Course Outcomes:

Students will be able to

CO1: Outline the internals components of the social network

CO2: Model and visualize the social network

CO3: Experiment with the behavior of the users in the social network

CO4: Analyze the possible next outcome of the social network

CO5: Apply social network in real time applications

Reference Books:

1. Ajith Abraham, Aboul Ella Hassanien, VáclavSnášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012.
2. BorkoFurht,”Handbook of Social Network Technologies and Applications”, Springer, 1st edition, 2011.
3. Charu C. Aggarwal, “Social Network Data Analytics”, Springer; 2014 .
4. Giles, Mark Smith, John Yen,”Advances in Social Network Mining and Analysis”, Springer, 2010.
5. GuandongXu ,Yanchun Zhang and Lin Li,”Web Mining and Social Networking – Techniques and applications”, Springer, 1st edition, 2012.
6. Peter Mika, “Social Networks and the Semantic Web”, Springer, 1st edition, 2007.
7. Przemyslaw Kazienko, NiteshChawla,”Applications of Social Media and Social Network Analysis”, Springer,2015.

M.E - C.S.E	M19CSP401 - PROJECT WORK (PHASE II)	T	P	TU	C
		0	24	0	12

Course Objectives:

1. To enable a student to do an individual project work which may involve design, modelling, simulation and/or fabrication.
2. To analyse a problem both theoretically and practically.
3. To motivate the students to involve in research activities leading to innovative solutions for industrial and societal problems.

Course Description:

Project work shall be carried out by each and every individual student under the supervision of a faculty of this department. A student may however, in certain cases, be permitted to work for the project in association with other departments or in an Industrial/Research Organization, on the recommendation of the Head of the Department. In such cases, the project work shall be jointly supervised by a faculty of the Department and an Engineer / Scientist from the organization. The student shall meet the supervisor periodically and attend the periodic reviews for evaluating the progress.

Project work will be carried out in two phases, Phase-I during the third semester and Phase-2 during the final semester. Phase-II shall be pursued for 24 periods per week. In phase II also, there will be three reviews for continuous internal assessment and one final review and viva voce at the end of the semesters. The Project Report prepared according to approved guidelines and duly signed by the supervisor(s) and the Head of the Department shall be submitted to the concerned department.

Course Outcomes:

Students will be able to

CO1: Design and develop the project, creativity and choose the most appropriate option for the Phase II project

CO2: Effectively communicate technical project information in writing/Seminar Presentation/ Technical Discussion.

CO3: Apply modern engineering tools for simulation, analysis and Solution.

CO4: Present the findings of the project by attending conference and communicate to journals for publication.

CO5: Engage in continuously learning the new practices, principles, and techniques using Computational solutions.