ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
M.TECH. INFORMATION TECHNOLOGY
REGULATIONS – 2017
CHOICE BASED CREDIT SYSTEM

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

1. To enable graduates to excel professionally by adapting to the dynamic needs of the industry, academia and research in the field of Information Technology.
2. To enable graduates to practice and promote information technologies for societal needs.
3. To enable graduates to contribute to advancement of information technology by means of research and lifelong learning.

PROGRAM OUTCOMES (POs):
ENGINEERING GRADUATES WILL BE ABLE TO:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OBJECTIVES (PSOs)

1. To analyse, design and develop applications relevant to the industrial needs.
2. To apply software engineering principles and practices for developing quality software for scientific and business applications.
3. To develop programs related to IT services based on open source technologies.

Provide mapping of 1) POs to PEOs and 2) PSOs to PEOs.
Use the following marking:

Contribution 1: Reasonable 2: Significant 3: Strong

MAPPING OF PROGRAMME EDUCATIONAL OBJECTIVES WITH PROGRAMME OUTCOMES

A broad relation between the programme objective and the outcomes is given in the following table

PROGRAMME EDUCATIONAL OBJECTIVES	**PROGRAMME OUTCOMES**									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
1.	2	3	2							
2.	3				3		2			**1**
3.			2	2		2		1	1	
4.		3		2	2	2	2	3	2	

MAPPING OF PROGRAM SPECIFIC OBJECTIVES WITH PROGRAMME OUTCOMES

YEAR	SEMESTER	SUBJECTS	PROGRAMME OUTCOMES									
			PO 1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
I YEAR	SEM I	Applied Probability and Statistics	2	3		2						
		Advanced Data Structures and Algorithms	2	2	2	2	3	1		1	1	
		Advanced Computer Architecture		1	3		2		1		1	**2**
		Operating Systems Internals	2		3		2	1	2			
		Programming Paradigms	1		2	1	2			2	2	2
		Advanced Databases	2	1	2		2		2			
		Data Structures Laboratory		2	3	1	2		1		1	2
		Databases Laboratory	3	2	3		2	1	2			
	SEM II	Software Industrialization	2	1	2		2	2	2	1		
		Network Engineering	1		1	3	2		2		1	2
		Internet of Things				1	2			3	2	2
		Big Data Analytics	2	1	2		2	2	2	1	1	1
		Professional Elective-I										
		Cloud Computing Technologies	2	1	2	2		2	2	1		2
		Machine Learning Techniques	1	1	2		2	3	1			
		Energy Aware Computing		3		2	2		2	1	1	1
		Bio - Inspired Computing			3				2	1	1	1
		Professional Elective-II										
		Digital Image Processing and Pattern Recognition		2	3	2	2		1		2	
		Computer Vision	2	1	2	2		2	2	1		2
		Human Computer Interaction	2	2	3		2		1		1	1
		Information Retrieval Techniques	2	2	2	3	2		1	1		1
		Practicals										

		Term Paper Writing and Seminar		1	3	2	2		1		1	1
		Data Analytics Laboratory		2	2	2	2		1	1		3
II YEAR	**SEM III**	Professional Elective - III										
		Social Network Analysis	3		3				2	1	1	1
		Mobile Application Development	2	2	2	3	2		1	1		1
		Video Analytics	1	2	2		2		1		1	
		Deep Learning	3		3				2	1	1	1
		Professional Elective – IV										
		Automata Theory and Formal Languages		3	2		2	1			2	
		GPU Architecture and Programming	2	2	3		2		1		1	1
		Cyber Forensics	2	2	2	3	2		1	1		1
		Trust Networks	3		3				2	1	1	1
		Professional Elective - V										
		Wireless Adhoc and Sensor Networks	2	2	3		2		1		1	1
		Cryptography and Network Security		2	3	2		1	1	1		
		Next Generation Data Centers		2	3	3	2	2	1	1	1	1
		Design Thinking	1	2	3		2		2	2	1	1
		Forecasting and Optimization		2	3	3	2	1	2	1	2	1
		Project Work (Phase I)	1	2	2		2		1		1	
	SEM IV	Project Work (Phase II)		2	3	3	2	1	2	1	2	1

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CURRICULA AND SYLLABI

SEMESTER - I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	MA5160	Applied Probability and Statistics	FC	4	4	0	0	4
2.	CP5151	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
3.	CP5152	Advanced Computer Architecture	PC	3	3	0	0	3
4.	CP5153	Operating System Internals	PC	3	3	0	0	3
5.	IF5101	Programming Paradigms	PC	3	3	0	0	3
6.	IF5191	Advanced Databases	PC	3	3	0	0	3
PRACTICALS								
7.	CP5161	Data Structures Laboratory	PC	4	0	0	4	2
8.	IF5161	Databases Laboratory	PC	4	0	0	4	2
			TOTAL	**28**	**20**	**0**	**8**	**24**

SEMESTER - II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.	IF5251	Software Industrialization	PC	3	3	0	0	3
2.	IF5201	Network Engineering	PC	3	3	0	0	3
3.	CP5292	Internet of Things	PC	3	3	0	0	3
4.	CP5293	Big Data Analytics	PC	3	3	0	0	3
5.		Professional Elective - I	PE	3	3	0	0	3
6.		Professional Elective - II	PE	3	3	0	0	3
PRACTICALS								
7.	CP5281	Term Paper Writing and Seminar	EEC	2	0	0	2	1
8.	CP5261	Data Analytics Laboratory	PC	4	0	0	4	2
			TOTAL	**24**	**18**	**0**	**6**	**21**

SEMESTER- III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
THEORY								
1.		Professional Elective - III	PE	3	3	0	0	3
2.		Professional Elective – IV	PE	3	3	0	0	3
3.		Professional Elective - V	PE	3	3	0	0	3
PRACTICALS								
4.	IF5311	Project Work Phase I	EEC	12	0	0	12	6
			TOTAL	**21**	**9**	**0**	**12**	**15**

SEMESTER- IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
PRACTICALS								
1.	IF5411	Project Work Phase II	EEC	24	0	0	24	12
				TOTAL	**0**	**0**	**24**	**12**

TOTAL NO. OF CREDITS: 72

FOUNDATION COURSES (FC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MA5160	Applied Probability and Statistics	FC	4	4	0	0	4

PROFESSIONAL CORE (PC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5151	Advanced Data Structures and Algorithms	PC	4	4	0	0	4
2.	CP5152	Advanced Computer Architecture	PC	3	3	0	0	3
3.	CP5153	Operating Systems Internals	PC	3	3	0	0	3
4.	IF5101	Programming Paradigms	PC	3	3	0	0	3
5.	IF5191	Advanced Databases	PC	3	3	0	0	3
6.	CP5161	Data Structures Laboratory	PC	4	0	0	4	2
7.	IF5161	Databases Laboratory	PC	4	0	0	4	2
8.	IF5251	Software Industrialization	PC	3	3	0	0	3
9.	IF5201	Network Engineering	PC	3	3	0	0	3
10.	CP5292	Internet of Things	PC	3	3	0	0	3
11.	CP5293	Big Data Analytics	PC	3	3	0	0	3
12.	CP5261	Data Analytics Laboratory	PC	4	0	0	4	2

EMPLOYABILITY ENHANCEMENT COURSE (EEC)

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5281	Term Paper Writing and Seminar	EEC	2	0	0	2	1
2.	IF5311	Project Work Phase – I	EEC	12	0	0	12	6
3.	IF5411	Project Work Phase – II	EEC	24	0	0	24	12

PROFESSIONAL ELECTIVES (PE)*
SEMESTER II
ELECTIVE I

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5092	Cloud Computing Technologies	PE	3	3	0	0	3
2.	CP5191	Machine Learning Techniques	PE	3	3	0	0	3
3.	IF5091	Energy Aware Computing	PE	3	3	0	0	3
4.	IF5001	Bio - Inspired Computing	PE	3	3	0	0	3

SEMESTER II
ELECTIVE II

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	MU5252	Digital Image Processing and Pattern Recognition	PE	3	3	0	0	3
2.	CP5095	Computer Vision	PE	3	3	0	0	3
3.	MP5091	Human Computer Interaction	PE	3	3	0	0	3
4.	CP5094	Information Retrieval Techniques	PE	3	3	0	0	3

SEMESTER III
ELECTIVE III

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CP5074	Social Network Analysis	PE	3	3	0	0	3
2.	CP5097	Mobile Application Development	PE	3	3	0	0	3
3.	IF5092	Video Analytics	PE	3	3	0	0	3
4.	IF5002	Deep Learning	PE	3	3	0	0	3

SEMESTER III
ELECTIVE IV

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	IF5003	Automata Theory and Formal Languages	PE	3	3	0	0	3
2.	IF5071	GPU Architecture and Programming	PE	3	3	0	0	3
3.	IF5004	Cyber Forensics	PE	3	3	0	0	3
4.	IF5005	Trust Networks	PE	3	3	0	0	3

SEMESTER III
ELECTIVE V

SL. NO	COURSE CODE	COURSE TITLE	CATEGORY	CONTACT PERIODS	L	T	P	C
1.	CU5097	Wireless Adhoc and Sensor Networks	PE	3	3	0	0	3
2.	IF5072	Cryptography and Network Security	PE	3	3	0	0	3
3.	IF5006	Design Thinking	PE	3	3	0	0	3
4.	IF5007	Forecasting and Optimization	PE	3	3	0	0	3

MA5160 APPLIED PROBABILITY AND STATISTICS L T P C
4 0 0 4

OBJECTIVES:
This course is designed to provide the solid foundation on topics in applied probability and various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis and multivariate analysis.

UNIT I PROBABILITY AND RANDOM VARIABLES 12
Probability – Axioms of probability – Conditional probability – Baye's theorem - Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions – Function of a random variable.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 12
Joint distributions – Marginal and conditional distributions – Functions of two dimensional random variables – Regression curve – Correlation.

UNIT III ESTIMATION THEORY 12
Unbiased estimators – Method of moments – Maximum likelihood estimation - Curve fitting by principle of least squares – Regression lines.

UNIT IV TESTING OF HYPOTHESIS 12
Sampling distributions – Type I and Type II errors – Small and large samples – Tests based on Normal, t, Chi square and F distributions for testing of mean, variance and proportions – Tests for independence of attributes and goodness of fit.

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: 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:

- Basic probability axioms and rules and the moments of discrete and continuous random variables.
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES:

1. Devore, J. L., “Probability and Statistics for Engineering and the Sciences”, 8th Edition, Cengage Learning, 2014.
2. Dallas E. Johnson, “Applied Multivariate Methods for Data Analysis”, Thomson and Duxbury press, 1998.
3. Gupta S.C. and Kapoor V.K.,” Fundamentals of Mathematical Statistics”, Sultan and Sons, New Delhi, 2001.
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”, 5th Edition, Pearson Education, Asia, 2002.

CP5151 ADVANCED DATA STRUCTURES AND ALGORITHMS L T P C

4 0 0 4

OBJECTIVES:

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

UNIT I ROLE OF ALGORITHMS IN COMPUTING 12

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 12

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 12

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 12

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 12

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

TOTAL: 60 PERIODS

OUTCOMES:

Upon the completion of the course the student should be able to

- Design data structures and algorithms to solve computing problems.
- Design algorithms using graph structure and various string matching algorithms to solve real-life problems.
- Apply suitable design strategy for problem solving

REFERENCES:

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.

CP5152	ADVANCED COMPUTER ARCHITECTURE	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.
- To learn the different multiprocessor issues.
- To expose the different types of multicore architectures.
- 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 : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students should be able to:

- Identify the limitations of ILP.
- Discuss the issues related to multiprocessing and suggest solutions
- Point out the salient features of different multicore architectures and how they exploit parallelism.
- Discuss the various techniques used for optimising the cache performance
- Design hierarchal memory system
- Point out how data level parallelism is exploited in architectures

REFERENCES:

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, New Delhi, 2003.

CP5153 OPERATING SYSTEM INTERNALS L T P C

3 0 0 3

OBJECTIVES :

- To be able to read and understand sample open source programs and header files.
- To learn how the processes are implemented in linux.
- To understand the implementation of the Linux file system.
- To study Linux memory management data structures and algorithms.
- To acquire the knowledge in the implementation of interprocess communication.
- 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.

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: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To explain the functionality of a large software system by reading its source.
- To revise any algorithm present in a system.
- To design a new algorithm to replace an existing one.
- To appropriately modify and use the data structures of the linux kernel for a different software system.

REFERENCES:

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

IF5101 **PROGRAMMING PARADIGMS** **L T P C**
3 0 0 3

OBJECTIVES:

The students should be made to:

- Acquire the knowledge of different programming paradigms.
- Be able to understand the methods of specifying the syntax formally.
- Learn the different data types available in programming languages and understand how the language translators handle the type checking process.
- Study the semantics of the various control structures.
- Understand the design issues for subprograms.
- Learn the different methods of specifying concurrency.
- Acquire knowledge on how the events and exceptions are handled.

UNIT I INTRODUCTION **9**

Programming Domains - Language Categories - Implementation Methods - Programming Environments - Syntax and Semantics – Introduction - Describing Syntax - Formal Methods of Describing Syntax - Attribute Grammars - Describing the Meanings of Programs: Dynamic Semantics.

UNIT II DATA TYPES, EXPRESSIONS AND CONTROL STRUCTURES **9**

Names - Contents - Variables – Binding – Scope – Lifetime - Referencing Environments - Named Constants - Data Types - Primitive Data Types - Character String Types - User-Defined Ordinal Types - 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 - Expressions and Assignment Statements - Arithmetic Expressions - Overloaded Operators - Type Conversions - Relational and Boolean Expressions - Short-Circuit Evaluation - Assignment Statements - Mixed-Mode Assignment - Statement-Level Control Structures - Selection Statements - Iterative Statements - Unconditional Branching - Guarded Commands.

UNIT III SUBPROGRAMS AND OBJECT-ORIENTED PROGRAMMING **9**

Subprograms - Fundamentals - Design Issues - Local Referencing Environments - Parameter-Passing Methods - Parameters That Are Subprograms - Calling Subprograms Indirectly - Overloaded Subprograms - Generic Subprograms - Design Issues for Functions - User-Defined Overloaded Operators - Closures - Coroutines - Object-Oriented Programming - Design Issues - Support for Object-Oriented Programming in C++, Java and Ruby - Implementation of Object-Oriented Constructs

UNIT IV CONCURRENCY AND HANDLING OF EXCEPTIONS AND EVENTS **9**

Concurrency – Introduction - Subprogram-Level Concurrency - Semaphores - Monitors - Message Passing - Java Threads. Introduction to Exception Handling - Exception Handling in Java - Introduction to Event Handling - Event Handling with Java.

UNIT V FUNCTIONAL AND LOGIC PROGRAMMING **9**

Functional Programming - Mathematical Functions - Fundamentals - Haskell – Logic Programming - Predicate Calculus – Overview.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- To explain the concepts of programming languages.
- To compare the different programming paradigms.
- To identify appropriate programming paradigm for designing large software systems.
- To choose appropriately data types and control structures during the implementation of software systems.

REFERENCES:

1. Maurizio Gabbrielli and Simone Martini, “Programming Languages: Principles and Paradigms”, Springer, 2010.
2. Mitchell, J. C. “Concepts in Programming Languages”, Cambridge University Press, 2002.
3. Robert W. Sebesta, “Concepts of Programming Languages”, 11th Edition, Pearson Education 2016.
4. Tucker A. and Noonan R, “Programming Languages: Principles and Paradigms”, 2nd Edition, McGraw Hill 2006.

IF5191	ADVANCED DATABASES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the design of databases.
- To acquire knowledge on parallel and distributed databases and its applications.
- To study the usage and applications of Object Oriented and Intelligent databases.
- 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)- Taxonomy- Applications- 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.

UNIT V MULTIMEDIA DATABASES 9

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

TOTAL :45 PERIODS

OUTCOMES:

Upon successful completion of this course, a student will be able to:

- To develop skills on databases to optimize their performance in practice.
- To analyze each type of databases and its necessity.
- To design faster algorithms in solving practical database problem.

REFERENCES:

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.

CP5161 DATA STRUCTURES LABORATORY L T P C
0 0 4 2

OBJECTIVES:

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

LIST OF EXPERIMENTS

Each student has to work individually on assigned lab exercises. Lab sessions could be scheduled as one contiguous four-hour session per week or two two-hour sessions per week. There will be about 15 exercises in a semester. It is recommended that all implementations are carried out in Java. If C or C++ has to be used, then the threads library will be required for concurrency. Exercises should be designed to cover the following topics:

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: 60 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Design and implement basic and advanced data structures extensively.
- Design algorithms using graph structures
- Design and develop efficient algorithms with minimum complexity using design techniques.

IF5161 **DATABASES LABORATORY** **L T P C**
0 0 4 2

OBJECTIVES:

The student should be able:

- To understand the concepts of DBMS.
- To familiarize with SQL queries.
- To write stored procedures in DBMS.
- To learn front end tools to integrate with databases.

EXPERIMENTS IN THE FOLLOWING TOPICS:

1. Data Definition, Manipulation of Tables and Views, Database Querying – Simple queries, Nested queries, Sub queries and Joins.
2. Triggers, Transaction Control.
3. Embedded SQL, Database Connectivity with Front End Tools High level language extensions - PL/SQL Basics, Procedures and Functions.
4. Active Databases, Deductive Databases.
5. Distributed and Parallel Transactions and Query Processing.
6. Mobile Database Query Processing.
7. Object Oriented Database Design.
8. Multimedia Database for Image and Video Processing.
9. Spatial and Temporal Databases.
10. XML Databases and No SQL Database Storage and Retrieval.

TOTAL: 60 PERIODS

OUTCOMES :

Upon completion of this course, the student should be able to:

- Design and Implement databases.
- Formulate complex queries using SQL.
- Design and Implement applications that have GUI and access databases for backend connectivity

IF5251 **SOFTWARE INDUSTRIALIZATION** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be able:

- To point out the need for industrialization in software development
- To understand the non functional requirements in software engineering
- To carry out performance analyses
- To study the various types of scalability
- To acquire the art of capacity planning
- To Understand the techniques for infrastructure management

UNIT I INDUSTRIALIZATION OF SOFTWARE DEVELOPMENT 9

The Fragile Hand Weaving – Features Vs Robustness – Components and Services Based Development – Agile and DevOps - Software Factory – Automation

UNIT II NON FUNCTIONAL REQUIREMENTS and ENGINEERING 9

NFRs - Cost of Quality – Business and System View – Industrialization Process in SDLC – Performance and Scalability – Capacity Planning –Production Operations

UNIT III PERFORMANCE and SCALABILITY ENGINEERING 9

Engineering for Performance and Scalability -Performance Modelling, Measurement and Testing – Workload Characterization – Latency and Throughput Requirements – Resource Usage Measurements Processor, Memory, Disk, Network – Performance Testing and Profiling – Bottleneck and Hotspot Identification – Vertical and Horizontal Scalability – Load, Space and Structural Scalability – Endurance Engineering – Analysis and Presenting Recommendations – Tools for Performance and Scalability

UNIT IV THE ART OF CAPACITY PLANNING 9

Capacity Planning Art Vs Science – Budgetary Capacity Planning - Utilization, Service Demand, The Forced Flow, Interactive Response Time, Little's Laws – Using Queuing Models – Markov Models – M/M/1 M/G/1 Single Queue Systems – Mean Value Analysis- Multi Class Models – Priority Scheduling – Fork/Join Queuing Networks – Production Capacity Forecasting With Regression and Time Series Models – Tools for Capacity Planning

UNIT V PRODUCTION SYSTEMS MANAGEMENT 9

Infrastructure Management and Support – Systems, Storage and Network Monitoring – High Availability – Service Levels – Change and Configuration Management- Capacity Augmentation - Modernizing and Cloud Enablement - Automation

TOTAL: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand SOA and DevOps
- Understand the non-functional requirements in software engineering
- Apply various performance analysis techniques
- Analyze software systems for scalability
- Apply capacity planning methods
- Apply infrastructure management techniques

REFERENCES:

1. Andre B. Bondi, "Foundations of Software and System Performance Engineering", Addison Wesley, 2015
2. Daniel A. Menasce, Dowdy, Almeida, "Computer Capacity Planning by Example", Prentice Hall, 2004
3. L. Chung, B. Nixon, E. Yu and J. Mylopoulos, "Non-Functional Requirements in Software Engineering", Springer, 2000
4. Rich Schiesser, "IT Systems Management", Pearson Education, 2010.

IF5201 NETWORK ENGINEERING L T P C

3 0 0 3

OBJECTIVES:

- To provide an introduction to the principles and practices of Network Engineering.
- To understand the architecture of the network devices.
- To learn QoS related methodologies.
- To explore the emerging technologies in network engineering.

UNIT I FOUNDATIONS OF NETWORKING 9

Communication Networks –Network Elements –Switched Networks and Shared media Networks – Probabilistic Model and Deterministic Model –Datagrams and Virtual Circuits –Multiplexing–Switching -Error and Flow Control –Congestion Control –Layered Architecture –Network Externalities –Service Integration.

UNIT II QUALITY OF SERVICE 9

Traffic Characteristics and Descriptors –Quality of Service and Metrics –Best Effort model and guaranteed Service Model –Limitations of IP networks –Scheduling and Dropping Policies for BE and GS models –Traffic Shaping Algorithms–End to End Solutions –Laissez Faire Approach –Possible improvements in TCP –Significance of UDP in Inelastic Traffic

UNIT III HIGH PERFORMANCE NETWORKS 9

Integrated Services Architecture –Components and Services –Differentiated Services Networks –Per Hop Behavior –Admission Control–MPLS Networks –Principles and Mechanisms –Label Stacking– RSVP–RTP/RTCP.

UNIT IV NETWORK DEVICE ARCHITECTURE 9

Network Devices –Switch–Router–Hardware Components-Software –Configuration–Routing Concepts-Static Routing –Dynamics Routing –Routing Information Protocol –Configuration –Open Shortest Path First Protocol –Configuration –Access Control List –Standard –Extended –Named. Multiplexers, Modems and Internet Access Devices –Switching and Routing Devices-Router Structure -Configuring EGP –RIP –OSPF –IS-IS-Hub -Bridges –Routers –Link Virtualization -Multicast Architecture.

UNIT V SOFTWARE DEFINED NETWORKING 9

Evolution of SDN -Control Plane - Control and data plane separation - Network Virtualization - Data Plane - Programming SDNs - Verification and Debugging - openflow networks.

TOTAL: 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Explain the of the principles of network engineering.
- Knowledge of network engineering concepts and techniques.
- Recent development in network engineering

REFERENCES:

1. James Macfarlane," Network Routing Basics: Understanding IP Routing in Cisco Systems", Wiley edition 1 2006.
2. Jean Warland and Pravin Vareya, 'High Performance Networks', Morgan Kauffman Publishers, 2002
3. Larry L Peterson and Bruce S Davie, 'Computer Networks: A Systems Approach', Fifth Edition, Morgan Kaufman Publishers, 2012.
4. Mahbub Hassan and Raj Jain, 'High Performance TCP/IP Networking', Pearson Education/PHI, 2009.
5. Thomas Nadeau , Ken Gray, "SDN - Software Defined Networks", O'reilly Publishers, 2013.
6. Wendell Odom and Rick McDonald, "Routers and Routing Basics CCNA 2 Companion Guide (Cisco Networking Academy)", Cisco press, 2006.

CP5292	INTERNET OF THINGS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To learn about the basics of IOT protocols.
- To build a small low cost embedded system using Raspberry Pi.
- 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 :45 PERIODS

OUTCOMES:

Upon completion of the course, the student should be able to:

- Analyze various protocols for IoT
- Develop web services to access/control IoT devices.
- Design a portable IoT using Rasperry Pi
- Deploy an IoT application and connect to the cloud.
- Analyze applications of IoT in real time scenario

REFERENCES:

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.

CP5293 **BIG DATA ANALYTICS** **L T P C**
3 0 0 3

OBJECTIVES:

- To understand the competitive advantages of big data analytics
- To understand the big data frameworks
- To learn data analysis methods
- To learn stream computing
- 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: 45 PERIODS

OUTCOMES:

At the end of this course, the students will be able to:

- Understand how to leverage the insights from big data analytics
- Analyze data by utilizing various statistical and data mining approaches
- Perform analytics on real-time streaming data
- Understand the various NoSql alternative database models

REFERENCES:

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. Learning R – A Step-by-step Function Guide to Data Analysis, Richard Cotton, O’Reilly Media, 2013.
4. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, Second Edition, 2007.
5. Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.
6. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Professional, 2012.

CP5281 TERM PAPERWRITING AND SEMINAR L T P C
0 0 2 1

In this course, students will develop the scientific and technical reading and writing skills 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 (atleast 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 and Topic 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,	3rd week	**3%** (the selected information must be area specific and of international and national standard)

	forums, news sites) 6. List 3 authors who publish regularly in your area 7. Attach a call for papers (CFP) from 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 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 limitations of their research? • What did the author say were the important directions for future research?	5th week	**8%** (the table given should indicate your understanding of the paper and the evaluation is based on your conclusions about each paper)

	Conclude with limitations/issues not addressed by the paper (from the perspective of your survey)		
Reading and notes for next5 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 final 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	11thweek	**10%** (this component will be evaluated based on the linking and classification among the papers)
Your conclusions	Write your conclusions and future work	12th week	**5%** (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 : 30 PERIODS

CP5261	DATA ANALYTICS LABORATORY	L	T	P	C
		0	0	4	2

OBJECTIVES:

- To implement MapReduce programs for processing big data
- To realize storage of big data using Hbase, MongoDB
- To analyse big data using linear models
- To analyse big data using machine learning techniques such as SVM / Decision tree classification and clustering

LIST OF 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: 60 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- Process big data using Hadoop framework.
- Build and apply linear and logistic regression models.
- Perform data analysis with machine learning methods.
- Perform graphical data analysis.

LIST OF SOFTWARE FOR A BATCH OF 30 STUDENTS:

Hadoop
YARN
R Package
Hbase
MongoDB

REFERENCES:

1. Alan Gates and Daniel Dai, "Programming Pig – Dataflow scripting with Hadoop", O'Reilley, 2nd Edition, 2016.
2. Gareth James, Daniela Witten, Trevor Hastie and Robert Tibshirani, “An Introduction to Statistical Learning with Applications in R”, Springer Publications, 2015(Corrected 6th Printing)
3. Hadley Wickham,”ggplot2 – Elegant Graphics for Data Analysis”, Springer Publications,2nd Edition, 2016
4. Kristina Chodorow, "MongoDB: The Definitive Guide – Powerful and Scalable Data Storage", O'Reilley, 2nd Edition, 2013.
5. Lars George, "HBase: The Definitive Guide", O'Reilley, 2015.
6. Tom White, “Hadoop: The Definitive Guide – Storage and Analysis at Internet Scale”, O'Reilley, 4th Edition, 2015.

CP5092	CLOUD COMPUTING TECHNOLOGIES	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the concepts of virtualization and virtual machines
- To gain expertise in server, network and storage virtualization.
- To understand and deploy practical virtualization solutions and enterprise solutions
- To gain knowledge on the concept of virtualization that is fundamental to cloud computing
- To understand the various issues in cloud computing
- To be able to set up a private cloud
- 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 :45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to

- Employ the concepts of storage virtualization, network virtualization and its management
- Apply the concept of virtualization in the cloud computing
- Identify the architecture, infrastructure and delivery models of cloud computing
- Develop services using Cloud computing
- Apply the security models in the cloud environment

REFERENCES:

1. Danielle Ruest, Nelson Ruest, “Virtualization: A Beginner‟s Guide”, McGraw-Hill Osborne Media, 2009.
2. Jim Smith, Ravi Nair , "Virtual Machines: Versatile Platforms for Systems and Processes", Elsevier/Morgan Kaufmann, 2005
3. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
4. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
5. Tim Mather, Subra Kumaraswamy, and Shahed Latif ,"Cloud Security and Privacy", O’Reilly Media, Inc.,2009.
6. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing, A Practical Approach", McGraw-Hill Osborne Media, 2009.
7. Tom White, "Hadoop: The Definitive Guide", Yahoo Press, 2012.

CP5191 MACHINE LEARNING TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques
- To study the various probability based learning techniques
- 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: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Distinguish between, supervised, unsupervised and semi-supervised learning.
- Apply the apt machine learning strategy for any given problem.
- Suggest supervised, unsupervised or semi-supervised learning algorithms for any given problem.
- Design systems that uses the appropriate graph models of machine learning.
- Modify existing machine learning algorithms to improve classification efficiency.

REFERENCES:

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.

IF5091 **L T P C**

ENERGY AWARE COMPUTING **3 0 0 3**

OBJECTIVES:

- To understand the fundamentals of Energy Efficient Computing
- To understand the concept of Energy Efficient Storage Systems
- To introduce the various types of scheduling algorithms in energy efficient computing
- To introduce the concept of Green Networking
- To study Energy Aware Computing Applications

UNIT I INTRODUCTION 9

Subreshold Computing – Energy Efficient Network-on-Chip Architectures for Multi-Core Systems-Energy-Efficient MIPS CPU Core with Fine-Grained Run-Time Power Gating – Case Study : Geyser

UNIT II ENERGY EFFICIENT STORAGE 9

Power-Efficient Strategies for Storage Systems-Energy-Saving Techniques for Disk Storage Systems -Thermal and Power-Aware Task Scheduling and Data Placement for Storage Centric Data centres - Energy-Saving Techniques for Disk Storage Systems

UNIT III ENERGY EFFCIENT SCHEDULING ALGORITHMS 9

Algorithms and Analysis of Energy-Efficient Scheduling of Parallel Tasks- Dynamic Voltage Scaling- Speed Scaling - Memetic Algorithms for Energy-Aware Computation and Communications Optimization in Computing Clusters- Online job scheduling Algorithms

UNIT IV INTRODUCTION TO GREEN NETWORKING 9

Power-Aware Middleware for Mobile Applications -Energy Efficiency of Voice-over-IP Systems - Intelligent Energy-Aware Networks - Green TCAM-Based Internet Routers

UNIT V ENERGY AWARE COMPUTING APPLICATIONS 9

Energy Awareness in Video Codec Design-Overview of H.264/AVC Video Codec Design-Energy Aware Surveillance Camera -Low Power Design Challenge in Biomedical Implant Electronics

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Design Power efficient architecture Hardware and Software
- Analyze the different types of Energy Efficient Storage systems.
- Design the algorithms for Energy Efficient Systems
- Identify the different types of Green Networking schemes in the energy efficient computing
- Explore the applications of Energy Aware Computing

REFERENCES:

1. Bob steiger wald ,Chris:Luero, Energy Aware computing, Intel Press,2012
2. Chong -Min Kyung, Sungioo yoo, Energy Aware system design Algorithms and Architecture, Springer, 2011.
3. Ishfaq Ah mad, Sanjay Ranka, Handbook of Energy Aware and Green Computing, Chapman and Hall/CRC, 2012

IF5001	BIO-INSPIRED COMPUTING	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To Learn bio-inspired theorem and algorithms
- To Understand random walk and simulated annealing
- To Learn genetic algorithm and differential evolution
- To Learn swarm optimization and ant colony for feature selection
- 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 Tunneling.

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 : 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Implement and apply bio-inspired algorithms
- Explain random walk and simulated annealing
- Implement and apply genetic algorithms
- Explain swarm intelligence and ant colony for feature selection
- Apply bio-inspired techniques in image processing.

REFERENCES:

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 , Jaao Paulo papa, "Bio-Inspired Computing and Applications in Image Processing",Elsevier 2016
4. Xin-She Yang, "Nature Ispired Optimization Algorithm,Elsevier First Edition 2014
5. Yang ,Cui,XIao,Gandomi,Karamanoglu ,"Swarm Intelligence and Bio-Inspired Computing", Elsevier First Edition 2013

MU5252 DIGITAL IMAGE PROCESSING AND PATTERN RECOGNITION **L T P C 3 0 0 3**

OBJECTIVES:

- To understand the basic concepts and algorithms of digital processing.
- To familiarize the student with the image processing environments like Matlab and its equivalent open source Image processing environments.
- To expose the students to a broad range of image processing techniques and issues and their applications, and to provide the student with practical experiences using them.
- To appreciate the use of image processing in current technologies and to expose the students to real-world applications of the image processing.

UNIT I FUNDAMENTALS OF IMAGE PROCESSING 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 INTRODUCTION TO PATTERN RECOGNITION 9

Component Labeling - Image Features - Textures - Boundary representations and descriptions - Regional descriptors - Feature selection and Feature dimensionality reduction. Image Classification and Recognition- Statistical Classifiers _ Clustering Algorithms - Hierarchical and Partitional clustering

UNIT V IMAGE PATTERN RECOGNITION CASE STUDIES 9

Image Understanding – Case Studies in Biometrics, Video Processing, Image Fusion - Image Security - Steganography and Watermarking - Stereo vision - Visual Effects - Image compositing.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course

- The students should be able to implement basic image processing algorithms using MATLAB tools
- Design an application that incorporates different concepts of Image processing
- Apply and explore new techniques in the areas of image enhancement, restoration, segmentation, compression, wavelet processing and image morphology
- critically analyze different approaches to implements mini projects
- Explore the possibility of Appling image processing concepts in various domains

REFERENCES:

1. Alasdair McAndrew, “Introduction to Digital Image Processing with Matlab”, Cengage Learning 2011, India.
2. Anil J Jain, “Fundamentals of Digital Image Processing”, PHI, 2011.
3. Rafael C.Gonzalez and Richard E.Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2008, New Delhi.
4. S.Sridhar, “Digital Image Processing”, Oxford University Press, 2011, New Delhi.
5. Wilhelm Burger, Mark J Berge, “ Digital Image Processing: An algorithmic Introduction using Java”, Springer International Edition,2008.

CP5095 COMPUTER VISION L T P C
3 0 0 3

OBJECTIVES:

- To review image processing techniques for computer vision
- To understand shape and region analysis
- To understand Hough Transform and its applications to detect lines, circles, ellipses
- To understand three-dimensional image analysis techniques
- To understand motion analysis
- To study some applications of computer vision algorithms

UNIT I IMAGE PROCESSING FOUNDATIONS 9

Review of image processing techniques – classical filtering operations – thresholding techniques – edge detection techniques – corner and interest point detection – mathematical morphology – texture

UNIT II SHAPES AND REGIONS 9

Binary shape analysis – connectedness – object labeling and counting – size filtering – distance functions – skeletons and thinning – deformable shape analysis – boundary tracking procedures – active contours – shape models and shape recognition – centroidal profiles – handling occlusion – boundary length measures – boundary descriptors – chain codes – Fourier descriptors – region descriptors – moments

UNIT III HOUGH TRANSFORM 9

Line detection – Hough Transform (HT) for line detection – foot-of-normal method – line localization – line fitting – RANSAC for straight line detection – HT based circular object detection – accurate center location – speed problem – ellipse detection – Case study: Human Iris location – hole detection – generalized Hough Transform (GHT) – spatial matched filtering – GHT for ellipse detection – object location – GHT for feature collation

UNIT IV 3D VISION AND MOTION 9

Methods for 3D vision – projection schemes – shape from shading – photometric stereo – shape from texture – shape from focus – active range finding – surface representations – point-based representation – volumetric representations – 3D object recognition – 3D reconstruction – introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion

UNIT V APPLICATIONS 9

Application: Photo album – Face detection – Face recognition – Eigen faces – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – Chamfer matching, tracking, and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Implement fundamental image processing techniques required for computer vision
- Perform shape analysis
- Implement boundary tracking techniques
- Apply chain codes and other region descriptors
- Apply Hough Transform for line, circle, and ellipse detections
- Apply 3D vision techniques
- Implement motion related techniques
- Develop applications using computer vision techniques

REFERENCES:

1. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects”, Packt Publishing, 2012.
2. E. R. Davies, “Computer & Machine Vision”, Fourth Edition, Academic Press, 2012.
3. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images”, O'Reilly Media, 2012.
4. Mark Nixon and Alberto S. Aquado, “Feature Extraction & Image Processing for Computer Vision”, Third Edition, Academic Press, 2012.
5. R. Szeliski, “Computer Vision: Algorithms and Applications”, Springer 2011.
6. Simon J. D. Prince, “Computer Vision: Models, Learning, and Inference”, Cambridge University Press, 2012.

MP5091 HUMAN COMPUTER INTERACTION L T P C

3 0 0 3

OBJECTIVES:

- To know how to analyze and consider user’s need in the interaction system
- To understand various interaction design techniques and models
- To understand the theory and framework of HCI
- Understand and analyze the cognitive aspects of human – machine interaction

UNIT I INTRODUCTION 9

Foundation – Human – Computer – Interaction – Paradigms – What is HCI – Components – Cognitive Framework – Perception and Representation – Attention and Memory Constraint – Knowledge and Mental Model – Interface Metaphors – Input – Output

UNIT II DESIGN PROCESS 9

Interaction Styles – Interaction Design Basics – HCI in the Software Process – Design Rules - Designing Windowing Systems - User Support and On-Line Information - Designing For Collaborative Work and Virtual Environments - Principles and User-Centred Design - Methods for User-Centred Design

UNIT III IMPLEMENTATION AND EVALUATION PROCESS 9

Implementation issues – Implementation Support - Evaluation techniques – Universal Design – User Support

UNIT IV MODELS 9

Cognitive models – Communication and collaboration models: Models of the system – Models of the System – Modeling Rich Interaction.

UNIT V APPLICATIONS 9

Socio – organization issues and stakeholder requirements - Ubiquitous Computing - Context – aware User Interfaces - Hypertext, multimedia and the World Wide Web

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to:

- To develop good design for human machine interaction system
- Analyze the user's need in interaction system
- To design new interaction model to satisfy all types of customers
- Evaluate the usability and effectiveness of various products
- To know how to apply interaction techniques for systems

REFERENCES:

1. Alan Dix, Janet Finlay, Gregory D.Abowd, Russell Beale, "Human Computer Interaction", Third Edition, Pearson Education, 2004
2. Dix, Finlay, Abowd and Beale. "Human – Computer Interaction", Second edition, Prentice Hall,1998.
3. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey. "Human – Computer Interaction", Addison Wesley, 1994.
4. John M.Carrol, "Human Computer Interaction in the New Millenium", Pearson Education, 2002.

CP5094 INFORMATION RETRIEVAL TECHNIQUES

L	T	P	C
3	0	0	3

OBJECTIVES:

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

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 : 45 PERIODS

OUTCOMES:

Upon completion of this course, the student should be able to

- Build an Information Retrieval system using the available tools
- Identify and design the various components of an Information Retrieval system
- Apply machine learning techniques to text classification and clustering which is used for efficient Information Retrieval
- Design an efficient search engine and analyze the Web content structure

REFERENCES:

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

CP5074	SOCIAL NETWORK ANALYSIS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the components of the social Network
- To model and visualize the social network
- To mine the users in the w4
- To understand the evolution of the social Network
- 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 : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students will be able to

- Work on the internals components of the social network
- Model and visualize the social network
- Mine the behaviour of the users in the social network
- Predict the possible next outcome of the social network
- Apply social network in real time application.

REFERENCES:

1. Ajith Abraham, Aboul Ella Hassanien, Václav Snášel, “Computational Social Network Analysis: Trends, Tools and Research Advances”, Springer, 2012
2. Borko Furht, “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. Guandong Xu , 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, Nitesh Chawla,”Applications of Social Media and Social Network Analysis”, Springer,2015

CP5097	MOBILE APPLICATION DEVELOPMENT	L	T	P	C
		3	0	0	3

OBJECTIVES:

- Understand system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution.

UNIT I INTRODUCTION 5

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 8

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 8

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 12

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 12

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

TOTAL :45 PERIODS

OUTCOMES:

- Describe the requirements for mobile applications
- Explain the challenges in mobile application design and development
- Develop design for mobile applications for specific requirements
- Implement the design using Android SDK
- Implement the design using Objective C and iOS
- Deploy mobile applications in Android and iPone marketplace for distribution

REFERENCES:

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

IF5092 VIDEO ANALYTICS L T P C
3 0 0 3

OBJECTIVES:

- To know the fundamental concepts of big data and analytics
- To learn various techniques for mining data streams
- To acquire the knowledge of extracting information from surveillance videos.
- To learn Event Modelling for different applications.
- To understand the models used for recognition of objects in videos.

UNIT I INTRODUCTION TO BIG DATA & DATA ANALYSIS 9

Introduction to Big Data Platform – Challenges of Conventional systems – Web data- Evolution of Analytic scalability- analytic processes and tools- Analysis Vs Reporting- Modern data analytic tools- Data Analysis: Regression Modeling- Bayesian Modeling- Rule induction.

UNIT II MINING DATA STREAMS 9

Introduction to Stream concepts- Stream data model and architecture – Stream Computing- Sampling data in a Stream- Filtering Streams- Counting distinct elements in a Stream- Estimating moments- Counting oneness in a window- Decaying window- Real time Analytics platform(RTAP) applications- case studies.

UNIT III VIDEO ANALYTICS 9

Introduction- Video Basics - Fundamentals for Video Surveillance- Scene Artifacts- **Object Detection and Tracking**: Adaptive Background Modelling and Subtraction- Pedestrian Detection and Tracking- Vehicle Detection and Tracking- Articulated Human Motion Tracking in Low-Dimensional Latent Spaces.

UNIT IV BEHAVIOURAL ANALYSIS & ACTIVITY RECOGNITION 9

Event Modelling- Behavioural Analysis- Human Activity Recognition-Complex Activity Recognition- Activity modelling using 3D shape, Video summarization, shape based activity models- Suspicious Activity Detection.

UNIT V HUMAN FACE RECOGNITION & GAIT ANALYSIS 9

Introduction: Overview of Recognition algorithms – Human Recognition using Face: Face Recognition from still images, Face Recognition from video, Evaluation of Face Recognition Technologies- Human Recognition using gait: HMM Framework for Gait Recognition, View Invariant Gait Recognition, Role of Shape and Dynamics in Gait Recognition.

TOTAL: 45 PERIODS

OUTCOMES:

On successful completion of this course, students will be able to:

- Work with big data platform and its analysis techniques.
- Design efficient algorithms for mining the data from large volumes.
- Work with surveillance videos for analytics.
- Design of optimization algorithms for better analysis and recognition of objects in a scene.
- Model a framework for Human Activity Recognition

REFERENCES:

1. Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets, Cambridge University Press, 2012.
2. Michael Berthold, David J.Hand, Intelligent Data Analysis, Springer, 2007.
3. Rama Chellappa, Amit K.Roy-Chowdhury, Kevin Zhou.S, "Recognition of Humans and their Activities using Video", Morgan&Claypool Publishers, 2005.
4. Yunqian Ma, Gang Qian, "Intelligent Video Surveillance: Systems and Technology", CRC Press (Taylor and Francis Group), 2009.

IF5002	DEEP LEARNING	L T P C
		3 0 0 3

OBJECTIVES:

This course covers the basics of machine learning, neural networks and deep learning. Model for deep learning technique and the various optimization and generalization mechanisms are included. Major topics in deep learning and dimensionality reduction techniques are covered. The objective of this course is:

- To present the mathematical, statistical and computational challenges of building neural networks
- To study the concepts of deep learning
- To introduce dimensionality reduction techniques
- To enable the students to know deep learning techniques to support real-time applications
- To examine the case studies of deep learning techniques

UNIT I INTRODUCTION 9

Introduction to machine learning- Linear models (SVMs and Perceptrons, logistic regression)- Intro to Neural Nets: What a shallow network computes- Training a network: loss functions, back propagation and stochastic gradient descent- Neural networks as universal function approximates

UNIT II DEEP NETWORKS 9

History of Deep Learning- A Probabilistic Theory of Deep Learning- Backpropagation and regularization, batch normalization- VC Dimension and Neural Nets-Deep Vs Shallow Networks- Convolutional Networks- Generative Adversarial Networks (GAN), Semi-supervised Learning

UNIT III DIMENTIONALITY REDUCTION 9

Linear (PCA, LDA) and manifolds, metric learning - Auto encoders and dimensionality reduction in networks - Introduction to Convnet - Architectures – AlexNet, VGG, Inception, ResNet - Training a Convnet: weights initialization, batch normalization, hyperparameter optimization

UNIT IV OPTIMIZATION AND GENERALIZATION 9

Optimization in deep learning– Non-convex optimization for deep networks- Stochastic Optimization- Generalization in neural networks- Spatial Transformer Networks- Recurrent networks, LSTM - Recurrent Neural Network Language Models- Word-Level RNNs & Deep Reinforcement Learning - Computational & Artificial Neuroscience

UNIT V CASE STUDY AND APPLICATIONS 9

Imagenet- Detection-Audio WaveNet-Natural Language Processing Word2Vec - Joint Detection- BioInformatics- Face Recognition- Scene Understanding- Gathering Image Captions

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to

- Understand basics of deep learning
- Implement various deep learning models
- Realign high dimensional data using reduction techniques
- Analyze optimization and generalization in deep learning
- Explore the deep learning applications

REFERENCES:

1. Cosma Rohilla Shalizi, Advanced Data Analysis from an Elementary Point of View, 2015.
2. Deng & Yu, Deep Learning: Methods and Applications, Now Publishers, 2013.
3. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
4. Michael Nielsen, Neural Networks and Deep Learning, Determination Press, 2015.

IF5003 AUTOMATA THEORY AND FORMAL LANGUAGES L T P C
3 0 0 3

OBJECTIVES:

- To know the formal relationships between machines, languages and grammar.
- To construct automata for any given word pattern and find its equivalent regular expressions
- To design grammars for recognizing the syntax of any given language
- To understand the need for designing Turing machines and their capability
- To have the capability to solve un-decidable problems and NP problems

UNIT I REGULAR EXPRESSIONS AND LANGUAGES 9

Introduction to Formal Proof – Additional Forms of proof – Inductive proofs – Proof by Contradiction - Regular Expressions – Regular and Non Regular Languages - Closure Properties of Regular Languages - Proving Languages Not to Be Regular - Decision Properties of Regular Languages.

UNIT II AUTOMATA 9

Finite Automata – Deterministic Finite Automata – Non-deterministic Finite Automata – Finite Automata with Epsilon Transitions - Kleene's Theorem –Equivalence and Minimization of Automata - Finite Automata and Regular Expressions.

UNIT III CONTEXT-FREE GRAMMARS AND LANGUAGES 9

Context-Free Grammars – Parse Trees – Ambiguity in Grammars and Languages – Normal forms for Context-Free Grammars – Pumping Lemma for Context-Free Languages - Closure and Decision Properties of Context-Free Languages - Phases of a complier - Lexical Analysis – Parsing – Compiler Design using Lexical Analysis and Parsing – Grammars for Natural Language Processing.

UNIT IV PUSHDOWN AUTOMATA AND TURING MACHINES 9

Definition– Languages of a Pushdown Automata – Equivalence of Pushdown Automata and Context-Free Grammars - Deterministic Pushdown Automata - Turing Machines – Programming Techniques for Turing Machines - Basic Turing Machine Extensions.

UNIT V UNDECIDABILITY 9

Not Recursively Enumerable Language – Recursively Enumerable Undecidable problem– Undecidable Problems about Turing Machines – Post's Correspondence Problem - The classes P and NP - NP-complete problems.

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of the course, the students will be able to:

- Construct automata for a language and regular expression for any pattern.
- Write Context free grammar for any construct and perform syntax analysis.
- Design Push down automata for any language and solve problems
- Propose computation solutions using Turing machines.
- Derive whether a problem is decidable or not.

REFERENCE S:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, and Jeffrey D. Ullman, "Compilers: Principles, Techniques, & Tools", Second Edition Boston: Addison-Wesley, 2007.
2. H.R.Lewis and C.H.Papadimitriou, "Elements of The theory of Computation", Second Edition, Pearson Education/PHI, 2003.
3. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Third Edition, Pearson Education, 2007.
4. J.Martin, "Introduction to Languages and the Theory of Computation", Third Edition, TMH, 2003.
5. Micheal Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.

IF5071 GPU ARCHITECTURE AND PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

- To understand the architecture of GPUs in order to program them effectively.
- To program using GPU programming frameworks.
- To optimize multimedia applications to run on GPUs.

UNIT I GPU ARCHITECTURES 9

Parallel Processors – Classification – Performance – Multimedia SIMD Architectures. GPU – NVIDIA Case Study – GPU Computational Structures – ISA – Memory Structures.

UNIT II GPU COMPUTING AND CUDA 9

Introduction – Parallel Programming Languages and models – Evolution of Graphic pipelines – GPGPUs - CUDA Program Structure – Device memories – Data Transfer – Kernel Functions

UNIT III CUDA DETAILS 9

CUDA Threads – Thread Organization – Synchronization & Scalability – CUDA memories – Performance – Imaging Case study

UNIT IV OPENCL BASICS **9**

OpenCL Standard – Kernels – Host Device Interaction – Execution Environment – Memory Model – Basic OpenCL Examples.

UNIT V OPENCL CONCURRENCY & EXECUTION MODEL **9**

OpenCL Synchronization – Kernels – Fences – Barriers – Queueing – Global Synchronization – Memory Consistency – Events – Host side memory model – Device Side memory Model – Case study

TOTAL: 45 PERIODS

OUTCOMES:

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

- Design multimedia applications using GPUs.
- Write Programs for GPUs using CUDA / OpenCL.
- Optimize programs to run on massively parallel architectures.

REFERENCES:

1. B.R. Gaster, L. Howes, D.R. Kaeli, P. Mistry, D. Schaa, " Heterogeneous computing with OpenCL", Morgan Kauffman, 2012
2. David B. Kirk, Wen-mei W. Hwu, "Programming massively parallel processors",Morgan Kauffman, 2010.
3. John L. Hennessey and David A. Patterson, "Computer Architecture –A quantitative approach", Morgan Kaufmann / Elsevier, 5th edition, 2012.
4. J. Sanders and E. Kandrot**,** "CUDA by Example: An Introduction to General-Purpose GPU Programming", Addison Wesley, 2010.
5. Wen–mei W. Hwu, "GPU Computing Gems", Morgan Kaufmann / Elsevier, 2011

IF5004 CYBER FORENSICS **L T P C**

3 0 0 3

OBJECTIVES:

- To study the fundamentals of computer forensics.
- To have an overview of techniques for Data Recovery and Evidence Collection.
- To study various threats associated with security and information warfare.
- To study the tools and tactics associated with cyber forensics.

UNIT I INTRODUCTION **7**

Computer Forensics Fundamentals – Types of Computer Forensics Technology – Types of Vendor and Computer Forensics Services.

UNIT II COMPUTER FORENSICS EVIDENCE AND CAPTURE **8**

Data Recovery – Evidence Collection and Data Seizure –Duplication and Preservation of Digital Evidence – Computer Image Verification and Authentication.

UNIT III COMPUTER FORENSIC ANALYSIS **10**

Discover of Electronic Evidence – Identification of Data – Reconstructing Past Events Fighting against Macro Threats – Information Warfare Arsenal – Tactics of the Military–Tactics of Terrorist and Rogues – Tactics of Private Companies.

UNIT IV INFORMATION WARFARE 10

Arsenal – Surveillance Tools- Hackers and Theft of Components- Contemporary computer Crime Identity Theft and Identity Fraud-Organized Crime & Terrorism Avenues Prosecution and Government Efforts- Applying the First Amendment to Computer Related Crime-The Fourth Amendment and Other Legal Issues.

UNIT V COMPUTER FORENSIC CASES 10

Developing Forensic Capabilities- Searching and Seizing Computer Related Evidence-Processing Evidence and Report Preparation - Future Issues.

TOTAL:45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to

- To apply the concepts of computer forensics.
- To handle threats associated with security and information warfare.
- To design tools and tactics associated with cyber forensics.

REFERENCES:

1. Chad Steel, “Windows Forensics”, W iley India, 2006.Majid Yar, “Cybercrime and Society”, Sag ePublications, 2006.Robert M Slade, “Software Forensics”, Tata Mc Graw Hill, 2004.
2. John R. Vacca, “Computer Forensics: Computer Crime Scene Investigation, Volume1, Cengage Learning, 2005.
3. Marie-Helen Maras, “Computer Forensics: Cybercriminals, Laws, and Evidence”, Jones & Bartlett 2013
4. Marjie T Britz , “Computer Forensics and Cyber Crime: An Introduction, 3/E, Pearson Education, Publishers, 2011.

IF5005 TRUST NETWORKS L T P C

3 0 0 3

OBJECTIVES:

- To understand trust networks
- To learn how decentralization of trust is achieved
- To study the technologies behind cryptocurrencies
- To impart knowledge in block chain network mining
- To acquire knowledge in emerging concepts using block chain

UNIT I TRUST NETWORKS 9

Technical and Business Imperatives – Trust Networks to enable the machine economy – Decentralization of Trust – Technologies Blockchain and Crypto currency

UNIT II DECENTRALIZATION OF NETWORK 9

Centralization Vs Decentralization – Building Consensus – Distributed Consensus – Consensus Algorithm – Consensus without Identity- Incentives and Proof of Work –Forming the Decentralized Network

UNIT II BLOCKCHAIN 9

Blockchain the protocol – Types of Blockchain Networks – Design principles of the Blockchain economy – Networked Integrity – Distributed power – Value as Incentive – Security and Privacy – Rights and Inclusion – Distributed Ledger – Non Repudiation

UNIT III CRYPTOCURRENCIES 9

Cryptographic Hash Functions – Cryptography basics and Concepts – Bitcoin – Digital Signatures as Identities – eWallets – Personal Crypto security

UNIT IV BLOCKCHAIN NETWORK MINING 9

Bitcoin Mining – Mining Hardware – Energy Consumption – Mining Pools – Mining Incentives and Strategies

UNIT V EMERGING CONCEPTS AND FRAMEWORKS 9

Smart Contracts – Ethereum, Hyperledger, Mulitchain Frameworks – Solidity Programming Language – Blockchain with IOT and Cloud

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course the students will be able to:

- Realize the importance of trust networks
- Comprehend the challenges and design issues in bitcoin technology
- Analyze the algorithms developed for bitcoin mining
- Use appropriate techniques for designing trust-based business networks

REFERENCES:

1. Don and Alex Tapscott, “Blockchain Revolution”. Portfolio Penguin 2016.
2. William Mougayar, “Business Blockchain Promise, Practice and Application of the Next Internet Technology, John Wiley & Sons 2016.

CU5097	WIRELESS ADHOC AND SENSOR NETWORKS	L	T	P	C
		3	0	0	3

OBJECTIVES:

- To understand the basics of Ad-hoc & Sensor Networks.
- To learn various fundamental and emerging protocols of all layers.
- To study about the issues pertaining to major obstacles in establishment and efficient management of Ad-hoc and sensor networks.
- To understand the nature and applications of Ad-hoc and sensor networks.
- To understand various security practices and protocols of Ad-hoc and Sensor Networks.

UNIT I MAC & TCP IN AD HOC NETWORKS 9

Fundamentals of WLANs – IEEE 802.11 Architecture - Self configuration and Auto configuration-Issues in Ad-Hoc Wireless Networks – MAC Protocols for Ad-Hoc Wireless Networks – Contention Based Protocols - TCP over Ad-Hoc networks-TCP protocol overview - TCP and MANETs – Solutions for TCP over Ad-Hoc Networks.

UNIT II ROUTING IN AD HOC NETWORKS 9

Routing in Ad-Hoc Networks- Introduction-Topology based versus Position based Approaches-Proactive, Reactive, Hybrid Routing Approach-Principles and issues – Location services - DREAM – Quorums based location service – Grid – Forwarding strategies – Greedy packet forwarding – Restricted directional flooding- Hierarchical Routing- **Issues and Challenges in providing QoS.**

UNIT III MAC, ROUTING & QOS IN WIRELESS SENSOR NETWORKS 9

Introduction – Architecture - Single node architecture – Sensor network design considerations – Energy Efficient Design principles for WSNs – Protocols for WSN – Physical Layer : Transceiver Design considerations – MAC Layer Protocols – IEEE 802.15.4 Zigbee – Link Layer and Error Control issues - Routing Protocols – Mobile Nodes and Mobile Robots - Data Centric & Contention Based Networking – Transport Protocols & QOS – Congestion Control issues – Application Layer support.

UNIT IV SENSOR MANAGEMENT 9

Sensor Management - Topology Control Protocols and Sensing Mode Selection Protocols - Time synchronization - Localization and positioning – Operating systems and Sensor Network programming – Sensor Network Simulators.

UNIT V SECURITY IN AD HOC AND SENSOR NETWORKS 9

Security in Ad-Hoc and Sensor networks – Key Distribution and Management – Software based Anti-tamper techniques – water marking techniques – Defense against routing attacks - Secure Adhoc routing protocols – Broadcast authentication WSN protocols – TESLA – Biba – Sensor Network Security Protocols – SPINS.

TOTAL : 45 PERIODS

OUTCOMES:

Upon Completion of the course, the students should be able to:

- Identify different issues in wireless ad hoc and sensor networks.
- To analyze protocols developed for ad hoc and sensor networks.
- To identify and address the security threats in ad hoc and sensor networks.
- Establish a Sensor network environment for different type of applications.

REFERENCES:

1. Adrian Perrig, J. D. Tygar, "Secure Broadcast Communication: In Wired and Wireless Networks", Springer, 2006.
2. C.K.Toh, “Ad Hoc Mobile Wireless Networks”, Pearson Education, 2002.
3. C.Siva Ram Murthy and B.S.Manoj, “Ad Hoc Wireless Networks – Architectures and Protocols”, Pearson Education, 2004.
4. Carlos De Morais Cordeiro, Dharma Prakash Agrawal “Ad Hoc and Sensor Networks: Theory and Applications (2nd Edition), World Scientific Publishing, 2011.
5. Erdal Çayırcı , Chunming Rong, “Security in Wireless Ad Hoc and Sensor Networks”, John Wiley and Sons, 2009.
6. Holger Karl, Andreas willig, Protocols and Architectures for Wireless Sensor Networks, John Wiley & Sons, Inc .2005.
7. Subir Kumar Sarkar, T G Basavaraju, C Puttamadappa, “Ad Hoc Mobile Wireless Networks”, Auerbach Publications, 2008.
8. Waltenegus Dargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, John Wiley and Sons, 2010.

IF5072 **CRYPTOGRAPHY AND NETWORK SECURITY** **L T P C**
3 0 0 3

OBJECTIVES:

The student should be able to

- To understand the mathematics behind Cryptography.
- To understand the standard algorithms used to provide confidentiality, integrity and authenticity.
- To get the knowledge of various security practices applied in the field of information technology

UNIT I FUNDAMENTALS AND MATHEMATICS OF CRYPTOGRAPHY 9

Overview - Classical Crypto Systems – Substitution Ciphers –Transposition Ciphers - Stream and Block Ciphers – Introduction to Number Theory – Congruences – Chinese Remainder theorem – Modular Arithmetic - Modular Exponentiation – Fermats and Eulers Theorem - Finite Fields – GF(2n) Fields.

UNIT II ENCRYPTION TECHNIQUES 9

Data Encryption Standard – Advanced Encryption Standard – Confidentiality using Symmetric Encryption - Public-Key Cryptography and RSA – Key Management - Diffie-Hellman Key Exchange – Elliptic Curve Cryptography – Symmetric Key Distribution – Kerberos - X.509 Authentication Service.

UNIT III HASH FUNCTIONS AND SIGNATURES 9

Message Authentication and Hash Functions – Description of MD Hash Family – Secure Hash Algorithms – SHA-512 - Digital Signatures and Authentication Protocols – Digital Signature Standard – Process - Services - Attacks on Digital Signature - Digital Signature Schemes.

UNIT IV NETWORK SECURITY 9

Security at the application layer - E-Mail - Pretty Good Privacy – S/MIME – Security at the transport layer - SSL Architecture – Protocols – Message Formats - TLS – Security at the Network Layer - IPSec – Two modes - Authentication Header (AH) – Encapsulating Security Payload (ESP) – Security Policy – Security Association – Internet Key Exchange.

UNIT V SYSTEM SECURITY 9

Intruders – Intrusion Detection – Password Management – Malwares and Related Threats – DOS Attacks - Distributed Denial of Service Attacks - Firewalls – Firewall Types-Configuration and Implementation - Demilitarized Zone - Firewall Forensics -Services and Limitations - Intrusion Prevention System.

TOTAL : 45 PERIODS

OUTCOMES :

Upon completion of this course, the student will:

- Analyze the basic security algorithms required by any computing system.
- Predict the vulnerabilities across any computing system.
- Design a security solution for any computing system.

REFERENCES :

1. Atul Kahate, “Cryptography and Network Security”, Tata McGraw Hill, 2003.
2. Behrouz A. Forouzan, Debdeep Mukhopadhyay, “Cryptography and Network Security”, Second Edition, Tata Mc Graw Hill, 2010.
3. Charles B. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Fourth Edition, Pearson Education, 2007.
4. Joseph Migga Kizza, “A Guide to Computer Network Security”, Springer International Edition, 2010.
5. William Stallings, “Cryptography And Network Security – Principles and Practices”, Sixth Edition, Pearson Education, 2013

IF5006 **DESIGN THINKING** **L T P C**

3 0 0 3

OBJECTIVES:

- To introduce the idea of design thinking in product development
- To understand the practice of design thinking
- To leverage use of tools for the design process
- To learn the application of design thinking for the IT industry
- To design using the methodology

UNIT I INTRODUCTION **9**

Understanding Design thinking – Shared model in team based design – Theory and practice in Design thinking – Exploring work of Designers across globe – MVP or Prototyping

UNIT II **9**

Tools for Design Thinking – Real-Time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Collaboration in distributed Design

UNIT III **9**

Design Thinking in IT – Design Thinking to Business Process modeling – Agile in Virtual collaboration environment – Scenario based Prototyping

UNIT IV **9**

DT For strategic innovations – Growth – Story telling - Predictability – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model design.

UNIT V **9**

Design Thinking Work shop Empathize, Design, Ideate, Prototype and Test.
http://dschool.stanford.edu/dgift/
Follow the above link to conduct workshop

OUTCOMES:

Upon completion of the course the students will be able to:

- Apply design thinking for product development
- Use design thinking tools
- Identify need for products and disruption
- Design innovative products
- Apply design thinking to improve on existing products in IT
- Facilitate design thinking workshop

TOTAL : 45 PERIODS

REFERENCES:

1. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage", Harvard Business Press , 2009.
2. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve – Apply", Springer, 2011 (Unit III).
3. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School", John Wiley & Sons 2013. (Unit IV).
4. https://dschool.**stanford**.edu/.../**design**resources/.../ModeGuideBOOTCAMP2010L.pdf
5. https://dschool.**stanford**.edu/use-our-methods/
6. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

7. http://www.creativityatwork.com/design-thinking-strategy-for-innovation/
8. https://www.nngroup.com/articles/design-thinking/
9. https://designthinkingforeducators.com/design-thinking/
10. www.**designthinking**formobility.org/wp-content/.../10/**NapkinPitch** Worksheet.pdf
11. Book - Solving Problems with Design Thinking - Ten Stories of What Works (Columbia Business School Publishing) Hardcover – 20 Sep 2013 by Jeanne Liedtka (Author), Andrew King (Author), Kevin Bennett (Author).

IF5007 FORECASTING AND OPTIMIZATION L T P C
3 0 0 3

OBJECTIVES:

- To provide a comprehensive introduction of the forecasting methods
- To study the various regression models and perform forecasting
- To understand the autoregressive models and its variants for forecasting
- To get an overview of various numerical methods of optimization
- To get an insight into advanced optimization techniques.

UNIT I INTRODUCTION TO FORECASTING 9

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

UNIT II REGRESSION ANALYSIS AND FORECASTING 9

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

UNIT III AUTOREGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) AND OTHER MODELS 9

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

UNIT IV NUMERICAL METHODS OF OPTIMIZATION 9

What is optimization? -Linear programming- Integer programming- Quadratic programming- Nonlinear programming- Stochastic programming- Dynamic programming- Combinatorial optimization- Infinite-dimensional optimization- Constraint satisfaction.

UNIT V ADVANCED OPTIMIZATION TECHNIQUES AND ASPECTS OF OPTIMIZATION 9

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

TOTAL: 45 PERIODS

OUTCOMES:

Upon completion of this course, the student will:

- Identify the types of forecasting techniques
- Perform time series modeling and forecasting
- Evaluate the performance of forecasting models
- Perform regression analysis using different regression models
- Distinguish and Identify a suitable numerical method of optimization
- Discuss the concept of advanced optimization techniques using soft computing techniques and apply them to various problems.

REFERENCES:

1. C. B. Gupta, “Optimization Techniques in Operation Research”.I.K. International Publishing House, Pvt Ltd., 2nd Edition, 2012.
2. George Athanasopoulos and Rob J. Hyndman, “Forecasting: Principles and Practice”.O texts, WWW. otexts.org
3. Hamdy A. Taha, ,“Operations Research: An Introduction”. Pearson; 9 edition September 2010.
4. L. R. Foulds, “Optimization Techniques: An Introduction”. Springer-Verlag New York, 1981
5. Ronald L. Rardin, “Optimization in operations research”. Prentice Hall, 1998
6. Spyros Makridakis and Steven C. Wheelwright, “Forecasting: Methods and Applications”. Wiley 1997.