தமிழ்நாடு மத்தியப் பல்கலைக்கழகம்

CENTRAL UNIVERSITY OF TAMIL NADU

तमिलनाडु केन्द्रीय विश्वविद्यालय

ESTABLISHED BY AN ACT OF PARLIAMENT IN 2009

SCHOOL OF MATHEMATICS AND COMPUTER SCIENCES

DEPARTMENT OF COMPUTER SCIENCE

M.Sc., COMPUTER SCIENCE PROGRAMME

CURRICULUM AND SYLLABUS

(Academic Year 2022-23 onwards)

VISION

To develop the department as a global leader in knowledge dissemination and to perform cutting edge research in computer science in compliance with international standards

MISSION

M1: To excel in transforming graduates into software experts with a high degree of technical creativity and managerial skills.

M2: To excel in imparting quality education with dedicated and strongly motivated faculty.

M3: To train the students to take up various challenges of the latest technologies in the field of computer science.

PROGRAM OBJECTIVES

PO1 – Core Knowledge: Ability to apply the knowledge of mathematics, probability and statistics and computer science in real-time applications

PO2 – Problem Analysis: Clear understanding of the subject related concepts and contemporary issues and apply them to formulate, design, model, and analyze complex problems.

PO3 – Design and Development of Product: Ability to design a component or a product that meet the specific needs with appropriate consideration for public health and safety, and the cultural, societal, and environmental considerations. Demonstrate knowledge and understanding of management skills related to project management.

PO4 – Design and Conduct Experiments on 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.

PO5 – Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern IT tools including prediction and modelling to complex activities with an understanding of the limitations.

PO7 – Individual and Teamwork: Function effectively as an individual, and as a member or leader in diverse teams.

PO8 – 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

PSO1: Ability to apply good analytical, design and implementation skills to formulate and solve scientific and business applications by promoting themselves with equipped ideas

PSO2: Equip students with profound knowledge and understanding in the theoretical foundations of computer science

PSO3: To mould themselves into successful personnel in IT industry / higher education and grow like entrepreneurs

PROGRAM STRUCTURE

SEMESTER	COURSE CODE	COURSE CATEGORY	COURSE TITLE	L	T	P	C
I	CSC1001	CC	Discrete Mathematics	3	0	0	3
	CSC1002	CC	Data Structures and Algorithms	3	1	0	4
	CSC1003	CC	Computer Organization and Architecture	3	0	0	3
	CSC1004	CC	Database Management Systems	3	0	0	3
	CSC1005	CC	Introduction to Programming using Python	3	0	0	3
	CSC1006	CC	Data Structures and Algorithms Lab	0	0	4	2
	CSC1007	CC	Database Management Systems Lab	0	0	4	2
	CSC1008	CC	Python Programming Lab	0	0	4	2
II	CSC2001	CC	Theory of Computation	3	0	0	3
	CSC2002	CC	Operating Systems	3	0	0	3
	CSC2003	CC	Computer Networks	3	0	0	3
	CSC2004	CC	Artificial Intelligence	3	0	0	3
	CSC2005	CC	Software Engineering	3	0	0	3
	CSC2006	CC	Object Oriented Programming using Java	3	0	0	3
	CSC2007	CC	Operating Systems and Networks Lab	0	0	4	2
	CSC2008	CC	Artificial Intelligence Lab	0	0	4	2
	CSC2009	CC	Java Programming Lab	0	0	4	2
III	CSC3001	CC	Cryptography and Network Security	3	0	0	3
	CSC3002	CC	Machine Learning	3	0	0	3
	CSC3003	CC	Web Technology	3	0	0	3
	CSC3004	CC	Machine Learning Lab	0	0	4	2
	CSC3005	CC	Web Technology Lab	0	0	4	2
	CSC3006	CC	Mini Project	0	0	0	5
	CSC50XX	SEC	Elective - 1 (Lab Integrated)	3	0	4	5
	CSC60XX	DSE	Elective - 2 / MOOC	3	0	0	3
IV	CSC4001	CC	Major Project	0	0	0	10
	CSC60XX	DSE	Elective - 3	3	0	0	3
	CSC60XX	DSE	Elective - 4	3	0	0	3
TOTAL CREDITS							**88**

CC: Core Course	DSE: Discipline Specific Elective	SEC: SKILL ENHANCEMENT COURSE	
L: Lectures per week	T: Tutorials per week	P: Practical hours per week	C: Credits

Note: Students are encouraged to do mini projects in the courses based on the instructor's guidelines

BRIDGE COURSES

COURSE CODE	COURSE TITLE
CSC0001	Introduction to Computers
CSC0002	Problem Solving Techniques

SKILL ENHANCEMENT COURSES

COURSE CODE	COURSE TITLE	L	T	P	C
CSC5001	Computational Intelligence	3	0	4	5
CSC5002	Computer Graphics	3	0	4	5
CSC5003	Business Data Analytics	3	0	4	5
CSC5004	Digital Image Processing	3	0	4	5

DISCIPLINE SPECIFIC ELECTIVES

COURSE CODE	COURSE TITLE	L	T	P	C
CSC6001	Data Warehousing and Data Mining	3	0	0	3
CSC6002	Pattern Recognition	3	0	0	3
CSC6003	Natural Language Processing	3	0	0	3
CSC6004	Principles of Deep Learning	3	0	0	3
CSC6005	Deep Learning in Computer Vision	3	0	0	3
CSC6006	Artificial Emotional Intelligence	3	0	0	3
CSC6007	Data Visualization	3	0	0	3
CSC6008	Statistics for Data Science	3	0	0	3
CSC6009	Digital Watermarking and Steganography	3	0	0	3
CSC6010	Human Computer Interaction	3	0	0	3
CSC6011	Parallel and Distributed Computing	3	0	0	3
CSC6012	Software Testing	3	0	0	3
CSC6013	Agile Process and Devops	3	0	0	3
CSC6014	Software Project Management	3	0	0	3
CSC6015	Design Patterns	3	0	0	3
CSC6016	Wireless Sensor Networks	3	0	0	3
CSC6017	Block Chain Technology	3	0	0	3
CSC6018	Cloud Computing	3	0	0	3
CSC6019	Web Services	3	0	0	3
CSC6020	Ethical Hacking	3	0	0	3
CSC6021	Internet of Things	3	0	0	3
CSC6022	Internet of Things for Health Care	3	0	0	3
CSC6023	Text Analytics	3	0	0	3
CSC6024	Social Media Analytics	3	0	0	3
CSC6025	Approximation Algorithms	3	0	0	3
CSC6026	Parallel Algorithms	3	0	0	3
CSC6027	Mobile App Development	3	0	0	3
CSC6028	Formal Methods and Verification	3	0	0	3

VALUE ADDED COURSES

COURSE CODE	COURSE TITLE
CSC7001	Functional Programming
CSC7002	Object Oriented Programming using C++
CSC7003	Python Programming for Data Analytics
CSC7004	R Programming
CSC7005	C Programming
CSC7006	Orientation on Research for PG Students
CSC7007	LaTeX for Researchers

ABILITY ENHANCEMENT COMPULSORY COURSE

COURSE CODE	COURSE TITLE	L	T	P	C
CSC8001	Cyber Security	2	0	0	2

DETAILED SYLLABUS

SEMESTER – I

CSC1001	DISCRETE MATHEMATICS	3	0	0	3

Course Outcomes:

CO1: Apply Mathematical thinking, Mathematical proofs, and algorithmic thinking, and be able to apply them in problem-solving.

CO2: Explain the concept of Sets, Relations and Functions and their properties.

CO3: Describe mathematical induction and probability.

CO4: Describe basic properties of graphs and related discrete structures, and be able to relate these to practical examples.

CO5: Describe the use of group theory and its applications

Unit – 1	SETS – RELATIONS – FUNCTIONS – BOOLEAN ALGEBRA	9 hrs

Set Operations – Representation and Properties of Relations – Equivalence Relations – Partially Ordering. Functions – one-one – onto bijective – composition of relations and functions – inverse functions. Boolean Algebra and Boolean Functions and its representations – Simplifications of Boolean Functions.

Unit – 2	MATHEMATICAL LOGIC	9 hrs

Propositional and Predicate Logic – Propositional Equivalences – Normal Forms – Predicates and Quantifiers – Nested Quantifiers – Rules of Inference.

Unit – 3	COUNTING – MATHEMATICAL INDUCTION AND DISCRETE PROBABILITY	9 hrs

Basics of Counting – Pigeonhole Principle – Permutations and Combinations – Inclusion-Exclusion Principle – Mathematical Induction – Probability – Bayes Theorem.

Unit – 4	GROUP THEORY	9 hrs

Groups – Subgroups – Semi Groups – Product and Quotients of Algebraic Structures – Isomorphism – Homomorphism – Automorphism – Rings - Integral Domains – Fields – Applications of Group Theory – Polya's theory of counting – Introduction to Error-Correcting Codes. Discrete Geometry: Some basic definitions – Ham-Sandwich theorem.

Unit – 5	GRAPH THEORY	9 hrs

Simple Graph – Multigraph – Weighted Graph – Paths and Circuits – Shortest Paths in Weighted Graphs – Eulerian Paths and Circuits – Hamiltonian Paths and Circuits – Planner graph – Graph Coloring – Bipartite Graphs.

Text / Reference Books:

1. Rosen, K.H. and Kamala Krithivasan, Discrete Mathematics and its Applications, McGraw Hill, Eighth edition, 2021
2. Rosen, K.H, Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, McGraw Hill Education, Seventh edition, 2017
3. Tremblay, J.P. and Manohar.R, Discrete Mathematical Structures with Applications to Computer Science, McGraw Hill Education, First edition, 2017
4. Grimaldi, R.P. , Discrete and Combinatorial Mathematics: An Applied Introduction, Pearson, Fifth edition, 2013
5. Lipschutz, S. and Mark Lipson, Discrete Mathematics (Schaum's Outlines), McGraw Hill Education, Revised Third edition, 2017

CSC1002	DATA STRUCTURES AND ALGORITHMS	3	1	0	4

Course Outcomes:

CO1: Understand the concepts of algorithm analysis and solving recurrence relations
CO2: Learn linear and non-linear data structures and their usage in applications
CO3: Understand and Analyze various searching and sorting algorithms
CO4: Applying greedy and dynamic approaches to solve challenging problems
CO5: Understand computational complexity classes and their importance in designing algorithms

Unit – 1	INTRODUCTION TO ALGORITHMS AND ANALYSIS	10 hrs

Overview and importance of algorithms and data structures – Fundamentals of algorithm analysis – Space and time complexity of an algorithm – Asymptotic Notations – Order of growth – Algorithm Efficiency – Best case, Worst Case, Average Case – Recurrence Relations – Solving recurrence relations using substitution method, recurrence tree method and Master Method.

Unit – 2	LINEAR AND NON-LINEAR DATA STRUCTURES	12 hrs

Linear Data Structures: Stacks – Queues – Lists – Applications. Non-linear Data Structures: Graphs – Trees – Binary Trees – Traversal Techniques – Binary Search Tree and its operations – AVL Trees.

Unit – 3	SEARCHING AND SORTING ALGORITHMS, DIVIDE AND CONQUER APPROACH	16 hrs

Search Problem – Linear Search – Binary Search – Sorting Problem – Bubble Sort – Insertion Sort – Heap Sort – Divide and Conquer Paradigm – Merge Sort – Quick Sort – Complexity analysis of searching and sorting algorithms.

Unit – 4	GREEDY METHOD AND DYNAMIC PROGRAMMING APPROACH	12 hrs

Greedy Method: Activity Selection Problem – Graph Traversal Algorithms. Dynamic Programming Paradigm: Knapsack problem – Matrix Chain Multiplication – All Pair Shortest Path – Single Source Shortest Path – Travelling Salesman Problem.

Unit – 5	OTHER ALGORITHM PARADIGMS AND COMPUTATIONAL COMPLEXITY CLASSES	10 hrs

Backtracking: 8-Queens problem – Graph coloring. Brach and Bound: Least Cost 0/1 Knapsack problem. Tractable and Intractable problems – Decidable and Undecidable problems – P, NP and NP-Complete classes – Cook's Theorem (without proof) – NP-Hard problems.

Text / Reference Books:

1. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, MIT Press, Third edition, 2010
2. Sanjoy Dasgupta, C.Papadimitriou and U.Vazirani, Algorithms, McGraw-Hill Education, First edition, 2006
3. Aho A.V., J.E. Hopcroft and J. D. Ullman, The Design and Analysis of Computer Algorithms, Pearson India, First edition, 2002
4. Ellis Horowitz, Sartaj Sahni, Susan Anderson-Freed, Fundamentals of Data Structure in C, Silicon Press, Second edition, 2008

CSC1003	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3

Course Outcomes:

CO1: Describe the fundamental organisation of a computer system

CO2: Understand the organization of control units, and pipelining operations

CO3: Understand memory cells, different kinds of memory, address translation, and memory management

CO4: Learn input and output systems, I/O devices, ports, and bus organization

CO5: Compare Multi-core processors, and GPUs.

Unit – 1	BASIC STRUCTURE OF COMPUTERS	9 hrs

Function and Structure of a Computer, Interconnection of Components, Performance of a Computer. Machine Instructions, Operands, Addressing Modes, Instruction Formats, Instruction Sets, Instruction Set Architectures - CISC and RISC Architectures.

Unit – 2	PROCESSING UNIT AND PIPELINING	9 hrs

Organization of a Processor - Registers, ALU and Control Unit, Arithmetic Units - Addition, Subtraction, Multiplication, Division, Floating-point Units - Data Path in a CPU, Instruction Cycle, Organization of a Control Unit - Operations of a Control Unit - Hardwired Control Unit - Micro Programmed Control Unit – Pipelining – Hazards - Overcoming Hazards.

Unit – 3	MEMORY SUBSYSTEM	9 hrs

Semiconductor Memories, Memory Cells - SRAM and DRAM Cells, Internal Organization of a Memory Chip, Organization of a Memory Unit, Error Correction Memories, Interleaved Memories, Cache Memory Unit - Concept of Cache Memory, Mapping Methods, Organization of a Cache Memory Unit, Memory Management Unit - Concept of Virtual Memory, Address Translation, Hardware Support for Memory Management –HDMI: High Definition Multimedia Interface

Unit – 4	INPUT/OUTPUT SUBSYSTEM	9 hrs

Access of I/O Devices, I/O Ports, I/O Control Mechanisms - Program Controlled I/O, Interrupt Controlled I/O and DMA Controlled I/O - I/O Interfaces - Serial Port - Parallel Port - PCI Bus - SCSI Bus - USB Bus - I/O Peripherals - Input Devices - Output Devices - Secondary Storage Devices.

Unit –5	PARALLELISM, MULTI-CORE PROCESSORS AND GRAPHICS PROCESSING UNIT (GPUS)	9 hrs

Instruction-Level Parallelism (ILP) - Dynamic Scheduling, Introduction to Multi-Core Processors - Homogeneous Multicore Processor - Heterogeneous Multicore Processor - Current Trends in Multicore Processing - Pros and Cons of Multicore Processing, Graphics Processing Unit (Gpus) - GPU and CPU - GPU Vs. Graphics Card - Integrated Graphics Processing Unit - Discrete Graphics Processing Unit - GPUs For Gaming - GPUs for Video Editing and Content Creation - GPUs in the Data Center

Text / Reference Books:

1. William Stallings, Computer Organization and Architecture – Designing for Performance, Pearson Education, Eleventh edition, 2019
2. David Patterson & John Hennessy, Computer Organization and Design: The Hardware/Software Interface, Morgan-Kaufmann, Fifth Edition, 2014
3. Linda Null and Julia Lobur, Essentials of Computer Organization and Architecture, Jones & Bartlett Learning, Fifth edition, 2017
4. Joseph D. Dumas, Computer Architecture: Fundamentals and Principles of Computer Design, CRC Press, Second edition, 2016
5. John P. Hayes, Computer Architecture and Organization, Tata Mc Graw Hill, Third edition, 1998
6. Carl Hamacher, Zvonko Vranesic, Safwat Zaky and Naraig Manjikian, Computer Organization and Embedded Systems, Tata Mc Graw Hill, Sixth edition, 2012

CSC1004	DATABASE MANAGEMENT SYSTEMS	3	0	0	3

Course Outcomes:

CO1: Identify the basic concepts and apply relational database theory and recognize and identify the use of normalization and functional dependency, indexing technique used in database design

CO2: Describe relational algebra expression, tuple and domain relation expression for queries and query processing concepts.

CO3: Apply and relate the concept of transaction, concurrency control and recovery in database.

CO4: Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

CO5: Understand various concepts like Parallel, distributed and object-oriented databases.

Unit – 1	BASIC CONCEPTS & RELATIONAL DATABASE DESIGN	9 hrs

File System versus DBMS – Advantages -Views – Data models – Database languages – Architecture – ER Model – Entities, Attributes and Entity Sets, Relationships and Relationship Sets – Features of ER Model – Conceptual design with ER – Extended E-R. Relational Model - Codd's rule – Integrity Constraints over Relations – Relational database design – Anomalies - Functional dependencies – Normalization – Normal Forms – Decomposition – Denormalization.

Unit – 2	RELATIONAL MODEL , LANGUAGES & QUERY OPTIMIZATION	9 hrs

Relational Query Languages – Relational Algebra – Tuple and Domain Relational Calculus – SQL – Query processing and optimization – Transformation of relational expressions – Evaluation Plans.

Unit – 3	TRANSACTION CONCURRENCY CONTROL AND SECURITY	9 hrs

Transaction – Properties – Concurrent execution – Serializability – Concurrency control – Protocols – Recovery System – Database Security.

Unit – 4	FILE ORGANIZATION	9 hrs

File organization – Organization of records in files – Indexing – B tree and B+ tree index files – Static hashing – Dynamic hashing.

Unit – 5	ADVANCED CONCEPTS	9 hrs

Parallel and distributed databases – Object-based databases - Mobile databases - XML and Web databases – Intelligent databases – Mongo DB – NOSQL – PostgreSQL.

Text / Reference Books:

1. Silberchatz A., F. Korth, and S. Sudarshan, Database System Concepts, McGraw Hill, Seventh edition, 2021
2. R. Elmasri and S. B. Navathe, Fundamentals of Database Systems, Pearson, Seventh edition, 2016
3. Coronel, Carlos, and Steven Morris. t., Database systems: design, implementation, & management, Cengage Learning, Thirteenth edition, 2016
4. Ramakrishnan, R., Gehrke, J., & Gehrke, J., Database management systems, McGraw Hill, Third edition, 2006

CSC1005	INTRODUCTION TO PROGRAMMING USING PYTHON	3	0	0	3

Course Outcomes:

CO1: Understand the fundamental concepts of python and its main components.

CO2: Develop (Read and Write) python programs using variables, assignments, and conditional statements using functions.

CO3: Illustrate and implement different data structures.

CO4: Demonstrate Object-oriented concepts and file handling.

CO5: Analyze and plot data using python visualization libraries.

Unit – 1	Introduction to Python	9 hrs

Introduction to a programming language – History of Python- Python environment setup – Python 2 vs. Python 3 - Comments and documentation in Python- Keywords and Identifiers -Programming Errors - Writing and Running python programs.

Unit – 2	Variables and Conditionals in Python	9 hrs

Variables – Constants- Strings - Assignment statements – Expressions-Operators – Type Conversions- Control Flow statements and Loops- Functions.

Unit – 3	Data Structures in Python	9 hrs

List Basics- List Indexing and Slicing-Appending-Sorting and Ranging-Tuples-Creation-Deletion-Converting tuple to list- Assignment- Dictionaries-Adding-Modifying and Retrieving Values-Traversing all keys in the dictionary-Operations and methods-Sets- manipulating and accessing sets.

Unit – 4	Exception handling and File I/O	9 hrs

Exception handling - Catching and Handling Exceptions-Object Orientated Concepts (Basics) – Creating python class and Objects - Object properties and methods- Inheritance- Operator overloading-Polymorphism- File handling - Opening, Reading, Writing and Deleting files.

Unit – 5	Graph Plotting	9 hrs

Introduction to plotting python libraries -Plots and Graphs- Applied Visualizations – Seaborn – Matplotlib

Text / Reference Books:

1. Eric Matthes, Python Crash Course, No Starch Press, Second edition, 2019
2. Martin C. Brown, Python: The Complete Reference, McGraw Hill Education, Fourth edition, 2018
3. Ryan Marvin Mark Ng'Ang'A Amos Omondi, Python Fundamentals, Packet Publishing, Second edition, 2018
4. Zed Shaw, Learn Python 3 the Hard Way: A Very Simple Introduction to the Terrifyingly Beautiful World of Computers and Code, Addison-Wesley Professional, First edition, 2017

CSC1006	DATA STRUCTURES AND ALGORITHMS LAB	0	0	4	2

Course Outcomes:

CO1: Understand the fundamental concepts of python and its main components.

CO2: Develop (Read and Write) python programs using variables, assignments, and conditional statements using functions.

CO3: Illustrate and implement different data structures.

CO4: Demonstrate Object-oriented concepts and file handling.

CO5: Analyze and plot data using python visualization libraries.

Programs should include but not limited to:

Implementation of

i. Stacks and Queues
ii. Lists
iii. Linear Search and Binary Search
iv. Sorting Algorithms
v. Graph Traversal Algorithms
vi. Tree Traversal Algorithms
vii. Shortest Path Algorithms
viii. Knapsack Problem
ix. Travelling Salesman Problem
x. N-Queens's Problem

CSC1007	DATABASE MANAGEMENT SYSTEMS LAB	0	0	4	2

Course Outcomes:

CO1: Identify the basic concepts and apply relational database theory and recognize and identify the use of normalization and functional dependency, indexing technique used in database design

CO2: Describe relational algebra expression, tuple and domain relation expression for queries and query processing concepts.

CO3: Apply and relate the concept of transaction, concurrency control and recovery in database.

CO4: Familiar with basic database storage structures and access techniques: file and page organizations, indexing methods including B tree, and hashing.

CO5: Understand various concepts like Parallel, distributed and object-oriented databases.

Programs should include but not be limited to:

Exercises on

i. DDL commands
ii. DML commands- Basic Queries
iii. Aggregate Commands
iv. Nested Queries
v. Joins
vi. Views
vii. Index
viii. Functions
ix. Procedures
x. Triggers

CSC1008	PYTHON PROGRAMMING LAB	0	0	4	2

Course Outcomes:

CO1: Understand the fundamental concepts of python and its main components.

CO2: Develop (Read and Write) python programs using variables, assignments, and conditional statements using functions.

CO3: Illustrate and implement different data structures.

CO4: Demonstrate Object-oriented concepts and file handling.

CO5: Analyze and plot data using python visualization libraries.

Programs should include but not limited to:

I. Test and Debug simple Python programs
II. Different datatypes in python (variables constants and strings)
III. Programs on different operators
IV. Control statements and Loops
V. Working on Functions
VI. Data structures in python (List, Tuple, Dictionary and Set)
VII. Objects and Classes manipulation using python
VIII. Open, Read and write data from/to files in Python
IX. Different plots using Matplotlib
X. Visualization of data using seaborn

SEMESTER – II

CSC2001	THEORY OF COMPUTATION	3	0	0	3

Course Outcomes:

CO1: Model, compare and analyse different computational models using combinatorial methods

CO2: Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata

CO3: Learn the Push Down Automata and apply Pumping Lemma

CO4: Design Turning Machines for simple problems

CO5: Understand the theoretical aspects of Polynomial time and Non-Deterministic Polynomial Time

Unit – 1	FINITE AUTOMATA	9 hrs

Introduction- Basic Mathematical Notation and Techniques- Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-Deterministic Finite Automata (NFA) – Finite Automaton with €- Moves – Regular Languages – Regular Expression - Proving Languages not to be Regular – Closure Properties of Regular Languages – Equivalence of NFA and DFA – Equivalence of NDFA's with and Without €-Moves – Minimization of DFA – Pumping Lemma for Regular Language - Its Use as an Adversarial Game.

Unit – 2	CONTEXT FREE GRAMMARS (CFG) AND LANGUAGES	9 hrs

Notion of Grammars and Languages Generated by Grammars – Parse Trees – Derivations and Languages – Ambiguity – Relationship between Derivation and Derivation Trees – Simplification of CFG – Elimination of Useless Symbols – Unit Productions – Null Productions – Greibach Normal Form (GNF) – Chomsky Normal Form (CNF) – Problems related to CNF And GNF – Applications To Compliers.

Unit – 3	PUSHDOWN AUTOMATA (PDA)	9 hrs

Definition of the Pushdown Automata – Languages of a Pushdown Automata – Moves - Instantaneous Descriptions – Deterministic and Nondeterministic Pushdown Automata – Equivalence of Pushdown Automata and CFL – Pumping Lemma for CFL – Closure Properties of CFL – Problems Based on Pumping Lemma.

Unit – 4	TURING MACHINES	9 hrs

Definitions of Turing Machines – Models – Universal Turing Machine – Deterministic and Nondeterministic Turing Machines – Computable Languages and Functions – Techniques for Turing Machine Construction – Multi Head and Multi Tape Turing Machines – The Halting Problem – Partial Solvability - Problems about Turing Machines.

Unit – 5	UNDECIDABALITY AND INTRACTABILITY	9 hrs

A Language that is not Recursively Enumerable (RE) – An Undecidable Problem that is RE – Undecidable Problems about Turing Machine - Post's Correspondence Problem – Measuring and Classifying Complexity: Tractable and Intractable Problems – Tractable and Possibly Intractable Problems – P and NP.

Text / Reference Books:

1. Hopcroft J.E., Motwani R. and Ullman J.D, Introduction to Automata Theory, Languages and Computations, Pearson Education, Third edition, 2008
2. Dexter C. Kozen, Automata and Computability, Springer, Eighth edition, 2007
3. Micheal Sipser, Introduction of the Theory of Computation, Cengage, Third edition, 2014
4. Kamala Krithivasan and Rama R., Introduction to Formal Languages, Automata Theory and Computation, Pearson Education, First edition, 2009
5. J. Martin, Introduction to Languages and the Theory of Computation, McGraw-Hill Higher Education, Third edition, 2002

CSC2002	OPERATING SYSTEMS	3	0	0	3

Course Outcomes:

CO1: Understand the functions, features, and concepts of operating systems.
CO2: Learn the concept of process and Analyze the Inter Process Communication methods
CO3: Analyze the scheduling algorithms and deadlocks
CO4: Understand the concept of memory management
CO5: Evaluate security mechanisms in operating computing systems

Unit – 1	OVERVIEW OF OPERATING SYSTEMS	9 hrs

Introduction to Operating Systems – Computer System Organization, Architecture – Operating System Structure, Operations – Process, Memory, Storage Management – Protection and Security – Distributed Systems – Computing Environments – Open-Source Operating Systems – OS Services – User Operating-System Interface – System Calls – Types – System Programs – OS Structure – OS Generation – System Boot – Process Concept – Scheduling – Operations on Processes – Cooperating Processes – Inter-Process Communication – Examples – Multithreading Models – Thread Libraries – Threading Issues – OS Examples.

Unit – 2	PROCESS MANAGEMENT	9 hrs

Process Concept – Process Scheduling – Operations on Processes – Inter-Process Communication (IPC) – IPC Examples – Client-Server Communication – Threads – Multi-Core Models – Multi-Threading Models – Threading Issues – Process Synchronization – Critical Section Problem – Peterson's Solution – Synchronization Hardware – Mutex Locks – Semaphores – Monitors.

Unit – 3	CPU SCHEDULING AND DEADLOCKS	9 hrs

Basic Concepts – Scheduling Criteria – Scheduling Algorithms – Thread Scheduling – Multi-Processor Scheduling – Real-Time CPU Scheduling. Deadlocks: System Model – Deadlock Characterization – Methods for Handling Deadlocks – Deadlock Prevention – Deadlock Avoidance – Deadlock Detection – Recovery From Deadlock.

Unit – 4	MEMORY MANAGEMENT	9 hrs

Main Memory Concept – Swapping – Contiguous Memory Allocation – Segmentation – Paging – Example Architectures – Virtual Memory Concept – Demand Paging – Page Replacement - Frame Allocation – Thrashing – Memory Mapped Files – Kernel Memory Allocation. Secondary Storage: Disk Structure – Disk Scheduling – Disk Management – RAID Structure.

Unit – 5	I/O SYSTEMS AND CASE STUDIES	9 hrs

File Concept – Access Methods – Directory Structure – File-System Mounting –Protection – Directory Implementation – Allocation Methods – Free-Space Management – Protection File Systems. Case Studies: Linux – Windows – Mobile Operating Systems

Text / Reference Books:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, Operating System Concepts, John Wiley & Sons Inc, Tenth edition, 2021
2. Andrew S. Tanenbaum, Modern Operating Systems, Addison Wesley, Fourth edition, 2016
3. Charles Crowley, Operating Systems: A Design-Oriented Approach, Tata McGraw Hill Education, , 1996
4. D M Dhamdhere, Operating Systems: A Concept-based Approach, Tata McGraw-Hill Education, Second edition, 2007
5. William Stallings, Operating Systems: Internals and Design Principles, PHI , Seventh edition, 2011

CSC2003	COMPUTER NETWORKS	3	0	0	3

Course Outcomes:

CO1: Describe the fundamental concepts of Networking and Physical layer
CO2: Understand details and functionality of Data link layer.
CO3: Analyze switching protocols and routing algorithms
CO4: Analyze features, services and operations of various protocols of TCP/IP suite
CO5: Identify various application layer protocols and its functions

Unit – 1	FUNDAMENTAL CONCEPTS AND PHYSICAL LAYER	9 hrs

Basic Definitions - Basic Communication Models – Network Types – Protocol Layers and Service Models – OSI Model – TCP/IP Protocol Suite. Physical Layer: Data and Signals – Digital Transmission – Bandwidth Utilization – Transmission Media – Switching – Packet Switching – Circuit Switched Networks

Unit – 2	DATA LINK LAYER	9 hrs

Error Detection and Correction – Data Link Control – Multiple Access – Wired LANs – Wireless LAN – IEEE 802.11 – Bluetooth – Connecting Devices

Unit – 3	NETWORK LAYER	9 hrs

Circuit Switching – Packet Switching – Virtual Circuit Switching – IP – ARP – DHCP – ICMP – Routing – RIP – OSPF – Subnetting – CIDR – Interdomain Routing – BGP – IPV6 Basic Features – Multicast –Congestion Avoidance in Network Layer.

Unit – 4	TRANSPORT LAYER	9 hrs

Transport Layer Services – Port Numbers – Protocols – User Datagram Protocol (UDP) – Transmission Control Protocol (TCP) – Details - Flow Control – Congestion Control – Queuing Discipline - Introduction to Quality of services (QOS).

Unit – 5	APPLICATION LAYER AND INTERNET APPLICATIONS	9 hrs

Network Architecture – Layers - HTTP – DNS – E-Mail (SMTP, MIME, POP3, IMAP, Web Mail) – FTP – Telnet – SNMP.

Text / Reference Books:

1. J William Stallings, Data and Computer Communications, Pearson, Eighth Edition, 2011
2. Behrouz A. Forouzan, Computer Networks - A top-down approach, Tata McGraw-Hill, Fourth Edition, 2016
3. James F. Kurose, Keith W. Ross, Computer Networking, A Top-Down Approach Featuring the Internet, Pearson, Sixth Edition, 2012
4. Larry L. Peterson, Bruce S. Davie, Computer Networks: A Systems Approach, Morgan Kaufman, Fifth Edition, 2015
5. Ying-Dar Lin, Ren-Hung Hwang and Fred Baker, Computer Networks: An Open Source, McGraw Hill, First Edition, 2011

CSC2004	ARTIFICIAL INTELLIGENCE	3	0	0	3

Course Outcomes:

CO1: Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.

CO2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.

CO3: Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing

CO4: Attain the capability to represent various real-life problem domains using logic-based techniques and use this to perform inference or planning

CO5: Apply concepts to applications in various domains of Artificial Intelligence

Unit – 1	INTRODUCTION AND INTELLIGENT AGENTS	9 hrs

Introduction to Artificial Intelligence (AI) – Foundations of AI – History of AI – State-of-the-art – Risks and Benefits of AI. Intelligent Agents: Agents and Environments – Concept of Rationality – Nature of Environments – Structure of Agents.

Unit – 2	SEARCH PROBLEMS	9 hrs

Problem-solving Agents – Example Problems – Search Algorithms – Best-First Search – Search data structures – Uninformed Search Strategies – Breadth-First Search – Uniform Cost Search – Depth-First Search – Bi-directional Search – Heuristic Search Strategies – Greedy Best-First Search – A* Search – Bi-directional Heuristic Search – Heuristic Functions

Unit – 3	SEARCH IN COMPLEX ENVIRONMENTS AND ADVERSARIAL SEARCH	9 hrs

Local Search and Optimization Problems – Hill Climbing Search – Simulated Annealing – Evolutionary Algorithms – Local Search in Continuous Spaces – AND-OR Search Trees – Search in Partially Observable Environments – Online Search Agents. Adversarial Search: Introduction to Game theory – Two-player Zero sum games – Optimal Decisions in Games – Heuristic Alpha-Beta Tree Search – Monte Carlo Tree Search.

Unit – 4	KNOWLEDGE REPRESENTATION & PLANNING	9 hrs

Knowledge Representation and Reasoning: ontologies – Foundations of Knowledge Representation and Reasoning about Objects – Relations – Events – Actions – Time and Space - Predicate Logic - Situation Calculus – Reasoning about Knowledge, Sample Applications. The blocks world, Components of Planning Systems, Goal Stack Planning, Nonlinear Planning, Hierarchical Planning. Multi Agent Panning, Case based Planning.

Unit – 5	APPLICATIONS	9 hrs

Application Areas: Expert system, decision support systems, Speech and vision, Natural language processing, Information retrieval, Semantic web

Text / Reference Books:

1. S. Russell and P. Norvig, Artificial Intelligence: A Modern Approach, Pearson, Third Edition, 2010
2. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill., Third Edition, 2010
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Pearson Education., Second Edition, 1998

CSC2005	SOFTWARE ENGINEERING	3	0	0	3

Course Outcomes:

CO1: Understand the Fundamentals of Software Process Models

CO2: Acquire knowledge on Principles of Requirement Engineering

CO3: Learn design concepts with architectural design, component-level design and user interface design

CO4: Apply software testing strategies on real world problems, testing conventional applications and testing object-oriented applications

CO5: Familiarize with software configuration management, estimation of software projects, project scheduling and risk management maintenance.

Unit – 1	FUNDAMENTALS OF SOFTWARE ENGINEERING AND SOFTWARE PROCESS	9 hrs

The Nature of Software - Software Engineering - The Software Process - Software Engineering Practice - Software Process - Generic Process Model - A Generic Process Model - Process Assessment and Improvement - Prescriptive Process Models - Specialized Process Models - The Unified Process - Personal and Team Process Models - Agile Development - Extreme Programming (XP) - Other Agile Process Models

Unit – 2	PRINCIPLES OF REQUIREMENT ENGINEERING	9 hrs

Principles that Guide Practice - Understanding Requirements - Requirements Modelling: Scenarios, Information, and Analysis Classes - Creating a Behavioral Model - Patterns for Requirements Modelling

Unit – 3	DESIGN CONCEPTS AND DIFFERENT DESIGNS	9 hrs

Design Process - Design Concepts - Design Model - Software Architecture - Architectural Styles - Architectural Design - Architectural Design - Architectural Mapping Using Data Flow - Component - Designing Class-Based Components - Conducting Component-Level Design - User Interface Analysis and Design - Interface Analysis - Interface Design Steps

Unit – 4	SOFTWARE TESTING AND TESTING OF CONVENTIONAL AND OBJECT-ORIENTED APPLICATIONS	9 hrs

A Strategic Approach to Software Testing - Test Strategies for Conventional Software -Test Strategies for Object-Oriented Software - Validation and System testing - Basis Path Testing - Control Structure Testing - Black-Box Testing - Model-Based Testing - Object-Oriented Testing Strategies - Object-Oriented Testing Methods - Testing Methods Applicable at the Class Level

Unit – 5	SOFTWARE CONFIGURATION MANAGEMENT, ESTIMATION OF PROJECT SCHEDULING AND RISK MANAGEMENT	9 hrs

Software Configuration Management - SCM Repository - SCM Process- Estimation - Resources - Software Project Estimation - Decomposition Techniques - Empirical Estimation Models - Project Scheduling - Defining a Task Set for the Software Project - Scheduling - Software Risks - Risk Identification - Risk Projection - Risk Mitigation, Monitoring, and Management

Text / Reference Books:

1. Roger S.Pressman, Bruce R. Maxim, Software Engineering: A Practitioner's Approach, McGraw Hill International edition, Eighth edition, 2022
2. Ian Sommerville, Software Engineering, Pearson Education, Tenth edition, 2015
3. Stephan Schach, Object Oriented and classical Software Engineering, Tata McGraw Hill, Eighth edition, 2016

CSC2006	OBJECT ORIENTED PROGRAMMING USING JAVA	3	0	0	3

Course Outcomes:

CO1: Understanding Object-Oriented programming concepts using basic syntaxes of control Structures, strings for developing skills of logic building activity using Java

CO2: Identification of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem

CO3: Illustration to achieve reusability using inheritance, interfaces, and packages and describes faster application development can be achieved with exception handling mechanisms

CO4: Understanding concept of multithreading for robust faster and efficient application development and applications of collection interfaces in Java

CO5: Learning of various I/O operations, connecting Java with databases using JDBC and implementation of networking with Java

Unit – 1	OVERVIEW OF OOP AND INTRODUCTION TO JAVA	9 hrs

Structured Programming and its limitation – Object-Oriented Paradigm: Basic concepts of Object-Oriented Programming (OOP) – Structured Programming vs OOP – Benefits of OOP – Object Modeling – Association – Aggregation and Generalization. Introduction to Java – Evolution of Java – Features of Java – Java Environment – JVM – Data types – variables – operators – Decision statements – Control Structures – Loops – Arrays in Java – Strings in Java – String Buffer Class – Wrapper Classes.

Unit – 2	OBJECTS AND CLASSES	9 hrs

Introducing Classes - Class Fundamentals - Declaring Objects - Object Reference Variables - Introducing Methods - Constructors - this Keyword - Garbage Collection - A Closer Look at Methods and Classes - Overloading Methods - Objects as Parameters - Returning Objects - Access control - static - final - nested and inner class - Command line arguments

Unit – 3	INHERITANCE, PACKAGES, INTERFACES AND EXCEPTION HANDLING	9 hrs

Inheritance in Java – Constructors in Inheritance – super – Multilevel Inheritance – Overriding – Dynamic Method Dispatch – final Keyword – Interfaces – Packages – JAR files – Exception Handling

Unit – 4	MULTI THREADING AND JAVA COLLECTIONS	9 hrs

Threads – Multithreading in Java – Thread Priorities – Creating Multiple Threads – Inter Thread Communication – Synchronization – Suspending, Resuming and Stopping Threads – Collections Overview – Collection Interfaces – Collection Classes – Accessing collection via Iterator

Unit –5	JAVA I/O, JDBC AND JAVA NETWORKING	9 hrs

I/O Basics - Reading Console Input - Java I/O Classes and Interfaces - Serialization. Networking Classes and Interfaces - InetAddress - TCP/IP Client Sockets - URL - URL Connection - JDBC Driver, Database Connection Steps, DriverManager Class, Statement Interface, ResultSet Interface.

Text / Reference Books:

1. Herbert Schildt, Java: The Complete Reference, McGraw-Hill, Eleventh edition, 2018
2. Javin Paul, Grokking the Java Interview: Prepare for Java interviews by learning essential Core Java concepts and APIs, , Kindle Edition, 2020
3. Kishori Sharan, Adam L. Davis, Beginning Java 17 Fundamentals, Springer Nature, 2022

CSC2007	OPERATING SYSTEMS AND NETWORKS LAB	0	0	4	2

Course Outcomes:

CO1: Learn the concept of process and Analyze the Inter Process Communication methods
CO2: Analyze the scheduling algorithms and deadlocks
CO3: Understand details and functionality of Data link layer.
CO4: Analyze switching protocols and routing algorithms
CO5: Analyze features, services and operations of various protocols of TCP/IP suite

Programs should include but not limited to:

i. Implementation of Scheduling algorithms – FCFS, SJF, RR etc
ii. Message Passing
iii. Shared Memory
iv. Implementation of HTTP using TCP
v. Exercise on implementation of FTP using TCP
vi. Exercise on implementation of Chat Application using UDP
vii. Implementation of Stop and Wait, GBN and SR
viii. Implementation of Error detection and Error correction

CSC2008	ARTIFICIAL INTELLIGENCE LAB	0	0	4	2

Course Outcomes:

CO1: Demonstrate knowledge of the building blocks of AI as presented in terms of intelligent agents.
CO2: Analyze and formalize the problem as a state space, graph, design heuristics and select amongst different search or game-based techniques to solve them.
CO3: Develop intelligent algorithms for constraint satisfaction problems and also design intelligent systems for Game Playing
CO4: Attain the capability to represent various real-life problem domains using logic-based techniques and use this to perform inference or planning
CO5: Apply concepts to applications in various domains of Artificial Intelligence

Programs should include but not limited to:

i. 8-puzzle problem
ii. Constraint Satisfaction problem
iii. Magic Square
iv. 4-Queen Problem
v. River crossing problem
vi. TIC-TAC-TOE
vii. Water Jug Problem
viii. Simple CHATBOT
ix. Expert system
x. Simple Sudoku

CSC2009	JAVA PROGRAMMING LAB	0	0	4	2

Course Outcomes:

CO1: Understanding Object-Oriented programming concepts using basic syntaxes of control Structures, strings for developing skills of logic building activity using Java

CO2: Identification of classes, objects, members of a class and the relationships among them needed for a finding the solution to specific problem

CO3: Illustration to achieve reusability using inheritance, interfaces, and packages and describes faster application development can be achieved with exception handling mechanisms

CO4: Understanding concept of multithreading for robust faster and efficient application development and applications of collection interfaces in Java

CO5: Learning of various I/O operations, connecting Java with databases using JDBC and implementation of networking with Java

Programs should include but not limited to:

Programming Assignment on

i. Basic Problems
ii. Arrays
iii. Panagrams
iv. Duplicate Elements
v. Class – Objects – Constructors
vi. Access Specifiers
vii. Static and Non-static variables
viii. Packages and Interfaces
ix. Exception Handling
x. Multithreading
xi. JDBC and Networking

SEMESTER – III

CSC3001	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3

Course Outcomes:

CO1: Analyze Classical Cryptography Methods
CO2: Understand the Block Cipher Algorithms
CO3: Learn Asymmetric Key Cryptosystems
CO4: Understand Data Integrity Concepts and Usage of these methods in real-time applications
CO5: Learn to apply security concepts in digital payments

Unit – 1	FOUNDATIONS OF CRYPTOGRAPHY AND SECURITY	9 hrs

Computer Security Concepts – Security Attacks – Security Services – Security Mechanisms – Network Security Model – Modular Arithmetic – Divisibility and Division Algorithm – Euclidean Algorithm – Algebraic Structures – Galois Field GF(2n) – Symmetric Cryptography – Modern Symmetric Key Ciphers

Unit – 2	ADVANCED BLOCK CIPHER ALGORITHMS	9 hrs

Data Encryption Standard (DES) – Strength of DES – DES Analysis – Double DES – Triple DES – Advanced Encryption Standard (AES) – AES Analysis – Block cipher operations.

Unit – 3	ASYMMETRIC KEY CRYPTOGRAPHY	9 hrs

Concept of Prime Numbers – Fermat's Theorem – Euler's Theorem – Testing for primality – Exponentiation and Discrete Logarithms – Principles of Public Key Cryptosystems – RSA algorithm – Diffie Hellman Key Exchange – ElGamal Cryptosystem – Elliptic Curve Cryptography – Pseudo random number generation.

Unit – 4	DATA INTEGRITY	9 hrs

Cryptographic Hash Functions – Secure Hash Algorithm (SHA) – SHA-256 algorithm – Message Authentication Codes – Digital Signatures

Unit – 5	NETWORK SECURITY	9 hrs

Key Management and Distribution – Secure Sockets Layer – Transport Level Security – Network Security – Email security – IP Security – Electronic Commerce Security: Electronic Payment Systems, Secure Electronic Transaction, E-cash, Smart Card Based Systems.

Text / Reference Books:

1. William Stallings, Cryptography and Network Security - Principles and Practice, Pearson, Seventh edition, 2017
2. William Stallings, Network Security Essentials Applications and Standards, Pearson Education, Sixth edition, 2018
3. B. Forouzan, Cryptography And Network Security, McGraw Hill Education, Third edition, 2015
4. Atul Kahate, Cryptography And Network Security, McGraw-Hill; Fourth edition, Fourth edition, 2019

CSC3002	MACHINE LEARNING	3	0	0	3

Course Outcomes:

CO1: Understand the fundamentals of machine learning, model preparation and evaluation
CO2: Learn ability theory and its application in data understanding
CO3: Apply supervised learning algorithms and unsupervised learning algorithms on real data
CO4: Apply ensemble classifiers on data and compare the model performance
CO5: Explore data repositories and apply Machine Learning Algorithms on case studies

Unit – 1	INTRODUCTION – MODEL PREPARATION – EVALUATION	10 hrs

Introduction to Machine Learning: Human Learning and its Types; Machine Learning and its types; Well-Posed Learning Problem; Applications of Machine Learning; Issues in Machine Learning. **Preparing To Model:** Basic Data Types; Exploring Numerical Data; Exploring Categorical Data; Exploring Relationship Between Variables; Data Issues and Remediation; Data Pre-Processing. **Modelling And Evaluation:** Selecting A Model; Training Model – Holdout, *K*-Fold Cross-Validation, Bootstrap Sampling; Model Representation and Interpretability – Under-Fitting, Over-Fitting, Bias-Variance Tradeoff – Model Performance Evaluation – Classification, Regression, Clustering – Performance Improvement.

Unit – 2	FEATURE ENGINEERING – REVIEW OF PROBABILITY	6 hrs

Feature Engineering: Feature Construction – Feature Extraction – Feature Selection. **Brief Review of Probability:** Basic Concept Of Probability – Random Variables – Discrete Distributions – Binomial, Poisson – Bernoulli - Continuous Distribution – Uniform, Normal, Laplace; Central Theorem; Monte Carlo Approximation.

Unit – 3	CONCEPT LEARNING – SUPERVISED AND UNSUPERVISED LEARNING	12 hrs

Bayesian Concept Learning: Bayes Theorem – Prior and Posterior Probability, Likelihood; Concept Learning; Bayesian Belief Network. **Supervised Learning – Regression:** Simple Linear Regression; Other Regression Techniques. **Supervised Learning – Classification:** Basics of Supervised Learning – Classification; Logistic Regression – k-Nearestneighbour – Decision Tree – Support Vector Machine. **Unsupervised Learning:** Basics of Unsupervised Learning – Clustering Techniques; Association Rules.

Unit – 4	ENSEMBLE LEARNING	10 hrs

Concept of Ensemble Learning – Bagging and Boosting and its impact on bias and variance – Random Forest – Adaboost Classifier – Gradient Boosting Machines – XG Boost

Unit – 5	PUBLIC DATASETS AND CASE STUDIES	7 hrs

Exploring UCI Machine Learning Repository – Kaggle Data Sets – Analysing Data Sets – Case Studies

Text / Reference Books:

1. Saikat Dutt, Subramanian Chandramouli, Amit Kumar Das, Machine Learning, Pearson Education India, 2018
2. Tom Mitchell, Machine Learning, McGraw Hill Education, First Edition, 2017
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, First edition, 2010.
4. Ethem Alpaydin,"Introduction to Machine Learning‖, MIT Press, Prentice Hall of India, Third Edition 2015.

CSC3003	WEB TECHNOLOGY	3	0	0	3

Course Outcomes:

CO1: Understand the principles of www and concepts of web clients and web servers
CO2: Interpret the key responsibilities and functionalities of different internet technologies
CO3: Demonstrate Markup languages and illustrate the working of it
CO4: Analyze the different client side scripting/programming languages
CO5: Explain and demonstrate server side , presentation and database technologies

Unit – 1	WEB ESSENTIALS	9 hrs

Internet Principles – basic web concepts – Client/ server model – Retrieving data from Internet –Internet Protocols and applications

Unit – 2	INTERNET TECHNOLOGIES	9 hrs

Streaming – Networking Principles – Sockets for Clients – Sockets for Servers – Protocol Handlers – Content Handlers – Multicast sockets – Remote method Invocation.

Unit – 3	MARKUP LANGUAGES AND STYLE SHEETS	9 hrs

HTML Elements – HTML Lists – HTML Tables – HTML Forms – Links and addressing – HTML Frames and Images – DHTML – Document Object model (DOM) – XML Schemas – CSS – Text Properties – Advanced CSS

Unit – 4	CLIENT SIDE TECHNOLOGY	9 hrs

Scripts – Javascript – VB Script – JQuery and Ajax

Unit – 5	SERVER SIDE TECHNOLOGY AND DATABASE	9 hrs

Server Scripts – Servlets – Sessions – Cookies – PHP– Node.js – Java Server Pages (JSP) – Active Server pages (ASP) – Simple Applications – On-line databases – Monitoring user events – Plug-ins – Database connectivity – Case Studies on connecting MangoDB with Java

Text / Reference Books:

1. P. GOPALAN, T. A. ADIKESAVAN, WEB TECHNOLOGY: A DEVELOPER'S PERSPECTIVE, PHI Learning Private Limited, Second edition, 2014
2. Jeffrey C. Jackson, WEB TECHNOLOGIES A Computer Science Perspective, Pearson Edition, Second edition, 2007
3. Paul Deital, Internet & World Wide Web: How to Program, Pearson Edition, Fourth edition, 2007
4. Uttam K. Roy, Web Technologies, Oxford, First Edition, 2010

CSC3004	MACHINE LEARNING LAB	0	0	4	2

Course Outcomes:

CO1: Understand the fundamentals of machine learning, model preparation and evaluation
CO2: Learn ability theory and its application in data understanding
CO3: Apply supervised learning algorithms and unsupervised learning algorithms on real data
CO4: Apply ensemble classifiers on data and compare the model performance
CO5: Explore data repositories and apply Machine Learning Algorithms on case studies

Programs should include but not limited to:
Programming Assignment on

i. Data Analysis
ii. Data Visualization
iii. Linear Regression
iv. Multiple Regression
v. Logistic Regression
vi. Decision Trees
vii. k-Nearest Neighbor
viii. Random Forest
ix. Adaboost
x. XG Boost

CSC3005	WEB TECHNOLOGY LAB	0	0	4	2

Course Outcomes:

CO1: Understand the principles of www and concepts of web clients and web servers
CO2: Interpret the key responsibilities and functionalities of different internet technologies
CO3: Demonstrate Markup languages and illustrate the working of it
CO4: Analyze the different client side scripting/programming languages
CO5: Explain and demonstrate server side , presentation and database technologies

Programs should include but not be limited to:
Implementations of

i. Demonstration of client server programming
ii. Static and Dynamic web pages creation using HTML
iii. Inline, Internal and external style sheet using CSS
iv. Creation and manipulation of XML schema
v. Scripts – Simple programs
vi. Front end development using JavaScript, VBScript
vii. Programs based on sessions and cookies
viii. Web applications (Backend) using PHP, Servlets
ix. Exercises based on database connectivity
x. Web application for event tracking and monitoring

SKILL ENHANCEMENT ELECTIVES

CSC5001	COMPUTATIONAL INTELLIGENCE	3	0	4	5

Course Outcomes:

CO1: Identify the differences between traditional computing and soft computing
CO2: Understand artificial neural network architectures and its applications
CO3: Learn the concepts of fuzzy sets and fuzzy relations
CO4: Apply fuzzy logic in real-time applications
CO5: Learn the concepts of rough sets and its applications

Unit – 1	INTRODUCTION TO SOFT COMPUTING	5 hrs

Introduction to Soft Computing – Evolutionary Computing – Hard computing vs Soft computing – Recent Trends in Soft Computing.

Unit – 2	ARTIFICIAL NEURAL NETWORKS	16 hrs

History – Mathematical model of neuron – ANN architectures – Learning rules and paradigms – Perceptron – Back propagation Network – BPA Learning – Associative Memory: Auto Correlation and Hetero correlation – Self Organizing Map.

Unit – 3	FUZZY SETS AND RELATIONS	8 hrs

Uncertainty and Imprecision - Chance vs ambiguity - Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership functions - Properties of Membership functions - Fuzzification and Defuzzification.

Unit – 4	FUZZY LOGIC	8 hrs

Classical Logic and Fuzzy logic – Fuzzy Rule based systems – Fuzzy Classification – Fuzzy Pattern Recognition.

Unit – 5	ROUGH SETS	8 hrs

Introduction to Rough Sets - Information Tables and Attributes – Set Approximation - Knowledge representation and reduction systems – Comparison with other systems – Case studies.

Text / Reference Books:

1. T.J.Ross, Fuzzy Logic with Engineering Applications, Wiley, Third edition, 2010
2. S. Rajasekaran and G.A.V. Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications, PHI, Kindle Edition, 2013
3. S. Haykins, Neural Networks: A Comprehensive Foundation, Prentice Hall, Second edition, 2008
4. J.M. Zurada,, Introduction to Artificial Neural systems, Jaico Publishing House, 2009
5. C.M. Bishop, Neural Networks for Pattern Recognition, Oxford University Press, 2008

CSC5002	COMPUTER GRAPHICS	3	0	4	5

Course Outcomes:

CO1: Understand the working mechanism of display devices
CO2: Learn the 2D transformations and their usage with examples
CO3: Learn the 3D transformations and their usage with examples
CO4: Ability to apply scan conversion and filling algorithms
CO5: Ability to model the visible surfaces

Unit – 1	INTRODUCTION TO COMPUTER GRAPHICS	9 hrs

Overview of Computer Graphics, Computer Graphics Application and Software, Description of some graphics devices, Input Devices for Operator Interaction, Active and Passive Graphics Devices, Display Technologies, Storage Tube Graphics Displays, Calligraphic Refresh Graphics Displays, Raster Refresh (Raster-Scan) Graphics Displays, Cathode Ray Tube Basics, Color CRT Raster Scan Basics, Video Basics, The Video Controller, Random Scan Display Processor, LCD displays.

Unit – 2	TWO DIMENSIONAL TRANSFORMATIONS	9 hrs

Transformations and Matrices, Transformation Conventions, 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Translations and Homogeneous Coordinates, Rotation, Reflection, Scaling, Combined Transformation, Transformation of Points, Transformation of The Unit Square, Solid Body Transformations, Rotation About an Arbitrary Point, Reflection through an Arbitrary Line, A Geometric Interpretation of Homogeneous Coordinates, The Window-to-Viewport Transformations.

Unit – 3	THREE DIMENSIONAL TRANSFORMATIONS	9 hrs

Introduction, Three-Dimensional Scaling, Three-Dimensional Shearing, Three-Dimensional Rotation, Three-Dimensional Reflection, Three-Dimensional Translation, Multiple Transformation, Rotation about an Arbitrary Axis in Space, Reflection through an Arbitrary Plane, Matrix Representation of 3D Transformations, Composition of 3D Transformations, Affine and Perspective Geometry, Perspective Transformations, Techniques for Generating Perspective Views, Vanishing Points, the Perspective Geometry and camera models, Orthographic Projections, Axonometric Projections, Oblique Projections, View volumes for projections.

Unit – 4	SCAN CONVERSION AND FILLING ALGORITHMS	9 hrs

Scan Converting Lines, Mid-point criteria, Problems of Aliasing, end-point ordering and clipping lines, Scan Converting Circles, Scan Converting Ellipses, Filling Polygons, edge data structure, Clipping Lines algorithms– Cyrus-Beck, Cohen-Sutherland and Liang Barsky, Clipping Polygons, Problem with multiple components.

Unit – 5	VISIBLE SURFACE DETERMINATION	9 hrs

Techniques for efficient Visible-Surface Algorithms, Categories of algorithms, Back face removal, The z-Buffer Algorithm, Scan-line method, Painter's algorithms (depth sorting), Area sub-division method, BSP trees, Visible-Surface Ray Tracing, comparison of the methods.

Text / Reference Books:

1. J. D. Foley, A. Van Dam, S. K. Feiner and J. F. Hughes, Computer Graphics - Principles and Practice, Pearson Education, First edition, 2003.
2. D. Hearn and M. Pauline Baker, Computer Graphics (C Version), Pearson Education, 2nd Edition, 2004.
3. F. S. Hill Jr., Computer Graphics using OpenGL, Pearson Education, Third edition, 2007.

CSC5003	BIG DATA ANALYTICS	3	0	4	5

Course Outcomes:

CO1: Understand the concepts of Big Data Analytics
CO2: Learn the components of Map Reduce and Hadoop Eco-System
CO3: Ability to use SPARK
CO4: Ability to use NOSQL
CO5: Learn to plot data

Unit – 1	INTRODUCTION TO BIG DATA ANALYTICS	9 hrs

Big Data Technology Foundations – Challenges of Conventional Systems - Five Vs - Data analysis – Nature of Data – Big data analytic processes - Ingesting data into the system - Persisting the data in storage - Computing and Analyzing data - Visualizing the results – **Processing and Analyzing Big Data batch processing** - Stream Processing – overview on big data tools applied in different stages of Big data.

Unit – 2	MAP REDUCE	9 hrs

Introduction – Distributed file system – Map Reduce – Stages in Map Reduce - MapReduce Architecture - Algorithms using map reduce, Matrix-Vector Multiplication by Map Reduce – Hadoop - Understanding the Map Reduce architecture - Writing Hadoop MapReduce Programs - Loading data into HDFS - Executing the Map phase - Shuffling and sorting - Reducing phase execution.

Unit – 3	SPARK	9 hrs

Introduction to data analysis with spark - Programming with RDDs – working with key value pairs – loading and saving your data – Spark SQL – Spark Streaming – Apache spark MLIB – Machine Learning with MLib – Development of real time applications using SPARK

Unit – 4	NOSQL	9 hrs

NoSQL: Types of Databases – Advantages - No SQL databases: Mongo DB: Introduction – Features – Data types – Mongo DB Query language – CRUD operations – Arrays – Functions: Count – Sort – Limit – Skip – Aggregate – Map Reduce. Cursors – Indexes – Mongo Import – Mongo Export.

Unit – 5	CASSANDRA AND DATA VISUALIZATION	9 hrs

Cassandra: Introduction – Features – Data types – CQLSH – Key spaces – CRUD operations – Collections – Counter – TTL – Alter commands – Import and Export – Querying System tables. Big Data Visualization - Basics - Trends in Data Visualization - Interactive Graphics - Visualization Designers – Use of Data Visualization - Visualization Process Into Practice - Visualization Software - TABLEAU DESKTOP - Elastic Stack, Apache Solr and Banana

Text / Reference Books:

1. Raj Kamal, Preeti Saxena, Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, McGraw-Hill India, 2019
2. Subhashini Chellappan, Seema Acharya, Big Data and Analytics, Wiley, 2ed, 2019,
3. Big Data Fundamentals by Thomas Erl, PEARSON INDIA, 2016
4. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
5. Boris lublinsky, Kevin t. Smith, Alexey Yakubovich, “Professional Hadoop Solutions”, Wiley, 2015.
6. Chris Eaton, Dirk deroos et al. , “Understanding Big data ”, McGraw Hill, 2012.
7. Tom White, “HADOOP: The definitive Guide” , O Reilly 2012.
8. Spark - The Definitive Guide, Bill Chambers and Matei Zaharia, 2018, O'Reilly Media, Inc,USA,
9. Holden Karau, Andy Konwinski, Patrick Wendell & Matei Zaharia, Learning Spark Lightning Fast Data Analysis, O’Reilly, 2015
10. Josh Wills, Sandy Ryza, Sean Owen, and Uri Laserson, Advanced Analytics with Spark:

11. Patterns for Learning from Data at Scale 2nd Edition, O'Reilly, 2016
12. Sosulski kristen, Data visualization made simple insights into becoming visual, 2019, Routledge
13. Kieran Healy , Data Visualization: A Practical Introduction Paperback, 2018

CSC5004	DIGITAL IMAGE PROCESSING	3	0	4	5

Course Outcomes:

CO1: Identify the differences between traditional computing and soft computing
CO2: Understand artificial neural network architectures and its applications
CO3: Learn the concepts of fuzzy sets and fuzzy relations
CO4: Apply fuzzy logic in real-time applications
CO5: Learn the concepts of rough sets and its applications

Unit – 1	BASICS OF DIGITAL IMAGE PROCESSING	9 hrs

Introduction – Fundamental Steps in DIP – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Pixel Relationships – Intensity Transformations – Histogram Processing – Convolution – Spatial Filtering – Smoothing and Sharpening in Spatial Domain

Unit – 2	IMAGE TRANSFORMS	9 hrs

Unitary Transforms – Two Dimensional Discrete Fourier Transform – Fast Fourier Transform - Two Dimensional Discrete Cosine Transformation – KL Transform – Hadamard Transform – Haar Transform

Unit – 3	IMAGE ENHANCEMENT IN FREQUENCY DOMAIN AND IMAGE RESTORATION	9 hrs

Concept of Frequency Domain – Filtering in Frequency Domain – Smoothing and Sharpening in Frequency Domain – Image Degradation and Restoration Process – Noise Models – Restoration in the presence of Noise only using Spatial Filtering – Periodic Noise Reduction using Frequency Domain Filtering – Linear Position Invariant Degradation - Inverse Filtering

Unit – 4	MORPHOLOGICAL PROCESSING AND IMAGE SEGMENTATION	9 hrs

Preliminaries – Erosion and Dilation – Opening and Closing – Basic Morphological Algorithms – Segmentation Fundamentals – Point-Line Detection – Edge Detection – Thresholding – Region Based Segmentation

Unit – 5	FEATURE EXTRACTION AND OBJECT DETECTION	9 hrs

Basic Representations – Boundary Descriptors – Regional Descriptors – SIFT – Local Binary Pattern – Local Directional Pattern – Dimensionality Reduced Local Directional Pattern

Text / Reference Books:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, Fourth edition, 2018.
2. Anil K. Jain, Fundamentals of Digital Image Processing, Pearson, 2002.
3. Kenneth R. Castleman, Digital Image Processing, Pearson Education India, First edition,2007.
4. William K. Pratt, Digital Image Processing, John Wiley & Sons, Fourth edition, 2007
5. Milan Sonka et al, Image Processing, Analysis, and Machine Vision with MindTap, Cengage India Private Limited; Fourth edition, 2017

DISCIPLINE SPECIFIC ELECTIVES

CSC6001	DATA WAREHOUSING AND DATA MINING	3	0	0	3

Course Outcomes:

CO1: To understand the principles of Data warehousing and Data Mining
CO2: To be familiar with the Data warehouse architecture and its Implementation
CO3: To know the Architecture of a Data Mining system
CO4: To understand the various Data preprocessing Methods
CO5: To perform classification and prediction of data

Unit – 1	DATA WAREHOUSING AND BUSINESS ANALYSIS	9 hrs

Data warehousing Components –Building a Data warehouse –Data Warehouse Architecture – DBMS Schemas for Decision Support – Data Extraction, Cleanup, and Transformation Tools –Metadata – reporting – Query tools and Applications – Online Analytical Processing (OLAP) – OLAP and Multidimensional Data Analysis.

Unit – 2	DATA MINING & ASSOCIATION RULE MINING	9 hrs

Data Preprocessing – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization and Concept Hierarchy Generation- Architecture Of A Typical Data Mining Systems- Classification Of Data Mining Systems- Efficient and Scalable Frequent Item set Mining Methods – Mining Various Kinds of Association Rules – Association Mining to Correlation Analysis – Constraint-Based Association Mining.

Unit – 3	CLASSIFICATION AND PREDICTION	9 hrs

Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Selection.

Unit – 4	CLUSTER ANALYSIS	9 hrs

Types of Data in Cluster Analysis – A Categorization of Major Clustering Methods – Partitioning Methods – Hierarchical methods – Density-Based Methods – Grid-Based Methods – Model-Based Clustering Methods – Clustering High-Dimensional Data – Constraint-Based Cluster Analysis – Outlier Analysis.

Unit – 5	MINING OBJECT, SPATIAL, MULTIMEDIA, TEXT AND WEB DATA	9 hrs

Multidimensional Analysis and Descriptive Mining of Complex Data Objects – Spatial Data Mining – Multimedia Data Mining – Text Mining – Mining the World Wide Web.

Text / Reference Books:

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Elsevier, Third edition, 2011.
2. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw – Hill Edition, Tenth Reprint 2007.
3. K.P. Soman, Shyam Diwakar and V. Ajay, Insight into Data mining Theory and Practice, Easter Economy Edition, Prentice Hall of India, 2006.
4. G. K. Gupta, Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006.
5. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2007.

CSC6002	PATTERN RECOGNITION	3	0	0	3

Course Outcomes:

CO1: Understand the concepts of Bayesian Decision Theory
CO2: Apply Maximum Likelihood and Bayesian Estimation in solving problems
CO3: Compare linear and non-linear classifiers
CO4: Learn the principles of structural pattern recognition with examples
CO5: Ability to extract and select features from the given data

Unit – 1	INTRODUCTION TO PATTERN RECOGNITION AND BAYESIAN DECISION THEORY	9 hrs

Machine Perception – Sub-problems of Pattern Classification – Learning and Adaptation – Bayesian Decision Theory – Continuous Features – Minimum Error Rate Classification – Classifiers – Discriminants – Decision Surfaces – Normal Density – Discriminant Functions for Normal Density – Bayesian Decision Theory for Discrete Features

Unit – 2	MAXIMUM LIKELIHOOD AND BAYESIAN ESTIMATION	9 hrs

Maximum Likelihood Estimation – Bayesian Estimation – Bayesian Parameter Estimation: General Theory and Gaussian Case – Problems on Dimensionality – Expectation-Maximization – Bayesian Belief Networks – Hidden Markov Models

Unit – 3	LINEAR AND NON-LINEAR CLASSIFIERS	9 hrs

Linear Discriminant Functions and Decision Hyperplanes – Perceptron – Least Squares Methods – Mean Square Estimation – XOR Problem – SVM for XOR Problem – Polynomial Classifiers – Radial Basis Function Networks

Unit – 4	STRUCTURAL PATTERN RECOGNITION	9 hrs

Elements Of Formal Grammars – String Generation as Pattern Description – Recognition of Syntactic Description – Parsing – Stochastic Grammars and Applications - Graph based Structural Representation.

Unit – 5	FEATURE SELECTION AND GENERATION	9 hrs

Feature Selection: Pre-processing – Hypothesis Testing – ROC Curve – Feature Subset Selection. Feature Generation: Basis Vectors and Images – KL Transform – Singular Value Decomposition – Independent Component Analysis.

Text / Reference Books:

1. Duda R.O., and Hart.P.E., Pattern Classification and Scene Analysis, Wiley, Second edition, 2001.
2. Sergios Theo doridis and K. Koutroumbas , Pattern Recognition, Fourth edition, Elsevier, 2008.
3. Robert J.Schalkoff, Pattern Recognition:, Statistical, Structural and Neural Approaches,John Wiley & Sons Inc., New York, 2007.
4. Trevor H, Robert T,Jerome Friedman, The Elements of Statistical Learning, SpringerSeries,2017
5. Christopher M Bishop, Pattern Recognition and Machine Learning. Springer.2011.

CSC6003	NATURAL LANGUAGE PROCESSING	3	0	0	3

Course Outcomes:

CO1: Learn the fundamentals of Natural Language Processing
CO2: Ability to perform text processing operations
CO3: Ability to estimate parameters and evaluate language models
CO4: Understand the syntax and semantics of text data
CO5: Abililty to apply NLP concepts in related real time applications

Unit – 1	INTRODUCTION TO NLP	9 hrs

Introduction to various levels of natural language processing, Ambiguities and computational challenges in processing various natural languages. Introduction to Real life applications of NLP such as spell and grammar checkers, information extraction, question answering, and machine translation.

Unit – 2	TEXT PROCESSING	9 hrs

Character Encoding, Word Segmentation, Sentence Segmentation, Introduction to Corpora, Corpora Analysis.

Unit – 3	LEXICAL SYNTAX AND LANGUAGE MODELLING	9 hrs

Introduction to word types, POS Tagging, Maximum Entropy Models for POS tagging, Multi-word Expressions. The role of language models. Simple N-gram models. Estimating parameters and smoothing. Evaluating language models.

Unit – 4	SYNTAX & SEMANTICS	9 hrs

Introduction to phrases, clauses and sentence structure, Shallow Parsing and Chunking, Shallow Parsing with Conditional Random Fields (CRF), Lexical Semantics, Word Sense Disambiguation, WordNet, Thematic Roles, Semantic Role Labelling with CRFs.

Unit – 5	APPLICATIONS OF NLP	9 hrs

NL Interfaces, Text Summarization, Sentiment Analysis, Machine Translation, Question answering.

Text / Reference Books:

1. Chris Manning and Hinrich Schütze, Foundations of Statistical Natural Language Processing, MIT Press Cambridge, MA, Second edition, 2003.
2. NitinIndurkhya, Fred J. Damerau, Handbook of Natural Language Processing, CRC Press, Second edition,2010.
3. James Allen, Natural Language Understanding, Pearson Publication, Eighth edition. 2012.

CSC6004	PRINCIPLES OF DEEP LEARNING	3	0	0	3

Course Outcomes:

CO1: Recognize characteristics of deep learning models to solve real world problems

CO2: Understand the concepts of convolutional neural networks and its usage in classification problem

CO3: Learn deep learning supporting environments

CO4: Understand the concept of recurrent neural networks and apply them in solving real world problems

CO5: Generate auto encoders and generative models for real time applications

Unit – 1	INTRODUCTION TO DEEP LEARNING & ARCHITECTURES	9 hrs

Machine Learning Vs. Deep Learning – Representation Learning – Width Vs. Depth of Neural Networks - Activation Functions: RELU – LRELU – ERELU –Unsupervised Training of Neural Networks – Regularization – Dropout - Drop connect – Optimization methods for neural networks – Adagrad – Adadelta – Rmsprop – Adam – NAG.

Unit – 2	CONVOLUTIONAL NEURAL NETWORKS & TRANSFER LEARNING	9 hrs

Architectural Overview – Motivation - Layers – Filters – Parameter sharing – Regularization - Popular CNN Architectures: LeNet – ResNet – Vggnet – AlexNet. Transfer learning Techniques –DenseNet – PixelNet.

Unit – 3	TRAINING NEURAL NETWORKS	9 hrs

Deep Learning Hardware and Software – CPUs – GPUs – TPUs – PyTorch – TensorFlow – Dynamic vs Static computation graphs – Data Preprocessing – Data Augmentation – Batch Normalization – Transfer Learning – Deep Transfer Learning Strategies – Update Rules - Hyperparameter Tuning – Learning Rate Scheduling – Variants of CNN – ResNet – GoogleNet – Xception etc

Unit – 4	RECURRENT NEURAL NETWORKS	9 hrs

Recurrent Neural Networks – Bidirectional RNNs – Encoder-decoder sequence to sequence Architectures – Backpropagation Through Time for training RNN – Long Short Term Memory Networks.

Unit – 5	AUTO ENCODERS AND DEEP GENERATIVE MODELS	9 hrs

Under complete Autoencoders – Regulraized Autoencoders – Sparse Autoencoders – Denoising Autoencoders –Representational Power – Layer – Size and Depth of Autoencoders – Stochastic Encoders and Decoders – Contractive Encoders – Deep Belief networks – Boltzmann Machines – Deep Boltzmann Machine – Generative Adversarial Networks

Text / Reference Books:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning series), First edition, The MIT Press, 2016
2. Josh Patterson, Adam Gibson, Deep Learning: A Practitioner's Approach, First edition, O'Reilly Media, 2017
3. Giancarlo Zaccone, Md. Rezaul Karim, Ahmed Menshawy, Deep Learning with TensorFlow: Explore neural networks with Python, First edition, Packt Publisher, 2017

CSC6005	DEEP LEARNING IN COMPUTER VISION	3	0	0	3

Course Outcomes:

CO1: Learning computer vision, starting from basics and then turning to more modern deep learning models.

CO2: Learning of Convolution features for visual recognition and Identification of facial attributes and facial key points regression

CO3: learning and analysis of different problems in object detection using R-CNN

CO4: Understanding of Object tracking and action recognition with illustrations

CO5: Learning of Image segmentation and synthesis with case studies

Unit – 1	INTRODUCTION TO IMAGE PROCESSING, COMPUTER VISION AND DEEP LEARNING	9 hrs

Introduction to Computer Vision-Digital Images-Structure of Human Eye And Vision - Color Models - Image Processing Goals and Tasks - Contrast and Brightness Correction - Image Convolution - Edge Detection - Basic Image Processing- Neural Networks And Machine Learning - Convolutional Neural Networks (CNNs) and its Building Blocks - Object Detection/Localization with Deep Learning - Pre-Trained Imagenet Networks - Training Large-Scale (Imagenet-Level) Networks.

Unit – 2	CONVOLUTION FEATURES FOR VISUAL RECOGNITION	9 hrs

Recap: Image Classification - Alexnet, VGG and Inception Architectures - Resnet and Beyond - Fine-Grained Image Recognition - Detection and Classification of Facial Attributes - Content-Based Image Retrieval - Computing Semantic Image Embedding Using Convolutional Neural Networks - Employing Indexing Structures for Efficient Retrieval of Semantic Neighbours - Face Verification - The Re-Identification Problem in Computer Vision - Facial Keypoints Regression - CNN for Key Points Regression - Convolutional Features for Visual Recognition - Case Study: Smile Detection**.**

Unit – 3	OBJECT DETECTION	9 hrs

Object Detection Problem - Sliding Windows - HOG-Based Detector - Detector Training - Viola-Jones Face Detector - Attentional Cascades and Neural Networks - Region-Based Convolutional Neural Network - From R-CNN to Fast R-CNN - Faster R-CNN - Region-Based Fully-Convolutional Network - Single Shot Detectors - Speed Vs. Accuracy Trade-off - Fun with Pedestrian Detectors - Uncover Common Architectures & Training Patterns - Spot Underfitting and Overfitting - Decay And Learning Rate Schedulers**.**

Unit – 4	OBJECT TRACKING AND ACTION RECOGNITION	9 hrs

Introduction to Video Analysis - Optical Flow - Deep Learning in Optical Flow Estimation - Visual Object Tracking - Examples of Visual Object Tracking Methods - Multiple Object Tracking - Examples of Multiple Object Tracking Methods - Introduction to Action Recognition - Action Classification - Action Classification with Convolutional Neural Networks - Action Localization.

Unit – 5	IMAGE SEGMENTATION AND SYNTHESIS	9 hrs

Image Segmentation – Over Segmentation - Deep Learning Models for Image Segmentation - Human Pose Estimation as Image Segmentation - Style Transfer - Generative Adversarial Networks - Image Super Resolution - Imagenet: Large Scale Visual Recognition Challenge - Image Transformation with Neural Networks - Case Study: Age + Gender Recognition - Case Study: Emotion And Facial Expression Recognition**.**

Text / Reference Books:

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, Deep Learning (Adaptive Computation and Machine Learning series), First edition, The MIT Press, 2016
2. Grokking Deep Learning by Andrew W. Trask, 2019, Manning publications
3. Neural Networks and Deep Learning by Michael Nielsen.2015, Determination Press (2015); eBook (NeuralNetworksAndDeepLearning.com); CC BY-NC 3.0
4. Deep Learning for Computer Vision: Expert techniques to train advanced neural networks using TensorFlow and Keras, 2018, Packt Publishing; 1 edition (23 January 2018), ISBN: 1788295625
5. Computer Vision: Algorithms and Applications (Texts in Computer Science) 2011th Edition by Richard Szeliski, @ 2010 Springer
6. C. Solomon, T. Breckon, Fundamentals of Digital Image Processing.A Practical Approach with Examples in Matlab, Wiley-Blackwell, ISBN: 978-0-470-84472-
7. Digital Image Processing Using MATLAB, 2nd Edition by Rafael C. González, Richard Eugene Woods, Steven L. Eddins, 2017, Gatesmark Publishing; 2nd edition (2009)
8. Feature Extraction and Image Processing for Computer Vision, Third Edition, Mark Nixon, 2012, Academic Press, ISBN: 0123965497
9. Image Processing: The Fundamentals, Maria Petrou,Costas Petrou, 2nd edition, © 2010 John Wiley & Sons, ISBN: 047074586X,2010

CSC6006	ARTIFICIAL EMOTIONAL INTELLIGENCE	3	0	0	3

Course Outcomes:

CO1: Learning basics of Artificial Emotional Intelligence and its applications in different domains

CO2: Analysis on Affective Computing and recognizing of emotional context

CO3: Learning of difference between facial emotion recognition, text emotion recognition, speech emotion recognition techniques

CO4: Understanding of Emotions Classification techniques with illustrations

CO5: Learning of ethical issues related to emotions and AI

Unit – 1	INTRODUCTION TO ARTIFICIAL EMOTIONAL INTELLIGENCE	9 hrs

Introduction to Artificial Emotional Intelligence- Concept of Emotional Intelligence, Defining the Research Problem in AEI, Difference between AI and AEI, Affective Computing emotion, application, mood, attitude/sentiment, personality chatbots, robots, smartphones with emotional intelligence.

Unit – 2	AFFECTIVE COMPUTING AND INTERACTION	9 hrs

Affective Technology Interaction- Visual, Verbal and Vocal, Intelligent agents, Feature Extraction Techniques, Eulerian Motion Magnification, Viola-Jones face detector, Computational Appraisal Theory, Emotion and Learning, reinforcement learning based approaches, recognizing emotional context, facial affect recognition

Unit – 3	EMOTION RECOGNITION	9 hrs

Emotionally Intelligent-Human Computer Interaction, Emotion and Perception, Facial Emotion Recognition, Text Emotion Recognition, Speech Emotion Recognition techniques, Auto encoders and relation to PCA, Learning representations and multimodal.

Unit – 4	EMOTIONS CLASSIFICATION	9 hrs

Supervised learning, Unsupervised learning, Reinforcement learning, Clustering, Classifiers: Bayes, K-Nearest Neighbor, Artificial Neural Network models, Spatio-temporal analysis, Convolutional Neural Networks, Recurrent Neural Networks, Back propagation through time. Neurological Mechanisms involved in Emotion

Unit – 5	ETHICAL ISSUES RELATED TO EMOTIONS AND AI	9 hrs

Ethical issues related to emotion and AI privacy and surveillance, Manipulation of behaviour, Artificial Moral Agents, Machine Ethics, Singularity and Super-intelligence Dual-process theories of emotion, Constructivist theories, Appraisal theories.

Text / Reference Books:

1. André Mainville, Creating Emotional Artificial Intelligence, 2017, Blurb publishers
2. Richard Yonck, Heart of the Machine: Our Future in a World of Artificial Emotional Intelligence, Arcade, 2017
3. Phil Kwest, Intelligence: Understanding IQ, Emotional Intelligence, Artificial Intelligence, and how to use them to reach success in life (Intelligent Change, Intelligence Analysis, Smart, Understanding), Kindle Edition, 2020
4. Ekaterina, I., Georgii, B.: Optimization of Machine Learning Algorithm of Emotion Recognition in Terms of Human Facial Expressions. Procedia Computer Science, Elsevier Volume 169, P. 244-248 (2020)
5. Mellouk, W., Handouzi, W.: Facial Emotion Recognition Using Deep Learning: Review and Insights. The 2nd International Workshop (FIoE), Procedia Comp. Sci. Elsevier Vol. 175, Pages 689-694 (2020)

6. Sharma, V: Designing of Face Recognition System. *International Conference on Intelligent Computing and Control Systems (ICCS)* PP 459-461 Published by IEEE (2019)
7. Erol, B. A., Majumdar, A., Benavidez, P., Rad, P., Choo, R. K., Jamshidi, M.: Towards Artificial Emotional Intelligence for Cooperative Social Human-Machine Interaction. IEEE Transaction on the computational social system, Volume 7, Issue 1 (2019)
8. Amorim, M., Cohen, Y., Reis, J., Rodrigues, M.: Exploring Opportunities of Artificial Emotional Intelligence In-Service Production System. IFAC-Papers OnLine Volume 52, Issue 13, Pages 1145-1149 Elsevier (2019)

CSC6007	DATA VISUALIZATION	3	0	0	3

Course Outcomes:

CO1: Learning of data visualization, visualization designers , use of data visualization and data visualization into practice

CO2: Learning of Visualization tools, Comparisons, Distributions and Chart Interface

CO3: Understanding of data, explore the data and design standards for the visual data

CO4: Learning of Information Dashboard categorization, issues and visual perception

CO5: Learning of Information dashboard design, organization, testing with case studies

Unit – 1	FUNDAMENTALS OF DATA VISUALIZATION	9 hrs

Basics of Data visualization - Trends in Data Visualization - Interactive Graphics - Visualization Designers –Use of Data Visualization - Visualization Process Into Practice - Basic Productivity Applications - MICROSOFT EXCEL – iWORK - GOOGLE CHARTS - Visualization Software - TABLEAU DESKTOP.

Unit – 2	VISUALIZATION TOOLS, DISTRIBUTIONS AND CHART INTERFACE	9 hrs

Business Intelligence Tools - Programming Packages - Selecting Tools to Build Data Graphics - Comparisons of Categories and Time – Distributions – Proportions – Relationships – Locations - Trends— Showing Comparisons Over Time or Composition Over Time - Word Frequency and Sentiment - Connections and Networks - Chart Interface

Unit – 3	DESIGN STANDARDS FOR THE VISUAL DATA	9 hrs

data into information for visual representation – UNDERSTAND YOUR DATA - Review the Data Dictionary – different kinds of data - PREPARING YOUR DATA - Survey Data - RENAME THE VARIABLES - IDENTIFY MISSING VALUES - Compute Descriptive Statistics - Explore the Data Visually - Devise the Problem, Challenge, and/or Questions - Design Standards for visual data

Unit – 4	INFORMATION DASHBOARD CATEGORIZATION AND VISUAL PERCEPTION	9 hrs

Information dashboard - categorizing dashboards - typical dashboard data - dashboard design issues and best practices - visual perception - limits of short-term memory - visually encoding data - Gestalt principles -principles of visual perception for dashboard design

Unit – 5	INFORMATION DASHBOARD DESIGN WITH CASE STUDIES	9 hrs

INFORMATION DASHBOARD DESIGN II: Characteristics of dashboards - key goals in visual design process - dashboard display media - designing dashboards for usability- meaningful organization - maintaining consistency- aesthetics of dashboards - testing for usability - case studies: sales dashboard, CIO dashboard, Telesales dashboard, marketing analysis dashboard

Text / Reference Books:

1. Sosulski kristen, Data visualization made simple insights into becoming visual, 2019, Routledge
2. Kieran Healy , Data Visualization: A Practical Introduction Paperback, 2018
3. Cole Nussbaumer Knaflic, Storytelling with Data: A Data Visualization Guide for Business Professionals, 2015
4. Chun-houh Chen, Wolfgang Härdle, Antony Unwin, Handbook of Data Visualization, Springer, 2008
5. Stephen Few, Information Dashboard Design: Displaying Data for At-a-Glance Monitoring, 2013

CSC6008	STATISTICS FOR DATA SCIENCE	3	0	0	3

Course Outcomes:

CO1: Learn the fundamental concepts of statistical learning and Regression
CO2: Understand the resampling methods and their effectiveness in evaluating models
CO3: Ability to apply regularization methods for improving the performance of models
CO4: Compare classification algorithms using real time data
CO5: Ability to apply non-linear methods for solving complex problems

Unit – 1	INTRODUCTION TO STATISTICAL LEARNING	9 hrs

Statistical Learning – Trade-Off between Prediction Accuracy and Model Interpretability – Regression vs Classification Problems - Assessing Model Accuracy – Measuring the Quality of Fit – Bias-Variance Trade-Off – Linear Regression – Multiple Linear Regression – Other Factors in Regression Model

Unit – 2	RESAMPLING METHODS	9 hrs

Cross Validation – Validation Set Approach – Leave-One-Out Cross Validation – k-fold Cross Validation – Bias-Variance Trade-Off for k-fold Cross Validation – Cross Validation on Classification Problems – Bootstrap

Unit – 3	LINEAR MODEL SELECTION AND REGULARIZATION	9 hrs

Subset Selection – Best Subset Selection – Stepwise Selection – Choosing the Optimum Model - Shrinkage Methods – Ridge Regression – Lasso – Selecting the Tuning Parameter – Dimension Reduction Methods – Principal Components Regression – Partial Least Squares – High Dimensional Data

Unit – 4	CLASSIFICATION	9 hrs

Logistic Regression – Estimating Regression Coefficients – Linear Discriminant Analysis - Comparison of Classification Methods – Quadratic Discriminant Analysis

Unit – 5	MOVING BEYOND LINEARITY	9 hrs

Polynomial Regression – Regression Splines – Smoothing Splines – Local Regression – Decision Trees – Bagging – Random Forests - Boosting

Text / Reference Books:

1. James, G., Witten, D., Hastie, T., Tibshirani, R. An introduction to statistical learning with applications in R. Springer, 2013.
2. Hastie, T., Tibshirani, R., Friedman, J. The Elements of Statistical Learning, 2nd edition. Springer, 2009.
3. Murphy, K. Machine Learning: A Probabilistic Perspective. - MIT Press, 2012.
4. Montgomery, Douglas C., and George C. Runger. Applied statistics and probability for engineers. John Wiley & Sons, 2010

CSC6009	DIGITAL WATERMARKING AND STEGANOGRAPHY	3	0	0	3

Course Outcomes:

CO1: Understand watermarking models and message coding
CO2: Able to calculate errors and analyze the errors
CO3: Understand perceptual models
CO4: Ability to apply attacks and restore watermark from the data
CO5: Learn the concepts of Steganography

Unit – 1	INTRODUCTION	9 hrs

Information Hiding – Steganography and Watermarking – History of watermarking – Importance of digital watermarking – Applications – Properties – Evaluating watermarking systems. WATERMARKING MODELS & MESSAGE CODING: Notation – Communications – Communication based models – Geometric models – Mapping messages into message vectors – Error correction coding – Detecting multi-symbol watermarks.

Unit – 2	WATERMARKING WITH SIDE INFORMATION & ANALYSING ERRORS	9 hrs

Informed Embedding – Informed Coding – Structured dirty-paper codes – Message errors – False positive errors – False negative errors – ROC curves – Effect of whitening on error rates.

Unit – 3	PERCEPTUAL MODELS	9 hrs

Evaluating perceptual impact – General form of a perceptual model – Examples of perceptual models – Robust watermarking approaches – Redundant Embedding, Spread Spectrum Coding, Embedding in Perceptually significant coefficients

Unit – 4	WATERMARK SECURITY & AUTHENTICATION	9 hrs

Security requirements – Watermark security and cryptography – Attacks – Exact authentication – Selective authentication – Localization – Restoration

Unit – 5	STEGANOGRAPHY	9 hrs

Steganography communication – Notation and terminology – Information theoretic foundations of steganography –Dynamicity – Practical steganographic methods – Minimizing the embedding impact – Steganalysis

Text / Reference Books:

1. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, Jessica Fridrich, Ton Kalker, “Digital Watermarking and Steganography”, Margan Kaufmann Publishers, New York, 2008.
2. Ingemar J. Cox, Matthew L. Miller, Jeffrey A. Bloom, “Digital Watermarking”, Margan Kaufmann Publishers, New York, 2003.
3. Michael Arnold, Martin Schmucker, Stephen D. Wolthusen, “Techniques and Applications of Digital Watermarking and Contest Protection”, Artech House, London, 2003.
4. Juergen Seits, “Digital Watermarking for Digital Media”, IDEA Group Publisher, New York, 2005.
5. Peter Wayner, “Disappearing Cryptography – Information Hiding: Steganography & Watermarking”, Morgan Kaufmann Publishers, New York, 2002.

CSC6010	HUMAN COMPUTER INTERACTION	3	0	0	3

Course Outcomes:

CO1: To provide complimentary programming skills to those who have been trained in software engineering.

CO2: To acquire the user-centered approach to software design.

CO3: To know how human interact with physical and information environments, and how to design software with human's information needs and their cognitive capacities in mind.

CO4: To introduce several evaluation methods which help software designers discover usability problems in software systems and web applications.

CO5: To Understand various models and theories behind the cognition and modelling.

Unit – 1	INTRODUCTION	9 hrs

Historical Developments, Communication, Hardware, Interaction Paradigms: Models of interaction – Interaction Framework – Ergonomics – Software/interface guidelines – Interaction Styles – Context of Interaction – Interaction Paradigms – Mobile device interaction paradigms.

Unit – 2	DESIGN PROCESS	9 hrs

User Interface Design , User Experience Design, Task analysis, Dialog notation and design – Interaction design – Universal design – HCI in the software process.

Unit – 3	IMPLEMENTATION AND EVALUATION	9 hrs

Implementation issues: Elements of windowing systems – user interface management systems – Response time – Colors – Short cuts – Symbols – Adaptable interfaces – Self Configuring systems for mobile devices. Evaluation through expert analysis and user participation – Evaluation methodologies – Evaluation criteria: functionality – usability – learnability – initiative.

Unit – 4	MODELS AND THEORIES	9 hrs

Cognitive models – Communication and collaboration models: Models of the system Modelling rich interaction

Unit – 5	APPLICATIONS	9 hrs

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

Text / Reference Books:

1. Dix, Finlay, Abowd &Beale, Human Computer Interaction, Prentice Hall, Third edition, 2009.
2. J. Preece, Y. Rogers, H. Sharp, D. Benyon, S. Holland and T. Carey, Human Computer Interaction, Addison Wesley, 1994.
3. Linda Mcaulay, HCI for Software Designers, International Thompson Computer Press, USA,1998.
4. Ben Schneiderman, Designing the User Interface, Pearson Education, New Delhi,2005.
5. Alan Cooper, The Essentials of User Interface Design, IDG Books, New Delhi,1995.
6. Jacob Nielsen, Usability Engineering, Academic Press, 1993.

CSC6011	PARALLEL AND DISTRIBUTED COMPUTING	3	0	0	3

Course Outcomes:

CO1: Understand the concepts of parallelism and parallel architectures
CO2: Ability to develop parallel models
CO3: Learn the concepts of distributed systems
CO4: Understand the coordination between threads in execution
CO5: Identify the process of distributed transactions and the underlying architectures

Unit – 1	PARALLELISM FUNDAMENTALS PARALLEL ARCHITECTURES	9 hrs

Motivation – Key Concepts and Challenges – Overview of Parallel computing – Flynn's Taxonomy – Multi-Core Processors – Shared vs Distributed memory. Introduction to OpenMP Programming – Instruction Level Support for Parallel Programming – SIMD – Vector Processing – GPUs.

Unit – 2	PARALLEL ALGORITHM AND DESIGN	9 hrs

Preliminaries – Decomposition Techniques – Characteristics of Tasks and Interactions – Mapping Techniques for Load balancing – Parallel Algorithm Models.

Unit – 3	INTRODUCTION TO DISTRIBUTED SYSTEMS	9 hrs

Introduction – Characterization of Distributed Systems – Distributed Shared Memory – Message Passing – Programming Using the Message Passing Paradigm – Group Communication – Case Study (RPC and Java RMI).

Unit – 4	COORDINATION	9 hrs

Time and Global States – Synchronizing Physical Clocks – Logical Time and Logical Clock – Coordination and Agreement – Distributed Mutual Exclusion – Election Algorithms – Consensus and Related Problems.

Unit – 5	DISTRIBUTED TRANSACTIONS DISTRIBUTED SYSTEM ARCHITECTURE AND ITS VARIANTS	9 hrs

Transaction And Concurrency Control – Nested Transactions – Locks – Optimistic Concurrency Control – Timestamp Ordering Distributed Transactions – Flat and Nested – Atomic – Two Phase Commit Protocol – Concurrency Control. Distributed File System: Architecture – Processes – Communication Distributed Web-based System: Architecture – Processes – Communication. Overview of Distributed Computing Platforms.

Text / Reference Books:

1. George Coulouris, Jean Dollimore, Tim Kindberg, and Gordon Blair, Distributed Systems: Concepts and Design, Pearson / Addison – Wesley, Fifth Edition, 2012
2. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, Pearson, Second Edition, 2008.
3. Andrew S. Tanenbaum and Maarten Van Steen, Distributed Systems: Principles and Paradigms, Pearson, Second Edition, 2006
4. Pradeep K. Sinha, Distributed Operating System: Concepts and Design, PHI Learning Pvt. Ltd., 2007

CSC6012	SOFTWARE TESTING	3	0	0	3

Course Outcomes:

CO1: To explore the effective testing techniques (both black-box and white box) for ensuring high quality software

CO2: To learn Various Testing Strategies

CO3: To learn how to planning a test project, design test cases and data, conduct testing operations, manage software problems and defects, generate a testing report

CO4: To understand various testing tools and management

CO5: To understand software test automation problems and solutions

Unit – 1	INTRODUCTION	9 hrs

What is software testing and why it is so hard? Testing Process, Basic Definitions – Software Testing Principles - The Tester's Role in a Software Development Organization - Origins of Defects - Defect Classes - Error, Fault, Failure, and Incident - The Defect Repository and Test Design – Defect Examples – Developer/Tester Support for Developing a Defect Repository.

Unit – 2	TEST CASE	9 hrs

Test Case Design Strategies - The Smarter Tester - Functional Testing (Black Box) – Boundary Value Analysis - Equivalence Class Testing – Decision Table Based Testing, Cause Effect -Graphing Technique – error guessing - compatibility testing - Requirements based testing –positive and negative testing – Structural Testing (White Box) – Path testing, code functional testing - DD-Paths, Cyclomatic Complexity, Graph Metrics, Data Flow Testing, Mutation testing Test Adequacy Criteria – static testing vs. structural testing.

Unit – 3	LEVELS OF TESTING	9 hrs

Levels of Testing – Unit testing - Planning - Designing - Running and Recording results - Integration testing – Designing –Planning – scenario testing -System testing - Types – Acceptance testing - Performance testing - Regression Testing - Slice based testing - Debugging, Domain Testing - Alpha - Beta Tests - Object Oriented Testing.

Unit – 4	TESTING TOOLS AND TEST MANAGAEMENT	9 hrs

Static Testing Tools - Dynamic Testing Tools - Characteristics of Modern Tools - Test Planning - Test Plan Components - Test Plan Attachments - Test Items - Test management - Reporting Test Results – The role of three groups in Test Planning and Policy Development – Introducing the test specialist - Skills needed by a test specialist - Building a Testing Group - Working with JUnit.

Unit – 5	CONTROLLING AND MONITORING	9 hrs

Software test automation – skills needed for automation – scope of automation – design and architecture for automation – requirements for a test tool – challenges in automation - Test metrics and measurements –project, progress and productivity metrics – Status Meetings – Reports and Control Issues – Criteria for Test Completion – SCM – Types of reviews – Developing a review program – Components of Review Plans– Reporting Review Results. – Evaluating software quality – defect prevention – testing maturity model.

Text / Reference Books:

1. Srinivasan Desikan and Gopalaswamy Ramesh, Software Testing – Principles and Practices, First edition, Pearson education, 2006
2. Aditya P.Mathur, Foundations of Software Testing, Second edition, Pearson Education, 2008
3. Boris Beizer, Software Testing Techniques, Second edition, Dreamtech, 2003
4. Elfriede Dustin, Effective Software Testing, First edition, Pearson Education, 2003
5. Renu Rajani, Pradeep Oak, Software Testing – Effective Methods, Tools and Techniques, First edition, Tata McGraw Hill, 2004

CSC6013	AGILE PROCESS AND DEVOPS	3	0	0	3

Course Outcomes:

CO1: Able to compare and contrast the differences between Agile and other project management methodologies

CO2: Familiarize with Agility requirement engineering process

CO3: Able to identify and use various tools for Agile development

CO4: Apply sprint in Agile

CO5: Able to understand and implement DevOps principles

Unit – 1	AGILE METHODOLOGY	9 hrs

Introduction to Agile: Agile versus traditional method comparisons and process tailoring Software Process Models – overview, Introduction to Agile – Various Agile methodologies – Scrum, XP, Lean, and Kanban, Agile Manifesto, Scrum: Scrum process, roles – Product Owner – Scrum Master – Team, Project Manager, product manager, architect, events, and artefacts

Unit – 2	AGILITY AND REQUIREMENTS ENGINEERING	9 hrs

Product Inception: Product vision, stakeholders, initial backlog creation; Agile Requirements - User personas, story mapping, user stories, 3Cs, INVEST, acceptance criteria, sprints, requirements, product backlog and backlog grooming; Tools: Agile tracking tools such as JIRA; Scaled agile frameworks: SAFe, Scrum@Scale, Disciplined Agile

UNIT – 3	AGILE FORECASTING AND PROJECT MANAGEMENT	9 hrs

Definition of Done, Definition of Ready; Estimation; Agile forecasting and project Management - Big visible information radiators, velocity, progress tracking, Track Done pattern, project forecasting, Ux Design, Control the Flow: Sprint Planning, Sprint Reviews, Sprint Retrospectives, Sprint Planning - Agile release and iteration (sprint) planning, Develop Epics and Stories, Estimating Stories, Prioritizing Stories (WSJF technique from SAFe), Create product roadmap

Unit – 4	SPRINT IN AGILE	9 hrs

Sprints: Iterations/Sprints Overview. Velocity Determination, Iteration Planning Meeting, Iteration, Planning Guidelines, Development, Testing, Daily Stand-up Meetings, Progress Tracking, Velocity Tracking, Monitoring and Controlling: Burn down Charts, Inspect & Adapt (Fishbone Model), Agile Release Train

Unit – 5	AGILE TESTING AND DEVOPS	9 hrs

Testing: Functionality Testing, UI Testing, Performance Testing, Security Testing, Tools - Selenium Agile Testing: Principles of agile testers; The agile testing quadrants, Agile automation, Test automation pyramid DevOps: Continuous Integration and Continuous Delivery CI/CD: Jenkins Creating pipelines, Setting up runners Containers and container orchestration (Dockers and Kubernetes) for application development and deployment; Checking build status; Fully Automated Deployment; Continuous monitoring with Nagios; Introduction to DevOps on Cloud

Text / Reference Books:

1. Agile Project Management: Creating Innovative Products, Second Edition By Jim Highsmith, Addison-Wesley Professional, 2009

2. Agile Project Management: Managing for Success, By James A. Crowder, Shelli Friess, Springer 2014 Learning Agile: Understanding Scrum, XP, Lean, and Kanban, By Andrew Stellman, Jennifer Greene, 2015, O Reilly
3. DevOps: Continuous Delivery, Integration, and Deployment with DevOps: Dive ... By Sricharan Vadapalli, Packt, 2018
4. Agile Testing: A Practical Guide For Testers And Agile Teams, Lisa Crispin, Janet Gregory, Pearson, 2010
5. More Agile Testing: Learning Journeys for the Whole Team By Janet Gregory, Lisa Crispin, Addison Wesley, 2015
6. DevOps: Puppet, Docker, and Kubernetes By Thomas Uphill, John Arundel, Neependra Khare, Hideto Saito, Hui-Chuan Chloe Lee, Ke-Jou Carol Hsu, Packt, 2017

CSC6014	SOFTWARE PROJECT MANAGEMENT	3	0	0	3

Course Outcomes:

CO1: Demonstrate knowledge of concepts related to project management and software projects

CO2: Analyse the Steps involved in analyzing the Software projects and concepts to meet the estimation of the software Projects.

CO3: Schedule the activities of the project to get a critical path.

CO4: Develop an activity network to perform PERT and to get knowledge of Risk Management

CO5: Use and apply Visualization techniques for planning the activities related to Software projects.

Unit – 1	INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT STEP WISE APPROACH AND PROJECT EVALUATION	9 hrs

Project Definition – Types of Project –Problem with Software Project- Activities covered By Software Project Management – Management Control Cycle. Step wise approach for planning the software project- Product break down structure for identifying the project activities- Strategic Assessment – Technical Assessment –Cost Benefit Evaluation Techniques – Risk Evaluation

Unit – 2	ACTIVITY PLANNING	9 hrs

Objectives – Project Schedule –Activity based approach- Product based approach- Hybrid approach Sequencing and Scheduling Activities –Network Planning Models – Forward Pass – Backward Pass.

Unit – 3	RISK MANAGEMENT	9 hrs

Nature Of Risk – Types Of Risk – Managing Risk – Software project risk and strategies to reduce the risk- PERT using three estimates.

Unit – 4	MONITORING CONTROL	9 hrs

Creating Framework – Collecting The Data – Visualizing Progress – Cost Monitoring – Earned Value Analysis Change Control – Managing Contracts – Introduction – Types Of Contract – Contract Management

Unit – 5	MANAGING PEOPLE AND ORGANIZING TEAMS	9 hrs

Introduction – Understanding Behaviour – Organizational Behaviour: A Background – Selecting The Right Person For The Job – Working in group- Decision Making- Leadership.

Text / Reference Books:

1. Mike Cotterell, Bob Hughes, Rajib Mall - Software Project Management, Fifth edition, Tata McGraw-Hill, 2011.
2. Greg Horine-Project Management Absolute Beginner's Guide, Third Edition, Que Publishing, 2012.
3. Subramanian Chandramouli and Saikat Dutt, Software Project Management, First edition, Pearson Education, 2015.

CSC6015	DESIGN PATTERNS	3	0	0	3

Course Outcomes:

CO1: Learning of Design Patterns, Advantages and Pattern types

CO2: Learning of Principles and Strategies of Design Patterns and Commonality and Variability Analysis

CO3: Analysis on Values of Patterns and Template Method Pattern

CO4: Understanding of Applying Design Patterns , Singleton Pattern and the Double- Checked Locking Pattern

CO5: Learning of Expect from Design Patterns with case study

Unit – 1	INTRODUCTION TO DESIGN PATTERNS	9 hrs

Introduction to Design Patterns: Design Patterns Arose from Architecture and Anthropology – Architectural to Software Design Patterns – Advantages of Design Patterns – Adapter Pattern – Strategy Pattern – Bridge Pattern – Abstract Factory Pattern

Unit – 2	PRINCIPLES AND STRATEGIES OF DESIGN PATTERNS	9 hrs

New Paradigm of Design - Principles and Strategies of Design Patterns -Open-Closed Principle – Designing from Context - Encapsulating Variation. Commonality and Variability Analysis - Analysis Matrix - Decorator Pattern - Open Closed Principle – The Principle of encapsulating variation – Abstract Classes vs Interfaces

Unit – 3	VALUES OF PATTERNS AND TEMPLATE METHOD PATTERN	9 hrs

Values of Patterns - Observer Pattern - Categories of Patterns - Template Method Pattern – Applying the Template Method to the Case Study - Using Template Method Pattern to Reduce Redundancy

Unit – 4	APPLICATIONS OF DESIGN PATTERNS	9 hrs

Applying Design Patterns - Design Patterns - Factories - Singleton Pattern and the Double- Checked Locking Pattern - Applying Singleton Pattern to Case Study. Object Pool Pattern - Management of Objects - Factory Method Pattern - Object Oriented Pool Pattern

Unit – 5	EXPECT FROM DESIGN PATTERNS WITH CASE STUDY	9 hrs

Case Studies - What to Expect from Design Patterns - The Pattern Community An Invitation – A Parting Thought – Industrial Case Study

Text / Reference Books:

1. Smith, J. M. (2012). Elemental design patterns. Addison-Wesley.
2. Shalloway, A., & Trott, J. R. (2016). Design patterns explained: A new perspective on object-oriented design, 2/E. Pearson Education India.
3. Gamma, E., Helm, R, Johnson, R., Vlissides, J. (2015). Design patterns: elements of reusable object-oriented software Pearson India.
4. Freeman, E., Robson, E., Bates, B., & Sierra, K. (2016) Head First Design Patterns: A Brain-Friendly Guide," O'Reilly Media, Inc.".
5. Freeman, E., Robson, E. (2020) Head First Design Patterns: Building Extensible and Maintainable Object-Oriented Software," O'Reilly Media, Inc.".

CSC6016	WIRELESS SENSOR NETWORKS	3	0	0	3

Course Outcomes:

CO1: To understand the principles of Data warehousing and Data Mining
CO2: To be familiar with the Data warehouse architecture and its Implementation
CO3: To know the Architecture of a Data Mining system
CO4: To understand the various Data preprocessing Methods
CO5: To perform classification and prediction of data

Unit – 1	OVERVIEW OF WSN AND WSN SYSTEMS	9 hrs

Introduction, Applications of Wireless Sensor Networks, WSN Standards, IEEE 802.15.4, Zigbee. Network Architectures and Protocol Stack – Network architectures for WSN – classification of WSN – protocol stack for WSN. Wireless Transmission Technology and Systems – Radio Technology – Available Wireless Technologies. Wireless Sensor Technology – Sensor Node Technology – Hardware and Software – Sensor Taxonomy – WN Operating Environment

Unit – 2	MEDIUM ACCESS CONTROL PROTOCOLS FOR WIRELESS SENSOR NETWORKS	9 hrs

Fundamentals of MAC Protocols – MAC Protocols for WSNs – Contention-based protocols: Power-Aware Multi-Access with Signalling – Data-Gathering MAC – Contention-Free Protocols: Low-Energy Adaptive Clustering Hierarchy – B-MAC – S-MAC. Dissemination Protocol for Large Sensor Network

Unit – 3	DEPLOYMENT AND CONFIGURATION	9 hrs

Target tracking – Localization and Positioning – Coverage and Connectivity – Single-hop and Multi-hop Localization – Self-Configuring Localization Systems. Routing Protocols and Data Management for Wireless Sensor Networks – Routing Challenges and Design Issues in Wireless Sensor Networks – Routing Strategies in Wireless Sensor Networks – Routing protocols: data-centric, hierarchical, location based energy efficient routing etc. Querying – Data Dissemination and Gathering.

Unit – 4	ENERGY – POWER CONTROL AND OS FOR WSN	9 hrs

Need for energy efficiency and power control in WSN – passive power conservation mechanisms – active power conservation mechanisms. Operating System Design Issues – TinyOS – Contiki – Task management – Proto threads – Memory and IO management.

Unit – 5	SENSOR NETWORK PLATFORMS AND TOOLS	9 hrs

Sensor Node Hardware – Tmote – Micaz – Programming Challenges – Node-level Software Platforms – Node-level Simulators – State-centric Programming.

Text / Reference Books:

1. KazemSohraby, Daniel Minoli, TaiebZnati, Wireless Sensor Networks, Technology, Protocols and Applications, Wiley, 2007
2. Holger Karl, Andreas Willig, Protocols And Architectures for Wireless Sensor Networks, John Wiley, 2005.
3. Jun Zheng, Abbas Jamalipour, Wireless Sensor Networks: A Networking Perspective, Wiley, 2009.
4. Ian F. Akyildiz, Mehmet Can Vuran, Wireless Sensor Networks, Wiley, 2010
5. Ibrahiem M. M. El Emary, S. Ramakrishnan, Wireless Sensor Networks: From Theory to Applications, CRC Press Taylor & Francis Group, 2013

CSC6017	BLOCK CHAIN TECHNOLOGY	3	0	0	3

Course Outcomes:

CO1: Learn the fundamentals of Blockchain
CO2: Demonstrate the application of hashing and public key cryptography in protecting blockchain
CO3: Develop Smart Contracts in Ethereum framework
CO4: Identify Pros and Cons of Initial Coin Offering mechanism
CO5: Analyze the security aspects in blockchain

Unit – 1	FUNDAMENTALS OF BLOCKCHAIN	9 hrs

Introduction – Origin of Blockchain – Blockchain Solution – Components of Blockchain – Blockchain Types – Decentralization and Distribution – Consensus Protocol -

Unit – 2	CRYPTOCURRENCY AND PUBLIC BLOCKCHAIN SYSTEM	9 hrs

Bitcoin and Cryptocurrency – Basics of cryptocurrency – Types of Cryptocurrency – Usage of Cryptocurrency – Public Blockchain – Bitcoin Blockchain – Ethereum Blockchain

Unit – 3	SMART CONTRACTS AND PRIVATE BLOCKCHAIN SYSTEM	9 hrs

Smart Contract – Characteristics of Smart Contract – Types of Smart Contract – Smart Contracts in Ethereum – Smart Contracts in Industry – Key Characteristics of Private Blockchain – Private Blockchain and Open Source

Unit – 4	CONSORTIUM BLOCK CHAIN AND INITIAL COIN OFFERING	9 hrs

Key Characteristics of Consortium Blockchain – Hyperledger platform – overview of Ripple and Corda – Blockchain Fund raising methods – Launching ICO – Pros and Cons of ICO – ICO Platforms

Unit – 5	SECURITY IN BLOCKCHAIN AND APPLICATIONS	9 hrs

Security Aspects in Blockchain - Security and Privacy Challenges of Blockchain in General- Performance and Scalability - Identity Management and Authentication - Regulatory Compliance and Assurance – Applications - Blockchain in Banking and Finance - Blockchain in Education - blockchain in Healthcare – Blockchain in Real-estate – Blockchain in Supply Chain – The Blockchain and IoT.

Text / Reference Books:

1. Chandramouli Subramanian, Asha A George, Abhilash K A and MeenaKarthikeyan, Blockchain Technology , University Press, 2020
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder, Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3. J.A.Garay et al, The bitcoin backbone protocol - analysis and applications EUROCRYPT 2015 LNCS VOl 9057, (VOL II), pp 281-310.
4. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Venkatraman Ramakrishna, Anthony O'Dowd, Hands- On Block chain with Hyperledger, Packt Publishing , 2018

CSC6018	CLOUD COMPUTING	3	0	0	3

Course Outcomes:

CO1: Understand the models, principles, and benefits of Cloud Computing

CO2: Understand virtualization foundations to cater the needs of elasticity, portability and resilience by cloud service providers.

CO3: Identify the applications of Cloud Computing

CO4: Learn the security aspects of Cloud Computing

CO5: Demonstrate the message passing and map reduce in Cloud Computing

Unit – 1	FOUNDATION OF CLOUD COMPUTING	9 hrs

Introduction-History-Fundamentals-Cloud computing characteristics-Advantages and disadvantages-comparison of traditional and cloud computing paradigms-Evaluating-Business drivers-Future of cloud (FoC)-**Cloud services and deployment models**-Cloud deployment models-Cloud service model-Cloud infrastructure mechanism-Cloud service management

Unit – 2	CLOUD COMPUTING ARCHITECTURE	9 hrs

Cloud computing architecture-Design principle-Life cycle (CCLC)-Reference architecture-Load balancing approach-Mobile cloud computing (MCC)-Case study of oracle cloud management-**Virtualization technology**-Techniques-How virtualisation work - Kernel-based virtual machine (KVM)-VMware-Virtual Box-Citrix-Types of virtualization-Virtualisation in cloud

Unit – 3	SOA AND CLOUD COMPUTING APPLICATIONS	9 hrs

Service oriented Architecture-Objectives-SOA foundation-Web services and SOA-SOA communication-SOA components-SOA Infrastructure-Need of SOA-Business Process Management (BPM)-Services-BPM PaaS- BPaaS-**Cloud Computing Applications**-Introduction-Google App Engine-Google Apps-Google Cloud Data store-Dropbox Cloud-Apple iCloud-Microsoft Windows Azure Cloud-Amazon Web Services (AWS)

Unit – 4	CLOUD SECURITY AND PRIVACY	9 hrs

Cloud Security and Privacy-Cloud security-Cloud CIA security model-Cloud computing security architecture-Service provider security issues-Security issues in Virtualization- Data security in cloud-Data privacy risks-Business continuity and disaster recovery-Threats in cloud-Security techniques for threats-Cloud service level agreements(SLA)-Components-Types-Cloud vendors-Quality of Cloud Services-Techniques-Migration-Trust management

Unit – 5	CLOUD COMPUTING TECHNOLOGIES	9 hrs

Cloud Computing Technologies - High performance Computing-Message Passing Interface(MPI)-MapReduce programming model-Dryad and Dryad LINQ -Eucalyptus cloud platform-Components - OpenNebula-Layers-Features-OpenStack - components-Benefits Apache Hadoop ecosystem-**Adoption of Cloud Computing**-Factors affecting the adoption-Existing area of application-Case studies-Certifications.

Text / Reference Books:

1. Kant Hiran, Kamal, Ruchi Doshi, Temitayo Fagbola, Mehul Mahrishi, Cloud Computing: Master the Concepts, Architecture and Applications with Real-world examples and Case studies, BPB Publishers, 2019
2. Ben Piper and David Clinton, AWS Certified Solutions Architect Study Guide: Associate SAA-C01 Exam, Googel Book, 2019
3. Legorie Rajan Ps, Steven Porter, and Ted Hunter, Building Google Cloud Platform Solutions: Develop Scalable Applications from Scratch and Make Them Globally Available in Almost Any Language, Packt, 2019
4. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, Mastering Cloud Computing, Tata McGraw Hill Education Private Limited, 2013

CSC6019	WEB SERVICES	3	0	0	3

Course Outcomes:

CO1: Understand web protocols

CO2: Learn the priciples of SOAP and other web services' functionalities

CO3: Identify the recent technologies and their usage to demonstrate web based applications

CO4: Ability to develop web based transactions

CO5: Ability to develop web applications with possible web service functionalities

Unit – 1	FUNDAMENTALS OF WEB PROTOCOLS	9 hrs

Web Technology - Web 2.0 technologies, Introduction to Ajax, Ajax Design Basics, Introduction to WWW, TCP/IP, HTTP, ARP, ICMP FTP, UDP, routing protocols (RIP, OSPF, BGP), Network Management Protocols (SNMP), and Application-level protocols (FTP, TELNET, SMTP), URL, Web Browsers, Web Servers.

Unit – 2	ESSENTIAL WEB SERVICES	9 hrs

Web services, Evolution and differences with Distributed computing, XML - Name Spaces - Structuring With Schemas and DTD - Transformation - XML Infrastructure WSDL, SOAP, UDDI, ebXML - SOAP And Web Services in E-Com - Overview Of .NET And J2EE.

Unit – 3	TECHNOLOGIES FOR WEB SERVICE SUPPORT	9 hrs

Platform for Web Services Development, MVC Design Pattern, Web services - EJB, .NET, J2EE Architecture, J2EE Components & Containers, Specification, Application servers, Struts, Introduction to JSON.

Unit – 4	WEB TRANSACTIONS	9 hrs

Web Transactions, Coordination, Orchestration, and Choreography – tools BPEL, WS- CDL Overview of Web service standards -BPEL4WS. WS-Security and the Web services security specifications, WSReliable Messaging, WS-Policy, WS-Attachments.

Unit – 5	CASE STUDIES	9 hrs

Web Service Case Study - Web Service Search Engine, Web Service Discovery, Web Service Composition. Web Service – SOAP vs Web Service – REST.

Text / Reference Books:

1. Steve Clarke, UK Murray E. Jennex, S, Web Services, 1st Edition, IGI Global, 2018
2. Martin Karlin, Java Web Services: Up and Running: A Quick, Practical, and Thorough Introduction, Second edition, O'Reilly Media, 2013
3. Leonard Richardson , Sam Ruby , David Heinemeier Hansson, RESTful Web Services, 1st edition, O'Reilly Media, 2007
4. Frank. P. Coyle, XML, Web Services and the Data Revolution", 1st edition, Pearson Education, 2002
5. Sandeep Chatterjee - Ph.D., James Webber - Ph.D., Developing Enterprise Web Services: An Architect's Guide, 1st edition, Pearson Education, 2003

CSC6020	ETHICAL HACKING	3	0	0	3

Course Outcomes:

CO1: Understand the building blocks and characteristics of information security technologies
CO2: Understand the scope and capabilities of ethical hacking
CO3: Illustrate and describe cryptography essentials
CO4: Analyze the different foot printing techniques and network attacks
CO5: Familiarize yourself with wireless attacks and IoT attacks and its countermeasures.

Unit – 1	INFORMATION SECURITY OVERVIEW	9 hrs

Fundamentals of Information Security - Elements- Characteristics-Security Model-Tools-Basic concepts of computer networking-Models-components-Addressing and Routing - Importance of Internet security.

Unit – 2	INTRODUCTION TO ETHICAL HACKING	9 hrs

Hacking concepts- Types and Classes-Potential security threats - viruses, worms and other malwares - Need of ethical hacking- Benefits and Limitations - Phases of Ethical hacking - Vulnerability Analysis - Basics of Penetration testing/hacking

Unit – 3	CRYPTOGRAPHY ESSENTIALS AND SOCIAL ENGINEERING	9 hrs

Issues Regarding Classification and Prediction – Classification by Decision Tree Introduction – Bayesian Classification – Rule Based Classification – Classification by Back propagation – Support Vector Machines – Associative Classification – Lazy Learners – Other Classification Methods – Prediction – Accuracy and Error Measures – Evaluating the Accuracy of a Classifier or Predictor – Ensemble Methods – Model Section

Unit – 4	FOOTPRINTING AND NETWORK ATTACKS	9 hrs

Footprinting - concepts and methodology- Types - Network and Packet sniffing basics-Types- -Fake authentication attacks-DDoS attacks-ARP Request spoofing attacks-ARP poisoning attacks - Spying on network devices- DNS spoofing-SSL Stripping, SQL Injection.

Unit – 5	WIRELESS AND IOT HACKING	9 hrs

Hacking wireless networks-standards and authentication modes-threats-Hacking methodology-Discovering technology uses in website - Web Hacking- WEP/WPA hacking and traffic analyzer Tools-Wireless Vulnerability Scanning Tools - IoT threats and vulnerabilities - IoT hacking methodology - Hacking tools and countermeasures.

Text / Reference Books:

1. Kevin Beaver, Ethical Hacking for Dummies, Sixth Edition, Wiley, 2018
2. Rafay Baloch, Ethical Hacking and Penetration Testing Guide, First edition, CRC Press, 2014
3. Jon Erickson, Hacking: The Art of Exploitation, Second Edition, No Starch Press, 2008
4. Georgia Weidman, Penetration Testing: A Hands-On Introduction to Hacking, First edition, No Starch Press, 2014

CSC6021	INTERNET OF THINGS	3	0	0	3

Course Outcomes:

CO1: Understand the building blocks, characteristics, technologies and application areas of IoT

CO2: Interpret the design levels and protocols of IoT

CO3: Analyze and describe IoT design methodology

CO4: Examine the architectures and functions of IoT development tools (Interfaces and IDEs) and infer the knowledge of cloud services of IoT

CO5: Design and develop application specific IoT projects

Unit – 1	FUNDAMENTALS OF IOT	9 hrs

Introduction-Characteristics-Physical design - Protocols – Logical design – Enabling technologies - IoT Levels – Domain Specific IoTs – IoT vs M2M. IoT Example: The Refrigerator - IoT Devices - IoT Devices vs. Computers - Trends in the Adoption of IoT - IoT Is Powerful and Pervasive - Societal Benefits of IoT

Unit – 2	IOT DESIGN METHODOLOGY	9 hrs

IoT systems management – IoT Design Methodology – Specifications Integration and Application Development. Embedded Systems - Generic Embedded Systems Structure - Components of Embedded Systems - Analog/Digital Conversion.

Unit – 3	BUILDING IOT WITH RASPBERRY PI	9 hrs

Basic Equipment - Design Methods for Networked Devices - Physical device – Raspberry Pi Interfaces – Programming – APIs / Packages – Web services.

Unit – 4	BUILDING IOT WITH GALILEO/ARDUINO	9 hrs

Intel Galileo Gen2 with Arduino- Interfaces - Arduino IDE – Programming - APIs and Hacks

Unit – 5	CASE STUDIES AND IOT CLOUD	9 hrs

Various Real time applications of IoT- Connecting IoT to cloud – Cloud Storage for Iot – Data Analytics for IoT – Software & Management Tools for IoT – IOT - Risks, Privacy, and Security

Text / Reference Books:

1. Arshdeep Bahga, Vijay Madisetti, Internet of Things – A hands-on approach, First edition, Universities Press,, 2015
2. Samuel Greengard, The Internet of Things, First edition, MIT Press, 2015
3. Cuno Pfister, Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud, First edition, Make Community, 2011
4. Ing. Klaus Schwab, The Fourth Industrial Revolution, First edition, Currency, 2017
5. Stefan Avesand David Boyle, From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence, First edition, Elsevier Ltd, 2014

CSC6022	INTERNET OF THINGS FOR HEALTH CARE	3	0	0	3

Course Outcomes:

CO1: Understand the Fundamentals of IoT and IoHT**.**

CO2: Explain the purpose and goals of different communication protocols and embedded systems.

CO3: Illustrate various wearable devices for smart health care

CO4: Analyze the objectives of Remote Patient Monitoring System and role of cloud services

CO5: Explain security issues and demonstrate various case studies for IoT emergency systems.

Unit – 1	FUNDAMENTALS OF IOT	9 hrs

Introduction to the Internet of Things - Evolution - Characteristics – loT Architectures- Basic Building blocks- IoT Enabling Technologies- Fundamentals of Sensor networks – Basic concepts of the Internet of Health Things (IoHT).

Unit – 2	IOT COMMUNICATION PROTOCOLS AND EMBEDDED SYSTEMS	9 hrs

IoT Communication models - Client-Server Communication Paradigm- Standards- Models- APIs and Protocols - Design Methodology – Embedded computing devices- Analysis - control and management of sensor data- Systems on Chip (SOC)– Raspberry Pi – Interfacing – Microcontroller boards- Arduino IDE and Cloud - NodeMCU v2

Unit – 3	WEARABLE ELECTRONICS	9 hrs

Fundamentals of Wearable IoT device - Body sensor networks - Driving circuits and converters for sensors- Sensor interface - Temperature sensor- Pressure sensor – Heart rate sensor-Accelerometer and oxygen sensors saturation sensor - Light sensor - IR sensor – ECG smart healthcare monitoring - Other Physiological data biosignals measurements – imaging devices Wearable gadgets – Actuators – Benefits of Mobile healthcare (m-health).

Unit – 4	REMOTE PATIENT MONITORING AND CLOUD COMPUTING	9 hrs

Introduction and Scope of Remote Patient Monitoring System(RPMS) – Types-Key Components - Device hardware – RPM devices - Client-side mobile application- - Microcontroller interface to the mobile gateway RPMS use cases – Role of Cloud computing for IoT solutions- Types of Cloud Computing Models - Cloud Services – Cloud platforms for IoT Deployments.

Unit – 5	SECURITY ISSUES AND CASE STUDIES FOR IOT-BASED EMERGENCY HEALTHCARE SYSTEM	9 hrs

Security Issues- Threats and Countermeasures- Case studies – Wearable Health and Monitoring system– Remote patient communications - Response measures for COVID-19 - Contact tracing

Text / Reference Books:

1. Venkata Krishna, Sasikumar Gurumoorthy, Mohammad S. Obaidat, Internet of Things and Personalized Healthcare Systems, First edition, , Springer Briefs in Applied Sciences, and Technology, Forensic and Medical Bioinformatics, 2019
2. Nishu Gupta , Sara Paiva , IoT and ICT for Healthcare Applications, First edition, Springer Nature Switzerland AG, 2020
3. Jerome Henry, IoT Fundamentals - Networking Technologies, Protocols and Use Cases for the Internet of Things, First edition, Pearson, 2017
4. Arshdeep Bahga, Vijay Madisetti, Internet of Things – A hands-on approach, First edition, Universities Press,, 2015
5. Akash Kumar Bhoi Victor Hugo C. de AlbuquerqueHareesha K.S, IoT in Healthcare and Ambient Assisted Living, First edition, Springer Nature Switzerland AG, 2020

CSC6023	TEXT ANALYTICS	3	0	0	3

Course Outcomes:

CO1: To understand the methods for keyword extraction from documents.

CO2: To learn classification and clustering methods for classifying and grouping of documents.

CO3: To explore text visualization techniques and anomaly detection

CO4: To learn about Events and trends in text streams

CO5: To explore applications in various domain

Unit – 1	TEXT EXTRACTION	9 hrs

Introduction- Rapid automatic keyword extraction: candidate keywords, keyword scores, adjoining keywords, extracted keywords-Benchmark evaluation: precision and recall, efficiency, stop list generation, Evaluation on new articles.

Unit – 2	DOCUMENT CLASSIFICATION AND CLUSTERING	9 hrs

Multilingual document clustering: Multilingual LSA, Constrained clustering with k-means classification, Classification algorithms for Document Classification, Content-based spam email classification, Topic modelling and Entity resolution.

Unit – 3	ANOMALY AND TREND DETECTION	9 hrs

Text visualization techniques: Visualization in text analysis, Tag clouds, tag clouds, authorship and change tracking, Data Exploration and the search for novel patterns, sentiment tracking, visual analytics and FutureLens, scenario discovery.

Unit – 4	TEXT STREAMS	9 hrs

Events and trends in text streams: Introduction, Text streams, Feature extraction and data reduction, Event detection, Trend detection, Event and trend descriptions. Embedding semantics in LDA topic models: Introduction, vector space modelling, latent semantic analysis, probabilistic latent semantic analysis, Latent Dirichlet allocation.

Unit – 5	APPLICATIONS	9 hrs

Predicting Stock Price Movements Based on Newspaper Headlines, Working with Social media Text Data, Decision support system for Health care.

Text / Reference Books:

1. Michael W. Berry & Jacob Kogan, Text Mining Applications and Theory, First edition, Wiley publications, 2010
2. Aggarwal, Charu C., and ChengXiangZhai, Mining text data, First edition, Springer Science & Business Media, 2012
3. Miner, Gary, Practical text mining and statistical analysis for non-structured text data applications, , Academic Press, 2012
4. Srivastava, Ashok N., and MehranSahami, Text mining: Classification, clustering, and applications", , Chapman and Hall/CRC, 2009
5. Buitelaar, Paul, Philipp Cimiano, and Bernardo Magnini, Ontology learning from text: methods, evaluation and applications, , IOS press, 2005

CSC6024	SOCIAL MEDIA ANALYTICS	3	0	0	3

Course Outcomes:

CO1: Learning of Social Media Analytics (SMA), applications, components of SMA and information visualization

CO2: Analysis of Making connections in SMA with tools and techniques

CO3: Learning of Facebook Analytics, Analyzing social campaigns and other social media analytics

CO4: Understanding of Processing and Visualizing SMA Data, Scraping and Extracting Conversational Topics

CO5: Learning of Social Spam and Malicious Behavior, analysis on case studies in different application domains

Unit – 1	FUNDAMENTALS OF SOCIAL MEDIA ANALYTICS	9 hrs

Introduction to Social Media Analytics (SMA) - Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas - Network fundamentals and models: The social networks perspective - nodes, ties and influencers - Social network and web data and methods - Graphs and Matrices- Basic measures for individuals and networks - Information visualization.

Unit – 2	MAKING CONNECTIONS IN SMA WITH TOOLS AND TECHNIQUES	9 hrs

Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity- Web analytics tools: Click stream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis.

Unit – 3	FACEBOOK ANALYTICS AND OTHER SOCIAL MEDIA ANALYTICS	9 hrs

Facebook Analytics: Introduction, parameters, demographics - Analyzing page audience. Reach and Engagement analysis - Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis - Other Social media analytics: Linkedin, Instagram, YouTube Twitter etc. Google analytics.

Unit – 4	PROCESSING AND VISUALIZING SMA DATA	9 hrs

Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics - Collecting and analyzing social media data; visualization and exploration - Scraping and Extracting
Conversational Topics on Internet Forums.

Unit – 5	SOCIAL SPAM AND MALICIOUS BEHAVIOR	9 hrs

Social Spam and Malicious Behavior, Geospatial social data mining, Privacy in a Networked World, Predicting the future with social media, Social tagging and folksonomies. Case Studies : analysis on case studies in different application domains

Text / Reference Books:

1. Matthew Ganis, AvinashKohirkar, "Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media", Pearson, 1st edition, 2016
2. Jim Sterne, "Social Media Metrics: How to Measure and Optimize Your Marketing Investment", Wiley, 1st edition, 2010
3. Marshall Sponder, "Social Media Analytics", McGraw Hill, 1st edition, 2011

CSC6025	APPROXIMATION ALGORITHMS	3	0	0	3

Course Outcomes:

CO1: Understand the complexity analysis of parallel algorithms
CO2: Solve Linear systems using parallel algorithms
CO3: Ability to write search procedures in parallel
CO4: Develop parallel graph algorithms
CO5: Learn the performance analysis of parallel algorithms

Unit – 1	INTRODUCTION TO APPROXIMATION ALGORITHMS	9 hrs

Algorithm and problem solving – Conventional algorithm design paradigms – Approximation Algorithms, – Concept of Approximation – Sample Problem Statements – Vertex Cover – TSP – Set Cover – Subset Problem

Unit – 2	GREEDY ALGORITHMS AND LOCAL SEARCH	9 hrs

Scheduling Jobs with Deadline on a Single Machine – k-center problem – Scheduling Jobs on Identical Parallel Machines – TSP – Finding Minimum Degree Spanning Trees – Edge Coloring

Unit – 3	SEMI-DEFINITE PROGRAMMING	9 hrs

Introduction to SDP – Finding Large Cuts – Approximating Quadratic Programs – Finding Correlation Clustering – Coloring 3-colorable Graphs

Unit – 4	CUTS AND METRICS	9 hrs

Multiway Cut Problem – Minimum Cut based Algorithm – LP Rounding Algorithm for Multiway Cut Problem – Multicut Problem – Balanced Cuts.

Unit – 5	PROVING THE HARDNESS OF APPROXIMATION	9 hrs

Reductions from NP-Complete Problems – Reductions that preserve Approximation – Reductions from Label Cover – Reductions from Unique games.

Text / Reference Books:

1. David P. Williamson, David B. Shmoys, The Design of Approximation Algorithms, Cambridge University Press, 2011
2. J Kleinberg, E Tardos, Algorithm Design, Pearson, First edition, 2005.
3. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran., Fundamentals of Computer Algorithms, University Press, 2008.
4. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, MIT Press, Third edition, 2010

CSC6026	PARALLEL ALGORITHMS	3	0	0	3

Course Outcomes:

CO1: Understand the complexity analysis of parallel algorithms
CO2: Solve Linear systems using parallel algorithms
CO3: Ability to write search procedures in parallel
CO4: Develop parallel graph algorithms
CO5: Learn the performance analysis of parallel algorithms

Unit – 1	PARALLEL ALGORITHM DESIGN	9 hrs

Task channel model – Foster's method of design – Boundary Value Problem – Finding the maximum sum – Complexity measure for parallel algorithms.

Unit – 2	PARALLEL ALGORITHMS FOR SOLVING LINEAR SYSTEMS	9 hrs

Back substitution – Gaussian elimination – Iterative methods – Row and Column Oriented Design

Unit – 3	PARALLEL SEARCHING ALGORITHMS	9 hrs

Finding largest and smallest element – median – kth largest/smallest element – Parallel sorting algorithms: Odd-Even transposition – Shell sort – Quick sort

Unit – 4	PARALLEL GRAPH ALGORITHMS	9 hrs

Parallel graph search and tree traversal algorithms – Minimum spanning tree: Prim's algorithm, parallel algorithms for path problems: Single source shortest paths – Dijkstra's Algorithm – All Pair Shortest Paths – Dijkstra's Algorithm – Floyd Warshall algorithm – Connected Components.

Unit – 5	PERFORMANCE ANALYSIS	9 hrs

Speed-up – efficiency – Amdahl's Law – Gustafson – Barsis's Law – The Karp Flatt metric – Isoefficiency metric – Scalability function – Message-Passing Programming – Circuit Satisfiability.

Text / Reference Books:

1. Ananth Grama, Anshul Gupta, George Karypis and Vipin Kumar, Introduction to Parallel Computing, Second edition, Addison-Welsey, 2009.
2. Michael J Quinn, Parallel Programming in C with MPI & OpenMP, Second edition, Tata McGraw Hill, 2009.
3. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, MIT Press, Third edition, 2010

CSC6027	MOBILE APP DEVELOPMENT	3	0	0	3

Course Outcomes:

CO1: To understand the principles of Data warehousing and Data Mining
CO2: To be familiar with the Data warehouse architecture and its Implementation
CO3: To know the Architecture of a Data Mining system
CO4: To understand the various Data preprocessing Methods
CO5: To perform classification and prediction of data

Unit – 1	MOBILE ARCHITECTURES	5 hrs

Mobile Network Architecture – Mobile Device Architecture – Mobile Application Development – Mobile Web Applications – Business Communication

Unit – 2	DESIGN AND INTERFACES	10 hrs

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 – 3	NETWORKING APPLICATIONS	9 hrs

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 – 4	ANDROID	12 hrs

Overview of Android – What does Android run On? – Android Internals-Android for mobile apps development – Environment setup for Android apps Development – Framework – Android- SDK, Eclipse – Emulators – What is an Emulator / Android AVD? – Android Emulation – Creation and set up – First Android Application – Design criteria for Android Application: Hardware Design Consideration – Design Demands For Android application – Intent, Activity, Activity Lifecycle and Manifest

Unit – 5	USER INTERFACES	9 hrs

Simple UI -Layouts and Layout properties: Introduction to Android UI Design – Introducing Layouts – Event driven Programming in Android (Text Edit, Button clicked etc.) – Activity Lifecycle of Android - Menu :Basics, Custom v/s System Menus, Create and Use Handset menu Button (Hardware) – Basic operation of SQLite Database

Text / Reference Books:

1. Architecting Mobile Solutions for the Enterprise, Dino Esposito, Microsoft press, 2015
2. Professional Mobile Application Development, Author: JEFF MCWHERTER, SCOTT GOWELL, Publisher: Wiley India Pvt Lt, 2014
3. Mobile Application Penetration Testing Paperback – Import, 11 Mar 2016, Vijay Kumar Velu

CSC6028	FORMAL METHODS AND VERIFICATION	3	0	0	3

Course Outcomes:

CO1: To understand the principles of Data warehousing and Data Mining
CO2: To be familiar with the Data warehouse architecture and its Implementation
CO3: To know the Architecture of a Data Mining system
CO4: To understand the various Data preprocessing Methods
CO5: To perform classification and prediction of data

Unit – 1	LOGIC - ACL2 (APPLIED/MECHANIZED LOGIC)	12 hrs

Syntax – Models – semantics – Proof theory – Soundness – Completeness theorem – Compactness & Lowenheim-Skolem theorems – Foundations of mathematics – Godel's incompleteness theorems – The ACL2 programming language – Primitive data types – Functions/macros – Modeling systems – List processing – Modeling examples from hardware, software, and security – The ACL2 logic – Definitional principle – The ACL2 ordinals and termination proofs – Induction – Hand Proofs – Quantification & encapsulation – Mechanization of ACL2 – Computation as proof – Overview of the waterfall – Overview of simplification – Induction

Unit – 2	THEORY OF REWRITE SYSTEMS AND DECISION PROCEDURES	12 hrs

Confluence – Termination – Completion – Conditional Rewriting – Decision procedures – Propositional logic – Soundness & completeness – If-normatization – Davis/Putnam – BDDs – Lineararithmetic – Combining decision procedures – Nelson-Oppen and/or Shostak

Unit – 3	REACTIVE SYSTEMS	11 hrs

Transformational vs. reactive systems – Safety and liveness – Topological characterization – Lattice theoretic – Temporal logic – Lineartime – Branching time – Tarski-Knaster fix point theorem – Mu-calculus – Notions of correctness: Trace containment – equivalence – Simulation – bisimulation – Complexity/ Algorithms

Unit – 4	VERIFICATION BY MODEL CHECKING	5 hrs

Model checking the mu-calculus – Symbolic model checking – Tablaux method for CTL

Unit – 5	ABSTRACTION	5 hrs

Boolean and predicate abstractions – counter-example guided refinement Homomorphisms – Conservative abstractions – Abstract interpretation

Text / Reference Books:

1. M Kaufmann, P Manolios, and J Strother Moore. Computer-Aided Reasoning: An Approach. Kluwer Academic Publishers, 2000.
2. Edmund M. Clarke, Jr., Orna Grumberg, and Doron A. Peled. Model Checking. MIT Press,1999
3. Mathematical Logic, Second Edition. H.-D. Ebbinghaus and J. Flum and W. Thomas. Springer-Verlag, 1994..
4. Term Rewriting and All That. Franz Baader and Tobias Nipkow. Cambridge University Press, 1998. (ISBN: 0-521-77920-0)
5. Formal Modelling and Analysis of Security Protocols. Peter Ryan and Steve Schneider. AAddison Wesley, 2001
6. Computer-Aided Reasoning: ACL2 Case Studies. Matt Kaufmann, PanagiotisManolios, and J Strother Moore (eds.). Kluwer Academic Publishers, June, 2000. (ISBN: 0-7923-7849-0).

VALUE ADDED COURSES

CSC7001	FUNCTIONAL PROGRAMMING

Topics covered in this course should include but not limited to:

i. Introduction to Haskell and Lazy, Functional Programming
ii. Datatypes
iii. Programs and Proofs
iv. Simple Graphics.
v. Polymorphism
vi. Trees
vii. Regions
viii. Pictures
ix. The Haskell Class System
x. Infinite Lists and Streams
xi. File IO, Channels and Concurrency
xii. Higher Order Types

CSC7002	OBJECT ORIENTED PROGRAMMING USING C++

Topics covered in this course should include but not limited to:

i. OOPS concepts
ii. Function Overloading
iii. Default Arguments
iv. Classes and Objects
v. Members and Member Functions
vi. Constructors
vii. Overloading Constructors
viii. Destructor
ix. Friend Functions
x. Inheritance
xi. Polymorphism
xii. Exception Handling

CSC7003	PYTHON PROGRAMMING FOR DATA ANALYTICS

Topics covered in this course should include but not limited to:

i. Basics of Python
ii. Python Programming
iii. Numpy
iv. Scipy
v. Pandas
vi. Matplotlib
vii. Scikit Learn
viii. Keras
ix. Tensorflow
x. Importing Datasets
xi. Analysis of Data
xii. Plotting of Data

CSC7004	R PROGRAMMING

Topics covered in this course should include but not limited to:

i. Basic fundamentals, installation and use of software, data editing, use of R as a calculator, functions and assignments.
ii. Use of R as a calculator, functions and matrix operations, missing data and logical operators.
iii. Conditional executions and loops, data management with sequences.
iv. Data management with repeats, sorting, ordering, and lists.
v. Vector indexing, factors, Data management with strings, display and formatting.
vi. Data management with display paste, split, find and replacement, manipulations with alphabets, evaluation of strings, data frames.
vii. Data frames, import of external data in various file formats, statistical functions, compilation of data. Graphics and plots, statistical functions for central tendency, variation, skewness and kurtosis, handling of bivarite data through graphics, correlations, programming and illustration with examples.

CSC7005	C PROGRAMMING

Topics covered in this course should include but not limited to:

i. Principles of Structured Programming
ii. Identifiers and Keywords– Datatypes – Constants – Variables – Declarations- Expressions
iii. Control Statements
iv. Iterative Structures and Functions
v. Arrays
vi. Pointers
vii. Functions
viii. Structures

CSC7006	ORIENTATION ON RESEARCH FOR PG STUDENTS

Course Outcomes:

CO1: Basics of Research, Research types and different phases in research

CO2: Learning of Research Areas, Research Opportunities in Computer Science

CO3: Illustration to conduct Effective Literature Survey and Problem Identification, Experimentation and Results

CO4: Learning of Reference Managers, Research Manuscript writing, publication, Journal Indexing

CO5: Understanding of Plagiarism, Fellowships, Higher Education opportunities in India and Abroad

Unit – 1	BASICS OF RESEARCH, RESEARCH TYPES AND DIFFERENT PHASES IN RESEARCH	6 hrs

Basics of research, types of research, Fundamental research, Applied research, Qualitative research, Mixed research, Exploratory research, Field research, Laboratory research and other type of research, Different phases in research

Unit – 2	RESEARCH AREAS, RESEARCH OPPORTUNITIES IN COMPUTER SCIENCE	6 hrs

Research areas in computer science, Data Analytics, Systems Architecture, Web Semantics, Information Security, Pervasive and Mobile Computing, IoT, Computer Networks, Soft Computing Techniques, Information Management, Artificial Intelligence and other research areas. Research opportunities in these areas

Unit – 3	EFFECTIVE LITERATURE SURVEY AND PROBLEM IDENTIFICATION, EXPERIMENTATION AND RESULTS	6 hrs

Literature Review, Conduction of literature review, How to read a scientific paper, Review articles, Primary research articles, Read critically, Read creatively, Literature findings and problem identification, Data sets, experimentation, results and discussion

Unit – 4	REFERENCE MANAGERS, RESEARCH MANUSCRIPT WRITING, PUBLICATION, JOURNAL INDEXING	6 hrs

Referencing, citation and Reference Manager, steps in writing research manuscript, conference publications, proceedings of the conference, publications in Journals, Scopus indexed and SCI indexed journals

Unit – 5	PLAGIARISM, FELLOWSHIPS, HIGHER EDUCATION OPPORTUNITIES IN INDIA AND ABROAD	6 hrs

Plagiarism - Plagiarism types - Plagiarism Checker - avoiding plagiarism – Ph.D program - PhD admission requirements - Fellowships offered in India for Ph.D - Junior Research Fellow (JRF) - Non-NET fellowship - Fellowships offered in other countries (abroad) for Ph.D - Post Doctoral Fellowships in India [Part Time & Full Time].

Text / Reference Books:

1. Garg.B.L., Karadia, R., Agarwal,F. and Agarwal, U.K., 2002. An introduction to Research Methodology, RBSA Publishers.
2. Kothari, C.R.(2008). Research Methodology: Methods and Techniques. Second Edition.New Age International Publishers, New Delhi.
3. Sinha, S.C. and Dhiman, A.K., 2002. Research Methodology, Ess Ess Publications. 2 volumes.

4. Trochim, W.M.K., 2005. Research Methods: the concise knowledge base, Atomic Dog Publishing. 270 p.
5. Day RA (1992) How to write and publish a scientific paper. Cambridge University press. London
6. Hempel,C. Philosophy of Natural science Englewood Cliffs, N.J: Prentice Hall, 1966.
7. Burtt, E.A. The Metaphysical Foundations of Modern Science. London, 2003.
8. Latour, B. & Woolgar. 3. Laboratory Life. The construction of scientific facts. 2nd Edition. Princeton: Princeton University Press.1986
9. Gupta S.P. (2008). Statistical Methods. 37th ed. (Rev)Sultan Chand and Sons. New Delhi. 1470 p.

CSC7007	LATEX FOR RESEARCHERS

Topics covered in this course should include but not limited to:

i. Software Installation for LaTeX
ii. Simple Typesetting
iii. Document Class
iv. Page Style and Page Numbering
v. Bibliography
vi. Bibliographic Databases
vii. Table of Contents, Index and Glossary
viii. Displayed Text
ix. Rows and Columns
x. Typesetting Mathematics and Theorems
xi. Float Environment
xii. Table Environment
xiii. Figure Environment
xiv. Cross References
xv. Footnotes, Marginpars and Endnotes
xvi. Overleaf tool

ABILITY ENHANCEMENT COMPULSORY COURSE

CSC8001	CYBER SECURITY	3	0	0	3

Course Outcomes:

CO1: To understand the principles of Data warehousing and Data Mining
CO2: To be familiar with the Data warehouse architecture and its Implementation
CO3: To know the Architecture of a Data Mining system
CO4: To understand the various Data preprocessing Methods
CO5: To perform classification and prediction of data

Unit – 1	COMPUTER SECURITY CONCEPTS	9 hrs

Definitions – Threats – Harm – Vulnerabilities – Unintentional (Non-Malicious) Programming – Malicious Code – Malware Countermeasures

Unit – 2	ELECTRONIC PAYMENTS AND SAFEGUARDS	9 hrs

Concept of E-payments – ATM and Tele Banking – Immediate Payment Systems – Mobile Money Transfer and E-Wallets – Unified Payment Interface – Cybercrimes in Electronic Payments – Precautions in Electronics Money Transfer – Precautions in Electronic Money Transfer – RBI Guidelines of Customer Protection in Unauthorized Banking Transactions – KYC: Concept, cases and safeguards

Unit – 3	CYBER CRIMES AND SAFETY	9 hrs

Introdution to cybercrimes – Kinds of Cybercrimes: Phishing – Identity Theft – Cyber Stalking – Cyber Terrorism – Cyber Obscenity – Computer Vandalism – Ransomware – Identity Theft Forgery – fraud from Mobile Devices

Unit – 4	INTRODUCTION TO SOCIAL NETWORKS	9 hrs

Social Network and its contents – Blogs – Safe and Proper use of Social Networks – Inappropriate Content on Social Networks – Flagging and Reporting of Inappropriate Content – Laws regarding posting of Inappropriate Content

Unit – 5	INTRODUCTION TO INFORMATION AND TECHNOLGOY ACT, 2000 (IT ACT) AND ITS USE IN CYBER SPACE	9 hrs

Concepts as defined in IT Act – Communication Device – Computer, Cyber Security, Data Security – Secure System – Online Gaming and its Risks – Basic Concepts of Blockchain and Cryptocurrency

Text / Reference Books:

1. W.A.Coklin, G.White, Principles of Computer Security: Fourth Edition, McGrawHill, 2016
2. William Stallings, Cryptography and Network Security Principles and Practices, Seventh Edition,Pearson
3. Pfleeger, C.P., Security in Computing 5th Edition, Prentice Hall, Copyright 2010, ISBN 0-13-239077-9
4. Schneier, Bruce. Applied Cryptography, Second Edition, John Wiley & Sons, 1996..
5. J Michael Stewart, "Network Security, Firewalls And Vpns", Jones and Bartlett Publishers, Inc; 2nd edition, 2013
6. Charlie Kaufman and Radia Perlman, "Network Security: Private Communication in a Public World", Prentice Hall, 2002

BRIDGE COURSES

CSC0001	INTRODUCTION TO COMPUTERS

Topics covered in this course should include but not limited to:

i. Parts of a computer
ii. Hardware – Software -
iii. System Configuration
iv. Office Tools
v. Internet Concepts

CSC0002	PROBLEM SOLVING TECHNIQUES

Topics covered in this course should include but not limited to:

i. Summation of a set of numbers
ii. Reversing the digits of an integer
iii. Character to Number conversion
iv. Smallest Divisor of an integer
v. Linear Pattern Search
vi. Computing nth Fibonacci number