Integral University, Lucknow
Department of Computer Science and Engineering
M.TECH-CSE(ACDS)
Subject Name: Soft Computing, Subject Code: CS-518
w.e.f Session 2020-21

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

CO 1	**Know about the concepts of fuzzy logic, crisp logic, fuzzy relation, fuzzy implication rule**
CO 2	**Know about the concepts of optimization theory genetic computing, and evolutionary computing.**
CO 3	**Know about the concepts of the neural network,Single Layer, Multilayer, classifications, Implementation, and training**
CO 4	**Know about the concepts of classifications, Implementation, and training**
CO 5	**Know about the concept of hybrid systems, like neuro-fuzzy systems, fuzzy genetic systems, and particle intelligence.**

Objective: The course curriculum helps to understand the concepts of fuzzy rule, fuzzy data, crisp rule, crisp data, fuzzy relation,
implication, and elaborates the concepts of particle intelligence, swarm intelligence, evolutionary computing, optimization theory,
different kind of neural network, learning theory by neural network, algorithm based computing, probabilistic computing, hybrid
system concepts, etc..

UNIT I	Introduction of soft computing: What is Soft Computing, soft computing vs. hard computing, soft computing paradigms, and applications of soft computing. Basics of Machine Learning. Dealing with Imprecision and Uncertainty- Probabilistic Reasoning- Bayesian network, Pearl's Scheme for Evidential Reasoning, Dempster-Shafer Theory for Uncertainty Management, Certainty Factor Based Reasoning	8
UNIT II	Neural Networks: Basics of Neural Networks- Neural Network Structure and Function of a single neuron: Biological neuron, artificial neuron, definition of ANN, Taxonomy of neural net, characteristics and applications of ANN, McCulloch Pitt model, different activation functions, Supervised Learning algorithms- Perceptron (Single Layer, Multi layer), Linear separability, ADALINE, MADALINE, RBF networks , Widrow Hoff, learning rule, Delta learning rule, Back Propagation algorithm, Un-Supervised Learning algorithms- Hebbian Learning, Winner take all, Self Organizing Maps, Adaptive Resonance Theory: Architecture, classifications, Implementation and training. Associative Memory	8

UNIT III	**Fuzzy Logic:** Fuzzy set theory, Fuzzy set versus crisp set, Crisp relation & fuzzy relations, Fuzzy systems: crisp logic, fuzzy logic, introduction & features of membership functions, Fuzzy rule base system : fuzzy propositions, formation, decomposition & aggregation of fuzzy rules, fuzzy reasoning, fuzzy inference systems, Mamdani Fuzzy Models – Sugeno Fuzzy Models, Adaptive Neuro-Fuzzy Inference Systems Architecture	8
UNIT IV	Optimization: Derivative-based Optimization – Descent Methods – The Method of Steepest Descent – Classical Newton's Method, Simulated Annealing, Random Search, Downhill Simplex Search Derivative-free Optimization- Genetic algorithm Fundamentals, basic concepts, working principle, encoding, fitness function, reproduction, Genetic modeling: Inheritance operator, cross over, mutation operator, Generational Cycle, Convergence of GA, Applications & advances in GA, Differences & similarities between GA & other traditional methods.	8
UNIT V	Evolutionary Computing: Genetic programming (GP), Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial Immune System (AIS).	8

References:

1. **S, Rajasekaran& G.A. Vijayalakshmi Pai, "Neural Networks, Fuzzy Logic & Genetic Algorithms, Synthesis & applications",**

   PHI Publication.
2. **S.N. Sivanandam& S.N. Deepa, "Principles of Soft Computing", Wiley Publications.**
3. **Jyh-Shing Roger Jang, Chuen-Tsai Sun, EijiMizutani, "Neuro-Fuzzy and Soft Computing", Prentice-Hall of India.**
4. **SAndries P Engelbrecht, Computational Intelligence: An Introduction, Wiley Publications.**

CO-PO/PSO MAPPING

PO-PSO / CO	**P**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	**1**	**2**	**2**	**3**	**1**	**2**	**1**	**3**	**1**	**2**	**1**	**2**	**1**	**2**	**2**
CO2	**3**	**2**	**1**	**1**	**1**	**2**	**3**	**2**	**2**	**2**	**3**	**1**	**3**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**1**	**1**	**3**	**2**	**3**	**1**	**1**	**2**	**2**	**1**	**2**
CO4	**3**	**2**	**1**	**2**	**3**	**1**	**1**	**3**	**2**	**2**	**3**	**3**	**2**	**3**	**1**
CO5	**1**	**2**	**2**	**3**	**1**	**2**	**1**	**3**	**1**	**2**	**1**	**2**	**1**	**2**	**2**
1. Low Association 2: Average Association 3: Strong Association															

Integral University, Lucknow
Department of Computer Science and Engineering
M.TECH-CSE(ACDS)
Subject Name: MATHEMATICAL PROGRAMMING, Subject Code: CS-546

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

OBJECTIVE:

- Introduction to linear optimization and its extensions emphasizing the underlying mathematical structures, geometrical ideas, algorithms and solutions of practical problems.
- how different formulations and algorithms can be combined to efficient solution methods
- theory about linear programming, integer programming, and heuristics
- knowledge about many different models and when they can be good starting points for modeling richer problems
- solving real world problems problems with computer software, discrete optimization formulations and algorithms

COURSE OUTCOMES (CO):

After completion of the course, a student will be able to

COURSE OUTCOME (CO)	DESCRIPTION
CO1	understand how commercial software for solving optimization problems works
CO2	understand how different ways to formulate optimization problems can affect the practical solvability of the problem
CO3	assess when optimization models might be solved by exact methods and when heuristics are needed
CO4	structure technical problems so that they can be formulated as mathematical programs
CO5	understand the pros and cons of different formulations and solution methods and the interaction between model and method

UNIT I		8

	Mathematical Foundation: Basic Theory of Sets And Functions: Sets, Vectors, Sequences of Subsequences, Mapping and Functions, Continuous Functions; Vector Spaces; Matrices and Determinants; Linear Transformation and Rank; Convex Sets and Convex Cones, Convex and Concave Functions.	
UNIT II		**8**
	Linear Programming:Definitions and Terminologies, Basic Solutions of Linear Programs, Fundamental Properties for Linear Programs; Simplex Methods: Theory of Simplex Methods, Method of Computation Replacement Operation; Degeneracy in Linear Programming: Charnes' Perturbation Method.	
UNIT III		**8**
	Duality in Linear Programming: Cannonical Dual Programs and Duality Theorems, Equivalent Dual Forms, Lagrange Multipliers and Duality, Duality in the Simplex Method; Bounded Variable Problems; Transportation Problems; Assignment Problems.	
UNIT IV		**8**
	Nonlinear and Dynamic Programming:Constrained and Unconstrained Optimization, Kuhn- Tucker Optimality Conditions; Quadratic Programming: Wolfe's Method, Dantzig's Method, Beale's Method, Lemke's Complementary Pivoting Algorithm.	
UNIT V		**8**
	Methods of Nonlinear Programming: Separable Programming, Kelley's Cutting Plane Method, Zouten dijik's Method of Feasible Direction, Rosen's Gradient Projection Method, Zangwill's Convex Simplex Methods, Dantzig's Method for Convex Programs; Goal Programming, Multiple Objective Linear Programming, Functional Programming.	

REFERENCES:

1. S. M. Sinha, ―Mathematical Programming: Theory and Methods‖,Elsevier, 2005.
2. Steven Vajda ―Mathematical Programming‖ Courier Corporation, 2009.
3. Melvyn Jeter, ―Mathematical Programming: An Introduction to Optimization‖, CRC Press, 1986.
4. A. Bachem, M. Grötschel, B. Korte, ―Mathematical Programming The State of the Art‖, Springer Science & Business Media, 2012

CO-PO MAPPING:

	CO	**PO1** Engineering Knowledge	**PO2** Problem Analysis	**PO3** Design/development of solutions	**PO4** Conduct investigations into complex problems	**PO5** Modern tool usage	**PO6** Engineer and Society	**PO7** Environment and Sustainability	**PO8** Ethics	**PO9** Individual and Team work	**PO10** Communication	**PO11** Project Management and Finance	**PO12** Lifelong learning
CO1	understand how commercial software for solving optimization problems works	1	3				2						2
CO2	understand how different ways to formulate optimization problems can affect the practical solvability of the problem	2	2		3								2
CO3	assess when optimization models might be solved by exact methods and when heuristics are needed	2	3										2
CO4	structure technical problems so that they can be formulated as mathematical programs	2	2	3	1						2		2
CO5	understand the pros and cons of different formulations and solution methods and the interaction between model and method	3	3		1		2				1		2

1. Low Association 2: Average Association 3: Strong Association

Integral University, Lucknow
Department of Computer Science and Engineering
M.TECH-CSE(ACDS)
Subject Name: Advance Data Structure and Algorithm, Subject Code: CS-516
w.e.f Session 2020-21

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

CO 1	**Know about the concepts of data structures, their types, design concepts**
CO 2	**Know about the concepts of recursive equations, working with recursive programs., algorithm analysis.**
CO 3	**Know about the concepts of graphs and trees and their various traversals and properties.**
CO 4	**Know about the concepts of approximation algorithms and NP class problems**
CO 5	**Know about the concept of parallel algorithms and pipelines.**

Objective: The course curriculum helps to understand the various data structures and various relationships between different types
of data structures. Its major objective is the analysis of algorithms, trees, graphs, traversal techniques, solutions of recursive equations,
NP class problems and parallel algorithms.

UNIT I	**Data Structures** Overview of data structures Review of Arrays, sparse matrices, Stacks, Queues, linked lists, doubly linked lists, Applications, dynamic storage management Overview of Advance Data structure Red-Black Trees, AVL Trees and B-Trees	**8**
UNIT II	**Analysis of Algorithms** Algorithms and various analysis models, Analyzing Recursive Programs using various strategies Divide and Conquer Paradigm: Divide and conquer recurrence equations and their solutions, Review of various examples Binary search, Quick sort, merge sort.	**8**
UNIT III	**Graphs & Trees** Basic traversal and search techniques: Game Tree, traversal techniques of graph, connected component and spanning tree, Bi-connected components, AND/OR graph, LOWER BOUND THEORY comparison tree and lower bound through reduction.	**8**
UNIT IV	**Approximation Algorithms** Introduction, absolute approximation, - Approximation, Polynomial time approximation scheme, fully Polynomial time approximation scheme, NP Hard and NP Complete problem basic concept, Cook Theorem, NP Hard graph problems, NP Hard scheduling problems,	**8**

	NP Hard code generating problems.	
UNIT V	**Parallel Algortihms**	**8**
	PRAM Algorithms: Introduction, computational model, fundamental techniques and algorithms, merging and lower bounds MESH Algorithms: computational model, packet routing fundamental algorithm, merging computing the convex hull.	

References:

1. Fundamental of computer algorithms-Ellis Horowits, Sartaj Sahani,Saguthevar Rajasejaran (Universities press) second Edition
2. The design and analysis of Computer algorithms- Aho, hopcraft &ulman (Pearson Education)
3. Introduction to Algorithms- Thomas H. Coremen, Charles S. Lieserson, Ronald L Rivest and Clifford Stein (PHI)-2 nd edition
4. Randomized Algorithms- Rajiv Motwani and Prabhakar Raghavan (Cambridge University Press)
5. Algorithm Design Foundation analysis and Internet examples-Michael T. Goodrich, Roberto Tamassia (Wiley student Edition)

CO-PO/PSO MAPPING

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	3	1	2	2	3	1	2	1	2	1	2	3
CO2	3	1	1	1	1	2	1	2	2	2	3	1	3	2	2
CO3	1	3	3	2	1	1		1		1	1	2	2	1	3
CO4	4	2	1	2	3	1	3	3	2	2			2	3	2
CO5	3	4	1	3	1	2	3	3	1	2	1	2	1	2	3
1. Low Association 2: Average Association 3: Strong Association															

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advance Concepts of Database Design, Subject Code: CS-525

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

CO 1	**Know about the concepts of indexing, query processing & query optimization. Evaluation of expressions and cost estimation.**
CO 2	**Have knowledge about database tuning and concept building of object oriented database systems and the terminologies used.**
CO 3	**Know about the distributed database systems, their types, data fragmentation, data replication, deadlock handling and concurrency control techniques used in distributed databases.**
CO 4	**Know about database security threats, issues, role of DBA, database audits and discretionary access control.**
CO 5	**Have knowledge about enhanced data models (active databases, temporal databases, statistical databases, & multimedia databases) for advanced applications.**

Objective:

- To give the knowledge of Advance SQL Queries, which help the student to learn the working of internal processing of DBMS and how the underlying queries compute.
- To give the knowledge about database tuning and object oriented database concepts
- To give knowledge and understandings of distributed databases.
- Explain basic issues of database security and how to built secure databases.
- To give the knowledge about the working of emerging databases.

UNIT 1	**Indexing** – Primary & Secondary Index, Multilevel Indexing, B tree Indexing, B+ tree indexing, Hashing- Static & dynamic. **Query Processing**- Measures of query cost, selection operations, Join operations, Evaluation of expressions-Materialization, Pipelining. **Query Optimization**- Introduction, generating equivalence relation, Transformation of relational expression- equivalence rules, Choice of evaluation plans, Cost estimation-cost based optimization, Heuristic optimization, Statistical Information for Cost Estimation.	**8**

UNIT II	**Database Tuning**- Database workload, Physical design and tuning decisions, Need for database tuning, Index selection, Tuning Indexes, Tuning the conceptual schema, Tuning queries and views, DBMS Benchmarks. **Object Oriented Database System**- properties, need for OODBMS, Structured types, Inheritance, Multiple Inheritance, Object identity, Object containment, Nested Relational Model.	**8**
UNIT III	**Distributed Database System**- Heterogeneous and Homogeneous Databases, Distributed Data Storage –Data replication, Data fragmentation, Distributed Transactions, Concurrency Control in Distributed Databases Commit Protocols –Two-Phase commit, Three- Phase commit, Deadlock handling, Distributed Query Processing In R * System .	**8**
UNIT IV	**Database Security**- Database Security and Authorization, Introduction to Database Security Issues, Types of Security, Database Security and DBA, Access Protection, User Accounts, and Database Audits Access Control and Grant & Revoke on Views and Integrity Constraints, Discretionary Access Control, Role of DBA, Security in Statistical Databases.	**7**
UNIT V	**Enhanced Data Model for Advanced Applications**- Active database concept and triggers and their design and implementation issues, Temporal data base concepts, Spatial and multimedia databases, Introduction to deductive databases, introduction to expert database system.	

REFERENCES

1. Korth, Silberchatz, Sudarshan, "Database Concepts", Addison Wesley.
2. Majumdar & Bhattacharya, "Database Management System", TMH.
3. Elmastri, Navathe, "Fundamentals of Database Systems", Addison Wesley.
4. Date C.J., "An Introduction to Database System", Addison Wesley.
5. Ramakrishnan, Hadzilacous, Goodman, "Concurrency Control & Recovery", Addiosn Wesley.
6. Ceri & Palgatti, "Distributed Databases", McGraw Hill.

CO-PO/PSO MAPPING

PO	PO												PSO			
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1	3			2	1		3	1	3	2	3
CO2	3	3	1	2	1	2		1				1	1	2	2	3
CO3	3	3	2	1	2	2		3	2			3	1	2	1	3
CO4	3	3	3	2	3	3				1		2	3	2	1	1
CO5	3	3	1	1	1	2	1					3	2	1	3	1

1. Low Association 2: Average Association 3: Strong Association

SOFT COMPUTING LAB
COURSE CODE: CS 519
COURSE CREDIT: 1

Pre-requisite	Co-requisite	L	T	P	C
None	None	0	0	2	2

COURSE OBJECTIVES:

- Artificial Intelligence, Various types of production systems, characteristics of production systems.
- Neural Networks, architecture, functions and various algorithms involved.
- Fuzzy Logic, Various fuzzy systems and their functions.
- Genetic algorithms, its applications and advances.

Syllabus:

1. Exposure to Scilab Script &Functions.

2. Write a program for Recursion inScilab.

3. Write a program in Scilab for decision control andloops.

4. Write a program in Scilab for surfaceplots.

5. Write a program in Scilab for FileHandling.

6. Find whether the given matrix is (a) reflexive (b) tolerance and (c) transitivity matrix or not by writing a Scilabprogram.

7. Find whether the given matrix is symmetry or not by writing a Scilabprogram.

8. Write aprograminScilab tocalculateunion,intersection,complement anddifferenceoftwo fuzzysets.

9. Find the fuzzy relation between two vectors R and S, Using max–product and max-min method by writing aScilabprogram.

10. Illustrate different types of generalized bell membership functions using Scilabprogram

11. DesignnetworksofMcCulloch-PittsneuronsthatimplementlogicalNOT,ANDandORgates.Draweachnetwork and label all the weight and thresholdvalues.

12. WriteaprogramofPerceptronTrainingAlgorithm.

13. Write a program to implement deltarule.

14. WriteaScilabprogramforHebbnettoclassifytwodimensionalinputpatternsbipolarwiththeirtargetsgiven „*“ indicates a „+1“ and „.“ Indicates „-1“.

15. Implement Classical Genetic Algorithm inScilab.

16. Write a Scilab program for Linear & Quadraticoptimization.

COURSE OUTCOMES (CO):
After completion of the course, a student will be

CO 1	1. Learn about soft computing techniques and their applications
CO 2	2. Analyze various neural network architectures
CO 3	3. Understand perceptrons and counter propagation networks.
CO 4	4. Define the fuzzy systems
CO 5	5. Analyze the genetic algorithms and their applications.

CO-PO MAPPING:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	1	1	1	1	1	**3**	3	-	-
CO2	3	3	3	3	3	3	3	1	1	1	1	**3**	-	-	-
CO3	3	3	3	3	3	3	**3**	1	1	1	1	3	-	2	-
CO4	**3**	3	3	3	3	1	1	1	1	1	1	3	3	-	-
CO5	**3**	3	3	3	3	**-**	1	-	1	1	1	3	3	-	2
1. Low Association 2: Average Association 3: Strong Association															

Advanced Database System Lab

COURSE CODE: CS543

COURSE CREDIT: 1

1. Data definition language command.
2. Data Manipulation language command.
3. Data control language command and Data control transfer language command.
4. In Built function command.
5. Nested queries and join queries command.
6. Set operator command.
7. View operator command.
8. Procedure and function command.
9. Trigger command.
10. Control structure command.
11. Study and compare following command:
    a. Oracle
    b. Mysql
    c. DB2

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH.-CSE(ACDS)
Subject Name: Advanced Distributed Operating System, Subject Code: CS-520
w.e.f Session 2020-21

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

CO1	Elucidate the foundations and issues of distributed systems
CO2	Understand the various synchronization issues and global state for distributed systems.
CO3	Understand the Mutual Exclusion and Deadlock detection algorithms in distributed systems.
CO4	Describe the agreement protocols and fault tolerance mechanisms in distributed systems.
CO5	Describe the features of peer-to-peer and distributed shared memory systems

Objective:

- To understand the foundations of distributed systems.
- To learn issues related to clock Synchronization and the need for global state in distributed systems.
- To learn distributed mutual exclusion and deadlock detection algorithms.
- To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.
- To learn the characteristics of peer-to-peer and distributed shared memory systems

UNIT I		**9**
	Advanced Operating Systems: Overview and architecture, Distributed computing models and their comparison, Client Server Models:	
UNIT II		**8**
	Distributed objects and remote invocation: communication between Distributed objects, RPC, events and notification Case Study: Java RMI	
UNIT III		**8**
	Distributed File System: Models, service interface and directory interface design, DFS system structure, Case Study: Google file system.	
UNIT IV		**8**
	Distributed Multimedia systems: Characteristics of multimedia, multimedia data. Quality of service management, resorce management,	
UNIT V		**9**

References:

1. **Distributed Systems — Coulouris [Pearson Education]**
2. **Distributed Operating Systems- Tannenbaum [Pearson Education]**
3. **Distributed Systems:Principles andParadigms —Tannenbaum[Pearson**

CO-PO/PSO MAPPING

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	2	3	1	1	1	1	1	**3**	3	-	-
CO2	3	3	3	3	3	3					1	**3**	-	-	-
CO3	3	3	2	2	3	3					1	3	-	2	-
CO4	**3**	3	2	2	3	1					1	3	3	-	-
CO5	**3**	3	3	1	3	**-**	1	-	1	1	1	3	3	-	2
1. Low Association 2: Average Association 3: Strong Association															

Integral University, Lucknow
Department of Computer Science and Engineering
M.TECH-CSE(ACDS)
Subject Name: Machine Learning: Theory and Methods, Subject Code: CS-544
w.e.f Session 2020-21

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

CO 1	**Know about the concepts of Learning Problems, Induction, Decision Tree**
CO 2	**Know about the concepts of Neural Networks, Perceptrons, Genetic Algorithms, Boltzmann Machine.**
CO 3	**Know about the concepts of Bayes theorem, Maximum Likelihood Method, Bayesian Classifier**
CO 4	**Know about the concepts of K-means, clustering**
CO 5	**Know about the concept of first order rule set, associative learning**

Objective: The course curriculum helps to understand the various machine learning methods and approaches. It aims to model learning problems, neural networks, genetic modelling, hypothesis testing, Gibbs algorithm, Bayes theorem and Bayesian Classifiers, probability learning , clustering approaches, associative learning.

UNIT I	**Introduction** Learning Problems Perspectives and Issues Concept Learning Version Spaces and Candidate Eliminations Inductive bias Decision Tree learning Representation Algorithm Heuristic Space Search.	**8**
UNIT II	**Neural Networks and Genetic Algorithms** Neural Network Representation Problems Perceptrons Multilayer Networks and Back Propagation Algorithms Advanced Topics Genetic Algorithms Hypothesis Space Search Genetic Programming Models of Evaluation and Learning	**8**
UNIT III	**Bayesian and Computational Learning** Bayes Theorem Concept Learning Maximum Likelihood Minimum Description Length Principle Bayes Optimal Classifier Gibbs Algorithm Naïve Bayes Classifier Bayesian Belief Network EM Algorithm Probability Learning Sample Complexity Finite and Infinite Hypothesis Spaces Mistake Bound Model.	**8**
UNIT IV	**Instant Based Learning** K- Nearest Neighbour Learning Locally weighted Regression Radial Basis Functions Case Based Learning.	**8**
UNIT V	**Advanced Learning** Learning Sets of Rules Sequential Covering Algorithm Learning Rule Set First Order Rules Sets of First Order Rules Induction on Inverted Deduction Inverting Resolution Analytical Learning Perfect Domain	**8**

	Theories Explanation Base Learning FOCL Algorithm Reinforcement Learning Task Q-Learning Temporal Difference Learning.	

References:

1. Tom M. Mitchell-Machine Learning, Tata McGraw Hill Education (India) Private Limited, 2013.
2. Ethem Alpaydin-Introduction to Machine Learning, (Adaptive Computation and Machine Learning), The MIT Press-2004
3. Stephen Marsland-Machine Learning: An Algorithmic Perspective, CRC Press 2009

CO-PO/PSO MAPPING

PO - PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	1	2	2	3				2	1	2	1	2	1
CO2	1	3	2	1	1		2	3		2	3	1	3	2	
CO3	3	3	2	2	1	2	2	2	3	1	1	2	2	1	2
CO4	3	2	3	2	3	1	3	3	2	2	3	3	2	3	
CO5	3	3	1	3	1	2	3	3	1	2	1	2	1	2	1

1. Low Association 2: Average Association 3: Strong Association

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advanced Human Computer Interaction, Subject Code: CS-540
w.e.f Session 2020-21

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

UNIT I	**Introduction** Introduction: Course objective and overview, Historical evolution of the field, Concept of usability - definition and elaboration, HCI and software engineering	**8**
UNIT II	Interactive system design (theory and practice) : GUI design and aesthetics, Prototyping techniques,Model based Design and evaluation: Basic idea, introduction to different types of models, GOMS family of models (KLM and CMN-GOMS), Fitts' law and HickHyman's law, Model- based design case studies.	**8**
UNIT III	Guidelines in HCI: Shneiderman's eight golden rules, Norman's seven principles, Nielsen's ten heuristics with example of its use, Heuristic evaluation, Contextual inquiry, Cognitive walkthrough. Empirical research methods in HCI: Introduction (motivation, issues, research question formulation techniques) Experiment design and data analysis (with explanation ofone-way ANOVA).	**8**
UNIT IV	Task modeling and analysis : Hierarchical task analysis (HTA), Engineering task models and Concur Task Tree (CTT). Dialog Design: Introduction to formalism in dialog design, design using FSM (finite state machines), State charts and (classical) Petri Nets in dialog design, Cognitive architecture: Introduction to CA, CA types,relevance of CA in IS design, Model Human Processor (MHP).	**8**
UNIT V	Design -Case Studies: Case Study 1- MultiKey press Hindi Text Input Method on a Mobile Phone Case Study 2 - GUI design for a mobile phone based Matrimonial. Case Study 3 - Employment Information System for unorganised construction workers on a Mobile Phone.	**8**

REFERENCES:

1. Dix A., Finlay J.,Abowd G. D. and Beale R. Human Computer

Interaction, 3 rd edition, Pearson Education, 2005.

2. Preece J., Rogers Y.,Sharp H.,Baniyon D., Holland
S. and Carey T. Human Computer
Interaction,Addison-Wesley, 1994.

3. B.Shneiderman; Designing the User Interface,Addison Wesley 2000 (Indian Reprint).

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Software Testing & Quality Management, Subject Code: CS-524
w.e.f. July 2016

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

CO 1	Develop and manage test plan as per the software testing guidelines.
CO 2	Apply software testing techniques to uncover errors.
CO 3	Develop test cases on the basis of different testing strategies.
CO 4	Plan, assess and improve the quality of software.
CO 5	Work on standard quality models.

Objective:

1. To understand and describe software testing in general.
2. To understand various testing techniques.
3. To understand various software testing strategies.
4. To identify the role of software testing in software quality improvement.

UNIT I	**Introduction to Software Testing** Evolution, Myths, Facts, Goals, Psychology, Models, Principles , Axiom of Testing, Study of Bugs: Classification, Priority, Severity and their tracking .Software Testing: Terminology, Life cycle, Methodology, Types of Testing, Test planning: Test Plan Specification, Leveled Test Plan, Development of Test Plan ,Master Test plan ,Phase Wise Test Plan, Test management, Software Testing Guidelines, Defect Management, Analyzing & Reporting Test.	**8**
UNIT II	**Testing Technique** Static Testing: Inspection, Structured Walkthrough, Technical reviews, Automated Techniques ,Black box testing, Types of Black box Testing: Requirement based Testing, Positive & Negative Testing, Boundary Value Analysis, Compatibility Testing, Domain Testing, Graph Based Testing, Robustness Testing , Syntax Testing, Finite State Testing, CauseEffect Graphing Based Testing. White Box Testing, Types of White box Testing: Basis Path Testing, Control Structure Testing, Mutation Testing, and Gray Box Testing. Software Testability, Software Test Automation, Test Metrics and its Measurements.	**8**
UNIT III	**Software Testing Strategies** Model for Software Testing, Unit Testing, Integration, System & Acceptance Testing: Alpha Testing, Beta Testing, Stress testing, Load testing, Reliability Testing, Scalability Testing . Performance Testing, Regression Testing, Ad-hoc Testing, Usability and Accessibility Testing, Object Oriented Testing: Object-Oriented Testing Model, Object-oriented Software Test Strategy.	**8**
UNIT IV	**Introduction to Software Quality** Concepts of quality, perspectives and expectations, Quality Framework, Quality engineering: Activity and process, Quality planning, Quality assessment and improvement. Quality assurance: Classification, Q.A activities, Q.A. Techniques, Defect prevention and process improvement, Software Inspection, Formal Verification, Introduction to Software Reliability Engineering, Software Quality Measurement & Metrics.	**8**
UNIT V	**Quality Models** McCall's model, Bohem's model, Dromey's model, FURPS Model,ISO-9126 Model, Cost Of Quality, Software Quality Factors, Quality Control , CMMI-Framework : Process Area Components, Capability & Maturity Levels,	**8**

	Relationship Among Process Areas.	

References:

1. Software Testing : K.Mustafa,R.A. Khan ,Narosa
2. Software Testing : Srinivasan Desikan,Pearson
3. Software Testing : Naresh Chauhan , Oxford
4. Software Quality Engineering : Jeff Tian ,Wiley
5. Software Testing Fundamentals: Marnie L.Hutcheson,Wiley
6. Software Testing : Ron Patton, Pearson

CO-PO/PSO MAPPING

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
CO1	2			1				3						1
CO2			3			2					2			
CO3									1			2		
CO4	3			2							1		3	
CO5	1	2				1			2					
1. Low Association 2: Average Association 3: Strong Association														

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advance Concepts of Database Design, Subject Code: CS-525

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

CO 1	**Know about the concepts of indexing, query processing & query optimization. Evaluation of expressions and cost estimation.**
CO 2	**Have knowledge about database tuning and concept building of object oriented database systems and the terminologies used.**
CO 3	**Know about the distributed database systems, their types, data fragmentation, data replication, deadlock handling and concurrency control techniques used in distributed databases.**
CO 4	**Know about database security threats, issues, role of DBA, database audits and discretionary access control.**
CO 5	**Have knowledge about enhanced data models (active databases, temporal databases, statistical databases, & multimedia databases) for advanced applications.**

Objective:

- To give the knowledge of Advance SQL Queries, which help the student to learn the working of internal processing of DBMS and how the underlying queries compute.
- To give the knowledge about database tuning and object oriented database concepts
- To give knowledge and understandings of distributed databases.
- Explain basic issues of database security and how to built secure databases.
- To give the knowledge about the working of emerging databases.

UNIT 1	**Indexing** – Primary & Secondary Index, Multilevel Indexing, B tree Indexing, B+ tree indexing, Hashing- Static & dynamic. **Query Processing**- Measures of query cost, selection operations, Join operations, Evaluation of expressions-Materialization, Pipelining. **Query Optimization**- Introduction, generating equivalence relation, Transformation of relational expression- equivalence rules, Choice of evaluation plans, Cost estimation-cost based optimization, Heuristic optimization, Statistical Information for Cost Estimation.	**8**
UNIT II	**Database Tuning**- Database workload, Physical design and tuning decisions, Need for database tuning, Index selection, Tuning Indexes, Tuning the conceptual schema, Tuning queries and views, DBMS Benchmarks. **Object Oriented Database System**- properties, need for OODBMS, Structured types, Inheritance, Multiple Inheritance, Object identity, Object containment, Nested Relational Model.	**8**
UNIT III	**Distributed Database System**- Heterogeneous and Homogeneous Databases, Distributed Data Storage –Data replication, Data fragmentation, Distributed Transactions, Concurrency Control in Distributed Databases Commit Protocols –Two-Phase commit, Three- Phase commit, Deadlock handling, Distributed Query Processing In R * System .	**8**
UNIT IV	**Database Security**- Database Security and Authorization, Introduction to Database Security Issues, Types of Security, Database Security and DBA, Access Protection, User Accounts, and Database Audits Access Control and Grant & Revoke on Views and Integrity Constraints, Discretionary Access Control, Role of DBA, Security in Statistical Databases.	**7**
UNIT V	**Enhanced Data Model for Advanced Applications**- Active database concept and	

	triggers and their design and implementation issues, Temporal data base concepts, Spatial and multimedia databases, Introduction to deductive databases, introduction to expert database system.	

REFERENCES

1. Korth, Silberchatz, Sudarshan, "Database Concepts", Addison Wesley.
2. Majumdar & Bhattacharya, "Database Management System", TMH.
3. Elmastri, Navathe, "Fundamentals of Database Systems", Addison Wesley.
4. Date C.J., "An Introduction to Database System", Addison Wesley.
5. Ramakrishnan, Hadzilacous, Goodman, "Concurrency Control & Recovery", Addiosn Wesley.
6. Ceri & Palgatti, "Distributed Databases", McGraw Hill.

CO-PO/PSO MAPPING

PO	PO												PSO			
CO	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	2	1	3			2	1		3	1	3	2	3
CO2	3	3	1	2	1	2		1				1	1	2	2	3
CO3	3	3	2	1	2	2		3	2			3	1	2	1	3
CO4	3	3	3	2	3	3				1		2	3	2	1	1
CO5	3	3	1	1	1	2	1					3	2	1	3	1

1. Low Association 2: Average Association 3: Strong Association

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advance cryptography and Network Security, Subject Code: CS-526
w.e.f. July 2016

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

Syllabus:

UNIT 1	**Introduction and Mathematical Foundations:** Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory. **Classical Cryptosystems:** Classical Cryptosystems, Cryptanalysis of Classical Cryptosystems, Shannon's Theory.	**8**
UNIT II	**Symmetric Key Ciphers:** Modern Block Ciphers (DES), Modern Block Cipher (AES) Cryptanalysis of Symmetric Key Ciphers: Linear Cryptanalysis, Differential Cryptanalysis, Other Cryptanalytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers. Key distribution.	**8**
UNIT III	**Stream Ciphers and Pseudo randomness:** Stream Ciphers, Pseudorandom functions. **Hash Functions and MACs:** Hash functions: The Merkle Damgard Construction, Message Authentication Codes	**8**
UNIT IV	Asymmetric Key Ciphers: Construction and Cryptanalysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP)and the Diffie Hellman Key Exchange algorithm, The El Gamal Encryption Algorithm, Cryptanalysis of DLP.	**7**
UNIT V	**Digital Signatures:** Signature schemes. **Modern Trends in Asymmetric Key Cryptography:** Elliptic curve based cryptography, Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy(PGP),SecureSocketLayer(SSL),IntrudersandViruses,Firewalls.	

References:

1. William Stallings, "CryptographyandNetworkSecurity:PrinciplesandPractice"PrenticeHall,NewJersey
2. . Johannes. A. Buchmann, "Introduction to cryptography", Springer Verlag. Bruce Schiener, "AppliedCryptography".
3. Behrouz A. Forouzan, "Cryptography

   & Network Security" , TMH

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advance Concepts Real Time System, Subject Code: CS-527

Pre-requisite	Co-requisite	L	T	P	C
None	None	3	1	0	4

UNIT 1	Introduction- Definition, Structure, Typical Real Time Applications: Digital Control, High Level Controls, Signal Processing etc., Release Times, Deadlines, and Timing Constraints, Hard Real Time Systems and Soft Real Time Systems, Reference Models for Real Time Systems: Processors and Resources, Periodic Task Model, Critical and Non-critical tasks Precedence Constraints.	**8**
UNIT II	Real Time Scheduling of Uni- processor systems- Common Approaches to Real Time Scheduling: Clock Driven Approach, Weighted Round Robin Approach, Priority Driven Approach, Dynamic Versus Static Systems. Classical Uniprocessor Scheduling Algo-Rate Monotonic, EDF, Uniprocessor Scheduling of IRIS Tasks: Identical and Non identical Linear & Concave Reward Function, 0/1RewardFunction.	**8**
UNIT III	**Real Time Scheduling of Multi- Processor systems-** Multiprocessor and Distributed System Model, Bin- Packing Assignment Algorithm for EDF,Next-FitAlgorithmforRMScheduling,MyopicOfflineScheduling,FABAlgorithm& Buddy Strategy. Real Time Database: Real Time vs. General purpose Database, Main Memory database, Concurrency Control Issues.	**8**
UNIT IV	**Real Time Operating Systems-** An overview of RTOS, Real Time Threads, Tasks & Kernels, Case Study of QNX, VRTX, Vx Works. Fault Tolerance in Real Time Operating Systems- Introduction to Fault, Fault Detection and Error Containment, Redundancy, Data Diversity, Reversal Checks, Malicious & Integrated Failure Handling. Clock Synchronization: Introduction to Clocks.	**7**
UNIT V	Real Time Communication- Model of Real Time Communication, Medium Access Control Protocols for Broadcast Networks, Internet and Resource Reservation Protocols, Real Time Protocols, VTCSMA, Communication in Multicomputer System, N/W Topologies.	

[8]

REFERENCE

1. C.M. Krishna & Shin, “Real Time Systems”, Mc Graw Hill1985.
2. Jane W.S. LIU, “Real Time Systems”, PearsonEducation”.
3. Levi & Agarwal, “Real Time System”, McGrawHill.
4. Mall Rajib, “Real Time Systems”, Pearson

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Forensic & Cyber Crime, Subject Code: CS-528
w.e.f. July 2016

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

Course Outcome	
CO1	Demonstrate competency in the principles of crime scene investigation, including the recognition, collection, identification, preservation, and documentation of physical evidence.
CO2	Underline the need of digital forensic and role of digital evidences. List the method to generate legal evidence and supporting investigation reports and will also be able to use various digital forensic tools.
CO3	Explain the methodology of incident response and various security issues in ICT world, and identify digital forensic tools for data collection
CO4	Demonstrate the ability to document and orally describe crime scenes, physical evidence, and scientific processes.
CO5	Identify and examine current and emerging concepts and practices within the forensic science field.

Objective:

- To understand underlying principles and many of the techniques associated with the digital forensic practices and cyber crime.
- To explore practical knowledge about ethical hacking methods.
- To learn the importance of evidence handling and storage for various devices.
- To develop an excellent understanding of current cyber security issues (Computer Security Incident) and analyzed the ways that exploits in securities.
- To investigate attacks, IDS .technical exploits and router attacks and "Trap and Trace" computer networks.
- To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Syllabus:

UNIT 1	Cyber Forensic Basics - Introduction to Cyber Forensics, Storage Fundamentals, File System Concepts, Operating System Software and Basic Terminology, Introduction to Encase Forensic Edition, Analysis and Advanced Forensic Tool Kit. Forensic Technology and Practices, Forensic Ballistics and Photography, Face, Iris and Fingerprint Recognition, Audio Video Analysis, Windows System Forensics, Linux System Forensics, Network Forensics.	**8**
UNIT II	Cyber Crimes and Cyber Laws- Introduction to IT laws & Cyber Crimes – Unauthorized Access to Computers, Computer Intrusions, White collar Crimes, Viruses and Malicious Code, Internet Hacking and Cracking, Virus Attacks, Pornography, Software Piracy, Mail Bombs, Exploitation, Stalking and Obscenity in Internet. Information Technology Act, 2000. Intellectual Property Right, Penalties Under IT Act Offences, Digital Signature and Electronic Signature Under IT Act Statutory Provisions Establishment of Authorities and their functions, Certifying Authorities &	**8**

	Cyber Regulation Appellate	
UNIT III	Cyber Forensics Investigation- Introduction to Cyber Forensic Investigation, Investigation Tools, eDiscovery, Digital Evidence Collection, Evidence Preservation, E-Mail Investigation, E-Mail Tracking, IP Tracking, E-Mail Recovery, Encryption and Decryption methods, Search and Seizure of Computers, Recovering deleted evidences, Password Cracking.	**8**
UNIT IV	Data and Evidence Recovery :Data Recovery, Introduction to Deleted File Recovery, Formatted Partition Recovery, Data Recovery Tools, Data Recovery Procedures and Ethics, Preserve and safely handle original media, Document a "Chain of Custody", Complete time line analysis of computer files based on file creation, file modification and file access.	**7**
UNIT V	Cyber Security- Introduction to Cyber Security, Implementing Hardware Based Security, Software Based Firewalls, Security Standards, Assessing Threat Levels, Forming an Incident Response Team, Reporting Cyber crime, Operating System Attacks, Application Attacks, Reverse Engineering & Cracking Techniques and Financial Frauds.	

TEXT BOOKS:

1. Nelson, B., Phillips, A., Enfinger, F. and Steuart, C., Guide to Computer Forensics and Investigations, Fourth Edition. Thomson/Course Technology, 2008. 4'th Edition
2. Bernadette H Schell, Clemens Martin, "Cybercrime", ABC – CLIO Inc, California, 2004.
3. "Understanding Forensics in IT ", NIIT Ltd, 2005.

REFERENCES:

1. Kevin Mandia, Chris Prosise, Matt Pepe, "Incident Response and Computer Forensics ", Tata McGraw -Hill, New Delhi, 2006.
2. Robert M Slade," Software Forensics", Tata McGraw - Hill, New Delhi, 2005.
3. Faiyaz Ahmad, "Cyber law and Information Security", Dreamtech, New Delhi, 2013.
http://www.ifs.edu.in/cyber-forensics-cyber-crimes-cyber-security-cyber-law/

CO-PO-PSO Mapping

PO	**PO**											**PSO**			
CO	**POI**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	2	1	3		1	3	1		1	1	2	**2**	**2**	1	
CO2	3	2	3		1	1			2		2	**1**	**3**		
CO3	2	2	1		2	2	3		1		3	1		**3**	
CO4	3	2	2		3	3					2			**3**	
CO5	3	1	1		1	2	1				2				**3**
1. Low Association 2: Average Association 3: Strong Association															

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Digital image Processing and, Subject Code: CS-529
w.e.f. july2016

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

UNIT I	**Digital Image Fundamentals**: Image Sensing, and Acquisition, Image Sampling and Quantization, Basic Relationshipbetween Pixels. Sensor and Imaging: Imaging Optics, Radiometry of Imaging, illumination sources andtechniques, Camera Principles,Color Imaging,SingleSensorColorImaging andColorDemosaicing,RangeImages,3DImaging.	8
UNIT II	SignalRepresentation:VectorSpaceandUnitaryTrasnsforms,Multi-ResolutionalSignalRepresentation,WaveletDecomposition,Scalespaceanddiffusion,Representationofcolor,RetinexProcessing,MarkovRandomFieldModellingsofImages.	10
UNIT III	**Non-linear Image Processing: Median and Order Statistics Filters, Rank-Ordered-Mean Filtersand Signal DependentRank-Ordered-Mean Filters, TwoDimensional Teager Filters,Applications of nonlinear filters in image enhancement,edge detections, noise removal etc.**	8
UNIT IV	**ImageProcessinginBiometricSecurity:Introduction,FingerprintRecognition,FaceRecognition,IrisRecognition, Vein Pattern Recognition, Multimodal Biometrics Techniques. Biometric System Architeture, Extraction Algorithm,Matching Algorithm, Authentication, Biometric System Evaluation, Privacyissues.**	8
UNIT V	Image Processing in Medical Field: Introduction, CT scan images, MRI, Seeded segmentation methods : Desirableproperties, Pixel Based Methods, Contour Based Methods,Geodesic Active Contours, level set method, deformablemodel, graph based method, Image analysis of retinal images :acquisition,preprocessing.	10

[8]

References:
1.R.C Gonzalez and R.E. Woods, " Digital Image Pr ocessing" , Addison Wesley, 1992.
2.A.K.J ain, " Fundamentals of Digital Image Pr ocessing" , Pr entice Hall of India.
3. Digital Image Processing–M. Anji Reddy, BSPublications.

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Applied Data Mining and Warehousing, Subject Code: CS-530
w.e.f –july2016

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

CO 1	Develop a strong foundation of knowledge about data warehouse and related techniques.
CO 2	Design and build a data warehouse from the available historical data and perform OLAP operations to discover knowledge.
CO 3	Preprocess the data using cleaning, integration, transformation and reduction and find associations and correlations among that data.
CO 4	Classify the given dataset by using statistical and probabilistic models to predict the class labels of new data.
CO 5	Perform cluster analysis by using some major clustering methods and work on the recent advancements on text and web mining.

UNIT I	Overview & Concepts- Introduction to Data Warehousing, Data Warehousing Features, Data Warehouses and Data Marts; Difference between Operational Database Systems and Data Warehouses; Data Warehouse Implementation; Multidimensional Data Model, Data Warehouse Implementation, Further Development of Data Cube Technology, Architecture: Understanding Data Warehouse Architecture, Architectural Framework.	8
UNIT II	Technical Architecture: Introduction to Principles of Dimensional Modeling; Data Extraction, Transformation, and Loading, OLAP in the Data Warehouse: Demand for Online Analytical Processing, Major Features and Functions, OLAP Models; From Data Warehousing to Data Mining, Data Preprocessing: Needs Preprocessing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.	8
UNIT III	Data Mining: Introduction, Data Mining Functionalities, Classification of Data Mining System; Data Mining Primitives, Languages, and System Architectures: Data Mining Primitives, Data Mining Query Languages, Designing Graphical User Interfaces Based on a Data Mining Query Language Architectures of Data Mining Systems Concepts Description: Characterization and Comparison: Data Generalization and Summarization-Based Characterization, Analytical Characterization: Analysis of Attribute Relevance, Mining Class Comparisons: Discriminating between Different Classes, Mining Descriptive Statistical Measures in Large Databases.	8

UNIT IV	Mining Association Rules in Large Databases: Association Rule Mining, Mining Single-Dimensional Boolean Association Rules from Transactional Databases, Mining Multidimensional Association Rules from Relational Databases and Data Warehouses Classification and Prediction: Classification by Decision Tree Induction, Bayesian Classification, Classification by Back propagation, Classification Based on Concepts from Association Rule Mining	8
UNIT V	Cluster Analysis Introduction: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods, Density-Based Methods, Grid-Based Methods, Model-Based Clustering Methods, Outlier Analysis. Mining Complex Types of Data: Multidimensional Analysis and Descriptive Mining of Complex, Data Objects, Mining Spatial Databases, Mining Multimedia Databases, Mining Time-Ser ies and Sequence Data, Mining Text Databases, Mining the World Wide Web	8

REFERENCES :

1. Jiawei Han, Micheline Kamber, "Data Mining Concepts & Techniques" Elsevier.
2. Mallach,"Data Warehousing System",McGraw –Hill.
3. H.Dunham,"Data Mining:Introductory and Advanced Topics" Pearson Education.
4. Sam Anahory, Dennis Murray, "Data Warehousing in the Real World : A Practical Guide for Building Decision Support Systems, Pearson Education.

5. Data Mining: The Textbook Springer;2015th Edition

Integral University, Lucknow
Department of Computer Science & Engineering
M.Tech. CSE (ACDS)
Subject Name: R Programming Lab Subject Code: CS- 545

Objective:

This course aims to provide a practical introduction to the R programming language. By the end of the day-long course, the user will be comfortable operating in the R environment, including importing external data, manipulating data for specific needs, and running summary statistics and visualisations.

Course Outcome	
CO1	• download and install R and RStudio • navigate and optimize the R integrated development environment (IDE) RStudio
CO2	• install and load add-in packages • import external data into R for data processing and statistical analysis
CO3	• learn the main R data structures – vector and data frame • compute basic summary statistics
CO4	• produce data visualizations with the ggplot package • solve fundamental error problems.
CO5	• Write user-defined R functions • Use control statements

CO-PO-PSO Mapping

PO	PO												PSO			
CO	POI	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	2							2	**3**	**2**		
CO2	3	3	3	2	1				1			2	**1**	**3**		
CO3	3	2	1	2	2							1			**3**	
CO4	3	2	1	2	3							1			**3**	
CO5	3	3	2	1	2	1						2				**3**

COURSE: MACHINE LEARNING TOOLS LAB
COURSE CODE: CS549
COURSE CREDIT: 1

COURSE OBJECTIVES:

- To learn the basic concepts of programming for machine learning.
- To be able to develop logics which help them to create machine learning programs and applications using Python language.
- To analyze the datasets using supervised as well as unsupervised algorithms.
- To learn the training and testing phases of machine learning.
- After understanding the machine learning they can easily switch analyze various problems.

COURSE OUTCOMES (CO):

After completion of the course, a student will be

CO 1	**Able to understand the basic concepts of programming for machine learning.**
CO 2	**Able to design and develop various machine learning programming problems using Python programming concepts.**
CO 3	**Able to analyze and develop machine learning programs and applications.**
CO 4	**Able to develop programs for diverse datasets, domains and dimensionality.**
CO 5	**Able to draw inferences from analyzed dataset.**

CO-PO MAPPING:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	3		2		2						2	2	1
CO2	2	2	1	1			3						2	2	2
CO3	2	1	1	1			1						2	1	1
CO4	1	1		2		2	2						2	2	1
CO5	1	1	1				2						2	3	2

1. Low Association 2: Average Association 3: Strong Association

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Big Data, Subject Code: CS-609
w.e.f Session 2020-21

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

CO1	Student must be Able to understand the building blocks of Big Data
CO2	Student must be able to articulate the programming aspects of cloud computing(map Reduce etc)
CO3	Student must be able to understand the specialized aspects of big data with the help of different big data applications
CO4	Student must be able to represent the analytical aspects of Big Data
CO5	Student must be know the recent research trends related to Hadoop File System, MapReduce and Google File System etc

Objective:

1.To study the basic technologies that forms the foundations of Big Data.

2.To study the programming aspects of cloud computing with a view to rapid prototyping of complex applications.

3.To understand the specialized aspects of big data including big data application, and big data analytics.

4.To study different types Case studies on the current research and applications of the Hadoop and big data in industry

UNIT I	**Data structures in Java** **Data structures in Java: Linked List, Stacks, Queues, Sets, Maps; Generics: Generic classes and Type parameters,** **Implementing Generic Types, Generic Methods, Wrapper Classes, Concept ofSerialization.**	**8**
UNIT II	**Working with Big Data** **Google File System, Hadoop Distributed File System (HDFS) – Building blocks of Hadoop(Namenode, Datanode, Secondary Namenode, JobTracker, TaskTracker), Introducing and Configuring Hadoop cluster (Local,Pseudo-distributed mode, Fully Distributed mode), Configuring XML files**	**8**
UNIT III	**Writing MapReduce Programs** **Understanding Hadoop API for MapReduce Framework, Basic programs of Hadoop** **MapReduce: Driver code, Mapper code, Reducer code, RecordReader, Combiner, Partitioner**	**8**
UNIT IV	**Hadoop I/O** **The Writable Interface, Writable Comparable and comparators, Writable Classes: Writable wrappers for** **Java primitives, Text, Bytes Writable, Null Writable, Object Writable and Generic Writable, Writable collections,** **Implementing a Custom Writable: Implementing a RawComparator for speed, Custom comparators**	**8**
UNIT V	Pig and hive Pig Architecture, Evaluating Local and Distributed Modes of Running Pig Scripts, Checking out the Pig Script Interfaces. Hadoop Data with Hive: Saying Hello to Hive, Seeing How the Hive is Put Together, Getting Started with Apache Hive, Examining the Hive Clients, Working with Hive Data Types, Creating and Managing Databases and Tables, Seeing How the Hive Data Manipulation Language Works, Querying and Analyzing Data.	**8**

References:

1. Big Java 4th Edition, Cay Horstmann, Wiley John Wiley & Sons, INC

2. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly, Hadoop in Action byChuck Lam, MANNING Publ.

3. Hadoop: The Definitive Guide by Tom White, 3rd Edition, O'reilly Hadoop for Dummies by Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss

CO-PO/PSO MAPPING

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	1	1	1	–	–	–	–	–	–	–	–	2	2
CO2	2	2	1	1	1	–	–	–	–	–	–	–	–	2	2
CO3	2	2	1	2	1	–	–	–	–	–	–	–	–	2	2
CO4	2	2	1	2	1	–	–	–	–	–	–	–	–	2	2
CO5	2	2	2	3	2	–	–	–	–	–	–	–	–	2	2
1: Low Association, 2: Average Association, 3: Strong Association															

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Ad-hoc Sensor Network, Subject Code: CS-603
w.e.fSession2017

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

UNIT I	**Introduction of ad-hoc/sensor networks** Key definitions of ad-hoc/sensor networks, Advantages of ad-hoc/sensor networks, Unique constraints and characteristics of MANET, challenges & Performance parameters of Adhoc networks, Types & Applications of MANETs, Introduction of sensor network, sensor networks vs. ad-hoc networks, sensor network limitations, Design issues.	**8**
UNIT II	**Routing in Ad Hoc Networks** Introduction, Topology based routing protocol- Proactive routing- DSDV, WRP, TBRPF, OLSR, multipoint relay, STAR, Reactive routing- DSR, AODV, TORA, Hybrid routing approach- ZRP, FSR, LANMAR, CBRP, Position based routing- Location services- DREAM, quorum based location service, GLS, home zone, forwarding strategies- greedy packet forwording, Restricted Directional flooding- DREAM, LAR, RDMAR , Hierarchical routing, Other position based routing protocols.	**10**
UNIT III	**Wireless sensor networks** Design Issues, Challenges of Wireless sensor network, Energy consumption, Clustering of sensors- regularly placed sensor, randomly distributed sensors, Heterogeneous WSNs. Mobile Sensors, attacks on sensor network routing- Spoofed, altered, or replayed routing information, selective forwarding, sinkhole attacks, the Sybil attack, Wormholes, HELLO flood attacks, Acknowledgement spoofing, application of sensor networks.	**8**
UNIT IV	**Data retrieval in sensor networks** Introduction, Classification of WSNs- Architecture of sensor networks, network architecture, Routing Layer- Network structure based- flat routing- Directed diffusion, sequential assignment routing, MCFA, coherent and non-coherent processing, energy aware routing, Hierarchical routing- CBRP, LEACH, PEGASIS, MECN, TEEN, APTEEN, routing in fixed size clusters, sensor aggregates routing, Hierarchical power- Aware routing, flat versus Hierarchical.	**8**
UNIT V	**Security** Introduction, distributed system security, security in Ad- Hoc networks- requirements, security solutions constraints, challenges. Key Management- background, Diffie- Hellman key agreement, N- Party Diffie-Hellman Key agreement, The tree based generalized Diffie-Hellman protocol, Cooperation in MANETS, WSN security, Key distribution and management, Requirements for bootstrapping security in sensor networks, key distribution techniques in sensor networks- using a single network-wide key, using pair wise-shared keys, random key pre-distribution scheme, security protocols for sensor network, general consideration of using public key method, SPINS: SNEP AND µTELSA.	**10**

References:

1. AD HOC & SENSOR NETWORK "Theory and Application" by Carlos de MoraisCordeiro, World scientific press.
2. "Wireless Ad Hoc and Sensor Networks" by HoudaLabiod , Willy Publication

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Agile Software Engineering Subject Code: CS-605
w.e.fSession2017

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

UNIT I	Why Agile? Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile? Agile Methods Don't Make Your Own Method, The Road to Mastery, Find a Mentor.	**8**
UNIT II	UnderstandingXP:TheXPLifecycle,TheXPTeam,XPConcepts,AdoptingXP:IsXPRightforUs?Go !,AssessYour Agility.	**8**
UNIT III	Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand Up Meetings, Coding Standards, Iteration Demo, Reporting, Releasing:"DoneDone", No Bugs, Version Control, Ten-MinuteBuild,ContinuousIntegration,CollectiveCodeOwnership,Documentation,Planning:Vision, ReleasePlanning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating, Developing: Incremental Requirements, Customer Tests, Test-Driven Development, Refactoring, Simple Design, Incremental Design and Architecture,SpikeSolutions,PerformanceOptimization,ExploratoryTesting.10hours.	**8**
UNIT IV	Mastering Agility: Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules, Rely on People: Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, Eliminate Waste: Work in Small,ReversibleSteps,FailFast,MaximizeWorkNotDone,PursueThroughput.	**8**
UNIT V	Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, Seek Technical Excellence: Software Doesn't Exist, Design Is for Understanding, Design Tradeoffs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery. Text: 1. The Art of Agile Development (Pragmatic guide to agile software development), James shore, Chromatic, O'ReillyMedia,ShroffPublishers&Distributors,2007.	**8**

References:

1. AgileSoftwareDevelopment,Principles,Patterns,andPractices,RobertC.Martin,PrenticeHall;1stedition,2002
2. "AgileandIterativeDevelopmentAManger'sGuide",CraigLarmanPearsonEducation,FirstEdition,India,2004.

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advance Cloud Computing Subject Code: CS-606
w.e.f Session2017

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

CO 1	**Apply his knowledge to develop a cloud environment using hardware and software virtualization techniques and perform Map Reduce job execution**
CO 2	**Use common cloud services and components of Hadoop ecosystem in order to solve a real world problem.**
CO 3	**Utilize the SOA and MVC techniques, classify and cluster Big Data and able to develop a recommendation system**
CO 4	**Develop highly secured and high performance cloud applications.**
CO 5	Develop a research attitude in emerging fields of cloud computing and write **Quality research papers.**

UNIT I	**Introduction to Cloud Computing :**Definition(s) of Cloud Computing, Characteristics of Cloud, Cloud Deployment Models, Cloud Service Models, Driving Factors and Challenges of Cloud and Overview of Applications of Cloud. **Cloud Concepts & Technologies:** Virtualization, Load Balancing, Scalability & Elasticity, Deployment, Replication, Monitoring, MapReduce, Identity and Access Management, Service Level Agreements and Billing.	**8**
UNIT II	**Cloud Services and Platforms :**various types of cloud services including compute, storage, database, application, analytics, network and deployment services. **Hadoop & MapReduce:** Overview of Hadoop echo system, MapReduce architecture, MapReduce job execution flow and MapReduce schedulers.	**8**
UNIT III	**Cloud Application Design:** cloud application design considerations, cloud application reference architectures, design methodologies such as SOA, CCM and MVC, data storage technologies and cloud deployment approaches. **Big-Data Analytics:** big data analytics approaches: approaches for clustering big data, approaches for classification of big data and recommendation systems.	**8**
UNIT IV	**Cloud Security:** Cloud security challenges, approaches for authorization authentication, identify & access management, data security, data integrity encryption & key management. **Cloud Application Benchmarking & Tuning:** cloud application workload characteristics, performance metrics for cloud applications, cloud application testing, performance testing tools and a load test and bottleneck detection case study.	**8**
UNIT V	**Cloud Computing Case-Studies:** Review of Technical papers from Major journals (IEEE Transactions) and major conferences (IEEE / Springer etc.) on Cloud Computing / Software Engineering / Other Thrust Areas and Presentations by Students on their understanding of the same, after reviewing the papers concerned.	**8**

References:

1. CloudComputingAHands-onApproachbyA.Bagha&V.Madisetti[ISBN:978-81-7371-923-3]Published by University Press, pp. 456, Prin

CO-PO/PSO MAPPING

PO-PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
CO2	3	2	1	1	1	2	3	2	2	2	3	1	3	2	2
CO3	2	2	2	2	1	1	3	2	3	1	1	2	2	1	2
CO4	3	2	1	2	3	1	1	3	2	2	3	3	2	3	1
CO5	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
1: Low Association, 2: Average Association, 3: Strong Association															

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH. CSE (ACDS)
Subject NameNatural Language Processing Subject Code: CS-618
w.e.fSession2017

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

UNIT I	Introduction- Human languages, models, ambiguity, processing paradigms; Phases in natural language processing, applications. Text representation in computers, encoding schemes.	**8**
UNIT II	Linguistics resources- Introduction to corpus, elements in balanced corpus, Treebank, Prop Bank, WorldNet, Verb Net etc. Resource management with XML, Management of linguistic data with the help of GATE, NLTK. Regular expressions, Finite State automata, word recognition, lexicon. Morphology, acquisition models, Finite State Transducer.	**8**
UNIT III	N-grams, smoothing, entropy, HMM, ME, SVM, CRF. Part of Speech tagging- Stochastic POS tagging, HMM, Transformation based tagging (TBL), Handling of unknown words, named entities, multi word expressions. Natural language grammars, lexeme, phonemes, phrases and idioms, word order, agreement, tense, aspect and mood agreement, Context Free Grammar, spoken language syntax.	**8**
UNIT IV	Semantics- Meaning representation, semantic analysis, lexical semantics, WorldNet. Word Sense Disambiguation- Selection restriction, machine learning approaches, dictionary based approaches. Discourse- Reference resolution, constraints on co-reference, algorithm for pronoun resolution, text coherence, discourse structure.	**8**
UNIT V	Applications of NLP- Spell-checking, Summarization Information Retrieval- Vector space model, term weighting, homonymy, polysemy, synonymy, improving user queries. Parsing- Unification, probabilistic parsing, Tree Bank. Machine Translation– Overview.	**8**

References:

1. James A.. Natural language Understanding 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.. Natural language processing: a Paninianperspective,PHI, 2000
3. Siddiqui T., Tiwary U. S.. Natural language processing and Information retrieval.

CO-PO/PSO MAPPING

PO-PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3

CO															
CO1	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
CO2	3	2	1	1	1	2	3	2	2	2	3	1	3	2	2
CO3	2	2	2	2	1	1	3	2	3	1	1	2	2	1	2
CO4	3	2	1	2	3	1	1	3	2	2	3	3	2	3	1
CO5	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
1: Low Association, 2: Average Association, 3: Strong Association															

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH-CSE(ACDS)
Subject Name: Advanced Statistical Techniques for Data Analytics Subject Code: CS-624
w.e.fSession2017

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

UNIT I		**8**
	Data- Structured and Unstructured data, Importance, and analytics**; Data Sources-** Primary and Secondary data, advantages and disadvantages, Properties and data sets; **Classic data sets-** Iris flower data set, Categorical data analysis, robust statistics, Time series.	
UNIT II		**8**
	Data Analytics-Overview, data life cycle, Methodology ; **Key Stakeholders-** Data analyst, Data Scientist; **Data Analytics Project**- Problem definition, data collection, cleansing data, summarizing, data exploration.	
UNIT III		**8**
	Data Visualization- Variable types, Distribution function, Cumulative distribution functions, Histograms, Exploratory data analysis, Modeling output, Statistical predictions; **Statistical Techniques for Data Scientist:** Linear Regression, types of Linear Regression, Classification, Re-sampling Methods, subset selection, shrinkinage.	
UNIT IV		**8**
	Statistical Distributions- Poisson Distribution, Binomial Distribution; **Theorems and algorithms-** Bayes Theorem, K-Nearest Neighbor Algorithm, bagging, ROC Curve Analysis; **Hypothesis Testing-** Testing of Hypothesis, Population or Universe, Sampling, Parameters of Statistics, Standard Error.	
UNIT V		**8**
	Test of Significance-Critical Region, Level of Significance, Errors in Sampling, Steps in Testing of Statistical Hypothesis, Test of Significance for Large Samples, Test of Significance of Small Samples; **Time series Analysis-** Forecasting models and methods, Chi-square test, t-test, F-Test.	

References:

1. M. Goyal, "computer-based numerical & statistical techniques", Infinity Science Press LLC.
2. Rafael A. Irizarry, "Introduction to Data Science", CRC Press.

CO-PO/PSO MAPPING

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
CO2	3	2	1	1	1	2	3	2	2	2	3	1	3	2	2
CO3	2	2	2	2	1	1	3	2	3	1	1	2	2	1	2
CO4	3	2	1	2	3	1	1	3	2	2	3	3	2	3	1

CO5	**1**	**2**	**2**	**3**	**1**	**2**	**1**	**3**	**1**	**2**	**1**	**2**	**1**	**2**	**2**
1: Low Association, 2: Average Association, 3: Strong Association														

Integral University, Lucknow
Department of Computer Science & Engineering
M.TECH. CSE (ACDS)
Subject Name: Internet of Things Subject Code: CS-626
w.e.fSession2017

Pre-requisite	Co-requisite	L	T	P	C
None	None	4	0	0	4

CO 1	As per the new technology, a student should perform data transfer operations using IOT that help the students to guide in a formal way to communicate over new IOT devises within a short span of time..
CO 2	For a given situation, a student should be able to deal with different structural aspects of designing and he/she can know the use of key technologies that would be used by the students to promote the development of a coherent learning program.
CO 3	With the enhancement in technology, IOT deals with the challenges and unique product codes for a particular product so a student should be able to tackle the unique codes and he/she should development different approaches that can continue the legacy of an organization.
CO 4	During clustering phenomena, a student should be prepared to deal with principles and policies governed according to the company rules so as to provide better identity management using different models like isolated and federated user identity models.
CO 5	A student should know the basic idea of security requirements and vulnerabilities in IOT. He/she should be good enough to deal with the establishment of identity for smart applications to be used in IOT

OBJECTIVES:

- To understand the fundamentals of Internet of Things.
- To build a small low cost embedded system using Arduino / Raspberry Pi or equivalent boards.
- To apply the concept of Internet of Things in the real world scenario
- Develop web services to access/control IoT devices.

UNIT I	Introduction Characteristics Physical design Protocols Logical design Enabling technologies IoT Levels Domain Specific IoTsIoT vs M2M.	**8**
UNIT II	IoT systems management IoT Design Methodology Specifications Integration and Application Development.	**8**
UNIT III	BUILDING IOT WITH RASPBERRY PI Physical device Raspberry Pi Interfaces Programming APIs / Packages Web services	**8**
UNIT IV		**8**

	BUILDING IOT WITH GALILEO/ARDUINO Intel Galileo Gen2 with Arduino Interfaces Arduino IDE Programming APIs and Hacks	
UNIT V		**8**
	CASE STUDIES and ADVANCED TOPICS Various Real time applications of IoT Connecting IoT to cloud Cloud Storage for Iot Data Analytics for IoT Software & Management Tools for IoT	

References:

3. Marco Schwartz, "Internet of Things with the Arduino Yun", Packt Publishing, 2014.
4. ArshdeepBahga, Vijay Madisetti, "Internet of Things A hands on approach", Universities Press, 2015.

CO-PO/PSO MAPPING

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
CO2	3	2	1	1	1	2		2	2	2	3	1	3	2	2
CO3	2	2	2	2	1	1		2		1	1	2		1	
CO4	3	2	1	2		1	1	3		2	3	3		3	1
CO5	1	2	2	3	1	2	1	3	1	2	1	2	1	2	2
1: Low Association, 2: Average Association, 3: Strong Association															

COURSE: Big Data management and Data Analytics Lab
COURSE CODE: CS617
COURSE CREDIT: 1

COURSE OBJECTIVES:

- To learn the basic ofdata structures like Linked list, stack, queue, set and map in Java.
- To be able to develop the knowledge of big data analytics and implement different file management task in Hadoop.use of C libraries functions in C language.
- To learn theMap Reduce Paradigm and develop data applications using variety of systems
- To Analyze and perform different operations on data using Pig Latin scripts.

COURSE OUTCOMES (CO):
After completion of the course, a student will be

CO 1	Understand and implement the basics of data structures like Linked list, stack, queue, set and map in Java.
CO 2	Demonstrate the knowledge of big data analytics and implement different file management task in Hadoop.
CO 3	Understand Map Reduce Paradigm and develop data applications using variety of systems.
CO 4	Analyze and perform different operations on data using Pig Latin scripts.
CO 5	Illustrate and apply different operations on relations and databases using Hive

CO-PO MAPPING:

PO-PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	-	2	2	-	-	-	-	-	-	-	3	-	-
CO2	2	1	1	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	1	1	3	-	-	-	-	-	-	-	-	2	-
CO4	2	-	1	2	2	-	-	-	-	-	-	-	3	-	-
CO5	2	-	1	2	3	-	-	-	-	-	-	-	3	-	-
1: Low Association, 2: Average Association, 3: Strong Association															