# Integral University, Lucknow

| Effective from Session: 2019-20 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-516** | **Title of the Course** | **Advance Data Structure and Algorithm** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **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.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Know about the concepts of data structures, their types, design concepts |
| **CO2** | Know about the concepts of recursive equations, working with recursive programs., algorithm analysis. |
| **CO3** | Know about the concepts of graphs and trees and their various traversals and properties. |
| **CO4** | Know about the concepts of approximation algorithms and NP class problems |
| **CO5** | Know about the concept of parallel algorithms and pipelines. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| **1** | **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 | 1 |
| **2** | **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 | 2 |
| **3** | **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 | 3 |
| **4** | **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, NP Hard code generating problems. | 8 | 4 |
| **5** | **Parallel Algorithms** | 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. | 8 | 5 |

**Reference Books:**


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)


**e-Learning Source:**

https://nptel.ac.in/courses/106106130

| 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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2019-20 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-525** | **Title of the Course** | **Advance Concepts of Database Design** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | • **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.**<br>• **To give the knowledge about database tuning and object-oriented database concepts**<br>• **To give knowledge and understandings of distributed databases.**<br>• **Explain basic issues of database security and how to build secure databases.**<br>• **To give the knowledge about the working of emerging databases.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Know about the concepts of indexing, query processing & query optimization. Evaluation of expressions and cost estimation. |
| **CO2** | Have knowledge about database tuning and concept building of object-oriented database systems and the terminologies used. |
| **CO3** | Know about the distributed database systems, their types, data fragmentation, data replication, deadlock handling and concurrency control techniques used in distributed databases. |
| **CO4** | Know about database security threats, issues, role of DBA, database audits and discretionary access control. |
| **CO5** | Have knowledge about enhanced data models (active databases, temporal databases, statistical databases, & multimedia databases) for advanced applications. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction** | **Indexing** – Primary & Secondary Index, Multilevel Indexing, B tree Indexing, B+ tree indexing, Hashing- Static & dynamic.<br>**Query Processing**- Measures of query cost, selection operations, Join operations, Evaluation of expressions-Materialization, Pipelining.<br>**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 | 1 |
| 2 | **Database Tuning-** | **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.<br>**Object Oriented Database System**- properties, need for OODBMS, Structured types, Inheritance, Multiple Inheritance, Object identity, Object containment, Nested Relational Model. | 8 | 2 |
| 3 | **Distributed Database System** | **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 | 3 |
| 4 | **Database Security** | **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 | 4 |
| 5 | **Enhanced Data Model for Advanced Applications** | **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. | 8 | 5 |

**Reference Books:**


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.


**e-Learning Source:**

https://nptel.ac.in/courses/106105175

| | Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2018-2019 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-546** | **Title of the Course** | **MATHEMATICAL PROGRAMMING** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | • **Introduction to linear optimization and its extensions emphasizing the underlying mathematical structures, geometrical ideas, algorithms and solutions of practical problems.**<br>• **how different formulations and algorithms can be combined to efficient solution methods**<br>• **theory about linear programming, integer programming, and heuristics**<br>• **knowledge about many different models and when they can be good starting points for modeling richer problems**<br>• **solving real world problems, problems with computer software, discrete optimization formulations and algorithms** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **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 No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **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. | 8 | 1 |
| 2 | **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. | 8 | 2 |
| 3 | **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. | 8 | 3 |
| 4 | **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. | 8 | 4 |
| 5 | **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. | 8 | 5 |

**Reference Books:**


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. Grötsche, B. Korte, ―Mathematical Programming, The State of the Art, Springer Science & Business Media, 2012


**e-Learning Source:**

https://onlinecourses.nptel.ac.in/noc23_cs11

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

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2019-20 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS 519** | **Title of the Course** | **SOFT COMPUTING LAB** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **0** | **0** | **2** | **2** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | • **Artificial Intelligence, Various types of production systems, characteristics of production systems.**<br>• **Neural Networks, architecture, functions and various algorithms involved.**<br>• **Fuzzy Logic, Various fuzzy systems and their functions.**<br>• **Genetic algorithms, its applications and advances.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | 1. Learn about soft computing techniques and their applications |
| **CO2** | 2. Analyze various neural network architectures |
| **CO3** | 3. Understand perceptrons and counter propagation networks. |
| **CO4** | 4. Define the fuzzy systems |
| **CO5** | 5. Analyze the genetic algorithms and their applications. |

| **Sr. No.** | **List of Experiments** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|
| 1 | Exposure to Scilab Script &Functions. | 2 | 1 |
| 2 | Write a program for Recursion in Scilab. | 2 | 1 |
| 3 | Write a program in Scilab for decision control and loops. | 2 | 2 |
| 4 | Write a program in Scilab for surface plots | 2 | 2 |
| 5 | Write a program in Scilab for File Handling. | 2 | 2 |
| 6 | Find whether the given matrix is (a) reflexive (b) tolerance and (c) transitivity matrix or not by writing a Scilab program. | 2 | 3 |
| 7 | Find whether the given matrix is symmetry or not by writing a Scilab program. | 2 | 3 |
| 8 | Write a program in Scilab to calculate union, intersection, complement and difference of two fuzzy sets | 2 | 3 |
| 9 | Find the fuzzy relation between two vectors R and S, using max–product and max-min method by writing a Scilab program. | 2 | 4 |
| 10 | Illustrate different types of generalized bell membership functions using Scilab program | 2 | 4 |
| 11 | Design networks of McCullochPittsneurons that implement logical NOT, AND and OR gates. Draw each network and label all the weight and threshold values | 2 | 4 |
| 12 | Write a program of Perceptron Training Algorithm. | 2 | 5 |
| 13 | Write a program to implement delta rule. | 2 | 5 |
| 14 | Write a Scilab program for Hebbnetto classify two-dimensional input pattern sbi polar with their targets given „*" indicates a „+1" and „. " Indicates „-1". | 2 | 5 |
| 15 | Implement Classical Genetic Algorithm in Scilab | 2 | 5 |
| 16 | Write a Scilab program for Linear & Quadratic optimization. | 2 | 5 |

| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2019-20 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-518** | **Title of the Course** | **Soft Computing** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **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, optimalization theory, different kind of neural network, learning theory by neural network, algorithm-based computing, probabilistic computing, hybrid system concepts, etc.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Know about the concepts of fuzzy logic, crisp logic, fuzzy relation, fuzzy implication rule |
| **CO2** | Know about the concepts of optimization theory genetic computing, and evolutionary computing. |
| **CO3** | Know about the concepts of the neural network, Single Layer, Multilayer, classifications, Implementation, and training |
| **CO4** | Know about the concepts of classifications, Implementation, and training |
| **CO5** | Know about the concept of hybrid systems, like neuro-fuzzy systems, fuzzy genetic systems, and particle intelligence. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction of soft computing:** | Introduction of soft computing: [8] 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 | 1 |
| 2 | **Neural Networks** | 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 | 2 |
| 3 | **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 | 3 |
| 4 | **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 | 4 |
| 5 | **Evolutionary Computing** | Evolutionary Computing: Genetic programming (GP), Ant colony optimization (ACO), Particle swarm optimization (PSO), Artificial Immune System (AIS). | 8 | 5 |

**Reference Books:**


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.


**e-Learning Source:**

**https://archive.nptel.ac.in/courses/106/105/106105173**

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2019-20 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS 543** | **Title of the Course** | **Advanced Database System Lab** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **0** | **0** | **2** | **2** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **This lab work will enhance database handling, data manipulation and data processing skills through SQL & PL/SQL, which will help them in developing data centric computer applications.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Students get practical knowledge on designing and creating relational database systems. |
| **CO2** | Understand various advanced queries execution such as relational constraints, joins, set operations, aggregate functions, trigger, views and embedded SQL. |
| **CO3** | Use of various software to design and build ER Diagrams, UML, Flow chart for related database systems. |
| **CO4** | Students will be able to design and implement database applications on their own |
| **CO5** | understand advanced DBMS techniques to construct tables and write effective queries, forms, and reports |

| **Sr. No.** | **List of Experiments** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|
| 1 | Data definition language command. | 2 | 1 |
| 2 | Data Manipulation language command. | 2 | 1 |
| 3 | Data control language command and Data control transfer language command. | 2 | 2 |
| 4 | In Built function command. | 2 | 2 |
| 5 | Nested queries and join queries command. | 2 | 2 |
| 6 | Set operator command. | 2 | 3 |
| 7 | View operator command. | 2 | 3 |
| 8 | Procedure and function command. | 2 | 4 |
| 9 | Trigger command. | 2 | 4 |
| 10 | Control structure command. | 2 | 5 |
| 11 | Study and compare following command:<br>a) Oracle<br>b) Mysql<br>c) DB2 | 2 | 5 |

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

**1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2019-20 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-520** | **Title of the Course** | **Advanced Distributed Operating System** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | To understand the foundations of distributed systems.<br>To learn issues related to clock Synchronization and the need for global state in distributed systems.<br>To learn distributed mutual exclusion and deadlock detection algorithms.<br>To understand the significance of agreement, fault tolerance and recovery protocols in Distributed Systems.<br>To learn the characteristics of peer-to-peer and distributed shared memory systems. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **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 |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Advanced Operating Systems:** | Overview and architecture, Distributed computing models and their comparison, Client Server Models: | 9 | 1 |
| 2 | **Distributed objects and remote invocation:** | communication between Distributed objects, RPC, events and notification Case Study: Java RMI | 8 | 2 |
| 3 | **Distributed File System:** | Models, service interface and directory interface design, DFS system structure, Case Study: Google file system. | 8 | 3 |
| 4 | **Distributed Multimedia systems:** | Characteristics of multimedia, multimedia data. Quality of service management, resource management. | 8 | 4 |
| 5 | **Real time distributed operating system:** | Design issues, distributed communications in LAN and WAN, scheduling: static and dynamic, scheduling algorithms, Case Study: MARS. Emerging trends in distributed computing: Introduction, Grid computing-architecture application, SOA overview, design, service-oriented grid, advantages and future scope, Cloud computing- feature and architecture. | 9 | 5 |

**Reference Books:**


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


**e-Learning Source:**

**https://nptel.ac.in/courses/106106168**

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **CO1** | **2** | 3 | **2** | – | – | – | – | – | – | – | – | – | 2 | | | | | |
| **CO2** | 3 | 3 | **2** | – | – | – | – | – | – | – | – | – | 3 | | | | | |
| **CO3** | 3 | 3 | **2** | _ | – | – | – | – | – | – | – | – | 3 | | | | | |
| **CO4** | **2** | 3 | **2** | **-** | – | – | – | – | – | – | – | – | 3 | | | | | |
| **CO5** | 3 | 3 | **2** | **_** | – | – | – | – | – | – | – | – | 3 | | | | | |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2020-21 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-524** | **Title of the Course** | **Software Testing & Quality Management** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **4** | **0** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **To understand and describe software testing in general.**<br>**To understand various testing techniques.**<br>**To understand various software testing strategies.**<br>**To identify the role of software testing in software quality improvement.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Develop and manage test plan as per the software testing guidelines. |
| **CO2** | Apply software testing techniques to uncover errors. |
| **CO3** | Develop test cases on the basis of different testing strategies. |
| **CO4** | Plan, assess and improve the quality of software. |
| **CO5** | Work on standard quality models. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **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 | 1 |
| 2 | **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, Cause Effect 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 | 2 |
| 3 | **Software Testing Strategies** | 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 | 3 |
| 4 | **Introduction to Software Quality** | 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 | 4 |
| 5 | **Quality Models** | 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 unorganized construction workers on a Mobile Phone. | 8 | 5 |

**Reference Books:**


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


**e-Learning Source:**

**https://nptel.ac.in/courses/106105150**

| | Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **CO1** | 2 | | | 1 | | | | 3 | | | | | | 1 | 2 | | | |
| **CO2** | | | 3 | | | 2 | | | | | 2 | | | | | | | |
| **CO3** | | | | | | | | | 1 | | | 2 | | | | | | |
| **CO4** | 3 | | | 2 | | | | | | | 1 | | 3 | | 3 | | | |
| **CO5** | 1 | 2 | | | | 1 | | | 2 | | | | | | 1 | | | |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2020-21 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-525** | **Title of the Course** | **Advance Concepts of Database Design** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | • **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.**<br>• **To give the knowledge about database tuning and object-oriented database concepts**<br>• **To give knowledge and understandings of distributed databases.**<br>• **Explain basic issues of database security and how to build secure databases.**<br>• **To give the knowledge about the working of emerging databases.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Know about the concepts of indexing, query processing & query optimization. Evaluation of expressions and cost estimation. |
| **CO2** | Have knowledge about database tuning and concept building of object-oriented database systems and the terminologies used. |
| **CO3** | Know about the distributed database systems, their types, data fragmentation, data replication, deadlock handling and concurrency control techniques used in distributed databases. |
| **CO4** | Know about database security threats, issues, role of DBA, database audits and discretionary access control. |
| **CO5** | Have knowledge about enhanced data models (active databases, temporal databases, statistical databases, & multimedia databases) for advanced applications. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction** | **Indexing** – Primary & Secondary Index, Multilevel Indexing, B tree Indexing, B+ tree indexing, Hashing- Static & dynamic.<br>**Query Processing**- Measures of query cost, selection operations, Join operations, Evaluation of expressions-Materialization, Pipelining.<br>**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 | 1 |
| 2 | **Database Tuning** | **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.<br>**Object Oriented Database System**- properties, need for OODBMS, Structured types, Inheritance, Multiple Inheritance, Object identity, Object containment, Nested Relational Model. | 8 | 2 |
| 3 | **Distributed Database System** | **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 | 3 |
| 4 | **Database Security** | **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 | 4 |
| 5 | **Enhanced Data Model for Advanced Applications** | **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. | 8 | 5 |

**Reference Books:**


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.

**e-Learning Source:**

**https://nptel.ac.in/courses/106105175**

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2020-21 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-528** | **Title of the Course** | **Forensic & Cyber Crime** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **4** | **0** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **To understand underlying principles and many of the techniques associated with the digital forensic practices and cyber-crime.**<br>**To explore practical knowledge about ethical hacking methods.**<br>**To learn the importance of evidence handling and storage for various devices.**<br>**To develop an excellent understanding of current cyber security issues (Computer Security Incident) and analyzed the ways that exploits in securities.**<br>**To investigate attacks, IDS. technical exploits and router attacks and "Trap and Trace" computer networks.**<br>**To apply digital forensic knowledge to use computer forensic tools and investigation report writing.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **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. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 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 | 1 |
| 2 | **Cyber Crimes and Cyber Laws-Introduction** | 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 & Cyber Regulation Appellate | 8 | 2 |
| 3 | **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 | 3 |
| 4 | **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 | 4 |
| 5 | **Cyber Security-** | 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. | | 5 |

**Reference Books:**


1. 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/ |
| |
| **e-Learning Source:** |
| **https://nptel.ac.in/courses/106106129** |
| |

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2020-21 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-529** | **Title of the Course** | **Digital image Processing** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **4** | **0** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **To explain basics of digital signal processing such as Fourier analysis**<br>**To expose students to different low level image processing tasks such as filtering, edgedetection etc.**<br>**To impart knowledge of image compression as well as various image Segmentationtechniques.**<br>**To introduce advanced image processing algorithms for face detection and recognition.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Explain basic image processing techniques for solving real Problems. |
| **CO2** | Apply image processing techniques for solving problems in computer science. |
| **CO3** | Develop understanding for object registration and recognition |
| **CO4** | Develop an application using existing image processing algorithms |
| **CO5** | Evaluate algorithms for higher level image processing. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| **1** | **Digital Image Fundamentals** | Image Sensing, and Acquisition, Image Sampling and Quantization, Basic Relationship between Pixels.<br>Sensor and Imaging: Imaging Optics, Radiometry of Imaging, illumination sources and techniques, Camera Principles, Color Imaging, Single Sensor Color Imaging and Color Demosaicing, Range Images,3DImaging. | 8 | 1 |
| **2** | **Signal Representation** | Vector Space and Unitary Transforms, Multi-Resolutional Signal Representation, Wave let Decomposition, Scale space and diffusion, Representation of color, Retinex Processing, Markov Random Field Modellings of Images | 10 | 2 |
| **3** | **Non-linear Image Processing** | Median and Order Statistics Filters, Rank-Ordered-Mean Filters and Signal Dependent Rank-Ordered-Mean Filters, Two Dimensional Teager Filters, Applications of nonlinear filters in image enhancement, edge detections, noise removal etc. | 8 | 3 |
| **4** | **Image Processing in Biometric Security** | Introduction, Fingerprint Recognition, Face Recognition, Iris Recognition, Vein Pattern Recognition, Multimodal Biometrics Techniques. Biometric System Architecture, Extraction Algorithm, Matching Algorithm, Authentication, Biometric System Evaluation, Privacy issues. | 8 | 4 |
| **5** | **Image Processing in Medical Field** | Image Processing in Medical Field: Introduction, CT scan images, MRI, Seeded segmentation methods: Desirable properties, Pixel Based Methods, Contour Based Methods, Geodesic Active Contours, level set method, deformable model, graph based method, Image analysis of retinal images :acquisition, preprocessing | 10 | 5 |

**Reference Books:**


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


**e-Learning Source:**

**https://nptel.ac.in/courses/117105135**

| | **Course Articulation Matrix: (Mapping of COs with POs and PSOs)** | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2020-21 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-530** | **Title of the Course** | **Applied Data Mining and Warehousing** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **4** | **0** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **Identify the scope and necessity of Data Mining & Warehousing for the society.**<br>**Describe various Data Models and Design Methodologies of Data Warehousing destined to solve the root problems.**<br>**To understand various Tools of Data Mining and their Techniques to solve the real time problems.**<br>**To learn how to analyze the data, identify the problems, and choose the relevant algorithms to apply. To assess the Pros and Cons of various algorithms and analyze their behaviour on real datasets.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Develop a strong foundation of knowledge about data warehouse and related techniques. |
| **CO2** | Design and build a data warehouse from the available historical data and perform OLAP operations to discover knowledge. |
| **CO3** | Preprocess the data using cleaning, integration, transformation and reduction and find associations and correlations among that data. |
| **CO4** | Classify the given dataset by using statistical and probabilistic models to predict the class labels of new data. |
| **CO5** | Perform cluster analysis by using some major clustering methods and work on the recent advancements on text and web mining. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| **1** | **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 | 1 |
| **2** | **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 | 2 |
| **3** | **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 | 3 |
| **4** | **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 | 4 |

| | | | | |
|---|---|---|---|---|
| **5** | **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 | 5 |

**Reference Books:**


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


**e-Learning Source:**

**https://nptel.ac.in/courses/106105174**

| PO-PSO / CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | 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- Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2018-19 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS-544 | **Title of the Course** | Machine Learning: Theory and Methods | **L** | **T** | **P** | **C** |
| **Year** | I | **Semester** | II | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | 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. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Know about the concepts of Learning Problems, Induction, Decision Tree |
| **CO2** | Know about the concepts of Neural Networks, Perceptrons, Genetic Algorithms, Boltzmann Machine. |
| **CO3** | Know about the concepts of Bayes theorem, Maximum Likelihood Method, Bayesian Classifier |
| **CO4** | Know about the concepts of K-means, clustering |
| **CO5** | Know about the concept of first order rule set, associative learning |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction** | Learning Problems Perspectives and Issues Concept Learning Version Spaces and Candidate Eliminations Inductive bias Decision Tree learning Representation Algorithm Heuristic Space Search. | 8 | 1 |
| 2 | **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 | 2 |
| 3 | **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 | 3 |
| 4 | **Instant Based Learning** | K- Nearest Neighbour Learning Locally weighted Regression Radial Basis Functions Case Based Learning. | 8 | 4 |
| 5 | **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 Theories Explanation Base Learning FOCL Algorithm Reinforcement Learning Task Q-Learning Temporal Difference Learning. | 8 | 5 |

**Reference Books:**


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


**e-Learning Source:**

**https://nptel.ac.in/courses/106105152**

| | Course Articulation Matrix: (Mapping of COs with POs and PSOs) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 |
| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| Effective from Session: 2018-19 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-545** | **Title of the Course** | **R Programming Lab** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **I** | **0** | **0** | **2** | **2** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **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 visualizations.** | | | | | | |

| Course Outcomes | |
|---|---|
| **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 |

| S. No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | Lab 1: Introduction to R | 2 | 1 |
| 2 | Lab 2: Identifying Types of Variables: Levels of Measurement | 2 | 1 |
| 3 | Lab 3: Univariate Statistics<br>1. How to generate and interpret frequency distributions<br>2. Data presentation<br>3. The connection between data presentation and levels of measurement. | 2 | 2 |
| 4 | Lab 4: Introduction to Probability, Recoding Variables | 2 | 2 |
| 5 | Lab 5: The Normal Curve<br>1. Creating a Histogram in R | 2 | 3 |
| 6 | Lab 6: Measures of Central Tendency and Dispersion<br>1.Generating Measures of Central Tendency | 2 | 3 |
| 7 | Lab 7: Standard Deviations, Standard Scores and the Normal Distribution<br>1. Reviewing the Shape and Characteristics of Distributions<br>2. Calculating z-scores | 2 | 4 |
| 8 | Lab 8: Sampling<br>3. Installing the ISCSS Package | 2 | 4 |
| 9 | Lab 9: Hypothesis Testing: Testing the Significance of the Difference Between Two Means | 2 | 5 |
| 10 | Lab 10: Hypothesis testing: One- and Two-tailed Tests | 2 | 5 |

**Reference Books:**

R for Data Science Hadley Wickham 1st edition O'Reilly

**e-Learning Source:**

**https://nptel.ac.in/courses/111104100**

| PO-PSO CO | PO1 | 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** |

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**

# Integral University, Lucknow

| **Effective from Session:** 2020-21 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **CS-549** | **Title of the Course** | **MACHINE LEARNING TOOLS LAB** | **L** | **T** | **P** | **C** |
| **Year** | **I** | **Semester** | **II** | **0** | **0** | **2** | **2** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | **To learn the basic concepts of programming for machine learning.**<br>**To be able to develop logics which help them to create machine learning programs and applications using Python language.**<br>**To analyze the datasets using supervised as well as unsupervised algorithms.**<br>**To learn the training and testing phases of machine learning.**<br>**After understanding the machine learning they can easily switch analyze various problems.** | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Able to understand the basic concepts of programming for machine learning. |
| **CO2** | Able to design and develop various machine learning programming problems using Python programming concepts. |
| **CO3** | Able to analyze and develop machine learning programs and applications. |
| **CO4** | Able to develop programs for diverse datasets, domains and dimensionality. |
| **CO5** | Able to draw inferences from analyzed dataset. |

| **S. No.** | **List of Experiments** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|
| | **Supervised Learning:** | | |
| 1 | Simple Regression | 2 | 1 |
| 2 | Logical Regression | 2 | 1 |
| 3 | Gradient Descent and Cost Function | 2 | 1 |
| 4 | Logistic Regression (Binary Classification) | 2 | 2 |
| 5 | Logistic Regression (Multiclass Classification) | 2 | 2 |
| 6 | Decision Tree Method | 2 | 2 |
| 7 | Support Vector Machine (SVM) | 2 | 3 |
| 8 | Random Forest Method | 2 | 3 |
| 9 | K Fold Cross Validation | 2 | 3 |
| | **Unsupervised Learning:** | | |
| 1 | K Means Clustering Algorithm | 2 | 4 |
| 2 | Naive Bayes Classifier | 2 | 4 |
| 3 | K nearest neighbors' classification | 2 | 5 |
| 4 | Principal Component Analysis (PCA) | 2 | 5 |
| | | | |

**e-Learning Source:**

**https://nptel.ac.in/courses/106105152**

| **PO-PSO CO** | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **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 Correlation; 2- Moderate Correlation; 3- Substantial Correlation**