# Syllabus of

# UNDERGRADUATE DEGREE COURSE

## Computer Science and Engineering
## (Artificial Intelligence)

## Rajasthan Technical University, Kota

Effective from session: 2022 – 2023

# RAJASTHAN TECHNICAL UNIVERSITY, KOTA

**B.Tech Computer Science and Engineering (Artificial Intelligence)**

## 5CAI3-01: Data Mining-Concepts and Techniques

**Credit: 2** **Max. Marks: 100(IA:30, ETE:70)**

**2L+0T+0P** **End Term Exam: 3 Hours**

**Course Objectives:**

1. To introduce the fundamental processes data warehousing and major issues in data mining
2. To impart the knowledge on various data mining concepts and techniques that can be applied to text mining, web mining etc.
3. To develop the knowledge for application of data mining and social impacts of data mining.

**Course Outcomes:** After completion of the course, students would be able to:

1. Interpret the contribution of data warehousing and data mining to the decision-support systems.
2. Prepare the data needed for data mining using pre-processing techniques.
3. Extract useful information from the labelled data using various classifiers.
4. Compile unlabeled data into clusters applying various clustering algorithms.
5. Discover interesting patterns from large amounts of data using Association Rule Mining
6. Demonstrate capacity to perform a self-directed piece of practical work that requires the application of data mining techniques.

**Detailed Syllabus: ( per session plan )**

| UNIT | Contents |
|---|---|
| 1 | Introduction to Data Mining: Introduction to data mining-Data mining functionalities-Steps in data mining process- Classification of data mining systems, Major issues in data mining. Data Wrangling and Preprocessing: Data Preprocessing: An overview-Data cleaning-Data transformation and Data discretization |
| 2 | Predictive Modeling: General approach to classification-Decision tree induction- Bayes classification methods- advanced classification methods: Bayesian belief networks-Classification by Backpropagation- Support Vector Machines-Lazy learners |
| 3 | Descriptive Modeling: Types of data in cluster analysis-Partitioning methods- Hierarchical methods-Advanced cluster analysis: Probabilistic model-based clustering- Clustering high-dimensional data-Outlier analysis |
| 4 | Discovering Patterns and Rules: Frequent Pattern Mining: Basic Concepts and a Road Map - Efficient and scalable frequent item set mining methods: Apriori algorithm, FP-Growth algorithm- Mining frequent itemsets using vertical data format- Mining closed and max patterns- Advanced Pattern Mining: Pattern Mining in Multilevel, Multidimensional Space |
| 5 | Data Mining Trends and Research Frontiers: Other methodologies of data mining: Web mining-Temporal mining-Spatial mining-Statistical data mining- Visual and audio data mining- Data mining applications- Data mining and society: Ubiquitous and invisible data mining- Privacy, Security, and Social Impacts of data mining |

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**TEXT BOOKS:**

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, third edition ,2013
2. Pang-Ning Tan,Michael Steinbach, Anuj Karpatne, Vipin Kumar, Introduction to Data Mining, second edition, Pearson, 2019

**REFERENCE BOOKS:**

1. Ian.H.Witten, Eibe Frank and Mark.A.Hall, Data Mining:Practical Machine Learning Tools and Techniques,third edition , 2017
2. Alex Berson and Stephen J. Smith, Data Warehousing, Data Mining & OLAP, Tata McGraw Hill Edition, Tenth Reprint, 2008.
3. Hand, D., Mannila, H. and Smyth, P. Principles of Data Mining, MIT Press: Massachusets. third edition, Pearson, 2013

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## 5CAI4-02: Compiler Design

**Credit: 3** **Max. Marks: 100(IA:30, ETE:70)**

**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 01 |
| 2 | **Introduction:** Objective, scope and outcome of the course. Compiler, Translator, Interpreter definition, Phase of compiler, Bootstrapping, Review of Finite automata lexical analyzer, Input, Recognition of tokens, Idea about LEX: A lexical analyzer generator, Error handling. | 06 |
| 3 | **Review of CFG Ambiguity of grammars:** Introduction to parsing. Top down parsing, LL grammars & passers error handling of LL parser, Recursive descent parsing predictive parsers, Bottom up parsing, Shift reduce parsing, LR parsers, Construction of SLR, Conical LR & LALR parsing tables, parsing with ambiguous grammar. Operator precedence parsing, Introduction of automatic parser generator: YACC error handling in LR parsers. | 10 |
| 4 | **Syntax directed definitions;** Construction of syntax trees, S-Attributed Definition, L-attributed definitions, Top down translation. Intermediate code forms using postfix notation, DAG, Three address code, TAC for various control structures, Representing TAC using triples and quadruples, Boolean expression and control structures. | 10 |
| 5 | **Storage organization;** Storage allocation, Strategies, Activation records, Accessing local and non-local names in a block structured language, Parameters passing, Symbol table organization, Data structures used in symbol tables. | 08 |
| 6 | **Definition of basic block control flow graphs;** DAG representation of basic block, Advantages of DAG, Sources of optimization, Loop optimization, Idea about global data flow analysis, Loop invariant computation, Peephole optimization, Issues in design of code generator, A simple code generator, Code generation from DAG. | 07 |
| | **Total** | 42 |

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## 5CAI4-03: Operating System

**Credit: 3** **Max. Marks: 100(IA:30, ETE:70)**

**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 01 |
| 2 | **Introduction and History of Operating systems:** Structure and operations; processes and files<br><br>Processor management: inter process communication, mutual exclusion, semaphores, wait and signal procedures, process scheduling and algorithms, critical sections, threads, multithreading | 04 |
| 3 | **Memory management:** contiguous memory allocation, virtual memory, paging, page table structure, demand paging, page replacement policies, thrashing, segmentation, case study | 05 |
| 4 | **Deadlock:** Shared resources, resource allocation and scheduling, resource graph models, deadlock detection, deadlock avoidance, deadlock prevention algorithms<br><br>**Device management:** devices and their characteristics, device drivers, device handling, disk scheduling algorithms and policies | 15 |
| 5 | **File management:** file concept, types and structures, directory structure, cases studies, access methods and matrices, file security, user authentication | 07 |
| 6 | **UNIX and Linux operating systems as case studies;** Time OS and case studies of Mobile OS | 08 |
| | **Total** | 40 |

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## 5CAI4-04: Computer Graphics & Multimedia

**Credit: 3** **Max. Marks: 100(IA:30, ETE:70)**
**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 01 |
| 2 | **Basic of Computer Graphics:**Basic of Computer Graphics, Applications of computer graphics, Display devices, Random and Raster scan systems, Graphics input devices, Graphics software and standards | 06 |
| 3 | **Graphics Primitives:**Points, lines, circles and ellipses as primitives, scan conversion algorithms for primitives, Fill area primitives including scan-line polygon filling, inside-outside test, boundary and flood-fill, character generation, line attributes, area-fill attributes, character attributers. Aliasing, and introduction to Anti Aliasing (No anti aliasing algorithm). | 07 |
| 4 | **Two Dimensional Graphics:**Transformations (translation, rotation, scaling), matrix representation, homogeneous coordinates, composite transformations, reflection and shearing, viewing pipeline and coordinates system, window-to-viewport transformation, clipping including point clipping, line clipping (cohen-sutherland, liang- bersky, NLN), polygon clipping | 08 |
| 5 | **Three Dimensional Graphics:**3D display methods, polygon surfaces, tables, equations, meshes, curved lies and surfaces, quadric surfaces, spline representation, cubic spline interpolation methods, Bazier curves and surfaces, B-spline curves and surfaces.3D scaling, rotation and translation, composite transformation, viewing pipeline and coordinates, parallel and perspective transformation, view volume and general (parallel and perspective) projection transformations. | 08 |
| 6 | **Illumination and Colour Models:**Light sources – basic illumination models – halftone patterns and dithering techniques; Properties of light – Standard primaries and chromaticity diagram; Intuitive colour concepts – RGB colour model – YIQ colour model – CMY colour model – HSV colour model – HLS colour model; Colour selection. | 06 |
| 7 | **Animations &Realism:**Design of Animation sequences – animation function – raster animation – key frame systems – motion specification – morphing – tweening.<br><br>**ComputerGraphics Realism:** Tiling the plane – Recursively defined curves – Koch curves – C curves – Dragons – space filling curves – fractals – Grammar based models – fractals – turtle graphics – ray tracing. | 06 |
| | **Total** | 42 |

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## 5CAI4-05: Analysis of Algorithms

**Credit: 3** **Max. Marks: 100(IA:30, ETE:70)**
**3L+0T+0P** **End Term Exam: 3 Hours**

| SN | Contents | Hours |
|---|---|---|
| 1 | **Introduction:** Objective, scope and outcome of the course. | 01 |
| 2 | **Background**: Review of Algorithm, Complexity Order Notations: definitions and calculating complexity.<br><br>**Divide And Conquer Method**: Binary Search, Merge Sort, Quick sort and Strassen's matrix multiplication algorithms. | 06 |
| 3 | **Greedy Method**: Knapsack Problem, Job Sequencing, Optimal Merge Patterns and Minimal Spanning Trees.<br><br>**Dynamic Programming**: Matrix Chain Multiplication. Longest CommonSubsequence and 0/1 Knapsack Problem. | 10 |
| 4 | **Branch And Bound**: Traveling Salesman Problem and Lower Bound Theory. Backtracking Algorithms and queens problem.<br><br>**Pattern Matching Algorithms**: Naïve and Rabin Karp string matching algorithms, KMP Matcher and Boyer Moore Algorithms. | 08 |
| 5 | **Assignment Problems:** Formulation of Assignment and Quadratic Assignment Problem.<br><br>**Randomized Algorithms-** Las Vegas algorithms, Monte Carlo algorithms, randomized algorithm for Min-Cut, randomized algorithm for 2- SAT. Problem definition of Multicommodity flow, Flow shop scheduling and Network capacity assignment problems. | 08 |
| 6 | **Problem Classes Np, Np-Hard And Np-Complete:** Definitions of P, NP-Hard and NP-Complete Problems. Decision Problems.Cook's Theorem. Proving NP-Complete Problems - Satisfiability problem and Vertex Cover Problem. Approximation Algorithms for Vertex Cover andSet Cover Problem. | 08 |
| | **Total** | 41 |

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## 5CAI5-11: Fundamentals of Blockchain

**Credit: 2** **Max. Marks: 100(IA:30, ETE:70)**
**2L+0T+0P** **End Term Exam: 3 Hours**

**Course Objectives:**

1. The students should be able to understand a broad overview of the essential concepts of blockchain technology.
2. To familiarize students with Bitcoin protocol followed by the Ethereum protocol – to lay the foundation necessary for developing applications and programming.
3. Students should be able to learn about different types of blockchain and consensus algorithms.

**Course Outcomes:** After completion of the course, students would be able to:

1. To explain the basic notion of distributed systems.
2. To use the working of an immutable distributed ledger and trust model that defines blockchain.
3. To illustrate the essential components of a blockchain platform.

**Detailed Syllabus: ( per session plan )**

| UNIT | Contents |
|---|---|
| 1 | Basics: The Double-Spend Problem, Byzantine Generals' Computing Problems, Public-Key Cryptography, Hashing, Distributed Systems, Distributed Consensus. |
| 2 | Technology Stack: Blockchain, Protocol, Currency.<br>Bitcoin Blockchain: Structure, Operations, Features, Consensus Model, Incentive Model |
| 3 | Ethereum Blockchain: Smart Contracts, Ethereum Structure, Operations, Consensus Model, Incentive Model. |
| 4 | Tiers of Blockchain Technology: Blockchain 1.0, Blockchain 2.0, Blockchain 3.0, Types of Blockchain: Public Blockchain, Private Blockchain, Semi-Private Blockchain, Sidechains. |
| 5 | Types of Consensus Algorithms: Proof of Stake, Proof of Work, Delegated Proof of Stake,<br>Proof Elapsed Time, Deposite-Based Consensus, Proof of Importance, Federated Consensus or Federated Byzantine Consensus, Practical Byzantine Fault Tolerance. Blockchain Use Case: Supply Chain Management. |

**TEXT BOOKS:**

1. Kirankalyan Kulkarni, Essentials of Bitcoin and Blockchain, Packt Publishing.
2. Anshul Kaushik, Block Chain & Crypto Currencies, Khanna Publishing House.
3. Tiana Laurence, Blockchain for Dummies, 2nd Edition 2019, John Wiley & Sons.
4. Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks by Imran Bashir, Packt Publishing (2017).

**REFERENCE BOOKS:**

1. Blockchain: Blueprint for a New Economy by Melanie Swan, Shroff Publisher O'Reilly Publisher

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Media; 1st edition (2015).
2. Mastering Bitcoin: Programming the Open Blockchain by Andreas Antonopoulos.

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## 5CAI5-12: Mathematical Modelling for Data Science

**Credit: 2** **Max. Marks: 100(IA:30, ETE:70)**

**2L+0T+0P** **End Term Exam: 3 Hours**

| **Course Objectives:** | |
|---|---|
| 1. To introduce the various mathematical concepts and models, and provide skills required to implement the models.<br>2. To undertake a critical evaluation of a wide range of numerical and data.<br>3. To develop designing skills for modeling non-deterministic problems. | |
| **Expected Course Outcome:** | |
| 1. Demonstrate understanding of basic mathematical concepts in data science, relating to linear algebra, probability, and calculus and employ them.<br>2. Apply linear models for regression and linear models for classification<br>3. Employ kernel models, SVM and RVM<br>4. Conceptualize problems as graphical models, mixture models and analyse using estimation-maximation algorithms<br>5. Demonstrate with illustrative examples PCA | |
| **Unit:1 Linear Algebra** | **3 hours** |
| Matrices, solving linear equations, vector spaces, linear independence, basis and rank, linear mappings, affine spaces, norms, inner products, orthogonality, orthonormal basis, inner product of functions, orthogonal projections | |
| **Unit:2 Matrix Decompositions** | **4 hours** |
| Determinant and trace, Eigen values and Eigen vectors, Cholesky decomposition, Eigen decomposition, Singular value decomposition, matrix approximation | |
| **Unit:3 Vector Calculus** | **4 hours** |
| Differentiation of Univariate Functions, Partial Differentiation and Gradients, Gradients of Vector-Valued Functions, Gradients of Matrices, Useful Identities for Computing Gradients, Backpropagation and Automatic Differentiation, Higher-Order Derivatives, Linearization and Multivariate Taylor Series. | |
| **Unit:4 Probability, Distributions and optimizations** | **4 hours** |
| Construction of a Probability Space, Discrete and Continuous Probabilities, Sum Rule, Product Rule, and Bayes' Theorem, Summary Statistics and Independence, Gaussian Distribution, Conjugacy and the Exponential Family, Change of Variables/Inverse Transform, Continuous Optimization, Optimization Using Gradient Descent, Constrained Optimization and Lagrange Multipliers, Convex Optimization | |
| **Unit:5 Data Models** | **4 hours** |
| Data, Models, and Learning, Empirical Risk Minimization, Parameter Estimation, Probabilistic Modeling and Inference, Directed Graphical Models, Model Selections | |

**Text Book(s)**

**1.** Marc Peter Deisenroth, A. Aldo Faisal, and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.

**Reference Books**

1. Matthias Dehmer, Salissou Moutari, Frank Emmert-Streib, Mathematical Foundations of Data Science Using R, De Gruyter Oldenbourg, 2020.
2. Norman Matloff, Probability and Statistics for Data Science: Math + R + Data, CRC Data Science Series, 2019.

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## 5CAI5-13: Programming for Data Science

**Credit: 2** **Max. Marks: 100(IA:30, ETE:70)**

**2L+0T+0P** **End Term Exam: 3 Hours**

| | | |
|---|---|---|
| **Course Objectives:** | | |
| 1. To provide necessary knowledge on data manipulation and to perform analysis on the practical problems using statistical and machine learning approach<br>2. To generate report and visualize the results in graphical form using programming tool | | |
| **Expected Course Outcome:** | | |
| 1. Ability to gain basic knowledge on data science<br>2. Convert the real time data into suitable form for analysis<br>3. Gain the insights from the data through statistical inferences<br>4. Develop suitable models using machine learning techniques and to analyze its performance<br>5. Identify the requirement and visualize the results<br>6. Analyze on the performance of the model and the quality of the results | | |
| **Unit:1** | **INTRODUCTION** | **4 hours** |
| Data Science: Introduction to Data Science – Digital Universe – Sources of Data – Information Commons – Data Science Project Life Cycle: OSEMN Framework | | |
| **Unit:2** | **DATA PREPROCESSING & CONCEPT LEARNING** | **6 hours** |
| Introduction to Data Preprocessing – Reading, Selecting, Filtering Data – Filtering Missing Values – Manipulating, Sorting, Grouping, Rearranging, Ranking Data Formulation of Hypothesis – Probabilistic Approximately Correct Learning - VC Dimension – Hypothesis elimination – Candidate Elimination Algorithm | | |
| **Unit:3** | **ESSENTIALS OF R** | **8 hours** |
| R Basics - data types and objects - control structures – data frame -Feature Engineering - scaling, Label Encoding and One Hot Encoding, Reduction | | |
| **Unit:4** | **MODEL FIT USING R** | **8 hours** |
| Regression Models- Linear and Logistic Model, Classification Models – Decision Tree, Naïve Bayes, SVM and Random Forest, Clustering Models – K Means and Hierarchical clustering | | |
| **Unit:5** | **VISUALIZATION** | **6 hours** |
| Data visualization: Box plot, histogram, scatter plot, heat map – Working with Tableau – Outlier detection – Data Balancing | | |
| **Unit:6** | **PERFORMANCE EVALUATION in R** | **4 hours** |
| Loss Function and Error: Mean Squared Error, Root Mean Squared Error – Model Selection and Evaluation criteria: Accuracy, Precision, F1 score, Recall Score – Binary Predictive Classification – Sensitivity – Specificity. | | |

**Text Book(s)**


1. Ethem Alpaydin, Introduction to Machine Learning, Fourth Edition, MIT Press, 2020
2. Hadley Wickham, Garrett Grolemund, R for data science : Import, Tidy, Transform, Visualize, And Model Data Paperback, 2017


**Reference Books**


1. Han, J., Kamber, M., Pei, J. Data mining concepts and techniques. Morgan Kaufmann. 2011
2. Carl Shan, Henry Wang, William Chen, Max Song. The Data Science Handbook: Advice and Insight from 25 Amazing Data Scientists. The Data Science Bookshelf. 2016
3. James, G., Witten, D., T., Tibshirani, R. An Introduction to statistical learning with applications in R. Springer. 2013


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## 5CAI4-21: Computer Graphics & Multimedia Lab

**Credit: 1** **Max. Marks:100 (IA:60, ETE:40)**
**0L+0T+2P** **End Term Exam: 2 Hours**

| SN | List of Experiments |
|---|---|
| 1 | Implementation of Line, Circle and ellipse attributes |
| 2 | To plot a point (pixel) on the screen |
| 3 | To draw a straight line using DDA Algorithm |
| 4 | Implementation of mid-point circle generating Algorithm |
| 5 | Implementation of ellipse generating Algorithm |
| 6 | Two Dimensional transformations - Translation, Rotation, Scaling, Reflection, Shear |
| 7 | Composite 2D Transformations |
| 8 | Cohen Sutherland 2D line clipping and Windowing |
| 9 | Sutherland – Hodgeman Polygon clipping Algorithm |
| 10 | Three dimensional transformations - Translation, Rotation, Scaling |
| 11 | Composite 3D transformations |
| 12 | Drawing three dimensional objects and Scenes |
| 13 | Generating Fractal images |

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## 5CAI4-22: Compiler Design Lab

**Credit: 1** **Max. Marks: 100 (IA:60, ETE:40)**
**0L+0T+2P** **End Term Exam: 2 Hours**

| SN | List of Experiments |
|---|---|
| 1 | Introduction: Objective, scope and outcome of the course. |
| 2 | To identify whether given string is keyword or not. |
| 3 | Count total no. of keywords in a file. [Taking file from user] |
| 4 | Count total no of operators in a file. [Taking file from user] |
| 5 | Count total occurrence of each character in a given file. [Taking file from user] |
| 6 | Write a C program to insert, delete and display the entries in Symbol Table. |
| 7 | Write a LEX program to identify following:<br>1. Valid mobile number<br>2. Valid url<br>3. Valid identifier<br>4. Valid date (dd/mm/yyyy)<br>5. Valid time (hh:mm:ss) |
| 8 | Write a lex program to count blank spaces,words,lines in a given file. |
| 9 | Write a lex program to count the no. of vowels and consonants in a C file. |
| 10 | Write a YACC program to recognize strings aaab,abbb using a^nb^n, where b>=0. |
| 11 | Write a YACC program to evaluate an arithmetic expression involving operators +,-,* and /. |
| 12 | Write a YACC program to check validity of a strings abcd,aabbcd using grammar a^nb^nc^md^m, where n , m>0 |
| 13 | Write a C program to find first of any grammar. |

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## 5CAI4-23: Analysis of Algorithms Lab

**Credit: 1** **Max. Marks: 100 (IA:60, ETE:40)**
**0L+0T+2P** **End Term Exam: 2 Hours**

| SN | List of Experiments |
|---|---|
| 1 | Sort a given set of elements using the Quicksort method and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. |
| 2 | Implement a parallelized Merge Sort algorithm to sort a given set of elements and determine the time required to sort the elements. Repeat the experiment for different values of n, the number of elements in the list to be sorted and plot a graph of the time taken versus n. The elements can be read from a file or can be generated using the random number generator. |
| 3 | a. Obtain the Topological ordering of vertices in a given digraph. b. Compute the transitive closure of a given directed graph using Warshall's algorithm. |
| 4 | Implement 0/1 Knapsack problem using Dynamic Programming. |
| 5 | From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra's algorithm. |
| 6 | Find Minimum Cost Spanning Tree of a given undirected graph using Kruskal's algorithm. |
| 7 | a. Print all the nodes reachable from a given starting node in a digraph using BFS method. b. Check whether a given graph is connected or not using DFS method. |
| 8. | Find Minimum Cost Spanning Tree of a given undirected graph using Prim's algorithm. |
| 9. | Implement All-Pairs Shortest Paths Problem using Floyd's algorithm. |
| 10 | Implement N Queen's problem using Back Tracking. |

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## 5CAI4-24: Advance Java Lab

**Credit: 1** **Max. Marks: 100 (IA:60, ETE:40)**
**L+0T+2P** **End Term Exam: 2 Hours**

| SN | List of Experiments |
|---|---|
| 1 | Introduction To Swing, MVC Architecture, Applets, Applications and Pluggable Look and Feel, Basic swing components : Text Fields, Buttons, Toggle Buttons, Checkboxes, and Radio Buttons |
| 2 | Java database Programming, java.sql Package, JDBC driver, Network Programming With java.net Package, Client and Server Programs, Content And Protocol Handlers |
| 3 | RMI architecture, RMI registry, Writing distributed application with RMI, Naming services, Naming And Directory Services, Overview of JNDI, Object serialization and Internationalization |
| 4 | J2EE architecture, Enterprise application concepts, n-tier application concepts, J2EE platform, HTTP protocol, web application, Web containers and Application servers |
| 5 | Server side programming with Java Servlet, HTTP and Servlet, Servlet API, life cycle, configuration and context, Request and Response objects, Session handling and event handling, Introduction to filters with writing simple filter application |
| 6 | JSP architecture, JSP page life cycle, JSP elements, Expression Language, Tag Extensions, Tag Extension API, Tag handlers, JSP Fragments, Tag Files, JSTL, Core Tag library, overview of XML Tag library, SQL Tag library and Functions Tag library |

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