**Integral University, Lucknow**

| **Effective from Session:** 2016-17 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | BM-226 | **Title of the Course** | Human Values & Professional Ethics | **L** | **T** | **P** | **C** |
| **Year** | **II** | **Semester** | III | **3** | **0** | **0** | **0** |
| **Pre-Requisite** | None | **Co-requisite** | none | | | | |
| **Course Objectives** | • To understand the moral values that ought to guide the Management profession, Resolve the moral issues in the profession,<br>• To justify the moral judgment concerning the profession.<br>• To create an awareness on Management Ethics and Human Values.<br>• To inspire Moral and Social Values and Loyalty. Intended to develop a set of beliefs, attitudes, and habits that engineers should display concerning morality.<br>• To create awareness about the important global issues: . Multinational corporations - Environmental ethics - computer ethics - weapons development | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Development of moral and ethical values, right understanding and relationships |
| **CO2** | Knowledge of Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property rights and its laws. |
| **CO3** | Awareness about the Professional Responsibility of engineers, Responsibility of engineers related to risks, hazards and safety. |
| **CO4** | Development of Engineers Ethics. Understanding of variety of moral issues, moral judgment concerning the profession. |
| **CO5** | Understanding of various of global issues; Environmental ethics - computer ethics - weapons development. |

| **Unit No.** | **Title of the Unit** | **Content of Unit** | **Contact Hrs.** | **Mapped CO** |
|---|---|---|---|---|
| 1 | Human Value Education | Understanding the need, basic guidelines, content and process for Value Education, Self-Exploration. Its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly. | 6 | CO1 |
| 2 | Introduction to Ethical Concept | Definition of industrial ethics and values, Ethical rules of industrial worker. Values and Value Judgments. Moral Rights and Moral rules, Moral character and responsibilities. Privacy, Confidentiality, Intellectual Property and the Law. Ethics as Law. | 6 | CO2 |
| 3 | Professional Responsibility | The basis and scope of Professional Responsibility, Professions and Norms of Professional Conduct, Ethical Standards versus Profession, Culpable mistakes, the Autonomy of professions and codes of ethics. Employee status and Professionalism. Central Professional Responsibilities of Engineers: The emerging consensus on the Responsibility for safety among engineers, hazards and risks. | 6 | CO3 |
| 4 | Engineers Ethics | Senses of 'Engineering Ethics' - variety of moral issues - types of inquiry - moral dilemmas – moral autonomy - Kohlberg's theory - Gilligan's theory - consensus and controversy – Models of Professional Roles theories about right action – Self-interest - customs and religion - uses of ethical theories. Valuing Time – Cooperation – Commitment. | 6 | CO4 |
| 5 | A Glimpse of Life Stories, Global Issues | Life story of Prophet Mohammad, Mahatma Gandhi, Swami Vivekanand, Marie Curie and Steve Jobs. Multinational corporations - Environmental ethics - computer ethics - weapons development - engineers as managers consulting engineers-engineers as expert witnesses and advisors -moral leadership. | 6 | CO5 |

**Reference Books:**


1. R.S. Naagarazan 2006, "A Textbook on Professional Ethics and Human values" New Age International Publisher.
2. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Value Education.
3. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw-Hill, New York 1996.


**e-Learning Source:**

1. Value Education website, http://www.uptu.ac.in . 2. Story of Stuff, http://www.storyofstuff.com
2. **https://www.youtube.com/watch?v=nlh9V5gd8hg&list=PLbMVogVj5nJQ20ZixllzM69agBq-m8ndV**
3. **https://www.youtube.com/watch?v=9LSEBK03CiY&list=PLysZquKdjuWSv87TaE7pByn5TE_e46O2C**

| **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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 3 | 3 | | | 3 | | 2 | | 2 | 2 | 2 | 3 | |
| **CO2** | 3 | 3 | 2 | 3 | 3 | | | 2 | | | | | 2 | 3 | 3 | |
| **CO3** | 2 | 3 | 2 | 3 | 2 | | | 3 | | 3 | | | 3 | 3 | 3 | |
| **CO4** | 2 | 3 | 2 | 3 | 2 | | | 2 | | | | 1 | 3 | 3 | 2 | |
| **CO5** | 3 | 2 | 3 | 3 | 2 | | | 3 | | 2 | | 1 | 2 | 2 | 3 | |

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS203 | **Title of the Course** | Cyber Law and Information Security | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 2 | 0 | 0 | 3 |
| **Pre-Requisite** | NIL | **Co-requisite** | NIL | | | | |
| **Course Objectives** | • Knowledge about cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft.<br>• Knowledge on the disciplines of technology, E-business and law to allow them to minimize the occurrence and severity of information security incidents.<br>• Knowledge about Information System and principles of Information Security (as confidentiality, integrity, and availability).<br>• Knowledge of cryptography and techniques used to detect and prevent network intrusions. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Understand key terms and concepts in cyber law, intellectual property and cybercrimes (internet security threats), trademarks and domain theft. |
| **CO2** | Apply and analyze knowledge of technology, E-business, and law to minimize the occurrence and impact of information security incidents. |
| **CO3** | Understand and evaluate the principles of Information Security, including confidentiality, integrity, and availability, in relation to information systems. |
| **CO4** | Understand and apply cryptographic techniques and methods to detect and prevent network intrusions, ensuring secure data transmission. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Fundamentals of Cyber Law** | Jurisprudence of Cyber Law, Object and Scope of the IT Act 2000, Introduction to Indian Cyber Law, Unicitral Model Law, ISP Guideline. Intellectual property issues and cyber space, Indian perspective, Overview of Intellectual property related legislation in India, Patent, CopyRight, Trademark law, Law related to semiconductor layout & design. | 8 | CO1 |
| 2 | **E - Commerce** | Security Threats to E - Commerce, Virtual Organization, Business Transactions on Web, EGovernance and EDI, Concepts in Electronics payment systems, E-Cash, Credit/Debit Cards, E- Agreement, Legal recognition of electronic and digital records, E- Commerce Issues of privacy, Wireless Computing- Security challenges in Mobile devices. Digital Signatures - Technical issues, legal issues, Electronic Records, Digital Contracts, and Requirements of Digital Signature System. | 7 | CO2 |
| 3 | **Investigation and Ethics** | Cyber Crime, Cyber jurisdiction, Cyber crime and evidence act, Treatment of different countries of cyber crime, Ethical issues in data and software privacy, Plagiarism, Pornography, Tampering computer documents, Data privacy and protection, Domain Name System, Software piracy, Issues in ethical hacking. Internet security threats: Hacking, Cracking, Sneaking, Viruses, Trojan horse, Malicious Code & logic bombs. Introduction to biometric security and its challenges, Finger prints, Cyber crime forensic: CASE STUDY in Cyber Crime. | 9 | CO3 |
| 4 | **Information security** | Information Systems and its Importance, Role of Security in Internet and Web Services, Principles of Information Security, Classification of Threats and attacks, Security Challenges, Security Implication for organizations, Security services - Authentication, Confidentiality, Integrity, Availability and other terms in Information Security, Information Classification and their Roles. Introduction to Cryptography, Issues in Documents Security, Keys: Public Key, Private Key, Firewalls, Basic Concepts of Network Security, Perimeters of Network protection & Network attack, Need of Intrusion Monitoring and Detection. | 9 | CO4 |

**Reference Books:**


Harish Chander "Cyber Law and IT Protection" , PHI Publication, New Delhi

Merkov, Breithaupt," Information Security", Pearson Education

"Cyber Law in India" - Farooq Ahmad-Pioneer books.

K. K. Singh, Akansha Singh "Information Security and Cyber law", Umesh Publication, Delhi


**e-Learning Source:**

https://nptel.ac.in/courses/106106248

https://onlinecourses.swayam2.ac.in/cec24_cs14/preview

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

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

# Integral University, Lucknow

| Effective from Session:2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS204 | **Title of the Course** | Data Structure Using C | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 0 | 2 | 4 |
| **Pre-Requisite** | - | **Co-requisite** | - | | | | |
| **Course Objectives** | • To comprehend the basics of Data Structure, their Managements and Operations such as array, string manipulations and various operations over different kinds of linked lists.<br>• To learn stack & queue data structure and various applications based on the phenomenon of recursion, polish notations and polish conversions, priority Queue & its Programming implementation.<br>• Understanding the tree data structure and its various types & applications to develop the efficient solutions and fine tune the complexity of solutions through its Programming implementation.<br>• To study the various sorting and searching techniques and various algorithmic approaches, know hashing and collision resolving techniques & its Programming implementation.<br>• To Understand and implement the hierarchical data structure such as Graph and its various traversal algorithms, concept of file organization and record handling | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Recall and understand the basics of data structures, their programming implementations, and foundational concepts for developing better solutions using Array and Linked list. |
| **CO2** | Apply, analyze, and evaluate stack and queue data structures, understand the phenomenon of recursion, and implement various applications based on these principles. |
| **CO3** | Develop and assess solutions using tree data structures, applying recursive approaches to enhance the efficacy of the solution to the complex problems. |
| **CO4** | Apply, analyze, and evaluate different searching and sorting algorithms, assessing their performance to ensure optimized data handling. |
| **CO5** | Understand, create, and, implement solutions for graph based data structures & file organization techniques to develop efficient solutions using non-linear data structure approaches. |

**THEORY**

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction to Data Structures** | **Basic Terminology:** Elementary Data Organization, Data Structure Operations. Algorithms, Analysis of Algorithms, Complexity of Algorithms, Time-Space Tradeoff.<br>**Arrays:** Array Definition, Representation and Analysis, Single and Multi-Dimensional Arrays, Address Calculation, Application of Arrays, Character String Representation, Character String Operation, Sparse Matrices & Vectors.<br>**Linked List:** Representation and Implementation of Singly Linked List, Traversing, Searching of Linked List, Insertion & Deletion to/from Linked List, Underflow & Overflow. Circular Linked List, Doubly Linked List, Two- way Header List, Polynomial Representation & Addition, Generalized Linked List, Garbage Collection and Compaction | 9 | 1 |
| 2 | **Stacks & Ques** | **Stack**: Array Representation and Implementation of Stack, Operations on Stacks: Push & Pop, Linked Representation of Stack, Application of Stack: Conversion of Infix to Prefix and Postfix Expressions, Evaluation of Postfix Expression using Stack. Recursion: Recursive Definition and Processes, Recursion in C, Example of Recursion, Tower of Hanoi Problem.<br>**Queues:** Array and Linked Representation and Implementation of Queues, Operations on Queue: Create, Add, Delete, Full and Empty; Circular Queues, D-queues and Priority Queues**.** | 9 | 2 |
| 3 | **Trees** | Basic Terminology, Binary Trees, Binary Tree Representation, Algebraic Expressions, Complete Binary Tree, Extended Binary Trees, Array and Linked Representation of Binary Trees, Traversing Binary Trees, Threaded Binary Trees, Traversing Threaded Binary Trees, Huffman Algorithm, Binary Search Tree (BST), Insertion and Deletion in BST, Path Length, AVL Trees, B-trees. | 8 | 3 |
| 4 | **Searching, Sorting and Hashing** | Sequential Search, Binary Search, Comparison and Analysis, Hash Table, Hash Functions, Collision Resolution Strategies, Hash Table Implementation.<br>**Sorting:** Insertion Sort, Bubble Sort, Quick Sort, Two Way Merge Sort, Heap Sort. | 7 | 4 |
| 5 | **Graphs** | **Graph:** Terminology & Representations, Graphs & Multi-Graphs, Directed Graphs, Sequential Representations of Graphs, Adjacency Matrices, Traversal, Connected Component and Spanning Trees, Minimum Cost Spanning Trees.<br>**File Handling:** Physical Storage Media File Organization, Organization of Records into Blocks, Sequential Files, Indexing and Hashing, Primary Indices, Secondary Indices | 7 | 5 |

**PRACTICAL**

| S.No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | To implement Array: Insertion, deletion and Pattern matching of a substring in an Arrays & searching an element in an Array using Iterative Binary Search | 2 | 1 |
| 2 | To implement Linked Lists: Creation, insertion deletion and searching in a singly linked list as well as in a doubly linked list. | 2 | 1 |
| 3 | To Implement Stack (using Array approach as well as Linked approach): Push & Pop operations, converting infix | 2 | 2 |

| | | | |
|---|---|---|---|
| | expression to its postfix form, and, Tower of Hanoi using Recursion. | | |
| 4 | To Implement QUEUES (using Array approach as well as Linked approach): Insertion & Deletion in a Linear Queue, DQueue and Circular Queue. | 2 | 2 |
| 5 | To Implement Tree: Creation, Insertion, Deletion of nodes in a tree and Tree Traversal algorithms using Recursive and Non-Recursive approach. | 2 | 3 |
| 6 | To implement an AVL Tree. | 2 | 3 |
| 7 | To Implement Searching: Linear Search, Binary Search, and Hashing. | 2 | 4 |
| 8 | To Implement Sorting: Insertion Sort, Quick Sort, Merge Sort, Bubble Sort and Heap Sort. | 2 | 4 |
| 9 | To Implement Graph: Creation of Graph, Searching in Graph. | 2 | 5 |
| 10 | To Implement various Graph traversal algorithms. | 2 | 5 |

**Reference Books:**


1. M. Tannenbaum. "Data Structure Using C/C+"
2. Horowitz And Sahani "Fundamental of Data Structure", Galgotia Publication
3. A Lipschutz "Data Structure", Schaum series.
4. Reema Thareja, "Data Structure Using C", Oxford University Press


**e-Learning Source:**

https://archive.nptel.ac.in/courses/106/102/106102064/

https://archive.nptel.ac.in/courses/106/105/106105085/

https://onlinecourses.swayam2.ac.in/cec24_cs17/preview

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS206 | **Title of the Course** | Discrete Structure | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 0 | 0 | 3 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | Explain the basic components of computers, their interconnection and data representation techniques in computer systems. To assess the working of CPU and become familiar with computer arithmetic's. Understand the control unit design using a hardwired and micro programmed approach. To study the memory organization and articulate design issues in each element of memory hierarchy | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Recall and understand set operations (union, intersection, complement, difference) using proper notation; interpret Venn diagrams and determine mappings as functions or relations. |
| **CO2** | Apply and analyze ordered sets, Hasse diagrams, and Boolean algebra properties, including logic gates and Karnaugh maps for effective simplification |
| **CO3** | Understand and evaluate logical propositions, first-order logic, truth tables, and logical equivalencies to develop valid logical arguments. |
| **CO4** | Apply and analyze recurrence relations, generating functions, and properties of graphs like bipartite and Euler graphs, determining chromatic numbers. |
| **CO5** | Identify and solve Recurrence Relations, Generating Functions, Bipartite, Regular, Connected Components in a Graph, Euler Graphs, Hamiltonian Path and Circuits, Chromatic Number |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1. | **Set Theory** | Definition of Sets, Countable and Uncountable Sets, Venn Diagrams, Proofs of Some General Identities on Sets Relation: Definition, Types of Relation, Composition of Relations, Pictorial Representation of Relation, Equivalence Relation, Partial Ordering Relation.<br>Function: Definition, Type of Functions, One to One, Into and Onto Function, Inverse Function, of Functions, Recursively Defined Functions.<br>Theorem Proving Techniques: Mathematical Induction Simple and Strong), Pigeonhole Principle, Prove by Contradiction. | 9 | 1 |
| 2. | **Algebraic Structures** | Definition, Properties, Types: Semi Groups, Monoid, Groups, Abelian Group, Properties of Groups, Subgroup, Cyclic Groups, Cosets, Factor Group, Permutation Groups, Normal Subgroup, Homomorphism and Isomorphism of Groups, Example and Standard Results, Rings and Fields: Definition and Standard Results. | 8 | 2 |
| 3. | **Posets, Hasse Diagram and Lattices** | Introduction, Ordered Set, Hasse Diagram of Partially, Ordered Set, Isomorphic Ordered Set, Well Ordered Set, Properties of Lattices, Bounded I and Complemented Lattices.<br>Boolean Algebra: Basic Definitions, Sum of Products and Product of Sums, Form in Boolean Algebra, Logic Gates and Karnaugh Maps.<br>Tree: Definition, Rooted Tree, Properties of Trees, Binary Search Tree, Tree Traversal. | 9 | 3 |
| 4. | **Propositional Logic** | Proposition, First Order Logic, Basic Logical Operation, Truth Tables, Tautologies, Contradictions, Algebra of Proposition, Logical Implications, Logical Equivalence, Predicates, Universal And Existential Quantifiers. | 7 | 4 |
| 5. | **Combinatorics & Graphs** | Recurrence Relation, Generating Function, Simple Graph, Multi Graph, Graph Terminology, Representation of Graphs, Bipartite, Regular, Planar and Connected Graphs, Connected Components in a Graph, Euler Graphs, Hamiltonian Path and Circuits, Graph Coloring, Chromatic Number, Isomorphism and Homomorphism of Graphs. | 8 | 5 |

**Reference Books:**


1. Deo, Narsingh, "Graph Theory With application to Engineering and Computer.Science.", PHI.
2. Liptschutz, Seymour, "Discrete Mathematics", McGraw Hill.
3. Trembley, J.P & R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", McGraw Hill.
4. Kenneth H. Rosen, "Discrete Mathematics and its applications", McGraw Hill.
5. Krishnamurthy, V., "Combinatorics Theory & Application", East-West Press Pvt. Ltd., New Delhi.


**e-Learning Source:**

https://archive.nptel.ac.in/courses/106/105/106105192/

https://onlinecourses.nptel.ac.in/noc22_cs49/preview

https://archive.nptel.ac.in/courses/106/106/106106094/

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS229 | **Title of the Course** | Software Engineering | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 0 | 0 | 3 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | • Explain the basic understanding of software, its characteristics, and importance of following engineering principles to develop software.<br>• Assess the applicability, strengths, and weaknesses of the different development life cycle models to provide real world software solutions.<br>• To understand various processes of each phase of SDLC and make the students capable of preparing quality documentation for software development.<br>• To develop effort estimation and risk management skills for developing software.<br>• Study of CASE tools, Quality Assurance activities etc. for focusing on quality issues of software. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Identify the best suitable SDLC model for a given set of user requirements. |
| **CO2** | Estimate the total effort, to assess and manage the potential risks involved while developing the software. |
| **CO3** | Create a good quality SRS and design a highly cohesive and low coupled software |
| **CO4** | Follow the standard coding guidelines and practices and prepare best possible test cases to uncover errors. |
| **CO5** | Work on modern CASE tools and follow the international quality standards to produce good quality software. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction to Software Engineering** | Types of Software, Software Characteristics, Quality of a Good Software, Software Myths, Software Crisis, Software Engineering: Definition, Challenges, Software Engineering Processes, Similarity and Differences from Conventional Engineering Processes. Software Development Life Cycle Models: Waterfall Model, Prototyping Model, RAD Model Iterative Enhancement Model and Spiral Model. | 8 | 1 |
| 2 | **Planning a Software** | Process Planning, Effort Estimation: Uncertainties in Effort Estimation, Building Effort Estimation Models, COCOMO Model, Project Scheduling & Staffing: Overall Scheduling, Detailed Scheduling, Team Structure, Software Configuration Management (SCM): - Baselines, Version Control, Change Control & Configuration Audit, Risk Management, Software Risks, Risk Analysis, Identification, Projection, Assessment, Monitoring and Managing the Risk, RMMM Plan. | 8 | 2 |
| 3 | **Software Requirements Analysis and Specification** | Software Requirements: Need for SRS, Requirement Process, Problem Analysis: Informal & formal Approaches, Data Flow Modeling, Prototyping, Requirements Specifications: Characteristics of an SRS, Components of SRS, Specification Language, Structure of Requirement Document: IEEE Standards for SRS. Software Design: Designing: Function Oriented Design: Design Principles: Problem Partitioning and Hierarchy, Abstraction, Modularity, Top Down and Bottom-Up Strategies, Module Level Concepts: Coupling, Cohesion; Introduction to Object Oriented Design, Software Measurement Metrics: Various Size Oriented Measures- Halestead's Software Science, Function Point (FP) Based Measures, Cyclomatic Complexity Measures: Control Flow Graphs. | 8 | 3 |
| 4 | **Coding & Testing** | Coding: Programming Principles and Guidelines: Common Coding Errors, Structured Programming, Information Hiding, Coding Standards, Refactoring, Verification: Code Inspection. Testing: Testing Fundamentals: Error Fault and Failure, Unit Testing, Integration Testing:: Top Down and Bottom up, Acceptance Testing: Alpha and Beta Testing., Regression Testing, functional and non-functional testing. Testing Techniques: White Box: Logic Coverage, Path Coverage, Loop Coverage. Black Box Testing: Boundary Value Analysis, Equivalence Class Testing. | 8 | 4 |
| 5 | **Computer Aided Software Engineering (CASE)** | CASE Tools, Scope, Benefits of CASE Tool, support in Software Life Cycle, Architecture of CASE Environment, Types of CASE Tools, Software Reliability and Quality Management: -Software Quality Management: Quality Concepts, Software Quality Assurance, Software Reviews, Formal Technical Reviews, Software Reliability, ISO 9000 Quality Standards, CMM Levels. | 8 | 5 |

**Reference Books:**


1. Software Engineering: A Practitioner's Approach by Roger S. Pressman, McGraw-Hill International edition.
2. An Integrated Approach to Software Engineering, by Pankaj Jalote, Narosa Publishing House
3 Software Engineering by K.K. Agarwal.
4. Software Engineering by Ian Sommerville, Addison-Wesley


**e-Learning Source:**

https://onlinecourses.nptel.ac.in/noc20_cs68/preview

https://archive.nptel.ac.in/courses/106/105/106105182/

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

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

# Integral University, Lucknow

| Effective from Session:2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS236 | **Title of the Course** | Computer Organization & Microprocessor | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | IV | 4 | 0 | 2 | 5 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | This course provides the fundamental structure and functioning of computer systems, including memory hierarchy, input/output mechanisms, and instruction execution. It Develop hands-on experience in assembly language programming, interfacing, and optimizing microprocessor-based systems for real-world applications. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Understand and analyze the basic architecture of digital computers, data representation formats, arithmetic operations, and error detection techniques. |
| **CO2** | Comprehend processor organization, memory hierarchy, cache mapping, and control unit design, including both hardwired and microprogrammed approaches. |
| **CO3** | Evaluate and apply concepts of parallel and pipelined processing, superscalar architecture, hazard mitigation, and high-performance computing techniques. |
| **CO4** | Develop and implement assembly language programs using 8086 and microcontrollers and explore the architecture and applications of embedded systems. |
| **CO5** | Design and simulate fundamental digital circuits including flip-flops, adders, counters, and registers to demonstrate core principles of digital electronics. |

**THEORY**

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Fundamentals of Processors and Data Representation** | Bus Architecture, and Bus Arbitration, Register Transfer, Bus and Memory Transfer, Arithmetic, Logic & Shift Microoperations, Fixed & IEEE 754 Floating Point Representation, Error Detection Codes, Signed Number Representation, Addition and Subtraction, Booth's Algorithm, Restoring and Non-Restoring Division Algorithm. | 8 | 1 |
| 2 | **Central Processing Unit, Computer Organization & Design** | Concept of Address Mapping, Instruction Codes, Instruction Cycle, Instruction Formats, Addressing Modes, CPU Organization & it's types, RISC and CISC Architectures, Timing & Control, I/O Interrupt Cycle, Interrupt types. | 8 | 2 |
| 3 | **Memory, I/O Organization & Programming** | Memory, Mapping of Cache Memory, I/O Interface, Data Transfer Techniques, DMA Controller, Serial Communication, Machine Language, Assembly Language, Assembler. | 8 | 3 |
| 4 | **Hardwired vs Microprogrammed control design, Parallel Processing & Pipelining** | Hardwired Control Design, Microprogrammed Control Design, Concept and Implementation of Parallel and Pipelined processing**,** Pipeline Hazards Instruction & Arithmetic Pipelining, Instruction Pipelining**,** Superscalar, Vector Processing Array Processor, and VLIW architecture | 8 | 4 |
| 5 | **Microprocessors and Embedded Systems** | **8086 Microprocessor:** Architecture, Pin Diagram**,** Instruction Set, 8086 assembly language Programming**, Introduction to Embedded Systems:** Features, applications, and real-time processing, Introduction to Microcontroller: 8051 | 8 | 5 |

**Practical**

| S. No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | Write a program to two add 16-bit Hexadecimal numbers with and without carry. | 2 | 4 |
| 2 | Write a program to multiply two 16-bit numbers result should be greater than 16 bits. | 2 | 4 |
| 3 | Write a program to find the greatest number from an array of 10 numbers.<br>Write a program to multiply two 8-bit signed - numbers. | 2 | 4 |
| 4 | Write a program to input 5 numbers and arrange them in descending order.<br>Write a program to convert the string data it's Two's complement form. | 2 | 4 |
| 5 | Write a program to move a block of data from one memory location to another. | 2 | 4 |
| 6 | Write a program to move a block of data from one memory location to another | 2 | 4 |
| 7 | Design & Implementation of various flip flop SR, JK, D and T. | 2 | 5 |
| 8 | Design & Implementation of Half adder and Full adder circuit.<br>Design & Implementation of Half Subtractor and Full Subtractor circuit. | 2 | 5 |
| 9 | Design & Implementation counters.<br>Design & Implementation Registers. | 2 | 5 |
| 10 | Design & Implementation of 2*2 bit unsigned multiplier. | 2 | 5 |
| 11 | Design & Implementation of associative memory cell. | 2 | 5 |
| 12 | Design & Implementation of MUX & DEMUX. | 2 | 5 |

| **Reference Books:** |
|---|
| 1.William Stallings, "Computer Organization and Architecture: Designing for Performance", Pearson Education, 2020 |
| 2 David A. Patterson, John L. Hennessy, "Computer Organization and Design: The Hardware/Software Interface", Morgan Kaufmann, 2021 |
| 3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization and Embedded Systems", McGraw Hill, 2011 |
| 4.R.S. Gaonkar, "Microprocessor Architecture, Programming, and Applications with 8085/8080", Penram International. |
| 5.B. Ram, "Fundamentals of Microprocessors and Microcomputers", Dhanpat Rai Publications. |
| 6. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", McGraw-Hill Education. |
| **e-Learning Source:** |
| 1. https://onlinecourses.nptel.ac.in/noc21_ee18/preview?utm_source=chatgpt.com |
| 2. https://www.coursera.org/learn/comparch?utm_source=chatgpt.com |
| 3. https://www.edx.org/learn/computer-architecture/arm-education-introduction-to-microprocessors?utm_source=chatgpt.com |

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

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS260 | **Title of the Course** | Data Science Fundamentals | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 4 | 0 | 0 | 4 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | This course introduces the fundamentals of data science, including Anaconda setup, basic statistical concepts, and data analysis using Python tools such as Pandas and Scikit-learn. Students will learn data cleaning, exploratory data analysis, and apply core machine learning algorithms like Linear and Logistic Regression. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Understand about Data Science Life Cycle and various steps like data wrangling, data exploration and selecting the model. |
| **CO2** | Students must be able to preprocess the data using cleaning, integration, transformation and find correlations among the data. |
| **CO3** | Students must be able to perform Exploratory Data Analysis (EDA). |
| **CO4** | Students must be able to characterize Machine Learning algorithms as Supervised and Unsupervised |
| **CO5** | Students must be able to implement Machine Learning Algorithms. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction to Data Science** | What is Data Science, what does a data scientist do, Real-world Applications (Healthcare, Finance, E-commerce, IoT)., Data Science Lifecycle**,** Python for Data Science (Jupyter Notebook, Anaconda) Various steps in Data Science processes like data wrangling, data exploration and selecting the Mode | 8 | 1 |
| 2 | **Data Manipulation and Visualization** | NumPy Basics: Arrays, Mathematical operations, Pandas Basics: Series operations, DataFrame operations, Indexing, Filtering, Data Cleaning & Transformation: Handling missing data, Outlier detection. Introduction to Matplotlib, Using Matplotlib for plotting Graphs and charts like Scatter, Bar, Pie, Line, Histogram and more**.** | 8 | 2 |
| 3 | **Machine Learning using Python** | Introduction to machine learning, Need for Machine learning, Key applications, Types of machine learning (Supervised vs Unsupervised Learning) and workflow of Machine Learning, Use Cases in ML: Fraud detection, Recommendation systems and its various algorithms. | 8 | 3 |
| 4 | **Supervised and Unsupervised Learning** | Supervised Learning:<br>● Regression**:** Linear Regression, Polynomial Regression, Ridge & Lasso Regression.<br>● Classification**:** Logistic Regression, Decision Trees, SVM, Random Forest.<br>.Unsupervised Learning:<br>● Clustering**:** K-Means, DBSCAN, Hierarchical Clustering.<br>Dimensionality Reduction**:** PCA, t-SNE. | 8 | 4 |
| 5 | **PROJECT** | Research Activities on Data Science with projects and research letters<br>Problem definition and dataset selection (Kaggle/UCI repositories).<br>Mini-project (Prediction, Classification, or Clustering task). | 8 | 5 |

**Reference Books:**


1. Data Science Fundamentals and Practical Approaches: Understand Why Data Science Is the Next by Dr Gypsy Anand/ Dr Rupam Sharma.
2. Python Data Science Handbook: Essential Tools for Working with Data by Jake Vander Plas.
3. Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data" by EMC Education Services.
4. IBM Content/Books.


**e-Learning Source:**

https://integral.skillsnetwork.site/

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

# Integral University

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS272 | **Title of the Course** | Python Programming Lab | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 0 | 0 | 2 | 1 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | To build a strong foundation of python and its IDEs and learn various object oriented programming constructs and data structures available in Python by Writing and using functions and modules. To Understand file handling application by exploring python libraries and developing real-world applications. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Understand the process of installing and configuring Python along with its IDEs. |
| **CO2** | Apply and create basic programs using Python's data structures, demonstrating foundational programming skills. |
| **CO3** | Develop, apply, and evaluate small modules and components using object-oriented programming principles in Python |
| **CO4** | Implement, analyze, and develop applications utilizing Python libraries, focusing on effective file handling techniques. |
| **CO5** | Create, apply, and assess working applications in Python, integrating multiple programming concepts for practical implementation |

| Unit No. | List of Experiment | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | • Understanding Python installation and its Integrated Development Environments (IDEs).<br>• Write a program to illustrate various data types & concepts of variables/Constant in Python. | 2 | 1 |
| 2 | • Write a program to perform different Arithmetic Operations on numbers in Python (Addition, Subtraction, Multiplication, Division, etc.)<br>• Write a program in python to demonstrate the concept of "Loop" and print the following pattern of prime numbers if input is number of lines. e.g.; if n=3, output should be: | 2 | 1 |
| 3 | • Write a program to implement the concept of "List" (create, append, and remove lists in python).<br>• Write a program to search an input number in a list of n numbers and print a "YES" along with its position (index) otherwise print a "No". | 2 | 2 |
| 4 | • Write a program to create, concatenate and print a "String" and accessing sub-string from a given string.<br>• Write a program to demonstrate working of "Tuples" in python. | 2 | 2 |
| 5 | • Write a program to illustrate the working of "Dictionaries" in python.<br>• Write a program to check whether input string is "Pangram" or not. | 2 | 2 |
| 6 | • Write a program to find factorial of a number using "Recursion".<br>• Write a program implement the concept of "Functions" in python and sort „n" numbers in ascending and descending order after taking input (Integer number) from user. | 2 | 3 |
| 7 | • Write a program to define a "module" and import a specific function in that module to another program.<br>• Write a program that reads an input text "File" and prints all of the unique words in the file in (alphabetical order). | 2 | 3 |
| 8 | • Write a program that depicts the implementation of Python "Class" which reverse a string word by word.<br>• Write a python script to print the current date in the following format "Sun May 29 02:26:23 IST 2017". | 2 | 4 |
| 9 | • Write a Python class to implement pow (x, n)<br>• Write a program to implement the working of "NumPy" in python. | 2 | 5 |

**Reference Books:**


1. Guido van Rossum and Fred L. Drake Jr., —An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011
2. Kenneth A. Lambert, —Fundamentals of Python: First Programs, CENGAGE Learning,2012.
3. Timothy A. Budd, —Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, —Introduction to Programming inPython: An Interdisciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.


**e-Learning Source:**

https://python-iitk.vlabs.ac.in/

https://nptel.ac.in/courses/106106145

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

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS282 | **Title of the Course** | Advance Java Programming Lab | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | IV | 0 | 0 | 2 | 1 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | • To learn the basic concepts and syntax of advance java programming.<br>• To be able to develop logics which help them to create applications using applets.<br>• To learn the use of JDBC-ODBC.<br>• To learn the use of JSP and servlet.<br>• To create web projects. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | To understand the basic concepts of Applets & AWT package. |
| **CO2** | To design and develop client server application and JDBC package. |
| **CO3** | To analyse and develop programs on Servlet and JAVA Beans |
| **CO4** | To develop programs on different project using Swing. |
| **CO5** | To analyse and develop programs on Servlet and JSP. |

| S. No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | Create GUI application using AWT & Applet classes:<br>A) To show a simple message along with background and foreground colours.<br>B) To create an applet that scrolls a message from left to right?<br>C)To create an applet that receives an integer in one text field, and computes its factorial value and returns it in another text field, when the button named "Compute" is clicked. | 4 | 1 |
| 2 | Design & develop the client-server application using NET package. | 2 | 1 |
| 3 | Create client server Application using RMI. | 2 | 2 |
| 4 | Implement database application using JDBC package. | 2 | 2 |
| 5 | A) Write a java program to create a bean that counts the number of mouse clicks?<br>B) Write a java program to create a bean that counts the number of button clicks? | 4 | 3 |
| 6 | Describe & develop Java Servlet, HTTP request and response program | 2 | 3 |
| 7 | Create a Servlet program for cookies | 2 | 4 |
| 8 | Create application using Java Swing package. | 2 | 4 |
| 9 | A) Write a java Program to create a JSP page to display a simple message along with current Date?<br>B) Write a java Program to create a JSP page to display the random number? | 4 | 5 |
| 10 | Design program for JSP by using JSP Exception and JSP Action Elements | 2 | 5 |

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

**Integral University, Lucknow**

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS303 | **Title of the Course** | Principles of Operating System | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | IV | 3 | 0 | 0 | 3 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | The course introduces fundamental operating system concepts, including memory management, process scheduling, synchronization, deadlocks, file systems, and security mechanisms. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Describe the fundamental concepts, evolution, structures, and kernel types of operating systems, including case studies on Android OS, iOS, Virtual OS, and Cloud OS. |
| **CO2** | Explain process management concepts, including process states, threads, scheduling criteria, and algorithms for uniprocessor and multiprocessor systems. |
| **CO3** | Analyze concurrency principles, synchronization mechanisms, and deadlock handling methods in operating systems. |
| **CO4** | Describe memory management concepts, including address spaces, paging, segmentation, and implement page replacement algorithms and techniques to handle thrashing. |
| **CO5** | Apply disk scheduling algorithms, file system structures, and evaluate allocation methods to optimize storage management and system performance. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Desktop OS and Mobile OS** | Importance of Operating Systems; Basic Concepts and Terminology; Evolution of Operating Systems: Batch, Interactive, Time Sharing & Real Time Systems. Operating System Structure: Simple Structure, Layered Approach; System Calls; Kernels: overview, objectives of kernel, types of kernels. Architecture,<br>Case Study- Android OS, iOS, Virtual OS, Cloud OS and their design. | 8 | 1 |
| 2 | **Process, Threads, CPU Scheduling and Real Time Scheduling** | Introduction, Process Model, Process State, Process Control Block. Overview, benefits of threads, types of threads. Basic Concepts, Scheduling Criteria, And Types of Scheduling, Scheduling Algorithms: FCFS, SJF, Round Robin, Priority Scheduling, Multilevel Queue Scheduling, Multilevel, Feedback Scheduling. Introduction, Uniprocessor scheduling, Multiprocessor Scheduling. | 8 | 2 |
| 3 | **Process Synchronization and Deadlock** | Principles of Concurrency, Race Condition, Critical Section, Critical Section Problem, Synchronization Mechanism, Semaphores and Classical Problems of Synchronization: Bounded Buffer Problem, Readers Writers Problem. Principles, System Model, Deadlock Characterization, Methods of Deadlock Handling: Prevention, Avoidance, Detection & Recovery from Deadlock | 8 | 3 |
| 4 | **Memory Management and Virtual Memory Management** | Introduction, logical vs. physical address space, swapping, contiguous memory allocation, paging, segmentation, segmentation with paging. Introduction, demand paging, performance, page replacement, page replacement algorithms (FCFS, LRU, Optimal), allocation of frames, thrashing. Other Memory Management Schemes: Swapping, Overlays. | 8 | 4 |
| 5 | **Device Management, Disk Scheduling and Protection & Security** | Introduction, types of devices, FCFS, SSTF, SCAN, CSCAN, LOOK, C-LOOK Scheduling File Systems: file concept, Access Mechanism, directory structure, file system structure, allocation methods (Contiguous, linked, indexed), free-space management (bit vector, linked list, grouping), Directory implementation (linear list, hash table), efficiency & performance. | 8 | 5 |

**Reference Books:**


1. Galvin, Silberchatz "Operating Systems Principles", Addision Wesley.
2. Milenekovie, "Operating System Concept", McGraw Hill.
3. Dietal, "An Introduction to Operating System", Addion Wesley.


**e-Learning Source:**

https://nptel.ac.in/courses/106105214

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

# Integral University, Lucknow
## B.Tech Computer Science and Engineering, B.Tech –, CSE

| Effective from Session: | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **ES202** | **Title of the Course** | Disasters, Management | **L** | **T** | **P** | **C** |
| **Year** | **II** | **Semester** | III | 2 | 1 | - | **3** |
| **Pre-Requisite** | 10+2 having a minimum of 45 % marks in the aggregate from a recognized Board/University | **Co-requisite** | | | | | |
| **Course Objectives** | • To Study the types of Disasters and its profile in India. • Knowledge of causes and impacts of Disasters, and Case studies of National and Global Disasters. • To learn about risk reduction approaches of Disasters with safety issues in mitigating Industrial disasters. • Basic concepts of Disaster Management Cycle and its Risk Reduction Measures. • To know the National Acts and policies for mitigating disasters. Role of Army, Police, Community, Corporate, Media etc. for post Disaster Management. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Students are able to learn types of disasters and its profile in India |
| **CO2** | Students are able to understand the causes and impacts of disasters on environment |
| **CO3** | Students are able to learn about risk reduction approaches of disasters with safety issues in mitigating industrial disasters. |
| **CO4** | To understand the concept of Disaster Management Cycle and its Risk Reduction |
| **CO5** | To understand the concept of Disaster Management Cycle and its Risk Reduction |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | Introduction to disaster | Introduction to Disasters, Concepts, Definition and types (Natural and Man-made), Disaster profile of India. | 8 | CO1 |
| 2 | Impact of Disaster | Causes and Impacts of Disasters, Global and National Perspective, Case studies from Disasters, Large Hydro projects and its risks for Disasters | 8 | CO2 |
| 3 | Disaster Risk Reduction | Approaches to Disaster risk Reduction, Safety issues in mitigating Industrial disasters, Case studies, EHS etc. | 8 | CO4 |
| 4 | Disaster Management | Disaster Management Cycle, Risk Reduction Measures (Preparedness, Mitigation, Response | 8 | CO3 |
| 5 | Disaster Act. and Policies | National Acts and policies for mitigating Disasters ( Disaster Management Act 2005, NDRF, | 8 | CO3 |

**Reference Books:**


(1) Gupta Harsh K., Disaster Management, Hyderabad University Press. Publications-Meerut.

(2) Sethi, V.K., Disaster Management, New Delhi Maxford Books

(3) Bhattacharya, Tushar, Disaster Science and Management, New Delhi Tata Mc Graw Hill.

(4) Nidhi Gauba, Dhawan/ Ambrina Sardar Khan, Disaster Management and Preparedness, CBS


**e-Learning Source:**

https://www.youtube.com/watch?v=9WIwlljva_s

https://www.youtube.com/watch?v=uA_OLKfQpYA

**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 | 1 | 1 | 1 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | - | - | - |
| **CO2** | 2 | 2 | 2 | 1 | 2 | 3 | 3 | 2 | 2 | 2 | 2 | 2 | 1 | 1 | 1 | - | - | - |
| **CO3** | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | - |
| **CO4** | 3 | 2 | 2 | 1 | 2 | 2 | 3 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | 1 | - | - | - |
| **CO5** | 3 | 1 | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 2 | 1 | 2 | 1 | 1 | 1 | - | - | - |

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

# Integral University, Lucknow

| Effective from Session: 2016-17 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | **MT238** | **Title of the Course** | **Mathematical Analysis for Computer Science & Engineering** | **L** | **T** | **P** | **C** |
| **Year** | **II** | **Semester** | **IV** | **3** | **1** | **0** | **4** |
| **Pre-Requisite** | **None** | **Co-requisite** | **None** | | | | |
| **Course Objectives** | The purpose of this undergraduate course is to impart basic and key knowledge of numerical analysis, complex analysis, probability and probability distribution. The content of course has various applications. After successfully completing the course, the student will be able explore the subject into their respective dimensions. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | Understand and apply numerical methods such as Bisection, Regula-Falsi, Iteration, Newton-Raphson, and LU Decomposition to solve different types of equations, including their convergence analysis. |
| **CO2** | Explore and apply various interpolation methods to approximate data effectively. |
| **CO3** | Implement numerical differentiation and integration techniques to solve real-world problems involving complex functions. |
| **CO4** | Solve ordinary differential equations using numerical techniques and analyze the results. |
| **CO5** | Develop an understanding of complex analysis, including analyticity, mapping, and evaluating definite integrals using simplified techniques. |

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Differential Equations** | **Algebraic & Transcendental Equations:** Bisection Method, Iteration Method, False Position Method, Newton-Raphson Method. Rate of Convergence of Methods. Solution of system of linear equations by LU decomposition method. | 8 | 1 |
| 2 | **Laplace Transform** | **Interpolation:** Finite differences, Newton's forward & backward formula, Gauss forward and backward formula for equal intervals. Lagrange's and Newton's divided difference formula for unequal intervals, | 8 | 2 |
| 3 | **Fourier Series and Partial Difference** | **Numerical differentiation and Numerical Integration:** Numerical differentiation, Quadrature formula, Numerical Integration by Trapezoidal Rule, Simpson's 1/3 Rule, Simpson's 3/8 Rule, Boole's & Weddle's Rule, | 8 | 3 |
| 4 | **Applications of Partial Differential Equations** | **Solution of Ordinary Differential Equations:** Numerical solution of ordinary differential equations by Euler's Method, Modified Euler's Method and Runge-Kutta Method, Picard's and Taylor's Methods. | 8 | 4 |
| 5 | **Basic Statistics and Curve Fitting** | **Complex Analysis:** Analytic functions, C-R equations, Cauchy's integral theorem, Cauchy's integral formula for derivatives of analytic functions, Conformal mapping, Bilinear transformation. | 8 | 5 |

**Reference Books:**


1. Sastry, Introductory method of Numerical Analysis, PHI, New Delhi.
2. Balaguruswamy, Numerical method, TMH, New Delhi.
3. Jain, Iyengar, Jain, Numerical Methods for Scientific & Engineering Computations, New Age International, New Delhi.
4. P. Kandasamy, Numerical Methods, S. Chand & Company, New Delhi.
5. H.K. Dass, Introduction to Engineering Mathematics, S. Chand & Company, New Delhi.
6. B.S. Grewal, Higher Engineering Mathematics, Khanna Pub lication.


**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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 3 | 1 | - | - | - | - | - | - | - | 3 | - | 1 | 2 | - |
| **CO2** | 3 | 2 | 2 | 1 | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - |
| **CO3** | 3 | 2 | 3 | 1 | - | - | - | - | - | - | - | 3 | - | 2 | 2 | - |
| **CO4** | 3 | 2 | 3 | 1 | - | - | - | - | - | - | - | 3 | - | 1 | 1 | - |
| **CO5** | 2 | 1 | 2 | 1 | - | - | - | - | - | - | - | 2 | - | - | - | - |

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

# Integral University, Lucknow

| Effective from Session:2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS212 | **Title of the Course** | Database Management System | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | IV | 3 | 0 | 2 | 4 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | • To describe a sound introduction to the discipline of database management systems and introduce concepts of the Entity-Relationship model.<br>• To build concepts of relational data model design by writing database queries using Relational Algebra and basic SQL as a universal database language<br>• To demonstrate the principles behind systematic database design approaches by covering conceptual design, logical design through normalization.<br>• To provide an overview of the concept of transactions, serializability, recoverability, deadlock, and how to recover from deadlock.<br>• To understand database locks, timestamps and various concurrency control protocols. | | | | | | |

| **Course Outcomes** | |
|---|---|
| **CO1** | ***Explain*** *the fundamental concepts of Database Management Systems (DBMS), including data models, schemas, and overall structures.* |
| **CO2** | ***Design*** *an Entity-Relationship (ER) model and* ***develop*** *a relational database using SQL with appropriate constraints and keys for real-world applications.* |
| **CO3** | ***Construct*** *complex SQL queries using relational algebra to efficiently retrieve and manipulate data in database.* |
| **CO4** | ***Apply*** *normalization techniques to optimize database design and* ***Implement*** *modern database tools through case studies for real-life applications* |
| **CO5** | ***Implement*** *transaction management, concurrency control mechanisms, and deadlock handling strategies to ensure database integrity and performance.* |

**THEORY**

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction to DBMS and Overall Database Structure** | An Overview of Database Management System, Database System Vs File System, Database System Concepts and Architecture, Data Models, Schema and Instances, Data Independence, Database Languages and Interfaces, Data Definitions Language, Data Manipulation Language, Data Control Language, Overall Database Structure, Indexing and Hashing. | 8 | 1 |
| 2 | **ER Model, Integrity Constraints & SQL** | ER Model Concepts: Notation for ER Diagram, Examples based on E-R diagram, Mapping Constraints, Keys, Concepts of Super Key, Candidate Key, Primary Key, Generalization, Aggregation, Reduction of an ER Diagrams to Tables.<br>Integrity Constraints: Entity Integrity, Referential Integrity, Domain Constraints,<br>Relational Algebra and SQL: Select, Insert, Update and Delete Operations. Joins, Unions, Intersection, Minus and aggregate function. | 9 | 2 |
| 3 | **Data Base Design & Normalization** | Functional Dependencies, Normal Forms, First, Second, and Third Normal Forms, BCNF, Fourth Normal Form, Fifth Normal Form, Normalization using FD, MVD, and JDs, Loss less join & Dependency preserving decomposition, case studies. | 9 | 4 |
| 4 | **Transaction Processing Concepts** | Transaction System, Testing of Serializability, Serializability of Schedules, Conflict & View Serializable Schedule, Recoverability, Recovery from Transaction Failures, Log Based Recovery, Checkpoints, Deadlock Handling. | 8 | 5 |
| 5 | **Concurrency Control Techniques** | Concurrency Control, Locking Techniques for Concurrency Control, Time Stamping Protocols for Concurrency Control, Validation Based Protocol, Multiple Granularity, Multi Version Schemes, Recovery with Concurrent Transaction. | 8 | 5 |

**PRACTICAL**

| S. No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | Overview of using SQL, data types in SQL, concept of DDL, DML & DCL commands, creating tables (along with primary and foreign keys), altering tables, and dropping tables. | 2 | 2 |
| 2 | Practicing DML commands- Insert, Select, Update, Delete. | 2 | 2 |
| 3 | Write queries using Logical Operators (=, <, > etc). | 2 | 3 |
| 4 | Write queries using SQL operators (BETWEEN…AND, IN (list), LIKE, ISNULL and along with negation expressions). | 2 | 3 |
| 5 | Write queries using COUNT, SUM, AVG, MAX, MIN, GROUP BY, HAVING. | 2 | 3 |
| 6 | Write queries using ANY, ALL, IN, EXISTS, NOT EXISTS, UNION, INTERSECT, MINUS, CONSTRAINTS etc. | 2 | 3 |
| 7 | Write queries for extracting data from more than one table (Equi-Join, Natural Join and Outer Join). | 2 | 3 |

| | | | |
|---|---|---|---|
| 8 | Write queries for Sub queries, Nested queries, VIEWS Creation and Dropping. | 2 | 3 |
| 9 | CASE STUDY: Student should decide on a case study and formulate the problem statement, Database Design using ER Model (Identifying entities, attributes, keys and relationships between entities, cardinalities, generalization, specialization etc.)<br>**Note: Student is required to use MS Access/Lucid Chart app to design ER-Diagram and take a print out.** | 2 | 4 |
| 10 | Converting ER Model to Relational Model (Represent entities and relationships in Tabular form, represent attributes as columns, identifying keys), Create tables using SQL.<br>**Note: Student is required to use Oracle/PostGreSQL/MS Access/Other Database Application for showing the database tables created from ER Model.** | 2 | 4 |

**Reference Books:**


1 Korth, Silbertz, Sudarshan, "Data base concepts", McGraw-Hill

2 Elmasari, Navathe, "Fundamentals of Database Systems", Addison Wesley

3 Date C.J., "An Introduction to Database Systems", Addison Wesley

4 Hector Garcia-Molina, Jeffrey D. Ullman, and Jennifer Widom, "Database Systems: The Complete Book", Pearson

5 Pramod J. Sadalage and Martin Fowler ,"NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence", Addison-Wesley Educational Publishers Inc

6 Baron Schwartz, Peter Zaitsev, and Vadim Tkachenko, "High-Performance MySQL: Optimization, Backups, and Replication", O'Reilly Media


**e-Learning Source:**

https://onlinecourses.nptel.ac.in/noc19_cs46/preview

https://onlinecourses.nptel.ac.in/noc25_cs40/preview

https://onlinecourses.nptel.ac.in/noc22_cs91/preview

https://onlinecourses.swayam2.ac.in/ini24_cs01/preview

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS261 | **Title of the Course** | Cloud Application Development | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | IV | **4** | **0** | **2** | **5** |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | This course will prepare students to provide an overview of an exciting field of Cloud Computing and introduce tools require building, deploying, running and managing applications on a cloud platform. This course will also enable students to develop the cloud application development skills, such as Node.js, REST architecture, JSON, Cloud Foundry and DevOps services and will help them to solve complex real-world problems. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Understand the vision of Cloud Computing from a global context. |
| **CO2** | Understand various computing options on IBM Cloud by market perspective of Cloud Computing |
| **CO3** | Analyze architecture and implementation of APIs with services of IBM Cloud in Cloud Computing. |
| **CO4** | Integrate the Node.js application with Watson services over IBM Cloud. |
| **CO5** | Build and create state of the art architecture in Kubernetes cluster |

**THEORY**

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction to Cloud Computing** | Definition & Characteristics of Cloud Computing, and benefits of cloud computing. Cloud service models (IaaS, PaaS, SaaS) and deployment models (Public, Private, Hybrid). IBM Cloud resources, Serverless computing (AWS Lambda, IBM Cloud Functions) and edge computing. Virtualization & Containers: VMs vs. Containers | 8 | 1 |
| 2 | **Deep Dive into IBM Cloud and DevOps Tools** | What is DevOps and why it is essential in the Cloud?, Key DevOps Principles: CI/CD, Automation, Monitoring, Benefits of DevOps for Cloud Application Development, Capabilities of IBM Cloud Continuous Delivery, Setting up CI/CD pipelines with IBM Cloud DevOps**,** IBM Watson services, Containerization with Docker, Kubernetes Basics & Container Orchestration, Cloudant databases, APIs interaction with Cloudant database. Deploying a static website on IBM Cloud Object Storage. | 8 | 2 |
| 3 | **Introduction to REST and Introduction to IBM Database** | Introduction to REST Architecture & API Design, Best practices for using REST in your application, Advantages of using JSON format, IBM Watson services REST APIs. Databases types and capabilities, Main data services on IBM Cloud and benefits of IBM Cloudant, APIs to interact with Cloudant database. NoSQL vs. SQL comparison (MongoDB, PostgreSQL). API testing with Postman/Swagger. | 8 | 3 |
| 4 | **Introduction to JavaScript and Node Creation** | Introduction to Node.js & JavaScript for Cloud Apps, Advanced JavaScript (ES6+), Node.js modules, and Express.js middleware, Asynchronous programming (async/await, event loops), Authentication & Security (OAuth, JWT, API Keys), Containerizing Node.js apps using Docker, Develop a simple Node.js cloud application. | 8 | 4 |
| 5 | **Introduction to Docker and Deep Dive into Docker Tools** | Understand business problems and goals, Functional and non-functional requirements, IBM Cloud services App ID, Watson Services. Introduction Dockers and Docker Hub, Benefits of using Docker for Cloud Applications, Docker Engine, Images, Containers, and Registries, Docker CLI vs Docker Compose, Writing a Dockerfile, Building, Running, and Managing Docker Containers, Docker Hub & Private Registries: Pushing & Pulling Images, Container Registry with IBM Cloud, Introduction to Kubernetes Container orchestration (Kubernetes), key capabilities of Kubernetes, Kubernetes building blocks: Pods, Deployment and Service, Kubernetes cluster | 8 | 5 |

**Practical**

| S. No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | Configure IBM Cloud Free Tier Account and explore IBM Cloud CLI. | 2 | 1 |
| 2 | Deploy a static website using IBM Cloud Object Storage**.** | 2 | 1 |
| 3 | Mention all commands used in IBM cli to push an application from the local system to the IBM cloud environment. | 2 | 2 |
| 4 | Configuring Cloudant and managing the datasets on IBM Cloud. | 2 | 2 |
| 5 | Configuring secure a web application with single sign-on (APP ID) on IBM cloud. | 2 | 3 |
| 6 | Develop a REST API using Node.js & Express.js to interact with a cloud database. | 2 | 3 |
| 7 | Developing NodeJs application for displaying weather information using IBM Cloud DevOps service and Deploying through delivery pipeline and manifest file configuration. | 2 | 4 |
| 8 | Build Chatbot applications for more than one sector like: Hospital, Industry, Banking etc, using Artificial | 2 | 4 |

| | | | |
|---|---|---|---|
| | Intelligence (AI) services | | |
| 9 | Containerizing applications using Docker and deploying on IBM Cloud Kubernetes Service. | 2 | 5 |
| 10 | Implementation of container orchestration using Kubernetes. | 2 | 5 |

**Reference Books:**


1. AnubhavHanjura , “Cloud Application Development”,Packt Publishing Ltd, 2014.
2. Gautam Shroff, “Enterprise Cloud Computing Technology Architecture Applications”, Cambridge University Press;2014.
3. Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 2015.
4. Dimitris N. Chorafas, “Cloud Computing Strategies” CRC Press; 2016


**e-Learning Source:**

1. https://integral.skillsnetwork.site/

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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

# Integral University, Lucknow

| Effective from Session: 2025-26 (NEP) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Course Code** | CS270 | **Title of the Course** | Object Oriented Concepts using JAVA | **L** | **T** | **P** | **C** |
| **Year** | II | **Semester** | III | 3 | 0 | 2 | 4 |
| **Pre-Requisite** | None | **Co-requisite** | None | | | | |
| **Course Objectives** | • Introduce programming paradigms and establish a strong foundation in Java programming concepts.<br>• Familiarize students with the Java environment, including program development, compilation, and execution.<br>• Teach Object-Oriented Programming (OOP) principles such as classes, objects, inheritance, and polymorphism.<br>• Develop skills in exception handling, multithreading, and file handling to build robust applications.<br>• Enable students to work with arrays, strings, and Java I/O operations for efficient data manipulation. | | | | | | |

| Course Outcomes | |
|---|---|
| **CO1** | Demonstrate an understanding of programming paradigms and fundamental Java programming concepts. |
| **CO2** | Implement Object-Oriented Programming feature of class design, object creation, constructors, access modifiers and Arrays. |
| **CO3** | Apply inheritance and polymorphism to create modular and reusable JAVA program |
| **CO4** | Perform file handling and input/output operations using Java's standard I/O streams and file handling classes. |
| **CO5** | Utilize exception handling techniques for efficient program execution & Develop multithreaded programs by implementing thread creation, synchronization, and inter-thread communication |

**THEORY**

| Unit No. | Title of the Unit | Content of Unit | Contact Hrs. | Mapped CO |
|---|---|---|---|---|
| 1 | **Introduction** | Overview of Programming languages & Types, Object oriented programming paradigms – Features of Object-Oriented Programming, Introduction to Java: Features, JVM, and Bytecode, Java Program Structure, Compilation, and Execution. Lexical Tokens, Identifiers, Keywords, and Literals | 8 | 1 |
| 2 | **Encapsulation** | **Classes and Objects**: Creation, Object Life time & Garbage Collection, Access Control, Modifiers and Methods, Constructor & initialization blocks, Recursion and Static Members, Use of "this" reference.<br>**Arrays:** Defining an Array, Initializing & Accessing Array, Multi –Dimensional Array | 8 | 2 |
| 3 | **Inheritance and Polymorphism** | **Inheritance**: Concept and Benefits, Types of Inheritance in Java, Inheriting Data Members and Methods, Role of Constructors in inheritance.<br>**Polymorphism:** Method Overloading and Method Overriding (Overriding Super Class Methods), Use of "super". | 8 | 3 |
| 4 | **Abstraction** | Nested, Inner, Anonymous and Abstract classes, Interfaces, Abstract classes vs Interfaces, Package: Defining Package, Organizing Classes and Interfaces in Packages<br>**I/O Classes**: Introduction to Java I/O (java.io Package), Streams, Buffers, and File Handling, Reading and Writing Files Using File I/O Operations<br>**String Class:** Mutable & Immutable String, Creating Strings using StringBuffer class. | 8 | 4 |
| 5 | **Exception Handling & Multithreading** | **Exception Handling:** Exceptions & Errors, Types of Exception, Use of try, catch, finally, throw, throws, Checked and Un-Checked Exceptions.<br>**Threads**: Needs of Multi-Threaded Programming, Thread Life-Cycle, Thread Priorities, Synchronizing Threads, Inter Communication of Threads. | 8 | 5 |

**PRACTICAL**

| S. No. | List of Experiments | Contact Hrs. | Mapped CO |
|---|---|---|---|
| 1 | Create a class named 'Student' with String variable 'name' and integer variable 'roll_no'. Assign the value of roll_no as '2' and that of name as "John" by creating an object of the class Student. | 2 | 1 |
| 2 | Print the average of three numbers entered by user by creating a class named 'Average' which has a method to calculate and print the average. | 2 | 1 |
| 3 | Twin Prime are the prime numbers whose difference is 2 such as (3, 5), (5, 7), (11, 13). Write a program to display all twin prime numbers from 1 to n. Where n is the last range that is to be inputted by the user.<br>Methods to be created are:<br>• prime () – method which will check whether the number is prime or not.<br>• show () – which will print the twin prime numbers and will call the prime() method.<br>• main() – which will call the show() method | 2 | 2 |
| 4 | Write a program to print the area and perimeter of a triangle by creating a class named 'Triangle' with a Parameterized constructor having the three sides as its parameters | 2 | 2 |
| 5 | Write a program to display the Fibonacci series from 1 to n using a recursive function. Where n is the last range that is to be inputted by the user. | 2 | 2 |
| 6 | Write a Java program to calculate the average value of array elements where array elements are {20,30,25,25,-16,60,-100} | 2 | 2 |

| | | | |
|---|---|---|---|
| 7 | Write a program to print the volume of a Cube, Cuboid, and Sphere by using the concept of Method Overloading. Create a class named 'Volume'. | 2 | 3 |
| 8 | Write a program to perform a single inheritance on two classes and also incorporating the concept of method overriding. | 2 | 3 |
| 9 | Write a Java program to perform employee payroll processing using packages. Create a package Employee.<br>In the package create 2 files:<br>**1. Emp.java**: Declare the variables name, empid, category, bpay, hra, da, npay, pf, grosspay, incometax, and allowance. Calculate the values in methods.<br>**2. Emppay.java.**: Create an object e to call the methods to perform and print values.<br>The salary is calculated according to the following rules:<br>Salary = Basic pay+HRA+DA<br>HRA = 30% of basic pay<br>DA = 40% of basic pay | 2 | 4 |
| 10 | Write a Java program that implements a Library Management System with the following features:<br>• Object-Oriented Programming (OOP): Create a Book class with attributes title and author, Implement a Library class that manages a collection of books.<br>• File Handling: Implement methods in the Library class to save and load books using serialization.<br>• Exception Handling: Handle exceptions in file operations using try-catch blocks.<br>• Multithreading: Implement a background task using multithreading that runs parallel to user operations.<br>• User Interaction: Provide a menu-driven interface where users can:<br>o Add a book (by entering title and author).<br>o View the list of books.<br>o Save the book list to a file.<br>o Load the book list from a file.<br>o Exit the program. | 2 | 5 |

**Reference Books:**


1. T.Budd"An Introduction to OOP" Pearson Education
2. Naughton, Schildt, "The Complete Reference JAVA2", TMH
3. Balagurusamy E, "Programming in JAVA", TMH
4. "Head First Java" by Kathe Sierra.


**e-Learning Source:**

https://onlinecourses.nptel.ac.in/noc19_cs48/preview

https://nptel.ac.in/courses/106105191

**Course Articulation Matrix: (Mapping of COs with POs and PSOs)**

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

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