IT201 : Discrete Mathematics

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basic Mathematics

Course Objectives

1. To provide the knowledge of Set, proof techniques and determine logical possibilities.
2. To understand relation, functions among various entities in real world.
3. To introduce the basic of Group and Ring.
4. To learn to formulate problems mathematically using graph theory.
5. To understand the fundamental mathematics requirement used in cryptographic algorithms.
6. To comprehend the concept of decodability and prefix-free property.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Apply the basic terminology of set, proof techniques and determine logical possibilities in a given situation.	3	Apply
CO2	Understand relations & functions and to determine their properties.	2	Understand
CO3	Solve problems based on Group and Rings.	3	Apply
CO4	Demonstrate the Information Theory.	3	Apply
CO5	Understand the fundamental mathematical requirement of cryptographic algorithms.	2	Understand
CO6	Understand the basics of Statistics and Probability.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	1	1	2	1	1	1	2	1	1
CO2	3	3	1	1	1	1	1	1	2	1	1	2	2	1	1
CO3	3	3	2	2	1	1	1	1	2	1	1	2	2	1	1
CO4	3	3	2	2	1	2	1	1	2	1	1	2	2	1	1
CO5	3	3	2	2	2	1	1	2	2	1	2	2	2	1	1
CO6	3	3	2	1	1	2	1	1	2	1	2	2	2	1	1

Course Contents			
Unit-I	**COMBINATORICS**	**No. of Hours**	**COs**
	Sets, Combinations of sets, Venn Diagrams, Finite and Infinite sets, Uncountable infinite sets, Principle of inclusion and exclusion, multisets. Propositions, Conditional Propositions, Logical Connectivity, Propositional calculus, Universal and Existential Quantifiers, Normal forms, methods of proofs, Mathematical Induction.	10	CO1
Unit-II	**RELATIONS AND FUNCTIONS**	**No. of Hours**	**COs**
	Relations : Binary Relations, Closure of relations, Warshall's algorithm, Equivalence Relations and partitions, Partial ordering relations and lattices, Chains and Anti chains. Recurrence Relation, Linear Recurrence Relations With constant Coefficients, Generating functions. Regression Analysis: Linear, Logistic and Polynomial Regression. Function Functions, Composition of functions, Invertible functions, Pigeonhole Principle, Discrete Numeric functions and Generating functions, Job scheduling Problem.	10	CO2
Unit-III	**GROUPS, SEQUENCES AND SUMMATIONS**	**No. Of Hours**	**COs**
	Group Theory: Elementary properties, subgroups, cosets, normal groups, quotient groups, cyclic groups, homomorphism and isomorphism, Isomorphism theorem, permutation groups, Sylow's theorem and application, Application to Number theory: Lagrange's theorem, Euler's theorem, Fermat's theorem. Sequences and summations: Arithmetic progression, Geometric progression, Recursively defined sequences, Fibonacci sequence, Summations, Arithmetic series, Double summations, Geometric series and Infinite geometric series.	10	CO3
Unit-IV	**INFORMATION THEORY**	**No. of Hours**	**COs**
	Information sources and entropy, Relative entropy, Joint and conditional entropy, mutual information. Lossless Source Coding with Variable Codeword Lengths, Best prefix-free codes, Huffman codes. Lossy Source Coding with Fixed Codeword Lengths, Channel Coding and Cyclic Codes.	10	CO4
Unit-V	**INTRODUCTION TO STATISTICS AND PROBABILITY**	**No. of Hours**	**COs**
	Rings and fields: Rings, Ideals, maximal ideals, quotient rings, Integral domains, principal ideal domain(PID), Euclidean domain(ED), ring of integers as example of PID and ED, Euclidean algorithm for GCD, extended Euclidean algorithm, finding modular inverse of an integer, Chinese Remainder Theorem(CRT), Euler's φ-function, quadratic residues.	10	CO5
Unit-VI	**INTRODUCTION TO STATISTICS AND PROBABILITY**	**No. of Hours**	**COs**
	Statistics, notion of probability, distributions, mean, variance,	10	CO6

	covariance, covariance matrix, understanding univariate and multivariate normal distributions. Introduction to hypothesis testing, confidence interval for estimates, Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection. Statistics, notion of probability, distributions, mean, variance, covariance, covariance matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates. Simple linear regression and verifying assumptions used in linear regression, Multivariate linear regression, model assessment, assessing importance of different variables, subset selection.		

Text Books:

1. S. K. Chakraborty, B.K. Sarkar, "Discrete Mathematics and its Applications", Oxford University Press 2011, ISBN9780198065432.
2. C. L. Liu and D. P. Mohapatra, "Elements of Discrete Mathematics", McGraw Hill 4th Edition. ISBN 9781259006395.

Reference Books:

1. N. Biggs, "Discrete Mathematics", Oxford University Press, 2nd Edition. ISBN - 978-0198507178
2. Singh, "Discrete Mathematical Structures", Wiley ISBN- 9788126527908
3. Eric Gossett, "Discrete Mathematics with Proof", Wiley 2nd Edition ISBN-9788126527588.
4. Edgar G. Goodaire and Michael M. Parmenter, "Discrete Mathematics with Graph Theory", Pearson Education 3rd Edition, ISBN-13978013167995.
5. Richard Johnsonbaugh, "Discrete Mathematics", Pearson Education, 7th Edition ISBN: 9332535183.

eLearning Resources:

1. Prof. Sudarshan Iyengar, Prof. Neeldhara , "Discrete Mathematics" NPTEL Course By | IIT Ropar, IIT Gandhinagar https://onlinecourses.nptel.ac.in/noc20_cs82/preview
2. Prof. Sudarshan Iyengar, Prof. Prabuchandran K.J , "Discrete Mathematics", NPTEL Course By IIT Ropar, IIT Dharwad, https://onlinecourses.nptel.ac.in/noc23_cs22/preview

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT202 : Digital Electronics & Computer Organization

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basic Electronics Engineering

Course Objectives

1. To design and implement combinational logic circuits.
2. To design and implement sequential logic circuits.
3. To develop VHDL programs.
4. To understand processor organization.
5. To understand memory and I/O Organization.
6. To understand parallel organization.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Design and implement combinational logic circuits.	3	Apply
CO2	Design and implement sequential logic circuits.	3	Apply
CO3	Develop VHDL programs.	3	Apply
CO4	Understand processor organization.	2	Understand
CO5	Understand memory and I/O Organization.	2	Understand
CO6	Understand parallel organization.	2	Undersand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2	3	1	2	3	1	-	3	2	-	2	-	3	-
CO2	1	2	3	1	2	3	1	-	3	2	-	2	-	3	-
CO3	1	2	3	1	3	-	-	-	3	2	-	2	-	3	-
CO4	3	1	1	-	-	-	-	-	1	1	1	1	-	3	-
CO5	3	3	1	-	-	-	-	1	1	1	1	1	-	3	-
CO6	3	-	1	-	-	-	-	1	1	1	-	1	-	3	-

Course Contents			
Unit-I	**COMBINATIONAL LOGIC CIRCUITS**	**No. of Hours**	**COs**
	Number Systems, Boolean Algebra & Logic Minimization. Design of code converters, Design of adders, Multiplexers, De-multiplexer/ Decoders, Encoder.	10	CO1
Unit-II	**SEQUENTIAL LOGIC CIRCUITS**	**No. of Hours**	**COs**
	Introduction to sequential circuits, Flip- Flops, Design of Counters, Modulo counters. Registers: Parallel in Parallel out, Serial in Serial Out, Parallel in Serial out, Serial in Parallel out, Ring counter, Johnson Counter.	10	CO2
Unit-III	**INTRODUCTION TO VHDL PROGRAMMING**	**No. Of Hours**	**COs**
	Design flow: Basic Concept of Simulation and Synthesis. Introduction to VHDL, Data Objects, Data Types, Attributes, Models of Design, Concurrent Statements Vs Sequential Statements, Design of Digital Circuits.	10	CO3
Unit-IV	**PROCESSOR ORGANIZATION**	**No. of Hours**	**COs**
	Computer Evolution, Computer Performance, RISC Vs CISC, Building Data Paths , Pipelined Datapath and Control. Data Hazards: Forwarding versus Stalling, Control Hazards.	10	CO4
Unit-V	**MEMORY AND I/O ORGANIZATION**	**No. of Hours**	**COs**
	Memory Organization: Computer Memory System Overview, Cache Memory: Elements of Cache Design, Mapping Functions, Replacement Algorithms. Virtual Memory: Demand paging, Translation Lookaside Buffer. Input/Output Organization: External Devices, I/O Modules, Programed I/O, Interrupt-Driven I/O, Direct Memory Access.	10	CO5
Unit-VI	**PARALLEL ORGANIZATIONS**	**No. of Hours**	**COs**
	Parallel Processing: Multiple Processor Organizations, Symmetric Multiprocessors. Multithreading and Chip Multiprocessors, Clusters, Nonuniform Memory Access, Vector Computation. Multicore Computers: Multicore Organization, Intel Core Duo, Intel Core i7-990X.	10	CO6

Text Books:

1. M Morris Mano, “Digital Design”, Prentice Hall, 3rd Edition, ISBN: 0130621218.
2. Mano M. Morris, Michael D. Ciletti, "Digital Design: with an Introduction to the Verilog HDL, VHDL, System Verilog", 6th Edition, Pearson, ISBN-13: 978-9353062019.
3. D. Patterson, J. Hennessy, “Computer Organization and Design: The Hardware Software Interface”, 4th Edition, 2013, ISBN 978-0-12-374750-1.
4. W. Stallings, “Computer Organization and Architecture: Designing for Performance”, Prentice Hall of India, 8th Edition, 2010, ISBN 13: 978-0-13-607373-4.

Reference Books:

1. Flyod, “Digital Principles”, Pearson EducationISBN:978-81- 7758-643-6.

2. John Yarbrough, “Digital Logic applications and Design”, Thomson Publication ISBN: 978-0314066756.
3. Malvino, D. Leach, “Digital Principles and Applications”, 5th edition, Tata McGraw Hill, ISBN-13: 978-9339203405.
4. R.P. Jain, “Modern Digital Electronics “, 3rd Edition, Tata McGraw-Hill, ISBN: 0–07–049492–4.
5. Stephen Brown, ZvonkoVranesic, “Fundamentals of Digital Logic with VHDL Design”, McGraw- Hill, ISBN: 978–0–07–352953–0.
6. J. Bhaskar, “VHDL Primer”, Pearson Education,3rd Edition, ISBN: 0071226249.
7. C. Hamacher, V. Zvonko, S. Zaky, “Computer Organization”, McGraw Hill,5th edition, 2002, ISBN: 007-120411-3.
8. M. Usha, T. S. Srikanth, “Computer System Architecture and Organization”, Wiley, 2014, ISBN: 978-81-265-2284-2.
9. A. S. Tanenbaum, “Structured Computer Organization”, Prentice Hall of India, 4th Edition, 1991, ISBN: 81–203–1553–7.
10. J. Hays, “Computer Architecture and Organization”, McGraw-Hill, 2nd Edition, 1988, ISBN 0–07–100479–3.

eLearning Resources:

1. Digital Electronic Circuits By Prof. Goutam Saha | IIT Kharagpur
   https://onlinecourses.nptel.ac.in/noc23_ee50/preview
2. Multi-Core Computer Architecture By Prof. John Jose | IIT Guwahati
   https://onlinecourses.nptel.ac.in/noc23_cs113/preview
3. Computer Architecture By Prof. Smruti Ranjan Sarangi | IIT Delhi
   https://onlinecourses.nptel.ac.in/noc23_cs67/preview

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT203 : Data Structures

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Fundamentals of Data Structures

Course Objectives

1. To apply appropriate data structures to implement stack and queue.
2. To apply appropriate data structures to implement binary trees.
3. To apply appropriate data structures to implement graphs.
4. To implement different hash techniques for problem solving.
5. To make use of heap data structure for problem solving.
6. To use different search tree for problem solving.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Apply appropriate data structures to implement stack and queue.	3	Apply
CO2	Apply appropriate data structures to implement trees.	3	Apply
CO3	Apply appropriate data structures to implement graphs.	3	Apply
CO4	Implement different hash techniques for problem solving.	3	Apply
CO5	Use heap data structure for problem solving.	3	Apply
CO6	Use different types of search tree for problem solving.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	2	1	1	1	3	2	2	2	3	-	2
CO2	3	1	3	1	2	2	1	1	3	2	2	2	3	-	2
CO3	3	1	3	1	2	2	1	1	2	2	2	2	3	-	2
CO4	3	1	3	1	2	1	1	1	2	2	2	1	3	-	2
CO5	3	1	3	1	2	1	1	1	2	2	2	2	3	-	2
CO6	3	1	3	2	2	2	1	1	2	2	2	1	3	-	2

Course Contents			
Unit-I	**LINKED ORGANIZATION**	**No. of Hours**	**COs**
	Introduction, References and Basic Types, Linked list ADT, Implementing Singly linked list, Doubly linked lists, Implementing Doubly linked list, Implementation of stack using Linked organization. Applications: well formed-ness of parenthesis, Implementation of queue using linked organization, cloning Data Structures, Linked list efficiency.	8	CO1
Unit-II	**TREES**	**No. of Hours**	**COs**
	General Trees, Tree Terminology, Binary Trees, Use binary trees, Conversion of general tree to binary tree, Array Based representation of Binary Tree, Binary tree as an ADT, Binary tree traversals - recursive and non-recursive algorithms, Construction of tree from its traversals, Huffman coding algorithm.	7	CO2
Unit-III	**GRAPHS**	**No. Of Hours**	**COs**
	Introduction to Graph, Graph Terminology, Graph as an ADT, Data Structures for graphs – edge list, adjacency matrix, adjacency list adjacency map, Graph Traversal – Depth-First Search and Breadth-First Search, Minimum Spanning Tree - Prim's and Kruskal's algorithms, Shortest paths - Warshall's and Dijkstra's algorithm.	8	CO3
Unit-IV	**HASH TABLES**	**No. of Hours**	**COs**
	Introduction to Hashing, Hash tables - hash functions, characteristics of good hash function. Different key-to-address transformations techniques (Compression Functions), Collisions, Collision resolution techniques-Linear probing, quadratic probing, chaining, Load factors, Rehashing.	7	CO4
Unit-V	**THE HEAP**	**No. of Hours**	**COs**
	The Heap data structure, Min and Max Heap, Implementing priority queue with heap, Heap Sort, When to use what? - Linked Lists, Binary Search Trees, Balanced Trees, Hash Tables.	8	CO5
Unit-VI	**SEARCH TREES**	**No. of Hours**	**COs**
	Binary Search Trees, Binary Search tree as ADT, OBST, Threaded binary Tree, AVL Trees, Splay Trees, Red-Black Trees, Multi-way Trees: B-trees, B+ trees.	7	CO6

Text Books:

1. Michael Goodrich, Roberto Tamassia, Michael H. Goldwasser, "Data Structures and Algorithms in Java", 6th edition, wiley publication, ISBN: 978-1-118-77133-4
2. R. Lafore, "Data structures and Algorithms in Java", Pearson education, ISBN: 9788 131718124.

Reference Books:

1. R. Gilberg, B. Forouzan, "Data Structure: A Pseudo code approach with C++", Cengage Learning.
2. Thomas H. Cormen, Charles E. Leiserson and Ronald L. Rivest, "Introduction to Algorithms", 2nd Edition, The MIT Press, 2001, ISBN0-262-03293-7.

3. J. P. Tremblay and G. A. Cheston “Data structures and Software Development in an Object Oriented Domain”, Java edition, Pearson Education.
4. Sartaj Sahni, “Data Structures, Algorithms and Applications in C++”, 2nd Edition, Universities Press.
5. Robert Sedgewick and Kevin Wayne, “Algorithms”, 4th Edition; Pearson Education, ISBN-13:978-0321573513.

eLearning Resources:

1. NPTEL, “Data Structure And Algorithms Using Java”, IIT Kharagpur, https://onlinecourses.nptel.ac.in/noc23_cs85/preview
2.

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT204 : Object Oriented Programming with Java

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 3	**Total:**	**100 Marks**

Prerequisite Course: Computer Fundamentals & Programming

Course Objectives

1. To understand the basics of Object Oriented Programming using Java.
2. To understand the java class and objects.
3. To apply the concept of inheritance and polymorphism for solving real world problems.
4. To use exception handling and multithreading concepts using java.
5. To apply files and JDBC concepts for storing the data.
6. To understand the basics of design patterns and its types.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the basics of object oriented programming using Java.	2	Understand
CO2	Understand the Java class and objects.	2	Understand
CO3	Apply the concept of inheritance and polymorphism for solving real world problems.	3	Apply
CO4	Use exception handling and multithreading concepts using java.	3	Apply
CO5	Apply Files and JDBC concepts for storing the data.	3	Apply
CO6	Understand the basics of design patterns and its types.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	1	2	1	1	1	2	3	3	--	--
CO2	3	2	2	1	2	1	2	1	2	1	2	3	3	--	3
CO3	3	3	2	2	2	1	1	2	2	1	2	2	--	--	3
CO4	3	3	2	2	2	1	1	2	2	1	2	2	--	--	3
CO5	3	3	2	2	2	1	1	1	2	1	2	2	2	--	--
CO6	3	3	2	2	2	1	1	1	2	1	2	2	2	--	--

Course Contents			
Unit-I	**INTRODUCTION TO JAVA**	**No. of Hours**	**COs**
	Procedural and object oriented programming paradigm, OOP concepts, Basics of Java programming, history of java, java programming paradigms, advantages of java. JDK, JVM, data types, variables, operators, control structures, looping, comments, type conversion and casting, overloading, math class, arrays, recursion, garbage collection	8	CO1
Unit-II	**OBJECTS AND CLASSES**	**No. of Hours**	**COs**
	Basics of objects and classes in java, constructors, types of constructors, new operator, this and static keyword, finalize() method, import statement, access control, visibility modifiers, methods and objects, inbuilt classes like String, Character, StringBuffer, File.	7	CO2
Unit-III	**INHERITANCE AND POLYMORPHISM**	**No. Of Hours**	**COs**
	Inheritance in java, super and sub class, overriding, object class, super keyword. Polymorphism: dynamic binding, method overriding, abstract classes and methods. Interface: Interfaces VS Abstract classes, defining an interface, implement interfaces, extending interface. Packages: Defining, creating and accessing a package, understanding classpath, importing packages.	8	CO3
Unit-IV	**EXCEPTION HANDLING AND MULTITHREADING**	**No. of Hours**	**COs**
	Exception Handling: Benefits of exception handling, the classification of exceptions , exception hierarchy, checked exceptions and unchecked exceptions, usage of try, catch, throw, throws and finally, built in exceptions. Multithreading: differences between multi-Threading and multitasking, thread life cycle, creating threads, thread priorities, synchronizing threads, inter thread communication.	7	CO4
Unit-V	**FILES AND DATABASE CONNECTIVITY**	**No. of Hours**	**COs**
	Files: streams, byte streams, character stream, text input/output, binary input/output, random access file operations, file management using file class, Connecting to Database, querying a database and processing the results, updating data with JDBC.	8	CO5
Unit-VI	**DESIGN PATTERN**	**No. of Hours**	**COs**
	Introduction, catalog of design pattern, organizing the catalog, select and use design pattern, Design Pattern Catalog: Introduction to creational patterns and its sub types, introduction to structural patterns and its sub types, introduction to behavioral patterns and its sub types, Case Study: designing a document editor.	7	CO6
Text Books:			
1. T.Budd, "Understanding Object- Oriented Programming with Java", Pearson Education, Updated Edition (New Java 2 Coverage)			

2. Herbert Schildt and Dale Skrien, “Java Fundamentals – A comprehensive Introduction”, McGraw Hill, 1st Edition, 2013
3. Erich Gamma, Richard Helm, Ralph Johnson, John Vlissides, “Design Pattern-Elements of Reusable Object Oriented Programming”, Pearson

Reference Books:

1. Herbert Schildt, “Java the complete reference”, McGraw Hill, Osborne, 7th Edition, 2011
2. P.Radha Krishna , “Object Oriented programming through Java”, CRC Press
3. Sachin Malhotra & Saurabh Chaudhary, “Programming in Java”, Oxford University Press

eLearning Resources:

1. NPTEL: Programming in Java, https://onlinecourses.nptel.ac.in/noc23_cs74/preview
2. Coursera: Object Oriented Programming in java, https://www.coursera.org/learn/object-oriented-java
3. Infosys Springboard: Java Programming Fundamentals, https://infyspringboard.onwingspan.com/web/en/app/toc/lex_29959473947367270000_shared/overview

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

HS205 : Universal Human Values And Ethics

Teaching Scheme	Examination Scheme	
Lectures: 3 Hrs./Week	Continuous Assessment:	40 Marks
	End-Sem Exam:	60 Marks
Credits: 3	Total:	100 Marks
Prerequisite Course:		

Course Objectives

1. To make the students aware about the concept and need of value education.
2. To help the students appreciate the essential complementarity between values and skills to ensure sustained happiness and prosperity.
3. To facilitate the development of a holistic perspective among the students towards life and profession.
4. To facilitate the understanding of harmony at various levels staring from self and going towards family, society and nature.
5. To make the students aware about the correlation between engineering ethics and social experimentation in various situations.
6. To highlight the importance of professional ethics in the wake of global realities.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	Descriptor
CO1	Understand the concept of self exploration as the process of value education.	2	Understand
CO2	Understand the human being as the coexistence of self and body.	2	Understand
CO3	Apply the holistic approach for fulfilling human aspirations for the humans to live in harmony at various levels.	3	Apply
CO4	Analyze the universal human order in correlation with professional ethics.	4	Analyze
CO5	Apply ethical practices in engineering profession.	3	Apply
CO6	Evaluate the importance of various ethical practices in the wake of global realities.	5	Evaluate

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	-	-	-	-	-	2	-	3	-	1	-	2	-	-	-
CO2	-	-	-	-	-	2	-	3	-	1	-	2	-	-	-
CO3	-	-	-	-	-	3	-	3	-	1	-	2	-	-	-
CO4	-	-	-	-	-	3	-	3	-	1	-	2	-	-	-
CO5	-	-	-	-	-	3	-	3	-	1	-	2	-	-	-
CO6	-	-	-	-	-	3	-	3	-	1	-	2	-	-	-

Course Contents			
Unit-I	**INTRODUCTION TO VALUE EDUCATION**	**No. of Hours**	**COs**
	Values, Morals and Ethics; Concept and need of value education; Self-exploration as the process for value education; Guidelines for value education; Basic human aspirations and their fulfillment.	8	CO1
Unit-II	**HARMONY IN HUMAN BEING**	**No. of Hours**	**COs**
	Human being as the coexistence of self and the body; Discrimination between the needs of the self and the body; The body as an instrument; Harmony in the self; Harmony of the self with the body.	7	CO2
Unit-III	**HARMONY IN THE FAMILY, SOCIETY AND NATURE**	**No. Of Hours**	**COs**
	Harmony in the family- The basic unit of human interaction; Values in the human to human relationship; Harmony in the society; Vision for the universal human order; Harmony in the nature; Realizing existence as coexistence at all levels.	8	CO3
Unit-IV	**PROFESSIONAL ETHICS**	**No. of Hours**	**COs**
	Natural acceptance of human values; Definitiveness of ethical human conduct; Humanistic education and universal human order; Competence in professional ethics; Transition towards value-based life and profession.	7	CO4
Unit-V	**ENGINEERING ETHICS AND SOCIAL EXPERIMENTATION**	**No. of Hours**	**COs**
	Need of engineering ethics; Senses of engineering ethics; Variety of moral issues; Moral autonomy; Utilitarianism; Engineering as experimentation. Engineers as responsible experimenters; Codes of ethics.	8	CO5
Unit-VI	**GLOBAL ISSUES**	**No. of Hours**	**COs**
	Globalization and multi-national corporations; Cross-cultural issues; Business ethics; Environmental ethics; Computer ethics; Bio-ethics; Ethics in research; Intellectual property rights and plagiarism.	7	CO6

Text Books:

1. R. R. Gaur, R. Sangal, G. P. Bagaria, "A Foundation Course in Human Values and Professional Ethics", Excel Books Pvt. Ltd.
2. R. S. Naagarazan, "A Textbook on Professional Ethics and Human Values", New Age International (P) Ltd. Publishers.

Reference Books:

1. B. P. Banerjee, "Foundations of Ethics and Management", Excel Books Pvt. Ltd.
2. P. L. Dhar, R. R. Gaur, "Science and Humanism", Commonwealth Publishers.
3. M. K. Gandhi, "The Story of my Experiments with Truth", Discovery Publisher.

eLearning Resources:

1. http://uhv.org.in/.
3. Considering the specific nature of this course, the methodology is explorational and thus universally adaptable. In order to connect the content of this course with practice, minimum 6 group activities should be conducted with active involvement of the students. The teacher's assessment should be

strictly based on the participation of the students in these activities.

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

BS202 : Engineering Mathematics - III

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Basics of Mathematics

Course Objectives

1. To Know and recall core knowledge of Scalar and vector function.
2. To Understand the concept of Vector integral.
3. To Apply core concept Higher Order Differential Equation applied problems in engineering.
4. To Analyse the Problem of Series Solution Of Differential Equations.
5. To Understand the core concept of Partial Differential Equation.
6. To Use PDEs in Various Applications.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	To Know and recall core knowledge of Scalar and vector function.	1	Remember
CO2	To Understand the concept of Vector integral.	2	Understand
CO3	To Apply core concept Higher Order Differential Equation applied problems in engineering.	3	Apply
CO4	To Analyse the Problem of Series Solution Of Differential Equations.	3	Apply
CO5	To Understand the core concept of Partial Differential Equation.	2	Understand
CO6	To Use PDEs in Various Applications.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	0	-	-	-	0	-	0	-	-	-
CO2	3	2	-	-	-	0	-	-	-	0	-	0	-	-	-
CO3	3	2	-	-	-	-	-	-	-	0	-	0	-	-	-
CO4	3	2	-	-	-	-	-	-	-	0	-	0	-	-	-
CO5	3	2	-	-	-	-	-	0	-	0	-	0	-	-	-
CO6	3	2	-	-	-	-	-	0	-	0	-	0	-	-	-

Course Contents			
Unit-I	**VECTOR DIFFERENTIATION**	**No. of Hours**	**COs**
	Scalar and vector point function, Derivative of a vector point function, Gradient of scalar function ∅, Directional derivative, Divergence and Curl of vector point function, Solenoidal and irrotational vector field and scalar potential, vector identities.	10	CO1
Unit-II	**VECTOR INTEGRATION**	**No. of Hours**	**COs**
	Line integral, Greens theorem, Work done, Conservative field, surface integral, Stokes theorem, volume integral, Gauss Divergence theorem.	10	CO2
Unit-III	**HIGHER ORDER DIFFERENTIAL EQUATION**	**No. Of Hours**	**COs**
	Homogeneous and non homogeneous linear differential equation of nth order and its solution, Method of variation of parameter, operator method for particular integral, solution of certain types of linear differential equation:-Cauchy's and Legendre's differential equation.	10	CO3
Unit-IV	**SERIES SOLUTION OF DIFFERENTIAL EQUATION**	**No. of Hours**	**COs**
	Linear differential equations with variable coefficients, solution about ordinary point, about singular point (Frobenius method) series solution of Bessel's equation, series solution of Legendre's equation.	10	CO4
Unit-V	**PARTIAL DIFFERENTIAL EQUATION**	**No. of Hours**	**COs**
	Formation of partial differential equation, Partial differential equation of order one (linear and nonlinear), Charpit method, PDE of higher order with constant coefficient.	10	CO5
Unit-VI	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION**	**No. of Hours**	**COs**
	One dimensional heat equation, Wave equation, Two dimensional heat equation (Laplace equation), Telephone equation, Radio equations.	10	CO6

Text Books:

1. B. S. Grewal, "Higher Engineering Mathematics", 42/e, Khanna Publishers, 2012, ISBN-13: 978-8174091154.
2. N. P. Bali and Manish Goyal, "A Text Book of Engineering, Mathematics", 8/e, Lakshmi Publications, 2012. ISBN: 9788131808320.
3. H. K. Das, "Engineering Mathematics", S Chand, 2006, ISBN-8121905209.

Reference Books:

1. K.A. Stroud & D. S. Booth, "Advanced Engineering Mathematics", Industrial Press, 5/e, 2011, ISBN-9780831134495.
2. P. C. Matthews, "Vector Calculus", Springer, 2/e, 2012, ISBN-9783540761808.
3. Robert C. Wrede, "Introduction to vector and tensor analysis", Dover, 2013.
4. W. E. Boyce, R. C. Diprima, "Elementary differential equation and boundary value problems", John Wiley & Sons, 2012, ISBN-978-0-470-45831-0833.
5. R. K. Jain and S. R. K. Iyengar, "Advanced Engineering Mathematics", Narosa Publishing House, 2014. ISBN-13: 978-1842653418.
6. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley, 9/e, 2013.

eLearning Resources:

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT210 : Microprocessor & Microcontroller

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Digital Electronics & Computer Organization.

Course Objectives

1. To use ALP concepts to write the programs.
2. To understand architectural details of 8086 and 80386 microprocessors.
3. To understand segmentation mechanism w.r.t. 80386 microprocessor.
4. To understand paging and protection in 80386 microcontroller.
5. To understand features of 8051 microcontroller.
6. To make use of 8051 microcontroller for interfacing I/O devices.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Use ALP concepts to write the programs.	3	Apply
CO2	Explain architectural details of 8086 and 80386 microprocessors.	2	Understand
CO3	Demonstrate segmentation w.r.t. 80386 microprocessor.	3	Apply
CO4	Demonstrate the Paging and Protection concepts.	3	Apply
CO5	Explain features of 8051 microcontroller.	2	Understand
CO6	Use 8051 for Interfacing I/O devices.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	2	1	1	3	-	-	-	0	-	0	-	3	1
CO2	3	1	2	1	1	3	-	-	-	0	-	0	-	3	1
CO3	2	1	3	1	1	2	-	-	-	0	-	0	-	3	1
CO4	2	1	3	1	1	2	1	-	2	0	-	0	-	3	2
CO5	2	3	2	2	1	2	1	0	1	0	-	0	-	3	1
CO6	2	1	3	1	1	2	2	0	2	0	-	0	-	3	2

Course Contents			
Unit-I	**INTRODUCTION TO ASSEMBLY LANGUAGE PROGRAMMING**	**No. of Hours**	**COs**
	Introduction to assembly language programming. ALP Tools: Assembler, Linker, Loader, Debugger, Emulator. Assembler directives, Far and near procedure, Macros, DOS Interrupts.	10	CO1
Unit-II	**INTRODUCTION TO 8086 & 80386 PROCESSOR**	**No. of Hours**	**COs**
	Introduction to 8086 Processor: Features, Architecture, Pin configuration, Instruction set, Addressing modes. 80386 Processor: 80386 Family, Features, Architecture, Pin Description, Register Set, Addressing modes, Instruction set.	10	CO2
Unit-III	**SEGMENTATION**	**No. Of Hours**	**COs**
	Segmentation: Introduction, Real mode segmentation. 80386 Protected Mode Segmentation: Segment Selector & Descriptors, Descriptor Types, System Tables (IDT, LDT, GDT). Logical to linear/physical address translation.	10	CO3
Unit-IV	**PROTECTION MECHANISM & PAGING**	**No. of Hours**	**COs**
	Protection in segmentation: Protection Levels, Privileged instructions, Inter-privilege level transfer using Call gates and conforming code segment. Paging: support registers, Data structures, Descriptors, Linear to physical address translation, Page level protection. Multitasking: TSS, Task Switching.	10	CO4
Unit-V	**INTRODUCTION TO 8051 MICROCONTROLLER**	**No. of Hours**	**COs**
	Microprocessor Vs Microcontroller. 8051 microcontroller: 8051 family, Features, Architecture, Pin Description, Register bank and Special Function Registers (SFRs), Addressing modes, Instruction set, External data memory and program memory organization. I/O ports programming: Structures, Related SFRs and Configuration.	10	CO5
Unit-VI	**8051 INTERFACING & APPLICATIONS**	**No. of Hours**	**COs**
	Timers/counters programming: Structure, Related SFRs, Operating modes, Delay calculations and Configuration. Serial port programming: Related SFRs, Operating modes, Baud rate calculation and Configuration. Interfacing of displays: LED, LCD, keys, ADC & DAC, Types of Sensors and Actuators, Relay. Design of minimum system using 8051 micro-controller for an applications.	10	CO6

Text Books:

1. Peter Abel, Niyaz Nizamuddin, "IBM PC Assembly Language and Programming", Pearson Education.
2. James Turley, "Advanced 80386 Programming Techniques", McGraw Hill Education.
3. A. Ray, K. Bhurchandi, “Advanced Microprocessors and peripherals: Arch, Programming & Interfacing”, Tata McGraw Hill, 2004, ISBN 0-07-463841-6.

4. M. A. Mazidi, J. G. Mazidi, "The 8051 Microcontroller and Embedded Systems", Pearson Education.

Reference Books:

1. Intel Datasheets of 8086, 80386 Microprocessors & 8051 Microcontroller, ISBN-13-978-0130930811.
2. Walter A. Tribel, Avtar Singh, "The 8088 and 8086 Microprocessors", 4th Edition, Prentice Hall of India.
3. Ray Duncan, "Advanced MS DOS Programming", 2nd Edition, BPB Publications, ISBN-13-978-8170294856.
4. Kenneth Ayala, "The 8051 Micro Controller", 3rd Edition, Delmar Cengage Learning, ISBN-13- 978-1401861582.
5. I. Scott MacKenzie, Raphael C.-W. Phan, "8051 Microcontroller", 4th Edition, Pearson Education, ISBN-13-978-0130195623.
6. Swati Joshi, Atul Joshi, Hemlata Jadhav, “Processor Architecture and Interfacing”, Wiley, ISBN-13-978-8126545605.
7. Douglas Hall, “Microprocessors and Interfacing”, 2nd Edition, 1992, McGraw-Hill, ISBN-13-978-0070257429.

eLearning Resources:

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT211 : Database Management System

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Discrete Mathematics, Data Structures.

Course Objectives

1. To apply the fundamental concepts of database management.
2. To devise queries using Relational Algebra, SQL.
3. To devise queries using PL/SQL.
4. To study systematic database design approaches.
5. To study basic issues of transaction processing, concurrency control.
6. To learn emerging database technologies.

Course Outcomes (COs):

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

Course Outcome (s)		Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Explore fundamental concepts of database management.	3	Apply
CO2	Apply relational algebra and SQL to database.	3	Apply
CO3	Apply PL/SQL to database.	3	Apply
CO4	Design systematic database schema.	3	Apply
CO5	Apply transaction management concepts and concurrency control protocols.	3	Apply
CO6	Understand emerging database technologies.	2	Understand

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	3	0	0	1	1	0	2	2	3	0	0
CO2	3	2	2	2	1	0	0	0	1	0	2	2	3	0	0
CO3	3	3	3	1	3	0	0	0	1	0	1	2	3	0	0
CO4	3	2	2	1	2	0	0	0	1	0	1	2	3	0	0
CO5	2	3	2	2	2	0	0	0	0	0	2	2	3	0	0
CO6	3	3	2	2	2	0	0	0	0	0	2	1	3	0	0

Course Contents			
Unit-I	**INTRODUCTION TO DBMS**	**No. of Hours**	**COs**
	Introduction: Introduction to database systems application, purpose of database system. Introduction to Data models, Three-schema architecture of a database, Components of a DBMS. E-R model: modeling, entity, attributes, relationships, constraints, components of E-R model. Relational model: basic concepts, attributes and domains, concept of integrity and referential constraints, schema diagram.	10	CO1
Unit-II	**RELATIONAL ALGEBRA, STRUCTURED QUERY LANGUAGE**	**No. of Hours**	**COs**
	Relational Algebra: Basic Operations, Selection, projection, joining, outer join, union, difference, intersection, Cartesian product, division operations (examples of queries in relational algebraic using symbols). Introduction to SQL: Characteristics and advantages, SQL Data Types and Literals, DDL, DML, DCL, SQL Operators. Tables: Creating, Modifying, Deleting, Views: Creating, Dropping, Updating using Views, Indexes, Nulls. SQL DML Queries: SELECT Query and clauses, Set Operations, Predicates and Joins, set membership, Tuple Variables, Set comparison, Ordering of Tuples, Aggregate Functions, Nested Queries, Database Modification using SQL Insert, Update and Delete Queries.	10	CO2
Unit-III	**PROCEDURAL LANGUAGE / SQL**	**No. Of Hours**	**COs**
	Introduction to PL/SQL, Benefits of PL/SQL, Creating PL/SQL Blocks, Defining Variables and Datatypes, Control Structures, Explicit Cursors, Stored Procedures and Functions, Create Packages, Dynamic SQL, Triggers.	10	CO3
Unit-IV	**NORMALIZATION**	**No. of Hours**	**COs**
	Functional Dependency, Purpose of Normalization, Data Redundancy and Update Anomalies, Single Valued Normalization: 1NF, 2NF, 3NF, BCNF. Decomposition: lossless join decomposition and dependency preservation, Decomposition Algorithms. Multi valued Normalization (4NF), Join Dependencies and the Fifth Normal Form.	10	CO4
Unit-V	**TRANSACTION MANAGEMENT AND CONCURRENCY CONTROL**	**No. of Hours**	**COs**
	Transactions: Basic concept of a Transaction, Transaction Management, Properties of Transactions, Concept of Schedule, Serial Schedule, Serializability: Conflict and View, Cascaded Aborts, Recoverable and No recoverable Schedules. Concurrency Control: Time-stamps and locking protocols, Recovery System: Shadow-Paging and Log-Based Recovery, Checkpoints.	10	CO5

Unit-VI	EMERGING DATABASE TECHNOLOGIES	No. of Hours	COs
	JSON: Overview, Data Types, Objects, Schema. Introduction to No SQL Databases: SQLite Database, XML Databases. MongoDB: MongoDB CRUD Operations, MongoDB Operators, Aggregation, Indexes, MongoDB Cloud, MongoDB Connectivity.	10	CO6

Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", 6th Edition, McGraw Hill, 2010.
2. Raghu Ramkrishnan and Johannes Gehrke, "Database Management Systems", 2nd Edition, McGraw Hill International Editions, ISBN 978-0072465631
3. Kristina Chodorow and MongoDB, "The Definitive Guide", 2nd Edition, O'Reilly Publications, ISBN: 978-93-5110-269-4.

Reference Books:

1. RamezElmasri and Shamkant B. Navathe, "Fundamental Database Systems", 3rd Edition, Pearson Education, 2003, ISBN 978-0321204486.
2. Hellerstein, Joseph, and Michael Stonebraker, "Big Data Black Book", DT Editorial services, 2015 Edition.
3. "Readings in Database Systems (The Red Book)", 4th Edition, MIT Press, 2005, ISBN: 9780262693141.
7. DBMS NPTEL PPC – IIT KGP https://www.youtube.com/playlist?list=PLyvBGMFYV3auVdxQ1-88ivNFpmUEy-U3M
8. NPTEL course on Data Base Management System By Prof. Partha Pratim Das, Prof. Samiran Chattopadhyay | IIT Kharagpur https://onlinecourses.nptel.ac.in/noc22_cs91/preview

eLearning Resources:

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.

IT212 : Software Engineering Modeling & Design

Teaching Scheme	Examination Scheme	
Lectures: 4 Hrs./Week	**Continuous Assessment:**	**40 Marks**
	End-Sem Exam:	**60 Marks**
Credits: 4	**Total:**	**100 Marks**

Prerequisite Course: Problem Solving, Object Oriented Programming, Fundamentals of Data Structures.

Course Objectives

1. To understand the nature of Software and comprehend software development life cycle through different models.
2. To apply software requirements techniques.
3. To describe principles of agile software development, the SCRUM process and agile practices.
4. To explore and analyze use case modeling, domain/ class modeling.
5. To teach the student Interaction and Behavior Modeling.
6. To Make aware students with design process in software development.

Course Outcomes (COs):

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

	Course Outcome (s)	Bloom's Taxonomy	
		Level	**Descriptor**
CO1	Understand the nature of Software and comprehend softwaredevelopment life cycle through different models.	2	Understand
CO2	Apply software requirements techniques.	3	Apply
CO3	Understand principles of agile software development, the SCRUM process and agile practices.	2	Understand
CO4	Apply use case modeling, domain/ class modeling.	3	Apply
CO5	Demonstrate Interaction and Behavior Modeling.	3	Apply
CO6	Apply design process in software development.	3	Apply

Mapping of Course Outcomes to Program Outcomes (POs) & Program Specific Outcomes (PSOs):

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	3	-	-	1	1	2	1	0	3	1	1	-	3
CO2	3	3	2	1	1	1	1	2	1	3	3	1	1	-	3
CO3	3	3	2	1	2	1	1	2	1	3	3	1	1	-	3
CO4	3	3	1	2	1	1	1	1	1	2	2	1	1	-	3
CO5	3	1	3	2	1	1	-	1	1	2	2	1	1	-	3
CO6	3	1	3	2	1	1	-	1	1	2	2	1	1	-	3

Course Contents			
Unit-I	**INTRODUCTION TO SOFTWARE ENGINEERING**	**No. of Hours**	**COs**
	Introduction to Software, Product vs. Process, Difference between hardware and Software, Nature of Software. Software Process, Software Engineering Practice, Software Development Life Cycle (SDLC), Software Myths, Generic Process model. Process Models: Waterfall Model, V-Model, Incremental Model, Evolutionary Models, RAD model, Concurrent, Specialized Process Models, Personal and Team Process Models.	10	CO1
Unit-II	**REQUIREMENT ANALYSIS**	**No. of Hours**	**COs**
	Requirements Capturing: Requirements Engineering, Requirement Engineering Tasks, Different Techniques of Inception & Elicitation, Prioritizing Requirements (Kano diagram). Requirements Analysis: Basics, Elements of analysis model, Data modeling, Scenario based modeling, Functional modeling & Information flow (DFD, CFD), Software Requirement Specification.	10	CO2
Unit-III	**AGILE DEVELOPMENT**	**No. Of Hours**	**COs**
	Agile Development: Agile manifesto, agility and cost of change, agility principles, myth of planned development. Extreme Programming: XP values, process, industrial XP. SCRUM: process flow, scrum roles, scrum cycle description, product backlog, sprint planning meeting, sprint backlog, sprint execution, daily scrum meeting, maintaining sprint backlog and burn-down chart, sprint review and retrospective. Agile Practices: test driven development, refactoring, pair programming, continuous integration, exploratory testing versus scripted testing. Introduction to kanban and its comparison with the SCRUM process.	10	CO3
Unit-IV	**OBJECT ORIENTED ANALYSIS**	**No. of Hours**	**COs**
	Object Oriented Analysis Process, Use Case Modeling: Actor Identification, Actor Classification, Actor Generalization, Use Cases Identification, Communication, Uses/Include and Extend Associations, Writing a Formal Use Cases, Use Case realizations. Domain / Class Modeling: Approaches For Identifying Classes (Noun-Phase Approach, Common Class Pattern Approach, Class Responsibilities Collaboration Approach, Naming Classes, Class Associations and Identification of Associations, Generalization/Specialization Relationship, Aggregation and Composition Relationships, Attributes and Methods Identification.	10	CO4
Unit-V	**INTERACTION AND BEHAVIOR MODELING**	**No. of Hours**	**COs**
	Activity Diagram: Activity and Actions, Initial and Final Activity, Activity Edge, Decision and Merge Points, Fork and Join, Input and Output Pins, Activity Group, Activity Partitions, Constraints on Action, Swim Lanes. Sequence Diagram: Context, Objects and Roles, Links, Object Life	10	CO5

	Line, Message or stimulus, Activation/Focus of Control, Modeling Interactions. Collaboration Diagram: Objects and Links, Messages and stimuli, Active Objects. Communication Diagram: Iteration Expression, Parallel Execution, Guard Expression, Timing Diagram. State Diagram: State Machine, Triggers and Ports, Transitions, Initial and Final State, Composite States, Submachine States.		
Unit-VI	**OBJECT ORIENTED DESIGN**	**No. of Hours**	**COs**
	Object Oriented Design Process Designing Business Layer : Object Oriented Constraints Language (OCL). Designing Business Classes : The Process, Designing Well Defined Class Visibility, Attribute Refinement, Method Design Using UML Activity Diagram, Packaging and Managing Classes. Designing Access Layer: Object Relational Systems, Object Relation Mapping, Table Class Mapping, Table – Inherited Classes Mapping. Designing the Access Layer Classes: The Process. Designing View Layer : View Layer Classes Design, Identifying View Classes by Analyzing Use Cases, Macro-Level Design Process. Prototyping the User Interface Component and Deployment Design using Component and Deployment Diagram.	10	CO6

Text Books:

1. Roger S Pressman, “Software Engineering: A Practitioner’s Approach”, McGraw-Hill, 7th or 8th Edition, ISBN: 0073375977.
2. Ali Bahrami, “Object Oriented System Development: Using Unified Modeling Language”, McGraw-Hill, International Edition 1999, ISBN:0-07-116090-6.

Reference Books:

1. Ian Sommerville, “Software Engineering”, Pearson Education, 6th Edition.
2. R. Mall, “Fundamentals of Software Engineering”, Prentice Hall of India.
3. Craig Larman, “Applying UML and Patterns”, Pearson Education, 2nd Edition, ISBN:978- 0130925695.
4. Martin Fowler, “UML Distilled, Pearson”, 3rd Edition, ISBN:978-81-317-1565-9.
5. Dan Pilone, Neil Pitman, “UML in Nutshell”, O’reilly Pub., ISBN:8184040024, 9788184040029.
6. JIM Arlow, Ila Neustadt, “UML 2 and the Unified Process”, Pearson, 2nd Edition, ISBN:978813170054.
7. Tom Pender, “UML 2 Bible”, Wiley India, ISBN:9788126504527.
8. Pankaj Jalote, “Software Engineering: A Precise Approach”, Wiley India, ISBN: 9788126523115.

eLearning Resources:

1. Object Oriented System Development Using UML, Java And Patterns By Prof. Rajib Mall | IIT Kharagpur Link: https://onlinecourses.nptel.ac.in/noc23_cs46/preview

Note: Number of hours allocated to units includes actual teaching hours, continuous internal assessment hours and experiential learning.