Credit Framework for Master of Computer Applications (NEP-2020)
School of Computer Applications, BBD University, Lucknow

Semester	Discipline Specific Core (DSC) (Major)	Discipline Specific Elective (DSE) (Major)	Generic Elective (GE)(Minor)	Co-Curricular (CC)	Vocational Course(VC)	Survey/Seminar/MOOC/Community Outreach (SSMC)	GP	Total Credit
1	6 Subjects 28 Credits (6+6+4+4+4+4 Credits)						1 Credit	29
2	5 Subjects 24 Credits (6+6+4+4+4 Credits)	1 Subject 4 Credits					1 Credit	29
3	3 Subjects 16 Credits (6+6+4 Credits) Dissertation 8 Credits	1 Subject 4 Credits					1 Credit	29
4	1 Subject 4 Credits (Online Mode) Project 24 Credits						1 Credit	29

Babu Banarasi Das University, Lucknow
School of Computer Applications
Master of Computer Applications
Evaluation Scheme (w. e. f. Academic Session 2023-24)

SEMESTER I

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
DSC	MCAN11101	Principles of Programming Using Java	3	1	0	40	60	100	4
DSC	MCAN11102	Computer Organization	3	1	0	40	60	100	4
DSC	MCAN11103	Relational Database Management System	3	1	0	40	60	100	4
DSC	MCAN11104	Web Technologies and Application Development	3	1	0	40	60	100	4
DSC	MCAN11105	Discrete Mathematics	3	1	0	40	60	100	4
DSC	MCAN11106	Principles of Management	3	1	0	40	60	100	4
DSC	MCAN11151	Relational Database Management System Lab	0	0	4	40	60	100	2
DSC	MCAN11152	Web Technologies and Application Development Lab	0	0	4	40	60	100	2
	GPN1101	General Proficiency	0	0	0	100	0	100	1
Total			**18**	**6**	**8**	**420**	**480**	**900**	**29**

SEMESTER II

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
DSC	MCAN12101	Advance Data Mining & Data Warehousing	3	1	0	40	60	100	4
DSC	MCAN12102	Computer Network	3	1	0	40	60	100	4
DSC	MCAN12103	Python Programming Concepts	3	1	0	40	60	100	4
DSC	MCAN12104	Data Structures Using Java	3	1	0	40	60	100	4
DSC	MCAN12105	Software Engineering	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-I	3	1	0	40	60	100	4
DSC	MCAN12151	Python Programming Lab	0	0	4	40	60	100	2
DSC	MCAN12152	Data Structures Using Java Programming Lab	0	0	4	40	60	100	2
	GPN1201	General Proficiency	0	0	0	100	0	100	1
Total			**18**	**6**	**8**	**420**	**480**	**900**	**29**

SEMESTER III

Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
DSC	MCAN13201	.NET Framework Using C#	3	1	0	40	60	100	4
DSC	MCAN13202	Mobile Application Development	3	1	0	40	60	100	4
DSC	MCAN13203	Design & Analysis of Algorithms	3	1	0	40	60	100	4
DSE		Discipline Specific Elective-II	3	1	0	40	60	100	4
DSC	MCAN13251	.NET Framework Using C# Lab	0	0	4	40	60	100	2
DSC	MCAN13252	Mobile Application Development Lab	0	0	4	40	60	100	2
DSC	MCAN13253	Dissertation	0	0	0	80	120	200	8
	GPN1301	General Proficiency	0	0	0	100	0	100	1
Total			**12**	**4**	**8**	**420**	**480**	**900**	**29**

SEMESTER IV									
Course Category	Course Code	Course Title	Contact Hours			Evaluation Scheme			Credits
			L	T	P	CIA	ESE	Course Total	
DSC	MCAN14201	Pattern Recognition(Online)	4	0	0	40	60	100	4
DSC	MCAN14251	Project	0	0	0	250	450	700	24
	GPN1401	General Proficiency	0	0	0	100	0	100	1
Total			**4**	**0**	**0**	**390**	**510**	**900**	**29**
Discipline Specific Elective-I									
1	MCAN12121	Artificial Intelligence							
2	MCAN12122	Cloud Computing							
3	MCAN12123	Theory Of Computation							
Discipline Specific Elective-II									
1	MCAN13221	Machine Learning							
2	MCAN13222	Internet Of Things(IoT)							
3	MCAN13223	Compiler Design							

DSC	Discipline Specific Core
DSE	Discipline Specific Elective
GE	Generic Elective
CC	Co-Curricular
VOC	Vocational Course
GP	General Proficiency
L	Lecture
T	Tutorial
P	Practical

Master of Computer Applications

FIRST SEMESTER

Program	Master of Computer Applications				
Year	I	**Semester**	I		
Course Name	Principles of Programming Using Java				
Code	MCAN11101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The Objective of the course is students will understand basic concepts and structure of programming languages				
Course Outcomes					
CO1	Understand the various programming paradigms.				
CO2	Understand the basics of data, data types and statements.				
CO3	Student able to solve problems using functions.				
CO4	Understand object-oriented programming, Functional and Logic Programming Languages.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction: The Role of Programming Languages:** Why Study Programming Languages, Towards Higher-Level languages, Programming paradigms; **Programming environments Language Description:** Syntactic structure; **Language Translation Issues:** Programming language Syntax, Stages in translation, Formal Translation Models.	15	CO1
2	**Data, Data Types, and Basic Statements:** Names, Variables, Binding, Type Checking, Scope, Scope Rules, Lifetime and Garbage Collection, Primitive Data Types, Strings, Array types, Associative arrays, Record types, Union types, Pointers and References, Arithmetic expressions, Overloaded operators, Type conversions, Relational and Boolean expressions, Assignment statements, Mixed mode assignments, Control structures, Selection, Iterations, Branching, Guarded statements.	15	CO2
3	**Subprograms and Implementations:** Subprograms, Design issues, Local referencing, Parameter passing, Overloaded methods, Generic methods, Design issues for functions, Semantics of call and return, Implementing simple subprograms, Stack and Dynamic local variables, Nested subprograms, Dynamic scoping.	15	CO3
4	**Object-Orientation, Functional and Logic Programming Languages:** Grouping of data and Operations, Constructs for Programming Structures, Abstraction Information Hiding, Program Design with Modules, Defined types, Object Oriented programming concept of Object, Inheritance, Polymorphism, Encapsulation. **Functional and Logic Programming Languages:** Introduction to Lambda calculus, Fundamentals of functional programming languages, Introduction to LISP Concepts; **Introduction to logic and logic programming:** Programming with Prolog.	15	CO4

Suggested Readings

1. "Programming Languages: Design and Implementations", Terrance W.Pratt, Marvin V. Zelkowitz, T.V. Gopal, Fourth ed., Prentice Hall.
2. "Programming Language Design Concept", David A. Watt, Willey India.
3. "Programming languages: Concepts and Constucts", Ravi Sethi, Second Ed., Pearson.

4. "Types and programming Languages", Benjamin C. Pierce. The MIT Press Cambridge, Massachusetts London, England.
5. Concepts of Programming Languages, Robert W. Sebesta, 10th Ed., Pearson.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs47/preview

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

Program	Master of Computer Applications				
Year	I	**Semester**	I		
Course Name	Computer Organization				
Code	MCAN11102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Enhance understanding of Computer Organization, its design, and implementation, enabling students to articulate design issues in developing processors and components that meet specific requirements.				
Course Outcomes					
CO1	Develop familiarity with Digital Electronics terminology and principles for effective analysis and application of digital circuits and systems.				
CO2	Gain familiarity with Computer Processor terminology and principles to analyze and design efficient and high-performance processor architectures.				
CO3	Understand the principles of communication between I/O devices and Processors, facilitating the design of effective I/O subsystems.				
CO4	Gain an understanding of concepts related to data storage and retrieval from memory systems, enabling the design and optimization of memory hierarchies.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction to Digital Electronics:** Number System, Boolean Algebra**,** Minimization of Boolean Expressions using K-Map; Logic Gates: Implementations of Logic Functions using Gates. **Combinational Circuits:** Introduction to combinational circuits, Adders & Subtractors; Multiplexer & De-Multiplexer; Decoder. **Sequential Circuit:** Introduction to Flip Flops, Types of Flip flop, Excitation table of Flip flop, Introduction of Registers; Classification of Registers, Introduction of Counter; Synchronous and Asynchronous counter.	15	CO1
2	**Register Transfer and Micro-operation:** Register Transfer Language: Bus and Memory Transfer; Micro operations: Arithmetic, Logical, Shift micro- operations; Arithmetic logic shift unit; Timing and control; Computer instructions, Instruction codes, Instructions Format., Instruction Cycle, Flow Chart of Instruction Cycle. **Central Processing Unit:** Accumulator based organization; General register organization; Stack organization; Addressing Modes; RISC vs. CISC, Hard wired & Micro Programmed control Unit**.**	15	CO2
3	**I/O Organizations:** Introduction to system buses; Input/ output interface; Interrupt and Interrupt handling: S/W Interrupt, H/W Interrupt, Vectored Interrupt, Daisy Chaining, Priority Interrupt; Device Polling; Serial Vs Parallel communications; I/O Processor; Synchronous Data Transfer; Asynchronous Data Transfer methods: Strobe Control, handshaking; Modes of Data Transfer: Programmed I/O, Interrupt initiated I/O. DMA; DMA: DMA Controller, DMA Transfer; CPU-IOP Communication.	15	CO2 & CO3
4	**Memory organizations**: Memory hierarchy; Main Memory: RAM Chips, ROM Chips; Concept of address space & Memory Space; Address Mapping; Auxiliary Memory; Cache memory: Mapping Techniques: Direct mapping, Associative mapping, Set associative mapping; Associative memory, Cache Basics-Measuring and improving Cache performances.	15	CO4

	Concepts of Parallel Processing: Definition of Parallel Processing, Characteristics of parallelism, Parallelism in Uniprocessor and Multi-Processor System, Introduction to multithreading, Concept of Multiprocessor and Shared memory microprocessor.		

Suggested Readings:

1. M. Morris Mano "Digital Logic and Computer Design", 2nd Edition, PHI.
2. P. Raja, "Switching Theory", Fourth Edition, Umesh Publication.
3. M. Morris Mano, "Computer System Architecture", PHI
4. William Stalling, "Computer Organization & Architecture", Pearson Education Asia.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105163/

Course Articulation Matrix

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

Program	Master of Computer Applications				
Year	I	**Semester**		**I**	
Course Name	Relational Database Management System				
Code	MCAN11103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The objective of this course is to introduce the fundamental concepts of DBMS, terminologies of database management system, E-R Modelling, PL/SQL concept, database transactions and concurrency control techniques.				
Course Outcomes					
CO1	Understand the basic concepts of the database and data models.				
CO2	Understand the fundaments concepts ER diagrams and map ER diagrams into Relations.				
CO3	Evaluate the alternative database designs to determine which one is better according to selected criteria.				
CO4	Understand the basic concepts/features of database transactions and concurrency control techniques.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Data and information, Concepts of persistent data, File system , Basic File Operations, File Structure and Organization, Types of File Organization: Sequential file organization, Heap file organization, Hash file organization, B+ file organization, Indexed sequential access method ,Cluster file organization. **Database Management System:** Introduction of DBMS, Characteristics of the Database Approach, Components of Database System, Database Management System vs. File Management System, Advantages and Disadvantages of DBMS, DBMS Users , DBMS Architecture: 1-Tier Architecture, 2-Tier Architecture and 3-Tier Architecture. Capabilities of good DBMS, Database Schemas and Instances, Classification of Database Management Systems, Database Languages. **Data Models:** Introduction of Data Models, Relational Data Model, Entity Relationship Data Model, Object Based Data Model, Semi-Structure Data Model.	15	CO1
2	**Relational Database Management System & Data Modelling:** Introduction to Relational database, Structure of Relational Database, Relational model terminology: Relations , Domains, Attributes, Tuples, Relational Constraints, Codd Rule, Entity-Relationship Model: Entity Sets, Entity Types, Attributes, Attributes Types, Relationships, Relationship Types ,Keys, Constraints, Entity-Relationship Model: E-R Model Concepts, Notation for E-R Diagram, Mapping Constraints, Extended E-R Features, Reduction of E-R Diagram to Relation. **Relational Algebra:** Concepts of Relational Algebra, Fundamentals Operations: Select, Project, Rename, Union, Set difference, division, Cartesian Product, Additional Relational-Algebra Operations: Set Intersection, Natural Join And Outer join	15	CO1 & CO2
3	**SQL and Database Design Theory:** Introduction on SQL: Characteristics of SQL, Advantage of SQL, SQL Data Type and Literals, Types of SQL Commands, SQL Operators and their Procedure, Queries and Sub Queries, Aggregate Functions, Insert, Update and Delete Operations, Joins, Unions,	15	CO3

	Intersection, Minus, View, Cursors Triggers and PL/SQL. **Functional Dependencies and Normalization:** Informal Design Guidelines for Relation Schemas, Database Anomalies, Functional Dependencies, Armstrong's axioms, Closure of Attribute sets, Normalization, Need of Normalization, Normal Forms, First Normal Form, Second Normal Form, Third Normal Forms and Boyce-Codd Normal Forms, Fourth Normal Form and Fifth Normal Form.		
4	**Transaction Processing & Concurrency Control:** Basic concept; Introduction to Transaction, ACID properties; transaction state; Basic idea of serializability, view and conflict serializability, Recovery and, Recovery Techniques: Log Based Recovery, Shadow Paging, deferred database modification, immediate database modification, checkpoints. **Concurrency Control:** Definition of concurrency, lost update, dirty read, and incorrect summary problems due to concurrency. Deadlock Handling: Deadlock Concepts, Deadlock Prevention, Deadlock Detection and Recovery, Concurrency Control Techniques: Lock Based Protocol, Timestamp-Ordering Protocol, Validation-Based Protocols**.**	15	CO3 & CO4

Suggested Readings

1. Korth, Silbertz, Sudarshan, Database Concepts, McGraw Hill, Seventh Edition-2019
2. Elmasri, Navathe, Fundamentals of Database Systems, Addison Wesley, Seventh Edition-2017
3. Date C J, An Introduction to Database Systems, Addison Wesley, Eight Edition-2017
4. Bipin C. Desai, An Introduction to Database Systems, Galgotia Publications, Sixth Edition-2013
5. Ramkrishnan, Gehrke, Database Management System, McGraw Hill, Third Edition-2002
6. Ivan Bayross -- SQL, PL/SQL: The Programming Language of Oracle, BPP Publication, Fourth Edition-2010
7. R. S. Despandey --SQL/PL SQL for Oracle, 2011.

Online Resources

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

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

Program	Master of Computer Applications				
Year	I	**Semester**	I		
Course Name	Web Technology & Application Development				
Code	MCAN11104				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To focus on the process of Web Development. To build sound concepts of several languages used in Web Technology and create a dynamic, interactive website quickly, confidently, and successfully				
Course Outcomes					
CO1	Understand the basic concept of HTML and application in web designing.				
CO2	Students develop static and dynamic website using HTML and CSS.				
CO3	Understanding the basic concept of Java Script and its application.				
CO4	Student able to develop personal and professional websites.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**HTML, DHTML:** Introduction to HTML5; Introduction to Text Formatting tags; **Types of Lists:** Ordered, Unordered, Definition lists; **Table tags:** Methods to Create Tables , Attributes of Table tag, colspan and rowspan; Block level and Inline elements; Classes; Entities; frameset tags and its Attributes; **Form tag:** Creation of Forms, Textbox, Radio Button, Hidden etc.; Introduction to DHTML; Document Object Model; Style Sheets: Need of CSS; **Types of Style Sheet:** Inline, Internal and External.	15	CO1
2	**JAVA SCRIPT:** Introduction to JavaScript: Advantages of JavaScript; Basic Programming Techniques: Data Types and Literal, Creating Variables and JavaScript Array; Operators and Expressions in JavaScript; JavaScript Programming Constructs: Conditional Checking, Loops; Functions in JavaScript: Built in Functions and User Defined Functions; Dialog Boxes; JavaScript Document Object Model (DOM): Object hierarchy in DOM, Event Handling; Form Object: Form Object's Methods and Properties, Text Element, Button Element, etc.; Other Built in Objects in JavaScript: String, Math and Date Object; Writing Client Side Validations HTML Form Elements.	15	CO2
3	**Working with XAMPP Web Server:** Introduction, Installation, Configuration; **Database Handling:** Introduction MySQL, Connecting MySQL, Creating and Selecting Database, Creating Table, Inserting, Retrieving, Deleting and Updating Data in Database; **Basic of PHP:** Introduction to PHP: Features of PHP, Basics of PHP, Data Types, Variables, Constants, Operators, Arrays; Conditional Statements and Iterations;	15	CO3
4	**Functions in PHP:**User Defined and Built in Functions; Working with String Functions; **Working with Forms in PHP:** Adding elements to a form, uploading files to the web server using PHP; Debugging and Errors: Types of Errors and Error handling in PHP; Database Connectivity with MySQL.	15	CO4

Suggested Readings

1. Burdman Jessica, "Collaborative Web Development", Addison Wesley. 2002.
2. Bayross Ivan,"HTML, DHTML. JavaScript, and PHP", BPB Publications, 4th Edition, 2001.
3. Xavier, C,"Web Technology and Design", New Age International, 2000.
4. Shah Dhruti "Node.JS Quickbook" BPB Publication. 2018.

5. Achyut S Godbole and Atul Kahate, “Web Technologies”, Tata McGraw Hill.
6. James L Mohler and Jon Duff, “Designing interactive web sites”, Delmar Thomson Learning.
7. Nicholas C. Zakas, Jeremy McPeak, Joe Fawcett, “Professional Ajax, 2nd Edition”, Wrox.
8. Lynn Beighley & Michael Morrison, “Headfirst PHP & MySQL, First Edition”, O’Reilly.

Online Resources

1. https://onlinecourses.swayam2.ac.in/nou20_cs05/preview

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

Program	Master of Computer Applications				
Year	I	Semester	I		
Course Name	Discrete Mathematic				
Code	MCAN11105				
Course Type	DSC	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	The objective is that students will be able to distinguish between the notion of discrete and continuous mathematical structures & will be able to apply fundamental counting algorithms to solve applied problems in the area of computer science.				
Course Outcomes					
CO1	To Perform operations on discrete structures such as sets, functions, relations, and sequences.				
CO2	To Solve problems of recurrence relations and generating functions.				
CO3	To Verify the correctness of an argument using propositional and predicate logic and truth tables.				
CO4	To understand the concept of graph theory.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Set Theory, Relation & Function**: **Set Theory:** Definition of Sets, Type of Sets, Venn Diagrams, Operation on Sets, Subsets, Power Set, Cartesian Product, Principle of Inclusion and Exclusion, Multisets; **Relation**: Definition of Relation, Binary Relations, Inverse Relations, Composition of Relations, Properties of Relations, Equivalence Relations, Partial Order Relations, Partial Ordered Set, Hasse Diagram of Poset; **Function**: Definition & Type of Functions, One-to-One Function, Onto Function, Inverse Function, Compositions of Functions .	15	CO1
2	**Discrete Numeric Function and Recurrence Relation**: Numeric Function, Generating Function, Recurrence Relation, Linear Recurrence, Relation with Constant Coefficients, Homogeneous and Particular Solution, Solution by Method of Generating Function.	15	CO2
3	**Fundamentals of Logics:** Proposition, First order Logic, Logical Operation, Truth Values, Compound Proposition, Tautologies & Contradiction, Logical Equivalences, De-Morgan's laws. Predicates, Universal and Existential Quantifiers.	15	CO3
4	**Graph Theory:** Graph: Graph Terminology, Types of Graph: Simple Graph, Complete Graph, Bipartite, Regular and Planar Graph, Euler Graphs, Directed Graph, Hamiltonian Path and Circuits, Graph Coloring, Chromatic Number; **Tree**: Definition of Tree, Spanning Tree, Minimal Spanning Tree, Kruskal's Algorithms, Prim's Algorithms.	15	CO4

Suggested Readings

1. J. P. Tremblay and R. Manohar, "Discrete Mathematical Structure with Application to Computer Science", TMH, New Delhi, 2000.
2. Kolman, Busby and Ross "Discrete Mathematical Structures" PHI/Pearson., 6th Ed., 2009.
3. Kenneth H. Rosen, "Discrete Mathematics & Applications", TMH, 6th Ed., 2007.
4. 4. C. L. Liu, "Elements of Discrete Mathematics", McGraw Hill Book Company, 2nd Ed., 1985.
5. Narsingh Deo, "Graph Theory", PHI, 24th Indian Print, 2003.

Online Resources

1. https://archive.nptel.ac.in/courses/106/108/106108227/

2. https://archive.nptel.ac.in/courses/106/103/106103205/

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

Program	Master of Computer Applications				
Year	I	**Semester**	I		
Course Name	Principles of Management				
Code	MCAN11106				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Principles of management is a comprehensive introductory course on the management process from a manager's perspective, with particular emphasis on the skills, competencies, techniques, and knowledge needed to successfully manage an organization				
Course Outcomes					
CO1	Understand how managers manage business organizations in the dynamic global environment.				
CO2	Get an understanding of the basic principles of staffing and leadership.				
CO3	Understand contemporary management concepts and skills and put these concepts and skills into practice.				
CO4	Apply conceptual tools and techniques in analyzing, evaluating, and addressing management issues.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Concept, nature, process, and significance of management. Managerial levels, skills, functions, and roles. Management Vs. Administration. Coordination is the essence of management. Development of management thought: classical, neo-classical, behavioral, systems and contingency approaches.	15	CO1
2	**Planning and Organizing I:** Planning: Nature, scope and objectives of planning, Types of plans, Planning process, Business forecasting. MBO: Concept, types, process and techniques of decision-making, Bounded Rationality. **Organizing:** Concept, nature, process, and significance. Principles of an organization Span of Control, Departmentation, Types of organization. Authority Responsibility, Delegation and Decentralization, Formal and Informal Organization	15	CO2
3	**Staffing and Motivation:** Staffing: Concept, Nature, and Importance of Staffing; Motivating and Leading: Nature and Importance of motivation, Types of motivation, Theories of motivation: Maslow, Herzberg, X, Y and Z. **Leadership:** meaning and importance, Traits of a leader, Leadership Styles: Likert's Systems of Management, Tannenbaum, and Schmidt Model and Managerial Grid.	15	CO3
4	**Controlling:** Nature and Scope of control, Types of Control, Control process, **Control techniques:** traditional and modern, Effective Control System.	15	CO4

Suggested Readings

1. Stoner, Freeman and Gilbert Jr., Management, Prentice Hall of India, New Delhi, 2003.
2. Gupta, C.B., Management Concepts and Practices, Sultan Chand and Sons, New Delhi, 2003.
3. Koontz. O Donnel and Weirich, Management, Tata McGraw Hill Publishing Company, New Delhi, 2001.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc23_mg33/preview

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

Program	Master of Computer Applications				
Year	I	**Semester**		I	
Course Name	Relational Database Management System Lab				
Code	MCAN11151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	The main objective is students gain knowledge about databases for storing the data and to share the data among different kinds of users for their business operations				
Course Outcomes					
CO1	Develop database modelling for a problem and normalization.				
CO2	Design a database using PL/SQL.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Creating and Managing Tables a. Creating and Managing Tables b. Including Constraints 2. Manipulating Data a. Using INSERT statement. b. Using DELETE statement. c. Using UPDATE statement. 3. SQL Statements – 1 a. Writing Basic SQL SELECT Statements b. Restricting and Sorting Data c. Single-Row Functions 4. SQL Statements – 2 a. Displaying Data from Multiple Tables b. Aggregating Data Using Group Functions c. Subqueries 5.. Using SET operators, Date/Time Functions, GROUP BY clause a. Using SET Operators b. Datetime Functions c. Enhancements to the GROUP BY Clause d. Advanced Subqueries 6. Creating and Managing other database objects a. Creating Views b. Other Database Objects c. Controlling User Access 7. Using DCL commands a. creating users. b. Authenticating users c. c. Roll back command	15	CO1 & CO2
2	1. Creating and Operation on Sequenced 2. Creating and Performing operation on Index 3. Creating a Simple Program of PL/SQL 4. Creating and Using Stored Procedure through PL/SQL 5. Creating and Using Function through PL/SQL 6. Creating Implicit and Explicit Cursor Program 7. Creating Triggers and Firing it	15	CO1 & CO2

Suggested Readings

1. Ivan Bayross , “SQL, PL/SQL: The Programming Language of Oracle”, BPP Publication
2. Connolly & Begg, “Database Systems: A Practical Approach to Design, Implementation and Management”, Pearson Education.

Online Resources

1. https://www.youtube.com/watch?v=TB5T2O8Hwm8

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2			1	2	1	1		2		1	1	1	
CO2	1	1	1	1	2	2	2		2		1	2	1	1

Program	Master of Computer Applications				
Year	I	**Semester**	I		
Course Name	Web Technology & Application Development Lab				
Code	MCAN11152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To focus on the process of Web Development. To build sound concepts of several languages used in Web Technology and create a dynamic, interactive website quickly, confidently, and successfully.				
Course Outcomes					
CO1	Gradually build a static website using HTML, DHTML and CSS. Move this skill upward by creating some degree of user interactivity using JavaScript.				
CO2	Server-side data processing by creating PHP scripts technologies.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Implementation of List Tags in HTML. 2. Implementation of Table Tag in HTML. 3. Implementation of Frameset Tag in HTML. 4. Implementation of different Form Tags in HTML. 5. Implementation of Cascading Style Sheet in Web Pages. 6. Implementation of control structure in Java Script. 7. Implementation of Looping structure in Java Script 8. Implementation of form validate in Java Script.	15	CO1
2	1. Installation, configuration and working with XAMPP Web Server. 2. Creating Database, table, and query handling in MySQL. 3. Implementation of PHP tags, variables, and conditional construct. 4. Implementation of looping structure in PHP 5. Implementation of functions in PHP 6. Implementation of string functions in PHP 7. Implementation of database connectivity using MySQL. 8. Writing simple applications with Technologies like HTML,JavaScript, PHP.	15	CO1

Suggested Readings

1. Burdman Jessica, “Collaborative Web Development”, Addison Wesley. 2002.
2. Bayross Ivan,”HTML, DHTML. JavaScript, and PHP”, BPB Publications, 4th Edition, 2001.
3. Xavier, C,”Web Technology and Design”, New Age International, 2000.
4. Shah Dhruti “Node.JS Quickbook” BPB Publication. 2018.
5. Achyut S Godbole and Atul Kahate, “Web Technologies”, Tata McGraw Hill.
6. James L Mohler and Jon Duff, “Designing interactive web sites”, Delmar Thomson Learning.
7. Nicholas C. Zakas, Jeremy McPeak, Joe Fawcett, “Professional Ajax, 2nd Edition”, Wrox.
8. Lynn Beighley & Michael Morrison, “Headfirst PHP & MySQL, First Edition”, O’Reilly.

Online Resources

1. https://html-iitd.vlabs.ac.in/
2. https://www.cybrary.it/practice-lab/introduction-to-programming-using-java-script

Course Articulation Matrix

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

SECOND SEMESTER

Program	Master of Computer Applications				
Year	I	**Semester**	II		
Course Name	Advance Data Mining & Data Warehousing				
Code	MCAN12101				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To understand the principles of Data warehousing and Data Mining and familiar with the Data warehouse architecture and its Implementation. Students also know the architecture of a Data Mining system, data pre-processing methods and classification of the data for the prediction and analysis.				
Course Outcomes					
CO1	Understand the concepts and techniques used in Data Warehouse development and deployment.				
CO2	Apply the exploratory analysis for data mining.				
CO3	Apply statistical and pattern analysis techniques.				
CO4	Design and Develop Data Mining Models.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Data Warehousing:** Introduction of Data Warehousing, Types of Data Warehouse, General stages, Components, Architecture, Tools, Database vs Data Warehouse, Characteristics of Data Warehouse, Applications of Data Warehousing, Query Tools, Data Warehouse Bus Architecture; ETL; Types of Data models, Advantages and Disadvantages of Data Model; **OLAP:** Introduction, Cube, Basic Analytical Operations, System types, Benefits of using OLAP services; ROLAP: Introduction, Architecture, Advantages, Tools; **MOLAP:** Introduction, Architecture, Advantages, Tools, OLTP vs. OLAP, Benefits of OLTP method. **Dimensional Model:** Dimensional Model in Data Warehouse, Elements, Steps, Rules, and benefits of Dimensional Modeling. **Schemas:** Star and SnowFlake Schema in data warehousing, Multidimensional schemas, Galaxy schema, Star Cluster schema. **Data Mart:** Type of Data Mart, Steps in implementing a Datamart. **Data Lake:** Architecture, concepts, Maturity stages, Difference between Data lakes and Data Warehouse.	15	CO1
2	**Introduction to Data Mining:** Data Mining, Predictive Analysis, Major issues in data mining. **Data Preprocessing:** Data Cleaning, Handling Missing Data, identifying misclassifications, Identifying Outliers, Measure of center and spread, Data transformations, Min-Max Normalization, Z-score Standardization, Decimal scaling, Normality, Transformations to achieve Normality, transforming categorical values to Numerical values, Binning, Reclassifying categorical values. **Exploratory Data Analysis:** Hypothesis Testing Versus Exploratory Data Analysis, Getting to Know the Data Set, Exploring Categorical Variables, Exploring Numeric Variables, Exploring Multivariate Relationships, Selecting Interesting Subsets of the Data for Further Investigation, Using EDA to Uncover Anomalous Fields, Binning Based on Predictive Value,	15	CO2

	Deriving New Variables: Flag Variables, Deriving New Variables: Numerical Variables, Using EDA to Investigate Correlated Predictor Variables. **Dimension-Reduction Methods:** Need for Dimension-Reduction in Data Mining, Principal Components Analysis, Profiling the Principal Components, Communalities, Validation of the Principal Components, Factor Analysis.		
3	**Univariate Statistical Analysis:** Data Mining Tasks in Discovering Knowledge in Data, Statistical Approaches to Estimation and Prediction, Statistical Inference, Confidence Interval Estimation of the Mean, Reducing the Margin of Error, Confidence Interval Estimation of the Proportion, Hypothesis Testing for the Mean, Assessing the Strength of Evidence Against the Null Hypothesis, Using Confidence Intervals to Perform Hypothesis Tests, Hypothesis Testing for The Proportion **Multivariate Statistics:** Two-Sample t-Test for Difference in Means, Two-Sample Z-Test for Difference in Proportions, Test for the Homogeneity of Proportions, Chi-Square Test for Goodness of Fit of Multinomial Data, Analysis of Variance. **Frequent Pattern Analysis:** Frequent Itemset, Frequent Pattern Mining, Apriori, FP growth, Pattern Mining in Multilevel, Multidimensional Space, Constraint based Frequent Pattern Mining, Mining High-Dimensional data, Mining Approximate Pattern, Pattern Application and Exploration	15	CO3
4	**Preparing to Model the Data:** Supervised Versus Unsupervised Methods, Statistical Methodology and Data Mining Methodology, Cross-Validation, Overfitting, Bias–Variance Trade-Off, Balancing the Training Data Set, Establishing Baseline Performance. **Simple Linear Regression:** Simple Linear Regression, Extrapolation, Coefficient of Determination, Standard Error of the Estimate, Correlation Coefficient, Anova Table for Simple Linear Regression, Outliers, High Leverage Points, and Influential Observations, Population Regression Equation, Verifying The Regression Assumptions, Inference in Regression, t-Test for the Relationship Between x and y, Confidence Interval for the Slope of the Regression Line, Confidence Interval for the Correlation Coefficient ρ, Confidence Interval for the Mean Value of Given, Prediction Interval for a Randomly Chosen Value of Given, Transformations to Achieve Linearity, Box–Cox Transformations. **Classification:** k-Nearest Neighbor Algorithm, Classification Task, k-Nearest Neighbor Algorithm, Distance Function, Combination Function, Quantifying Attribute Relevance: Stretching the Axes, Database Considerations, k-Nearest Neighbor Algorithm for Estimation and Prediction. Decision Tree, Classification and Regression Trees, C4.5 Algorithm, Decision Rules. **Clustering:** Hierarchical and *k*-Means Clustering, The Clustering Task, Hierarchical Clustering Methods, Single-Linkage Clustering, Complete-Linkage Clustering, *k*-Means	15	CO4

	Clustering, Example of *k*-Means Clustering, Behavior of MSB, MSE, and Pseudo-F as the *k*-Means Algorithm Proceeds **Model Evaluation Techniques:** Model Evaluation Techniques for the Description Task, Model Evaluation Techniques for the Estimation and Prediction Tasks, Model Evaluation Measures for the Classification Task, Accuracy and Overall Error Rate, Sensitivity and Specificity, False-Positive Rate and False-Negative Rate, Proportions of True Positives, True Negatives, False Positives, and False Negatives, Misclassification Cost Adjustment to Reflect Real-World Concerns, Decision Cost/Benefit Analysis, Lift Charts and Gains Charts, Interweaving Model Evaluation with Model Building, Confluence of Results: Applying a Suite of Models.		

Suggested Readings

1. Daniel T. Larose, Chantel D. Larose, "Data Mining and Predictive analysis", Wiley 2015.
2. Paul rajponniah "Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals," Wiley, 2013
3. Jiawei Han and Micheline Kamber, "Data Mining Concepts and Techniques" Elsevier.
4. Max Bramer, "Principles of Data Mining", Springer

Online Resources

1. "https://www.youtube.com/@datamining-iitkgp625", IIT Kharagpur, NPTEL 2018

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

Program	Master of Computer Applications				
Year	I	**Semester**	II		
Course Name	Computer Networks				
Code	MCAN12102				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To study the different aspects of data communication service integrated over the IP networks**,** focusing on protocol.				
Course Outcomes					
CO1	Understand concepts of data communication, signal transmission and different networking elements along with protocols in each layer of references models.				
CO2	Understand the fundamentals of Data Link Layers, Multiple Access Protocols, Wired, and Wireless LAN.				
CO3	Gain basic knowledge of Network layer with routing protocols.				
CO4	Gain basic knowledge of Transport layer and Application Layer with protocols.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Data Communications**: Definition, Effectiveness (Delivery, Accuracy, Timeliness, Jitter), Components (Message, Sender, Receiver, Transmission medium, Protocol), Data Representation (Text, Number, image, Audio, Video), Data Flow (Simplex, Half-Duplex, Full-Duplex), Guided and Unguided Media, Switching Techniques(Circuit Switching, Message Switching, packet Switching),Modem (ISDN and PSTN); **Signals and Transmission Media**: Analog and Digital, Transmission Channel, Bandwidth and Throughput; Transmission Modes: Introduction, Modulation (PCM, AM, FM, PM). **Introduction to Computer Network**: Definition, Application of Network, Network devices (Modem, Repeaters, Hub, Switch, Bridge, Gateway), Network Protocols and Standards, References Models: OSI Model, TCP/IP, Types of Addresses (Unicast, Multicast, Broadcast), Introduction to Physical Layer (Features and Protocols).	15	CO1
2	**Data Link Layer and Multiple Access:** Basic Function of Data Link Layer: Framing (Flow and Error control), Error Detection and Error Correction (Checksum, Hamming Distance), HDLC, Two Sub Layers (Data Link Control, Media Access Control); **Multiple Access Protocols**: ALOHA, CSMA/CD, CSMA/CA, Polling, FDMA, TDMA, CDMA; **Wired and Wireless LAN's**: IEEE Standards, Standard-Ethernet, Gigabit Ethernet, IEEE 802.11; Frame Relay and ATM.	15	CO2
3	**Network Layer:** Basic Function of Network Layer; Logical Addressing: IPv4, IPv6; Address Mapping: ARP, RARP, DHCP; Routing Protocols: Delivery, Forwarding Techniques, Routing Table, Distance Vector Routing, Link State Routing, Path Vector Routing, Multicast Routing, Flooding; Internetworking: Tunnelling, Fragmentation, OSPF, BGP; Congestion Control Techniques: Open and Closed Congestion with example.	15	CO3
4	**Transport Layer and User Defined Layer:** Basic Function of Transport Layer; Process-to-Process Delivery: TCP, UDP; QoS; Basic Function of Presentation and Session Layer with protocols. **Application Layer**: Namespace, Domain Namespace,	15	CO4

	Distribution and Resolution of Namespace, DNS, TELNET, E-Mail, SMTP, SNMP, POP, IMAP, FTP, WWW and HTTP.		

Suggested Readings

1. Andrew S Tanenbaum, David. J. Wetherall, “Computer Networks”, Pearson Education,5th Edition, 2011.
2. Behrouz A. Forouzan, "Data Communications and Networking", Tata McGraw-Hill, Fourth Edition, 2001.
3. Ying-Dar Lin, Ren-Hung Hwang, Fred Baker, “Computer Networks: An Open-Source Approach”, Mc Graw Hill Publisher, 2011.
4. Dayanand Ambawade, Dr. Deven shah, Prof. Mahendra Mehra, “Advance Computer Network”, Wiley India, 2017.
5. Todd Lammle, “CCNA Intro – Study Guide”, Sybex, 2015.

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105183/

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

Program	Master of Computer Applications				
Year	I	**Semester**	II		
Course Name	Python Programming Concepts				
Code	MCAN12103				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	To Understand & Appreciate the basic and advanced features of core language built-ins, handle, and control system/OS level features, communicate using sockets, write client and server-side scripts and design and implement basic applications with database connectivity.				
Course Outcomes					
CO1	Acquire programming skills in basic concepts of python.				
CO2	Understand and learn the concepts of the functions and arrays.				
CO3	Understand the data structure and data handling through the python functions.				
CO4	Acquire object-oriented skills and graphical user interface.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction to Python:** Introduction to python, History of python, installing python, Executing python programs, Comments in python, Internal working of python, Python Implementations, Difference between Python2 and Python3, Indentation Python character set, Tokens, **Core Data Types:** Integer, Floating Point Number, Complex Number, Boolean Type, String Type; print(), Assigning values to a variable, Multiple Assignments, input(), eval(), Formatting Number & String, Python inbuilt mathematical function, ord and chr Functions; **Python Operators & Expression:** Types of operators;Operator Precedence & Associativity. **Decision Statement:** if, if-else, nested if, multiway if-elif- else statement, conditional expression. **Loop Control Statement**: while Loop, for loop, range(), Nested Loops, break, continue, pass.	15	CO1
2	**Functions:** Syntax, use of function, return statement, parameters & arguments: Required argument, Default argument, Keyword Arguments, Variable length argument; Scope of a variable, Recursive function, Lambda function, Python Modules, Built-in Modules in Python: math, random, time & date module. **String:** str class, index [] operator, Traversing: for & while loop, Immutable strings, string operators: slicing, +, *; String operations: comparison, format (), split(), Built-in method: Testing string, search a substring, convert string from one to another, stripping string, Formatting string; **Array:** Creation, Array (datatype, value), Adding elements, accessing elements, removing elements, Slicing, searching element, Updating Array	15	CO2
3	**List:** Creation, list(), Accessing Elements in List, Negative List Indices , List Slicing[start:end], Built-in list class Methods, List operators, List Comprehension, List & Strings, Passing list to a function and returning from afunction, Difference between list & array; **List/Array Processing:** Searching: Linear, Binary; Sorting: Selection, Bubble, Insertion, Merge, Quick. **Tuple:** Creation, tuple(), Built-in tuple class methods, Indexing & slicing,	15	CO3

	Operations on tuple, Variable length tuple to functions, List & Tuple, Sort, Traverse, zip(), Inverse zip(*); **Set**: Creation, set(), set operator, Built-in set class methods,Set operations: union(), intersection(), difference(), symmetric_difference(); **Dictionary**: Creation, dict(), Adding values, Replacing values, Retrieving Values, Formatting, Deleting items, Comparing, Built-in dict class methods, Traversing, Nested Dictionary, Traversing Nested Dictionary, polynomial Dictionary. **File Handling:** Need, Text Files: Open, Read, Write, Append, Close, modes, seek(); Binary Files: Reading, Built-in Functions to to access files and directories;		
4	**Object Oriented Programming:** Introduction to OOPs Concepts; Defining Classes: Adding Attributes, Assigning values to an attribute; Self parametersand adding methods to a class, Displaying class attributes and methods, special class attributes, Accessibility, Defining Objects; Polymorphism; _init_()(Constructor), _del_()(Destructor), Passing object as a parameter to a method, Class Membership Test, Method overloading, Operator Overloading: Special Methods: Arithmetic Operations, comparing types; Reference Equality and Object Equality, Inbuilt Overloading Methods; Inheritance: Introduction, Types of Inheritance, Object Class, Using super(); Method Overriding; Encapsulation; Abstraction; Data hiding. **GUI Programming:** Introduction to graphical user interfaces (GUI); GUI frameworks in Python (e.g., Tkinter); Setting up the development environment for GUI programming, Introduction to Tkinter and its features, Creating and configuring GUI windows and widgets, Layout management (pack, grid, and place) Using various types of widgets (buttons, labels, entry fields, checkbuttons, radio buttons, etc.) Dialog boxes (message boxes, file dialogs, etc.) Customizing widget appearance (colors, fonts, etc.). **Database Connectivity:** Introduction to database concepts; Connecting Python with databases (e.g., SQLite, MySQL); Executing SQL queries using Python.	15	CO4

Suggested Readings

1. Ashok N. Kamthane & Amit A. Kamthane, “Programming and Problem Solving with Python”, McGraw Hill Educations
2. Kenneth A. Lambert, “The Fundamentals of Python: First Programs”, Cengage Learning, ISBN: 978-1111822705.
3. Jake VanderPlas “Python Data Science Handbook” O’Reilly Publications.
4. David Beazley, “Python Essential Reference (4th Edition) “Addison Wesley.

Online Resources

1. https://onlinecourses.swayam2.ac.in/cec22_cs20/preview

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

Program	Master of Computer Applications				
Year	I	**Semester**		II	
Course Name	Data Structure Using Java				
Code	MCAN12104				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course objective is to make the student learn fundamental data structures algorithms and to describe and implement algorithms such as stacks, queues, linked lists, trees, searching techniques, sorting techniques.				
Course Outcomes					
CO1	Students will be able to learn how and why java came about and what makes it so important.				
CO2	Build complex systems from software components.				
CO3	Apply advanced Java programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for problems.				
CO4	Design and implement abstract data types such as linked list, stack, queue, and tree by using Java as the programming language using static or dynamic implementations.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	**Introduction:** Introduction to Object Oriented Programming Concept, Paradigm, Classes, Abstraction, Encapsulation, Inheritance, Polymorphism; Introduction of Java: Java History, JDK Directory Structure, Java Features, Structure of Java Program, Compiling and Interpreting Applications; Java Tokens: Java character set, Keywords, Identifiers, Literals; Data types and Variables: Primitive Data types Declarations; Literals: Numeric Literals, Character Literals, String Literals; Non Primitive data types; Operators and Expressions, Implicit Type Conversions, The Cast Operator, Control Flow Statements. Introduction to Object-Oriented Programming, Type Casting, Input and output-Scanner and System class-print(), println(), and printf() methods.	15	CO1
2	**Classes & Objects:** Creating Classes and objects, Memory allocation for objects, Constructor, Access Modifiers and Access Control, Default, public private protected, Inheritance: Implementation of Inheritance, Simple, Multilevel, and Hierarchical. Polymorphism: Implementation of Polymorphism, Method Overloading, Method Overriding, **Thread:** Threaded programming. Strings: String, String Methods, String Buffer class. Abstract classes and methods. Package & Interfaces: Interfaces, Packages, Packages Concept, creating user defined packages, Java Built in packages, Java.lang, Java.util. Exception Handling: Exception types, Using try catch and Multiple catch, Nested try, throw, throws and finally, Creating User defined Exceptions.	15	CO1 & CO2
3	**Data Structure:** Definition & Classification. Array: Single and multidimensional array. Sorting Algorithm: Insertion, Bubble and Selection. Searching Algorithm: Linear & Binary Search.	15	CO2 & CO3

	Stack: Operations on Stack, array representation, Applications of Stack. Queue: Operations on Queue, Circular Queue, Dequeue.		
4	**Linked List:** Comparison with Array. Single Linked List: Structure & Implementations, Traversing, add new node, delete node. Stack with Single Linked List, Queue as Circular Linked List. Double Linked List. Tree & Binary Tree: Basic Terminology and Properties, Linked representation of Binary Tree. Tree Traversal: in order, pre order and post order.	15	CO3 & CO4

Suggested Readings

1. E. Balagurusamy, Programming with Java, Tata McGraw Hill.
2. Patrick Naughton and Herbertz Schildt, “Java 2.0: The Complete Reference”, TMH, 1999.
3. Deitel & Deitel, "Java How to program”, Prentice Hall, 4th Edition, 2000.
4. Gary Cornell and Cay S. Horstmann, "Core Java Vol 1 and Vol 2", TMH.
5. Java 6 Programming black books Kogent solutions published by dreamtech press edition 2007.
6. Steve Holzner, “Java black book”, Paraglyph Press; Second Edit ion (July 1, 2002)
7. Duncan A Buell, “Data Structures Using Java”, Jones & Bartlett Learning, January 2012
8. Robert Lafore, “Data Structures and Algorithms in Java”, Second Edition, SAMS, Second Edition, 2003.
9. Goodrich, “Data Structures & Algorithms in Java”, Sixth Edition, (January 2014).

Online Resources

1. https://onlinecourses.nptel.ac.in/noc22_cs92/preview

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

Program	Master of Computer Applications				
Year	I	**Semester**	II		
Course Name	Software Engineering				
Code	MCAN12105				
Course Type	DSC	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Student will be successful professionals in the field with fundamental knowledge of software engineering and apply their foundations in software engineering to adapt to readily changing environments using the appropriate theory, principles, and processes				
Course Outcomes					
CO1	Develop the understanding of Software Development Life Cycle.				
CO2	Preparation of SRS, High-Level, Low-Level Design and Test Cases.				
CO3	Aware of the various types of software design approaches.				
CO4	Knowledge of software testing and maintenance.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Fundamental Concept of Software Engineering & Models:** Introduction to Software Engineering, Software Crisis, Software Problems, Software Engineering Problems, Characteristics of Software, Software Evaluation, Software Applications, SDLC. **Software Development Models**: Waterfall Model, Prototyping Model, Interactive Enhancement Model, Spiral Model, Iterative Models, Evolutionary Process Models, Role of Management in Software Development and Problem Analysis.	15	CO1
2	**Software Requirement Analysis and Project Planning:** Requirement Analysis and Requirement Specification Documents, Software Requirement Specification (SRS), Characteristics of SRS, Components of SRS, IEEE Standard of SRS; Project Planning: Project Scheduling Staffing and Personal Planning, Software Cost Estimation: Basic COCOMO Model, Intermediate COCOMO Model, Complete COCOMO Model, Coupling and Cohesion.	15	CO2
3	**Software Analysis & Design Approach:** Design Concepts, Design Model, Top Down and Bottom-Up Approach, Structure Design Methodology, Functional Oriented Approach: Structured Analysis, Data Flow Diagram, Structured Design, Functional Modelling; Object Oriented Approach: Object Oriented Analysis and Design, Classes and Objects, Relationship among Objects, Inheritance and Polymorphism, Design Concepts, Design Notation and Specification, Design Methodology, Dynamic Modelling.	15	CO3
4	**Software Coding, Testing &Maintenance:** Introduction to Software Coding: Coding Standards and Guidelines, Code Walkthrough, Code Inspection; Testing: Testing Fundamentals, Functional Testing, Structural Testing, Test Cases and Test Criteria, Software Testing Strategies, Testing Levels, Unit Testing, Integration Testing and System Testing, Alpha and Beta Testing, Test Plan, Test Case Specification, Test Case Execution and Analysis. Introduction to Software Maintenance, Need of maintenance, Types of Software Maintenance, Software Quality Assurance (SQA), Software Re-	15	CO4

	Engineering, Reverse Engineering, Software Configuration Management Activities.		

Suggested Readings

1. Pankaj Jalote, "Software Engineering", Wiley Publications, 2010, USA, New Jersey.
2. Rajib Mall, "Fundamental of Software Engineering", PHI, 2014, India, New Delhi.
3. Roger S. Pressman, Bruce Maxim, "Software Engineering: A practitioner's Approach", 7th edition, TMH, 2014, India, New Delhi.
4. K.K. Agarwal, Yogesh Singh, "Software Engineering", New Age International Publishers, 2008, India, Rampur.

Online Resources

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

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

Program	Master of Computer Applications				
Year	I	**Semester**		II	
Course Name	Artificial Intelligence				
Code	MCAN12121				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	The course is proposed to teach concepts of Artificial Intelligence. The subject will provide the foundations for AI problem solving techniques and knowledge representation formalisms.				
Course Outcomes					
CO1	Ability to identify and formulate appropriate AI methods for solving a problem.				
CO2	Ability to implement AI based Game Playing techniques.				
CO3	Able to Solve Analytical based problems.				
CO4	Students will be able to use the concepts of AI for real world problem solving.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Introduction:** Definitions, Applications of Artificial Intelligence, Intelligent Agents, Problem Solving: Solving Problems by Searching, Uninformed search, BFS, DFS, Iterative deepening, Bidirectional search, Hill climbing, Informed search techniques: heuristic, Greedy search, A* search, AO* search, Constraint Satisfaction problems.	18	CO1
2	**Game Playing:** Minimax, Alpha-Beta pruning, Water Jug problem, Chess problem, Tiles problem, Wampus Problem, N-Queen Problem, Travelling Salesman Problem.	10	CO2
3	**Knowledge Representation:** Introduction, Approaches and Issues in Knowledge Representation, Propositional Logic and Inference, First-Order Logic and Inference, Unification and Resolution, Expert Systems. **Reasoning:** Introduction, Types of Reasoning, Probabilistic Reasoning, Probabilistic Graphical Models, Certainty factors and Rule Based Systems, Introduction to Fuzzy Reasoning.	17	CO3
4	**Planning and Learning:** Introduction to Planning, Types-Conditional, Continuous, Multi-Agent. Introduction to Learning, Overview of different forms of learning, Categories of Learning: Inductive Learning, Supervised base learning: Learning Decision Trees, SVM, Unsupervised based learning & Reinforcement Learning, Basic Introduction to Neural Net Learning. Introduction to Natural Language Processing: Different issue involved in NLP, Expert System, Robotics.	15	CO4

Suggested Readings

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson Education Asia, Third Edition, Latest Edition.
2. Elaine Rich, Kevin Knight, and Shivashankar B. Nair, “Artificial Intelligence”, Tata McGraw-Hill, Latest Edition.
3. Nils J. Nilsson, “Artificial Intelligence - A New Synthesis", Harcourt Asia Pvt. Ltd., Morgan Kaufmann, Latest Edition.
4. Ivan Bratko, “Prolog Programming for Artificial Intelligence”, Pearson Education Asia, Latest Edition.
5. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, PHI Learning, Latest Edition.

Online Resources

1. https://nptel.ac.in/courses/106105077

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

Program	Master of Computer Applications				
Year	I	Semester		II	
Course Name	Cloud Computing				
Code	MCAN12122				
Course Type	DSE	L	T	P	Credit
Pre-Requisite		3	1	0	4
Course Objectives	To provide skills and knowledge in cloud technology operations to implement large-scale systems and provide expertise for creating appropriate cloud infrastructure that fulfils the needs of business services and customers.				
Course Outcomes					
CO1	Understand the Cloud Computing, Reference, and Deployment model basics.				
CO2	To examine existing cloud infrastructures and determine an acceptable architecture that fulfils business goals, you must first understand the evolution, concepts, and benefits of cloud computing.				
CO3	Interpret alternative service delivery and deployment methods to find a model that best fits the company's needs and apply the tools, techniques, and skills acquired to develop Projects.				
CO4	Identify cloud computing security and privacy risks and develop appropriate security solutions to secure cloud resources.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**The Basic Concepts of Cloud Computing:** Cloud Computing; Definition, Cloud Computing Vision, Goals and Benefits, Characteristics of Cloud Computing, Risks and Challenges of Cloud Computing, Clustering and Grid Computing**. Fundamental Concepts and Models:** Roles and Boundaries**,** Cloud Deployment Models**;** Public, Private, Hybrid and Community Model, Pros and Cons. Cloud Service Models; Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS). **Fundamental Cloud Security:** Basic Concepts; Confidentiality**,** Integrity**,** Availability**,** Introduction Cloud Security Threat, and Mechanism.	15	CO1
2	**Cloud Computing Architecture and Virtualization:** The Cloud Reference Model; Introduction, Workload Distribution**,** Resource Pooling, Dynamic Scalability, Elastic Resource Capacity**,** Service Load Balancing**,** Cloud Bursting, **Virtualization:** Definition, Benefits, Drawback and. Characteristics of Virtualized Environments, Virtualization vs. Cloud Computing, Types of Virtualizations; Application, Network, Storage, Server, Data. **Taxonomy of Virtualization Techniques:** Introduction, Hypervisor, Type-1, Type-2, Pros and Cons, Full and Para Virtualization.	15	CO1 &CO2
3	**Cloud Computing Economics and Data in the Cloud:** Cloud Computing Economics: Cloud Infrastructure; Economics of Private Clouds, Software Productivity in the Cloud, Economies of Scale: Public vs. Private Clouds; Multi-software: Multi-entity Support, Multi-schema Approach, Multi-tenancy using Cloud Data Stores, Data Access Control for Enterprise Applications; **Data in the Cloud:** Relational Databases, Cloud File Systems: Introduction to Google File System and Hadoop Distributed File System, BigTable, HBase, Cloud Data Stores: Datastore and SimpleDB.	15	CO2 &CO3

4	**Cloud Platforms in Industry and Cloud Applications:** Amazon Web Services; Compute Services, Storage Services, Communication Services, Additional Services. Google AppEngine; Architecture and Core Concepts, Application Lifecycle, Cost Model, Observations. Microsoft Azure; Azure Core Concepts, SQL Azure, Windows Azure Platform Appliance. **Cloud Applications:** Healthcare; ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Gene Expression Data Analysis for Cancer Diagnosis. Geoscience; Satellite Image Processing.	15	CO3 & CO4

Suggested Readings

1. Thomas Erl, Ricardo Puttini, Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, 1st edition, Pearson, 2019.
2. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, —Mastering Cloud Computing, Tata Mcgraw Hill, 2013. Cloud Security & Privacy by Tim Malhar, S.Kumaraswammy, S.Latif (SPD,O’REILLY).
3. Gautam Shroff, “Enterprise Cloud Computing: Technology, Architecture, Applications”, Cambridge University Press, 2010.
4. Tim Mather, Subra Kumaraswamy, Shahed Latif, "Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance", 1st Edition, O'Reilly Media, 2009.
5. Anthony T.Velte, Toby J.Velte, Robert Elsenpeter “Cloud Computing, A Practical Approach”, Tata McGraw Hill Education Publication (TMH Publication), 2009.
6. Kailash Jayaswal, Jagnnath Kallakurchi, Donald J. Houde, Dr. Deven Shah, “Cloud Computing”, Black Book, Dreamtech, 2015.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs14/preview

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

Program	Master of Computer Applications				
Year	I	**Semester**	II		
Course Name	Theory of Computation				
Code	MCAN12123				
Course Type	DSE	**L**	**T**	**P**	**Credit**
Pre-Requisite		3	1	0	4
Course Objectives	Objective of a Theory of Computation (TOC) is to introduce the fundamental mathematical and computational principles that are the foundation of computer science.				
Course Outcomes					
CO1	Understand basic properties of deterministic and nondeterministic finite automata.				
CO2	Understand basic properties of formal languages and formal grammar.				
CO3	Understand the relation between types of languages and types of finite automata.				
CO4	Understand basic properties of Turing machines and computing with Turing machines.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	**Finite Automata (FA):** Introduction to Alphabets; Strings and Language, Deterministic Finite Automata (DFA) -Formal definition, simpler notations (state transition diagram, transition table), Language of a DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, Language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon transitions, Minimization of Deterministic Finite Automata, Finite automata with output (Moore and Mealy machines) and Inter conversion.	15	CO1
2	**Regular Expressions (RE):** Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, applications of Regular Expressions. **Regular Grammars**: Definition, regular grammars and FA, FA for regular grammar, Regular grammar for FA. Proving languages to be non-regular -Pumping lemma, applications, Closure properties of regular languages.	15	CO2
3	**Context Free Grammar (CFG):** Introduction to Context free language, Chomsky normal forms, Greibach normal forms, Derivation Trees, Sentential Forms, Rightmost and Leftmost derivations of Strings, Ambiguity in CFGs, Ambiguous and unambiguous CFG, Minimization of CFG's, Pumping Lemma for CFL's, Algebraic expression, Closure properties of Context Free Language.	15	CO3
4	**Push Down Automata (PDA) & Turing Machines:** Push Down Automata (PDA): Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG. **Turing Machines:** Introduction, Basic Features of Turing Machine, Languages of Turing Machine, Turing Machine as Acceptor, Computing Devices, Universal Turing Machine, Undecidable problems about Turing Machines; Rice's Theorem.	15	CO4

Suggested Readings

1. John E. Hopcroft & Jeffery D. Ullman, "Introduction to Automata Theory, Languages & Computation", Pearson.
2. K L P Mishra & N. Chandra Shekhran, "Theory of Computer Science", PHI 2010.
3. Kamala Krithivasan Rama R., "Introduction to Formal Languages, Automata theory & Computation", Pearson 2010.
4. E.V. Krishnamurthi," Introductory Theory of Computer Science", East West Press.
5. ZVI Kohavi, "Switching & Finite Automata Theory", TMH.

Online Resources

1. https://onlinecourses.nptel.ac.in/noc21_cs83/preview

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

Program	Master of Computer Applications				
Year	I	**Semester**		II	
Course Name	Python Programming Lab				
Code	MCAN12151				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To Understand & Appreciate the basic and advanced features of core language built-ins, handle, and control system/OS level features, communicate using sockets, write client and server-side scripts and design and implement basic applications with database connectivity.				
Course Outcomes					
CO1	Acquire programming basic concept implementation in python.				
CO2	Develop the skill of Object-Oriented and designing Graphical user Interfaces and ability to write database applications in Python.				

Module	Course Contents	Contact Hrs.	Mapped CO
1	1. Installing and configuring Anaconda on windows, Linux, or mac. 2. Introduction to Jupyter lab, Variables, keywords, basics operation in python, Taking input in jupyter , console Taking multiple inputs from user in Python operators implementation 3. Python Input Methods for Competitive Programming, Python Output using print () function Python end parameter in print(), if, else, if elif ladder implementation 4. Special keyword - in and is, for loop, range function, and examples use of enumerate, zip function in loops else with for. 5. Using strings in python, single quoted/double quoted/triple quoted Strings, string functions - split, trim, join, format, replace, count, find, index, just, rjust, ljust, center, upper, lower. 6. Practical implementation of Array, creation, and traversal, adding, removing, accessing, updating elements 7. Practical implementation of list, creation and traversal, listfunctions: append, insert, extend, remove, pop, clear, sort, count, index, and copy.	15	CO1
2	1. Practical implementation of tuples, creation and traversal, Practicalimplementation of Set, creation, and traversal, set functions - add, update, remove, clear, pop, union, intersection, difference, disjoint, subset, superset. 2. Practical implementation of Dict, creation and traversal, dictionaryfunction - get, update, keys, items, values. 3. creating functions in jupyter calling function, argument-based functions, different type of style for passing parameter in python 4. Making module for functions, and importing them different types of imports in python, random and math module OS module for file and folder operation, file handing in python 5. Creating classes, creating objects, implementing	15	CO2

	function calls, constructor, and self-keyword implementation, super method 6. Practical implementation on Inbuilt overloading Methods. 7. Practical implementation of inheritance and Method Overriding 8. Practical Implementation of GUI framework and connect it to the database (SQLite, MYSQL).		

Suggested Readings

1. Ashok N. Kamthane & Amit A. Kamthane, "Programming and Problem Solving with Python", McGraw Hill Educations
2. Kenneth A. Lambert, "The Fundamentals of Python: First Programs", Cengage Learning, ISBN: 978-1111822705.
3. Jake VanderPlas "Python Data Science Handbook" O'Reilly Publications
4. David Beazley, "Python Essential Reference (4th Edition) "Addison Wesley.

Online Resources

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

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	2	2	2	2	2	2	1		1	1	1	2	1	2
CO2	2	3	3	3	3	3	2		3	3	3	3	3	3

Program	Master of Computer Applications				
Year	I	**Semester**		II	
Course Name	Data Structure Using 'Java' Lab				
Code	MCAN12152				
Course Type	DSC-Lab	**L**	**T**	**P**	**Credit**
Pre-Requisite		0	0	4	2
Course Objectives	To understand Java Programming language and various concepts of Data Structures, their usage and implement them using 'Java' programming language.				
Course Outcomes					
CO1	Students will be able to learn how and why Java came about and what makes it so important. They will be able to Build complex system from software components and apply advance Java programming techniques such as pointers, dynamic memory allocation, structures to developing solutions for problem.				
CO2	Design and implement abstract data types such as linked list, stack, queue, and tree by using Java as the programming language using static or dynamic implementations.				

Module	**Course Contents**	**Contact Hrs.**	**Mapped CO**
1	1. Implementation of Fundamental Data Types & Testing and Debugging of Programs 2. Implementation of Basic Control Constructs such as loops etc. 3. Implementation of classes & objects 4. Implementation of Methods in Java. 5. Implementation of constructors. 6. Implementation of Inheritance 7. Implementation of Polymorphism. 8. Implementation of String Handling. 9. Implementation of Abstract Class, Interfaces & Packages. 10. Implementation of String Handling. 11. Implementation of Input Output Streams. 12. Implementation of Exception Handling. 13. Implementation of Event Handling	15	CO1
2	1. Implementation of Arrays (Single & Double Dimension). 2. Implementation of Searching techniques: Linear Search, Binary Search. 3. Array implementation of Stack, Queue, Circular Queue, Linked List. 4. Implementation of Stack, Queue, Circular Queue, Linked List using dynamic memory allocation. 5. Implementation of Binary tree. 6. Implementation of Tree Traversals (preorder, inorder, postorder). 7. Implementation of B-Tree. 8. Implementation of sorting techniques: Bubble sort, Merge sort, Insertion sort, Selection sort, and Quick sort	15	CO2

Suggested Readings

1. E. Balagurusamy, Programming with Java, Tata McGraw Hill.
2. Patrick Naughton and Herbertz Schildt, "Java 2.0: The Complete Reference", TMH, 1999.
3. Deitel & Deitel, "Java How to program", Prentice Hall, 4th Edition, 2000.
4. Gary Cornell and Cay S. Horstmann, "Core Java Vol 1 and Vol 2", TMH.
5. Java 6 Programming black books Kogent solutions published by Dreamtech press edition 2007.
6. Steve Holzner, "Java black book", Paraglyph Press; Second Edit ion (July 1, 2002)

7. Duncan A Buell, “Data Structures Using Java”, Jones & Bartlett Learning, January 2012
8. Robert Lafore, “Data Structures and Algorithms in Java”, Second Edition, SAMS, Second Edition, 2003.
9. Goodrich, “Data Structures & Algorithms in Java”, Sixth Edition, (January 2014).

Online Resources

1. https://archive.nptel.ac.in/courses/106/105/106105225/
2. http://cse01-iiith.vlabs.ac.in/

Course Articulation Matrix														
PO-PSO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	1	2	2	2	3	3		1	2		3	3	3
CO2	2	1	2	2	2	3	1		1	2		3	3	3