ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

Abbreviation used:

AC	Audit course	LC	Lab Course	PA	Practical Assessment
PC	Professional Core	PR	Project/ Practical/ Internship	L	Lecture
PE	Professional Elective	SE	Seminar/ Expert Lecture/ Etc.	T	Tutorial
OE	Open Elective	IA*	Internal Assessment	P	Practical
MC	Mandatory/ Common Course	EA	End-Semester Assessment		

Subject Code Format:

A1	A2	B3	C4	C5	C6
School/ Dept. (Offering) **BH:** Basic Sciences and Humanities **CS:** Computer Sciences **EE:** Electrical Sciences **EI:** Electronic Sciences **IP:** Infrastructure and Planning **MS:** Mechanical Sciences **BT:** Biotechnology **TE:** Textile Engineering		**Level** **1:** UG/ Int. Msc. (1st Year) **2:** UG/ Int. Msc. (2nd Year) **3:** UG/ Int. Msc. (3rd Year) **4:** UG/ Int. Msc. (4th Year) **5:** UG/ Int. Msc. (5th Year) **6:** PG (1st Year) **7:** PG (2nd Year) **8:** Ph.D.	**0:** AC **1:** PC **2:** PE **3:** OE **4:** MC **5:** LC **6:** PR **7:** SE **8:** **9:**	**Serial Number (01 to 99)** 01/ 03/…/ 19: Odd Sem. (CSE) 21/ 23/…/ 39: Odd Sem. (IT) 41/ 43/…/ 59: Odd Sem. (MCA) 61/ 63/…/ 79: Odd Sem. (Prog-4) 81/ 83/…/ 99: Odd Sem. (Prog-5) 02/ 04/…/ 20: Even Sem. (CSE) 22/ 24/…/ 40: Even Sem. (IT) 42/ 44/…/ 60: Even Sem. (MCA) 62/ 64/…/ 80: Even Sem. (Prog-4) 82/ 84/…/ 98: Even Sem. (Prog-5)	

1st Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC 1	CS6141	Introduction to Computational Techniques using C and C++	3	0	0	3	40	60	-	100
2	PC 2	CS6143	Computer Organization and Architecture	3	0	0	3	40	60	-	100
3	PE 1 (Any One)	CS6241	Web Design and Technology	3	0	0	3	40	60	-	100
		CS6243	Object Oriented Programming using Python								
		CS6245	Full Stack Development								
4	MC 1	BH6401	Mathematical Methods in Engineering	3	0	0	3	40	60	-	100
5	MC 2	MS6403	Research Methodology and IPR	2	0	0	2	40	60	-	100
6	LC 1	CS6541	Programming Lab using C and C++	0	0	4	2	-	-	100	100
7	LC 2	CS6543	Web Technology Lab	0	0	4	2	-	-	100	100
8	AC 1	Any One from the List of AC 1 (Appendix-I)		2	0	0	0	40	60	-	100
			Total	**16**	**0**	**8**	**18**	**240**	**360**	**200**	**800**

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2nd Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PC 3	CS6142	Data Structure and Design of Algorithms	3	0	0	3	40	60	-	100
2	PC 4	CS6144	Operating System	3	0	0	3	40	60	-	100
3	PE 2 (Any One)	CS6242	Computer Networks	3	0	0	3	40	60	-	100
		CS6244	Computer Security								
		CS6246	Artificial Intelligence								
4	PE 3 (Any One)	CS6248	Database Management Systems	3	0	0	3	40	60	-	100
		CS6250	Virtual Reality								
		CS6252	Machine Learning								
5	OE 1	Any One from the List of OE 1 (Appendix-I)		3	0	0	3	40	60	-	100
6	PR 1	CS6642	Project (Specialization Related)	0	0	4	2	-	-	100	100
7	LC 3	CS6542	Design Algorithm Lab	0	0	4	2	-	-	100	100
8	AC 2	Any One from the List of AC 2 (Appendix-I)		2	0	0	0	40	60	-	100
			Total	**17**	**0**	**8**	**19**	**240**	**360**	**200**	**800**

3rd Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PE 4* (Any One)	CS7241	Theory of Computation	3	0	0	3	40	60	-	100
		CS7243	Enterprise Java Technologies								
		CS7245	Deep Learning								
2	PR 2	CS7641	Dissertation (Phase-I)	0	0	24	12	-	-	100	100
			Total	**3**	**0**	**24**	**15**	**40**	**60**	**100**	**200**

* Virtual/Online Course either offered by OUTR or available in MOOCs platform (No physical class)

4th Semester

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	PR 3	CS7642	Dissertation (Phase-II)	0	0	32	16	-	-	100	100
			Total	**0**	**0**	**32**	**16**	**-**	**-**	**100**	**100**

Credits and Maximum Marks

Sl. No.	Semester	Credits	Maximum Marks
1	1st	18	800
2	2nd	19	800
3	3rd	15	200
4	4th	16	100
Total		68	1900

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1st Semester

PC 1	CS6141	Introduction to Computational Techniques using C and C++	3	0	0	3

Course Objectives:

1. To provide understanding of algorithmic approach to problem solving.
2. To provide knowledge on Procedural as well as Object Oriented Approaches to program design.
3. To provide elaborate knowledge on C language to write procedural programs.
4. To introduce relevant features of C++ language to write object oriented programs.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Develop skills to write computer programs to solve a variety of real-world problems.
2. Write programs using both procedural and object oriented approaches
3. Design programs using readable, reusable and cohesive modules.
4. Develop skills to use pointers and data files in programs.

Course Prerequisites:

1. This course does not require any prerequisite as such.

Module I

Introduction to Computer: Basic Organization of a Computer, Hardware and Software, Programming Languages, Number System, Conversion.

Program Development: Programming as Problem-Solving, Steps in Program Development, Algorithm, Flowchart, Pseudo code, Top-down and Bottom-up approaches, Characteristics of a good program, Structure of a C Program, Compiling, Linking and Executing Programs.

C Language Fundamentals: Language Elements, Data Types, Variables and Constants, Operators, Expressions, Type Conversions, Statements, Managing Console Input and Output Operations, Function.

Control Structures: Decision Making and Branching - If and Switch, Loop Structures - While, Do While and For, Unconditional Jumps - Continue, Break and Go To.

Arrays and Strings: Concept, Declaration and Manipulation of Arrays, One Dimensional and Multidimensional Arrays, Sorting and Searching an Array, Concept of Strings, String Handling Functions, Array of Strings.

Module II

Pointers: Pointer Variable and its Importance, Dereferencing, Pointer Arithmetic and Scale Factor, Pointers and Arrays, Pointer and Strings, Array of Pointers, Pointers to Pointers.

Functions: Designing Structured Programs, User Defined and Standard Functions, Formal and Actual Arguments, Function Prototype, Parameter Passing, Functions Returning Multiple Values, Functions Returning Pointers, Pointers to Functions, Nesting of Functions, Recursion, Passing Arrays to Functions.

Scope and Extent: Scope Rules, Storage Classes - Auto, Extern, Register and Static.

Module III

Structures, Unions and Enumerations: Declaration and Initialization of Structures, Structure as Function Parameters, Structure Pointers, Unions, Enumerations.

File I/O: Defining, opening a File and Closing a File, Input/output Operations in Files, Random Access to Files, Error Handling. Command Line Arguments, Dynamic Memory Management, Pre-Processor Directives.

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Introduction: Need of Object Orientation, Basic Concepts of Object Oriented Approach, Basic Program Construction in C++, Namespace, Data Types, Input and Output, Handling Exceptions.

Objects and Classes: Defining and Using Classes, Constructors and Destructors, Controlling Accessibility, Public and Private Class Members, Member Functions, *this* pointer, *static* class data and *const* Member Functions, Constructor and Function Overloading.

Inheritance: Base and Derived classes, Access Control Mechanisms, Types of Inheritance, Virtual Functions, Abstract Class and Pure Virtual Function, Virtual Base Class.

Text Book:

1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, 8th Edition, Pearson Education, 2016. (Module-I, II, III)
2. The C++ Programming Language, Bjarne Stroustrup, Addition Wesley. (Module-IV)

Reference Books:

1. R. G. Dromey, How to Solve it by Computer. Prentice-Hall India EEE Series.
2. E. Balagurusamy, Programming in ANSI C, 4th edition, McGraw-Hill Publication,2007.
3. PradipDey, ManasGhosh, Programming in C, Second Edition,OxfordUniversity Press, 2011.
4. Brian W. Kernighan, Dennis Ritchie, The C Programming Language, 2nd Edition, Prentice Hall, 1988.
5. Yashavant P. Kanetkar. Let Us C, BPB Publications, 2011.
6. Byron S Gottfried, Programming with C, Schaum's Outlines, Second Edition, Tata McGrawHill, 2006.
7. Bruce Eckel, Thinking in C++, Vol. 1: Introduction to Standard C++, 2nd Edition,

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PC 2	CS6143	Computer Organization and Architecture	3	0	0	3

Course Objectives:

1. To study the basic *organization* and architecture of digital computers
2. To study design aspects of different subsystems of a computer system
3. To understand the instructions and instruction execution life cycle
4. To understand various data transfer techniques in digital computer.
5. To understand processor performance improvement using instruction level parallelism
6. To understand microprocessor and assembly language program

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Understand basic structure of a computer.
2. Understand computer instruction and its execution
3. Understand ALU, design basic circuits and perform computer arithmetic operations.
4. Understand different memory and their performance issues
5. Understand cache mapping techniques.
6. Understand I/O organization and data transfer techniques.
7. Understand processor performance and instruction level parallelism.
8. Write basic assembly language programs

Module I

Introduction: Basic architecture of computer, Functional units, Operational concepts, Bus structures, Von Neumann Concept. Basic Processing: Instruction code, Instruction set, Instruction sequencing, Instruction Cycle & Execution Cycle, Instruction format, addressing modes, Micro instruction, Data path and control path design, Micro programmed vs. Hardwired controlled unit, RISC vs. CISC.
Arithmetic: Design of ALU, Binary arithmetic, Addition and Subtraction of signed number, Multiplication of Positive number, Signed operand multiplication, Division, Floating point number representation and arithmetic.
Digital Electronics: Boolean algebra, Digital Logic, Truth Tables, K map, Number system, Flip- Flop

Module II

Memory: Memory Hierarchy, RAM, ROM, Cache memory organization, Mapping techniques, Virtual memory, Memory Interleaving, Secondary Storage, Flash drives.

Module III

Input/output: Accessing I/O devices, I/O mapped I/O, Programmed I/O, Memory Mapped I/O, Interrupt Driven I/O, Standard I/O interfaces, Synchronous and Asynchronous Data transfer, DMA data transfer.
Introduction to Parallel processing: Flynn's Classification, Pipelining, Super Scalar processors, Array processing, vector processing. 8085 Microprocessor and Assembly Level Programming using 8085 microprocessor

Text Books:

1. William Stalling, Computer Organization and Architecture, PearsonEducation (Module I, II, II)
2. M. Mano, "Computer System and Architecture", PHI. (Module IV)

Reference Books:

1. J. P. Hayes, "Computer Architecture andOrganization", MGH
2. A.S. Tananbaum, "Structured Computer Organization", PearsonEducation
3. Alan Clements, Computer Organization and Architecture, Cengage.
4. C. Hamacher, Z. Vranesic, S. Zaky, "Computer Organization", McGraw-Hill Education India

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PE 1	CS6241	Web Design and Technology	3	0	0	3

Course Objectives:

1. To provide basic understanding of the Internet and World Wide Web.
2. To provide elaborate knowledge on how to use HTML, CSS and JavaScript to develop webpages.
3. To provide understanding on Front-End Libraries such as jQuery and Bootstrap to develop webpages.
4. To provide knowledge and skills on tools and techniques to develop and implement web projects.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Develop webpages using core front-end coding languages such as HTML, CSS and JavaScript.
2. Create Responsive Websites compatible with different devices and screen sizes.
3. Display ability to develop professional websites using Bootstrap and jQuery.
4. Create and maintain websites on the Internet.

Course Prerequisites:

Basic understanding of computer and programming.

Module-I:

Introduction to Internet and World Wide Web: Introduction to Internet, client- server model, IP address, protocols, Basic Services, the Internet verses the World Wide Web, Domain Name, URL, Evolution of World Wide Web, Web 2.0.

Page Structuring using HTML: Structure of a webpage, Basic formatting markups, Adding links, images, Table markup, Lists, Forms, Div and Span, Semantic markups in HTML 5.

Basics of Web Graphics: Image formats, Size and Resolution, Transparency, Scalable Vector Graphics, Image Optimization.

Presentation using CSS: Overview of CSS, benefits of CSS, Basic syntax of writing style rules, Selectors, Types of Style sheet, Inheritance and Cascading styles, Text and Font properties, Color and Background properties, Box Model, Page Layout, Floating and Positioning, Styling forms and tables, Basic responsive web design.

Module-II:

Page Interaction using JavaScript: Introduction to JavaScript, Adding JavaScript to a page, Basics of JavaScript Language, variable, data types, operators, array, control structures, Browser objects, Events, Document Object Model, Accessing page contents using JavaScript, Form validation using JavaScript,

Introduction to XML and AJAX: Basics of XML document, DTD, Schema, XML Http Request object, Sending request and receiving server response using AJAX.

Introduction to jQuery: Basics of jQuery, Selecting elements, Handling events, Applying effects and animations, Manipulating DOM, jQuery and AJAX.

Module-III:

Introduction to Bootstrap: Overview of Bootstrap, Grid basics, Using Bootstrap Base CSS, Typographic elements, Colors, Images, Buttons, Navs, Navbar, Carousel, Forms.

GUI Development: AWT Classes, Window fundamentals, working with graphics, working with color & fonts. Event handling in Java, Delegation Event Model, Swing Package: JFrame, JPanel, swing GUI controls, layout managers, working with menus, Introduction to JavaFX.

Main Texts:

1. The Web Warrior Guide to Web Design Technologies, Don Gosselin, et. al, Cengage Learning

Recommended Texts:

1. Learning Web Design, Jennifer N. Robbins, O'Reilly Media
2. HTML & CSS: Design and Build Websites, Jon Duckett, John Wiley
3. jQuery IN ACTION, Bear Bibeault et.al., Dreamtech

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PE 1	CS6243	Object Oriented Programming using Python	3	0	0	3

COURSE OBJECTIVES:

1. To start writing programs using python.
2. Programing with classes and GUI in python.
3. Programing with databases in python.
4. Programing with data analysis in python

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Write programs in python.
2. Write database programs in python.
3. Write data analysis programs in python.

Course Prerequisites:

Basic understanding of computer and programming.

Module-I:

Strings and text files: String manipulations, subscript operator, indexing, slicing a string; strings and number system: converting strings to numbers and vice versa; text files: reading/writing text and numbers from/to a file; creating and reading a formatted file (csv or tab-separated); manipulating files and directories, OS and SYS modules.

Lists, Sets, Tuples, and Dictionaries: basic list operations, replacing, inserting, removing an element; searching and sorting lists; dictionary, adding and removing keys, accessing and replacing values; traversing dictionaries.

Module-II:

Regular Expressions: re module, pattern-string syntax, find, match, search, split, sub functions,

Functions: defining and calling functions, arguments and return values, Recursive functions.

Classes and OOP: defining classes, attributes and methods, constructor, static and class methods, inheritance, polymorphism, operator overloading, exception handling, try, except, raise, assert, finally.

GUI Programming: Event-driven programming, tkinter module, GUI Basics, creating simple GUI, buttons, labels, entry fields, dialogs, widget attributes - sizes, fonts, colors layouts, nested frames.

Module-III:

Database and Persistence Programming: Persistence options in Python, Using DBM Files, Using Object Pickling, Using Shelves, Data Persistence in RDBMS, creating connection, executing queries, processing query results.

Python web frameworks: Django and Flask: Using Python packages, Web frameworks, Decorators, Routes, Running Flask locally, Building a basic dynamic site & Debugging a Python program, APIs + JSON, Requests package, Parsing a JSON response

Python Libraries: Python libraries for web development: Scrapy, the web crawler to extract data from application, Requests the library that allows to send HTTP requests easily to communicate with an application, Dash, that helps in developing web applications that have to do with data visualization

Text book: Python Object Oriented Programming by Steven F. Lott, Dusty Philips,Packt

Reference Books: Learn Web Development with Python by Fabrizio Romano, Gaston C.Hillar,ArunRavindran,,Packt

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PE 1	CS6245	Full Stack Development	3	0	0	3

COURSE OBJECTIVES:

1. To become knowledgeable about the most recent web development technologies.
2. Idea for creating two tier and three tier architectural web applications.
3. Design and Analyze real time web applications.
4. Constructing suitable client and server side applications.
5. To learn core concept of both front end and back end programming.

COURSE OUTCOMES:

1. Develop a fully functioning website and deploy on a web server.
2. Gain Knowledge about the front end and back end Tools
3. Find and use code packages based on their documentation to produce working results ina project.
4.Create web pages that function using external data.
5.Implementation of web application employing efficient database access

Course Prerequisites:

Basic understanding of computer and programming.

Module-I:

Web Development Basics: Web development Basics - HTML & Web servers Shell - UNIX CLI Version control - Git&Github HTML, CSS
Frontend Development: Javascript basics, OOPS Aspects of JavaScript Memory usage and Functions in JS AJAX for data exchange with server jQuery Framework jQuery events, UI components etc. JSON data format.

Module-II:

REACT JS: Introduction to React, React Router and Single Page Applications React Forms, Flow Architecture and Introduction to Redux More Redux and Client-Server Communication

Module-III:

Java Web Development: JAVA PROGRAMMING BASICS, Model View Controller (MVC) Pattern MVC Architecture using Spring RESTful API using Spring Framework Building an application using Maven
Databases & Deployment: Relational schemas and normalization Structured Query Language (SQL) Data persistence using Spring JDBC Agile development principles and deploying application in Cloud

TEXT BOOKS:

1. Web Design with HTML, CSS, JavaScript and JQuery Set Book by Jon Duckett Professional JavaScript for Web Developers Book by Nicholas C. Zakas
2. Learning PHP, MySQL, JavaScript, CSS & HTML5: A Step-by-Step Guide to Creating Dynamic Websites by Robin Nixon
3. Full Stack JavaScript: Learn Backbone.js, Node.js and MongoDB. Copyright © 2015 BYAZAT MARDAN

REFERENCE BOOKS:

1. Full-Stack JavaScript Development by Eric Bush.
2. Mastering Full Stack React Web Development Paperback – April 28, 2017 by TomaszDyl ,KamilPrzeorski , MaciejCzarnecki

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MC 1	BH6401	Mathematical Methods in Engineering	3	0	0	3

Refer Appendix-I for detailed Syllabus.

MC 2	MS6403	Research Methodology and IPR	2	0	0	2

Refer Appendix-I for detailed Syllabus.

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LC 1	CS6541	Programming Lab using C and C++	0	0	4	2

Note: This course shares the objectives and outcomes of its associated theory course PPCCA101. Suitable execution environment preferably Linux will be used to carry out laboratory exercises. Exercises will primarily follow algorithmic approach as provided in reference book serial number 1. The programs will follow proper modeling either function-oriented or object-oriented as the case may be. The exercises suggested below are illustrative in nature. Additional exercises suitably may be suggested by the faculty concerned to meet the course objectives.

List of Exercises:

1. Write a program that will exchange the values of three variables a, b and c as follows: the variable *b* will hold value of *a*, *c* will hold the value of *b* and *a* will hold the value of the variable *c*.
2. Write a program which reads a set of marks in an examination, count the number of pass marks, number of fail marks, percentage of pass and fail.
3. Write a program to find the harmonic mean of a set of n numbers.
4. Write a program to count the number of digits in an integer.
5. Write a menu based program to find LCM and GCD of a set of numbers
6. Write a program to convert binary numbers to octal and binary numbers to decimal.
7. Write a program to find the maximum, the minimum and how many times they both occur in an array of numbers.
8. Write a program to find the k^{th} smallest element in an array of numbers.
9. Write a menu based program to implement sorting algorithms.
10. Write a program to perform operations such as multiplication and transpose on matrices.
11. Write programs involving string manipulation (to be decided by faculty).
12. Write programs involving pointer arithmetic (to be decided by the faculty)
13. Write a program involving recursive function (to be decided by the faculty)
14. Write programs involving structures and unions (to be decide by the faculty)
15. Write programs involving data files (to be decided by the faculty)
16. Write an Object Oriented Program to find the area and perimeter of a circle.
17. Write a menu based Object Oriented Program to perform operations in a bank account.
18. Write OO programs to implement overloading of function and constructor.
19. Write an OO program to process student results in an examination. Model students and marks scored in an examination as classes using has-a relation. Print the grade sheet of a student.
20. Write an OO program to find the area and perimeter of different shapes such as rectangles, triangles and squares. Use inheritance appropriately.

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LC 2	CS6543	Web Technology Lab	0	0	4	2

Note: This course shares the objectives and outcomes of its associated Professional Elective-1 (i.e. PE 1).

List of Exercises:

1. Design the curriculum vitae developed earlier using colours and better appearance to enhance its presentation.
2. Design the registration form to enhance its appearance.
3. Validate data of the registration form at the client-side.
4. Develop JSON document for a list of Books in a library
5. Develop a webpage that fetches data from the server.
6. Use a query to display a list of students and their details in a table.
7. Develop a dynamic website for your department.
8. Publish the website on the Internet with basic search engine optimization for it.

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AC 1	Any One from the List of AC 1 (Appendix-I)	2	0	0	0

Refer Appendix-I for detailed Syllabus.

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2nd Semester

PC 3	CS6142	Data Structure and Design of Algorithms	3	0	0	3

Course Objectives:

1. To provide knowledge and understanding of various basic and advanced data structures and algorithms available in computing domain.
2. To provide skills to write programs to implement various data structures using procedural or object oriented programming languages.
3. To provide knowledge to do design and runtime analysis of algorithms.

Course Outcomes: On successful completion of the course, the students will be able to:

1. Be well-versed in various standard data structures available in computing domain.
2. Write programs to perform operations like searching, insertion, deletion, traversing mechanism etc. on various data structures.
3. Able to design various types of algorithms and perform complexity analysis.

Course Prerequisites: This course requires understanding of computer programming in any language.

Module I

Introduction to Data Structures, Classification of Data Structures, Abstract Data Types, Sparse Matrices, Strings. Stacks and Queues: Representation, Operations and applications on Stacks and Queues. Linked Lists: Dynamic Memory Management, Single Linked Lists, Double and circular Linked Lists, Operations on Polynomials.

Module II

Trees: Binary Trees, Binary Search Trees, Searching, Insertion and Deletions Operations in a Binary Search Tree, Introduction, Growth of Functions Asymptotic notations, Recurrences, solution of recurrences by substitution, recursion tree and Master methods, Divide and conquer algorithms: Insertion Sort, Merge
sort, Quick sort, heap sort algorithm. Greedy Algorithms -Huffman codes, Prim's algorithm- Kruskal's Algorithm-Dijkstra's Algorithm)

Module III

Fractional knapsack problem. Dynamic programming algorithms: Matrix-chain multiplication, Floyd – Warshall, Single source shortest paths Bellman-Ford Algorithm. Exhaustive Search – Traveling Salesman Problem, Backtracking – n-Queens problem, Hamilton Cycle; branch and bound: 15-puzzle problem.
P, NP, NP Completeness; Approximate algorithms: Traveling Salesman Problem, vertex cover, set cover.

Text Books:

1. Tremblay, Jean-Paul, and Paul G. Sorenson, "An introduction to data structures with applications", McGraw-Hill.
2. Aaron M. Tenenbaum, Data Structures Using C
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
4. ELLIS HOROWITZ and SARTAJ SAHNI. Fundamentals of Computer Algorithms. 2nd Edition, Universities Press

References:

1. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, "Data Structures and Algorithms", Pearson Education, Reprint2006.
2. Donald E. Knuth, "The Art of Computer Programming", Volumes 1& 3 Pearson Education, 2009. Steven S. Skiena, "The Algorithm Design Manual", Second Edition, Springer, 2008
3. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education, 2012. http://nptel.ac.in/
4. Richard F. Gilberg& Behrouz A. Forouzan, Data Structures APsedocode Approach with C, Second Edition, CENGAGE Learning.
5. Ellis Horowitz, SartajSahni, Susan Anderson-Freed, "Fundamentals of Data Structures in C", Universities Press Pvt. Ltd.
6. Seymour, Lipchitz. "Data Structures with C." TMH.

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PC 4	CS6144	Operating System	3	0	0	3

Course Objectives:

1. To study the main components of an OS and their functions.
2. To study the concept of process, process management and CPU scheduling algorithms.
3. To study the concepts and implementation Memory management policies and virtual memory
4. To study the file system, its implementation and disk management.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Understand the managerial roles of OS for resource, file system, process, memory and I/O.
2. Understand the process management policies and scheduling of processes by CPU
3. Understand process synchronization and coordination handled by operating system
4. Understand and analyze the memory management and its allocation policies.
5. Conceptualize the components involved in designing a contemporary OS.

Course Prerequisites:

This course requires understanding of computer organization and programming in any language.

Module I

Operating System Introduction- Functions, Characteristics, Structures - Simple Batch, Multi programmed, timeshared, Personal Computer, Parallel, Distributed Systems, Real-Time Systems, System components, Operating-System services, System Calls, Virtual Machines. Process and CPU Scheduling - Process concepts and scheduling, Operation on processes, Cooperating Processes, Threads, and Interposes Communication Scheduling Criteria, Scheduling Algorithm, Multiple -Processor Scheduling, Real-Time Scheduling.

Module II

Process Management and Synchronization - The Critical Section Problem, Synchronization Hardware, Semaphores, and Classical Problems of Synchronization, Critical Regions, Monitors.

Deadlocks - System Model, Dead locks Characterization, Methods for Handling Deadlocks Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, and Recovery from Deadlock.

Module III

Memory Management and Virtual Memory- Logical versus Physical Address Space, Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging.Demand Paging, Performance of Demanding Paging, Page Replacement, Page Replacement Algorithm, Allocation of Frames, Thrashing.

File System Interface and Implementation-Access methods, Directory Structure, Protection, File System Structure, Allocation methods, Free-space Management, Directory Management, Directory Implementation, Efficiency and Performance.

I/O Management – I/O software and its types, Disk Scheduling.

Text Books:

1. Operating System Concepts, by Abraham Silberschatz, Greg Gagne, and Peter Baer Galvin, Ninth Edition, John Wiley & Sons.

Reference Books

2. Operating Systems: Internals and Design Principles, by William Stallings, 8th edition Pearson Education Limited, 2014
3. Operating systems - A concept based Approach, by D.M Dhamdhere, 3rd Edition, Tata McGraw- Hill, 2012.
4. Operating systems, by Harvey M Deital, 3rd Edition, Pearson Education, 2011.

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 2	CS6242	Computer Networks	3	0	0	3

Course Objectives:

1. To provide students with broad concepts and fundamentals of computer networks.
2. To familiarize students with the layered approach to computer network.
3. To provide adequate knowledge on issues and protocols involved in different layers of network.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Understand the basic concepts of computer network and data communication.
2. Understand the functions of each layer in the OSI and TCP/IP reference model.
3. Understand the working of essential protocols of computer networks, and how they can be applied in network design and implementation.

Course Prerequisites:

This course requires understanding of computer programming and Data structures.

Module I

Network architecture, Layers, Transmission Media, Data Link Layer: Issues in the data link layer, Framing, Error detection and correction, Link-level Flow Control, Medium access, CSMA, Ethernet, Token ring, FDDI, Wired LAN, Wireless LAN

Module II

Connecting Devices, Bridges and Switches, Circuit switching vs. packet switching, Packet switched networks, Network Layer: Design Issues, Logical Addressing, Subnetting, CIDR, IPv4, IPv6, Address Mapping, ARP, RARP, DHCP, ICMP; Delivery, Forwarding, Routing algorithms, RIP, OSPF, BGP –Multicasting – Congestion avoidance in network layer

Module III

Transport Layer: Process-to-process delivery, UDP, TCP, Adaptive Flow Control, Adaptive Retransmission, Congestion control, Congestion avoidance and QoS

Application Layer: Email (SMTP, MIME, IMAP, POP3), Remote Logging (Telnet), File Transfer (FTP), WWW and HTTP, Domain Name System (DNS), Network management (SNMP)

Text Books:

1. Data Communications and Networking by Behrouz A. Forouzan. Third Edition, TMH.

Reference Books:

1. Computer Networks by Andrew S Tanenbaum, David. j. Wetherall, 5th Edition. Pearson Education/PHI
2. Computer Networks: A Systems Approach by Larry L. Peterson, Bruce S. Davie, Morgan Kauffmann Inc., 2003.
3. Computer and Communication Networks by Nader F. Mir, Pearson Education, 2007
4. Data and Computer Communication, William Stallings, Sixth Edition, Pearson Education, 2000

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Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 2	CS6244	Computer Security	3	0	0	3

Objective

1. To provide an understanding of requirement, different approaches and major issues in information security.
2. To develop a basic understanding of cryptography and its use in maintaining security.
3. To provide knowledge of computer security technologies used in computer operating systems, distributed systems, networks and representative applications.
4. To provide an understanding of different issues of overall social, economic and professional contexts, and getting aware of the ethical and legal responsibilities related to computer security.

Course Outcomes:

1. To understand about different external and internal threats to an organization.
2. To understand different procedures used to discover, analyze and how to deal with threats to an organization.
3. To understand and apply the cryptography techniques to transmit data securely.
4. To understand network security threats and solutions to handle those.
5. To understand security related legal and regulatory issues.

Course Prerequisite:

This course requires understanding of computer organization, operating system, network and discrete mathematics.

Module-I

Introduction to Cryptography: Security goals, cryptography attacks, services & mechanisms, techniques.

Symmetric-Key Encipherment: Mathematics of cryptography, Traditional Symmetric-key Ciphers, Data Encryption Standard-Introduction, structure, analysis & security, Advanced Encryption Standard –Introduction, Transformations, key expansion, AES ciphers

Module-II

Asymmetric-Key Encipherment: Mathematics of Asymmetric-Key Cryptography: primes, primality testing, factorization, Chinese remainder theorem, quadratic congruence, exponentiation and logarithm; Asymmetric-Key Cryptography: RSA cryptosystem, Rabin cryptosystem

Integrity, Authentication and Key Management: Message Integrity, Message Authentication, Cryptography Hash Functions – MD4 Hash, SHA-512, Digital Signature, Entity Authentication, Key Management: Symmetric key distribution- KDC, Kerberos, Symmetric key agreement – Diffie-Hellman, Public Key Distribution – X.509

Module-III

Network Security: Authentication Service – Electronic Mail Security – PGP – S/MIME - IP Security – Web Security.

System Security: Intrusion detection – password management – Viruses and related Threats – Virus Counter measures – Firewall Design Principles – Trusted Systems.

Text Books:

1. Behrouz A. Forouzan&DebdeepMukhopadhayay, “Cryptography & Network Security”, McGraw Hill, New Delhi

Reference Books:

1. William **Stallings** & Lawrie **Brown**, “Computer Security: Principles and Practice”, Pearson Education, Inc. New Delhi.
2. Charlie **Kaufman**, Radia**Perlman** & Mike **Speciner**, “Network Security: Private Communication in a Public World”, 2nd Edition, 2003, PHI Learning. New Delhi.

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 2	CS6246	Artificial Intelligence	3	0	0	3

Course Objectives:

The primary objective of this course is to introduce the basic principles, techniques, and applications of Artificial Intelligence. More specifically:

1. To introduce AI and its basic principles towards problem solving using various search techniques.
2. To provide understanding on knowledge representation and reasoning techniques used in intelligent systems.
3. To introduce machine learning, natural language processing and perception.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Understand basic principles and techniques of AI towards problem solving
2. Demonstrate their proficiency in knowledge representation in Intelligent systems
3. Demonstrate understanding of basic learning, communication and perception in intelligent system.

Course Prerequisites:

This course requires basic knowledge of computer algorithms and data structures.

Module-I

Artificial Intelligence: Introduction, Intelligent Agents: Agents & Environments, Concept of Rationality, Nature & Structure of Agents; Problem Solving: Solving Problems by Searching, Classical Search, Adversarial Search, Constraint Satisfaction Problems. Knowledge, Reasoning and Planning: Logical agents, First order logic, Inference in First order logic.

Module-II

Classical planning, Knowledge Representation; Uncertain Knowledge and Reasoning: Probabilistic Reasoning, Learning from Examples, Knowledge in Learning; Natural Language Processing: Language models, Text Classification, information retrieval, information extraction

Module-III

Natural Language for Communication: Phrase structure Grammars, Syntactic Analysis, Augmented grammars and semantic interpretation, Machine translation, Speech recognition; Perception; Expert Systems: Introduction, Design of Expert systems.

Text books:

1. Stuart Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", Third Edition, 2010, Pearson Education, New Delhi.
   Chapters: 1, 2, 3, 4 (4.1, 4.2), 5 (5.1, 5.2, 5.3), 6, 7, 8, 9, 10 (10.1, 10.2, 10.3, 10.5), 12, 14 (14.1-14.6), 18 (18.1- 18.7), 19 (19.1, 19.2, 19.3), 22, 23, 24 (24.1-24.3, 24.5).

Reference books;

1. Elaine A. Rich and Kevin Knight, "Artificial Intelligence", 3rd Edition, 2009, McGraw-Hill Education (India), New Delhi.
2. Nills J. Nilsson, "Artificial Intelligence: A New Synthesis", 2nd Edition, 2000, Elsevier India Publications, New Delhi.
3. Michael Negnevitsky, "Artificial Intelligence: A Guide to Intelligent Systems", Second Edition, 2005, Pearson Education, Inc. New Delhi.
4. Dan W. Patterson, "Introduction to Artificial Intelligence and Expert Systems", 1st Edition, 1996, PHI Learning Pvt. Ltd., New Delhi.
5. Ben Coppin, "Artificial Intelligence Illuminated", 2005, Narosa Publication, New Delhi. ISBN: 978-81-7319-671-3
6. Joseph Giarratano and Gary Riley, "Expert Systems: Principles and Programming", Fourth Edition, CENGAGE Learning India Pvt. Ltd., New Delhi. (Ch.1 and 6)

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 3	CS6248	Database Management Systems	3	0	0	3

Course Objectives:

1. To provide understanding on fundamental concepts of Relational database systems
2. To provide knowledge on Modeling and Design of Relational Databases
3. To provide elaborate knowledge on how to query databases
4. To provide understanding on database transactions

Course Outcomes: On successful completion of the course, the students will be able to:

1. Understand basic concepts of Relational databases management systems
2. Model data requirements of real-world applications
3. Develop databases for a variety of applications
4. Write SQL queries to perform simple to complex data manipulation tasks.

Course Prerequisites: This course requires basic understanding of computer and programming.

Module-I:

Introductory concepts of DBMS: Introduction and applications of DBMS, Purpose of data base, Data, Independence, Database System architecture- levels, Mappings, Database, users and DBA

Relational Model: Structure of relational databases, Domains, Relations, Relational algebra – fundamental operators and syntax, relational algebra queries, tuple relational calculus

Entity-Relationship Model: Basic concepts, Design process, constraints, Keys, Design issues, E-R diagrams, weak entity sets, extended E-R features – generalization, specialization, aggregation, reduction to E-R database schema.

Module-II:

Relational Database design: Functional Dependency – definition, trivial and non-trivial FD, closure of FD set, closure of attributes, irreducible set of FD, Normalization – 1NF, 2NF, 3NF, Decomposition using FD- dependency preservation, BCNF, Multi- valued dependency, 4NF, Join dependency and 5NF.

SQL Concepts: Basics of SQL, DDL,DML,DCL, structure – creation, alteration, defining constraints –Primary key, foreign key, unique, not null, check, IN operator, Functions – aggregate functions, Built-in functions –numeric, date, string functions, set operations, sub-queries, correlated sub-queries, Use of group by, having, order by, join and its types, Exist, Any, All, view and its types; transaction control commands – Commit, Rollback, Save point; Introduction to PL/SQL Concepts: Cursors, Stored Procedures, Stored Function, Database Triggers

Module-III:

Query Processing & Query Optimization: Overview, measures of query cost, selection operation, sorting, join, evaluation of expressions, transformation of relational expressions, estimating statistics of expression results, evaluation plans, materialized views

Transaction Management: Transaction concepts, properties of transactions, serializability of transactions, testing for serializability, System recovery, Two- Phase Commit protocol, Recovery and Atomicity, Log-based recovery, concurrent executions of transactions and related problems, Locking mechanism, solution to concurrency related problems, deadlock, two-phase locking protocol, Isolation, Intent locking

Security: Introduction, Discretionary access control, Mandatory Access Control, Data Encryption

Text Books:

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, “Database SystemsConcepts”, McGraw-Hill Education, New Delhi
2. RamezElmasri and Shamkant B. Navathe, “Fundamentals of DatabaseSystems”, Pearson Education Inc., New Delhi.

Reference Books:

1. Hector Garcia-Molina, Jeffret D. Ullman, JennifferWidom, “Database Systems: AComplete Book”, Pearson Education Inc., New Delhi.
2. C. J. Date “An introduction to Database System”, Pearson Education Inc., NewDelhi.
3. Bipin Desai, “An introduction to Database System”, Galgotia Publications.
4. Peter Rob & Carlos Coronel, “Database Systems: Design, Implementation, andManagement”, CENGAGE Learning India Pvt. Ltd., New Delhi.
5. Mark L. Gillenson, “Fundamentals of Database Management Systems”, WileyIndia Pvt. Ltd., New delhi.
6. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”,McGraw-Hill Education (India), New Delhi.

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 3	CS6250	Virtual Reality	3	0	0	3

Course Objectives: This course is designed to give historical and modern overviews and perspectives on virtual reality. It describes the fundamentals of sensation, perception, technical and engineering aspects of virtual reality systems.
Course Outcomes: On completion of the course, learner will be able to–
CO1: Describe how VR systems work and list the applications of VR.
CO2: Understand the design and implementation of the hardware that enables VR systems tobe built.
CO3: Understand the system of human vision and its implication on perception and rendering.
CO4: Explain the concepts of motion and tracking in VR systems.
CO5: Describe the importance of interaction and audio in VR systems. Course Contents Unit I

Module-I:
Defining Virtual Reality, History of VR, Human Physiology and Perception, Key Elements of Virtual Reality Experience, Virtual Reality System, Interface to the Virtual World-Input & output- Visual, Aural & Haptic Displays, Applications of Virtual Reality, Representation of the Virtual World, Visual Representation in VR, Aural Representation in VR and Haptic Representation in VR.

Module-II:
Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR. Visual Perception - Perception of Depth, Perception of Motion, Perception of Color, Combining Sources of Information Visual Rendering -Ray Tracing and Shading Models, Rasterization, Correcting Optical Distortions, Improving Latency and Frame Rates

Module-III:
Motion in Real and Virtual Worlds- Velocities and Accelerations, The Vestibular System, Physics in the Virtual World, Mismatched Motion and Vection Tracking- Tracking 2D & 3D Orientation, Tracking Position and Orientation, Tracking Attached Bodies
Interaction - Motor Programs and Remapping, Locomotion, Manipulation, Social Interaction. Audio -The Physics of Sound, The Physiology of Human Hearing, Auditory Perception, Auditory Rendering.

Text Books:
1. Virtual Reality, Steven M. LaValle, Cambridge University Press, 2016
2. Understanding Virtual Reality: Interface, Application and Design, William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
3. Developing Virtual Reality Applications: Foundations of Effective Design, Alan B Craig, William R Sherman and Jeffrey D Will, Morgan Kaufmann, 2009.
Reference Books:
1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
e-Books: http://lavalle.pl/vr/book.html
MOOC Courses: https://nptel.ac.in/courses/106/106/106106138/
https://www.coursera.org/learn/introduction-virtual-reality

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 3	CS6252	Machine Learning	3	0	0	3

Course Objectives:
Machine learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention. Machine learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security, from analyzing biochemical interactions to structural monitoring of aging bridges, and from emissions to astrophysics, etc. This class will familiarize students with a broad cross-section of models and algorithms for machine learning, and prepare students for research or industry application of machine learning techniques.

Course Outcomes: By the end of the course, students should be able to:

1. Develop an appreciation for what is involved in learning models from data.
2. Understand a wide variety of learning algorithms.
3. Understand how to evaluate models generated from data.
4. Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models.

Course Prerequisites:
The student must have studied courses on Statistics and Computer Algorithms

Module-I:
Introduction to Machine learning: Definition, Types of learning techniques, Concept learning task. Concept learning as search Decision tree learning: Introduction, Decision tree representation, Decision tree algorithm (ID3), Hypothesis space search in decision tree learning, Inductive bias in decision tree learning. Issues in decision tree learning: Data overfitting and its causes, Reduced error pruning, Rule-based pruning, Continuous valued attributes and attributes with missing values.

Module-II:
Artificial Neural Networks: Introduction, ANN representation, Appropriate problems for ANN learning. Perceptron: Representation power of Perceptron, Perceptron training rule, Gradient descent and Delta rule. Multilayer Networks and Back Propagation Algorithm: A Differentiable Threshold Unit, Back Propagation Algorithm. Linear Regression, Support Vector Machine, Kernel function.

Module-III:
Probability and Bayesian learning: Introduction, Bayes Theorem, Maximum Likelihood Hypotheses, Bayes Optimal Classifier, Naïve Bayes Classifier, Example to illustrate Naïve Bayes Classifier. Instance-Based Learning: Introduction, K-Nearest Neighbor. Clustering: K- means clustering algorithm, Agglomerative Hierarchy clustering algorithm.

Text book

1. Machine Learning by Tom Mitchell, First Edition, McGraw- Hill, 1997
2. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, 3rd ed. The Morgan Kaufmann Series in Data Management Systems, Morgan Kaufmann Publishers, July 2011. ISBN 978-0123814791

Reference book:

1. An Introduction to Machine Learning by Miroslav Kubat, Second Edition, Springer

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

OE 1	Any One from the List of OE 1 (Appendix-I)	3	0	0	3

Refer Appendix-I for detailed Syllabus.

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School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PR 1	CS6642	Project (Specialization Related)	0	0	4	2

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Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

LC 3	CS6542	Design Algorithm Lab	0	0	4	2

Note: This course shares the objectives and outcomes of its associated theory course PPCCA201. Suitable programming language preferably object-oriented will be used to carry out laboratory exercises. The exercises suggested below are illustrative in nature. Additional exercises may be suggested by the faculty concerned to meet the course objectives.

List of Exercises:

1. Implement Stack and use it for evaluation of post-fix expression.
2. Implement conversion of prefix expression into post-fix form using recursion.
3. Implement circular queue (using array) with menu options like insert, delete, display and exit.
4. Implement a priority queue (using pointers) and use it to organize student records prioritized by marks.
5. Implement doubly linked circular list to hold strings and use it for organizing a sequence of cities constituting at our program.
6. Implement of a binary search tree with menu options: Construct a tree, insert a node, delete a node, traverse and display preorder, in order and post order sequence of its nodes.
7. Implement of di-graphs using adjacency matrix and find the transitive closure using Warshall's algorithm.
8. Implement a weighted graph and find minimal cost spanning tree using PRIM's Algorithm.
9. Generate 70 random integers in a given range and sort them using quick sort. Apply both binary search and Interpolation search to locate a given integer and compare the search algorithms based on the number of comparisons / probes required or a successful as well as unsuccessful search.
10. Implement Heap Sort, Merge Sort and other sorting algorithms on the above random numbers.
11. Implement a small Real World Application illustrating DS usage.

AC 2	Any One from the List of AC 2 (Appendix-I)	2	0	0	0

Refer Appendix-I for detailed Syllabus.

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Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

3rd Semester

PE 4	CS7241	Theory of Computation	3	0	0	3

Course Objectives:

1. To understand how theoretical machine is designed.
2. To provide knowledge on theoretical machine design techniques.
3. To provide knowledge on complexity class of problems.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Acquire knowledge on theoretical machine design.
2. Realize the difference between determinism and non-determinism.
3. Get idea on recursive properties of languages.

Course Prerequisites:

1. This course requires data structures as prerequisite.

Module I

Alphabet, languages and finite automata (deterministic and nondeterministic), Minimization of finite automata. DFA/NFA to regular expression and vice versa using Arden's Formula.
grammars: Production rules and derivation of languages. Chomsky's hierarchy of languages and Grammars. Regular grammars, regular expressions. Closure and decision properties of regular languages. Pumping lemma of regular sets.

Module II

Context free grammars and pushdown automata. Chomsky and Griebach normal forms. Parse trees, Cook- Younger- Kasami-parsing algorithms. Ambiguity and properties of context free languages. Pumping lemma, Parikh's theorem. Deterministic pushdown automata, closure properties of deterministic context free languages.

Module III

Turing machines and variation of Turing machine model, Turing computability, Type of languages. Linear bounded automata and context sensitive languages. Primitive recursive functions.
Gödel numbering. Ackermann's function, recursiveness of Ackermann and Turing computable functions. Church Turing hypothesis. Recursive and recursively enumerable languages.

Universal Turing machine and undecidable problems. Undecidability of Post correspondence problem. Valid and invalid computations of Turing machines and some undecidable properties of context free language problems. Time complexity class P, class NP, NP completeness.

Text Books:

1. Introduction to the theory of computation: Michael Sipser, Cengage Learning
2. Introduction to Automata Theory, Languages and Computation: J.E. Hopcroft and J.D Ullman, Pearson Education, 3rd Edition.

Reference Books:

1. Automata Theory: Nasir and Srimani, Cambridge University Press.
2. Introduction to Computer Theory: Daniel I.A. Cohen, Willey India, 2nd Edition.

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Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 4	CS7243	Enterprise Java Technologies	3	0	0	3

Course Objectives:

1. To provide adequate knowledge on basic Server-side Java technologies such as Servlet and JSP.
2. To understand Java frameworks such as JSF and JPA and their use.
3. To understand web services, EJBs and how to use them in distributed n-tier applications.

Course Outcomes:

On successful completion of the course, the students will be able to:

1. Develop skills to write n-tier web applications for a variety of real-world problems.
2. Develop applications using Servlets, JSP and Java Bean following MVC model
3. Develop web applications using JSF framework
4. Develop distributed applications involving JPA, web service and EJB.

Course Prerequisites:

1. This course requires standard Java Programming as prerequisite.

Detail Syllabus

Module I

Enterprise Application Architecture, Enterprise Java Technologies, Web Applications, Servlet Overview, Servlet API, Writing HelloWorld Program using Servlet, Servlet Life Cycle, Configuring Servlet in web.xml, Retrieving information from Request object, HTML form processing using Servlet, Servlet Initialization, Session tracking, Cookies, Database Access using Servlet, Error Handling, Servlet Collaboration, Forward verses Redirect.

Overview of JSP, JSP Advantages, JSP Application Models: JSP Model1 and Model 2 architectures, Life Cycle of a JSP page, JSP Elements, JSP Comments, Scripting in JSP, Directives, Implicit Objects, Action Tags, JSP and Java Beans, Introduction to JSTL, Introduction to JSP Expression Language.

Module II

Introduction to JSF, Features, Benefits of JSF, JSF Architecture, JSF Elements, Request Processing Life Cycles, JSF HTML tags, JSF Core tags, Standard UI components, Managed Beans, Event handling, Page Navigation, convertors, validators, Expression Language, Using AJAX with JSF, sending AJAX Request;

Module III

Enterprise JavaBeans Technology: EJB Component Architecture, Role of EJB & its life cycle, Types of Beans, Session Beans, Stateless and Stateful beans, Message Driven Bean, Life Cycle, Managing Transactions in EJB;

Understanding Java Persistence: Object Relational Mapping, Java Persistence API, Benefits, components of JPA, Entity, Entity manager, Persistence unit, Life cycle of Entity, Entity Relationships, querying entities, Java Persistence Query Language, performing CRUD operations using JPA; Introducing Hibernate.

Overview of SOA, Web Services, Types of Web Service, Building Web services with JAX-WS;

Text Books:

1. Java Server Programming (Java EE 7) Black Book, by DT Editorial Services, Dreamtech Press, 2015.

References:

1. Eric Jendrock, Ricardo Cervera-Navarro, Ian Evans, Kim Haase, William Markito, "The Java EE 7 Tutorial", 5th Edition, Addison-Wesley Professional, Pearson India, 2014.
2. Advanced Java Technology by MT Savaliya, Dreamtech Press, 2015.
3. David Geary, Cay S. Horstmann, "Core Java Server Faces", Third Edition, 2010, Pearson Education, Inc. New Delhi.

ODISHA UNIVERSITY OF TECHNOLOGY AND RESEARCH

Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
Course: Master in Computer Application (MCA),
Programme: Master in Computer Application (MCA),
Duration: 2 years (Four Semesters)

PE 4	CS7245	Deep Learning	3	0	0	3

Course Objectives:
Deep learning uses interdisciplinary techniques such as statistics, linear algebra, optimization, and computer science to create automated systems that can sift through large volumes of data at high speed to make predictions or decisions without human intervention. Deep learning as a field is now incredibly pervasive, with applications spanning from business intelligence to homeland security, from analyzing biochemical interactions to structural monitoring of aging bridges, and from emissions to astrophysics, etc. This class will familiarize students with a broad cross-section of models and algorithms for Deep learning, and prepare students for research or industry application of Deep learning techniques.

Course Outcomes: By the end of the course, students should be able to:

1. Develop an appreciation for what is involved in learning models from data.
2. Understand a wide variety of learning algorithms.
3. Understand how to evaluate models generated from data.

Apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models

Prerequisites: Machine Learning

Module I

Feedforward Neural networks. Gradient descent and the backpropagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Nestors accelerated gradient descent. Regularization. Drop out. Convolutional Neural Networks Architectures, convolution/ pooling layers Recurrent Neural Networks LSTM, GRU, Encoder Decoder architectures

Module II

Deep Unsupervised Learning: Auto encoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, Adversarial Generative Networks, Auto encoder and DBM Attention and memory models, Dynamic memory networks, Applications of Deep Learning to Computer Vision Image segmentation, object detection, automatic image captioning, Image generation with Generative adversarial networks, video to text with LSTM models. Attention models for computer vision tasks.

Module III (10hrs)

Applications of Deep Learning to NLP:

Introduction to NLP and Vector Space Model of Semantics, Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of-Words model (CBOW)**,** Glove, Evaluations and Applications in word similarity, analogy reasoning**,** Named Entity Recognition, Opinion Mining using Recurrent Neural Networks, Parsing and Sentiment Analysis using Recursive Neural Networks**,** Sentence Classification using Convolutional Neural Networks Dialogue Generation with LSTMs**,** Applications of Dynamic Memory Networks in NLP ,Recent Research in NLP using Deep Learning: Factoid Question Answering, similar question detection, Dialogue topic tracking, Neural Summarization, Smart Reply

Reference Books and Papers:

1. Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville. "Deep learning." An MIT Press book in preparation. (2015).
2. Bengio, Yoshua. "Learning deep architectures for AI." Foundations and trends in Machine Learning 2.1 (2009): 1127.
3. Hochreiter, Sepp, and JargenSchmidhuber. "Long short-term memory." Neural computation 9.8 (1997): 17351780.
4. Oquab, Maxime, et al. "Learning and transferring midlevel image representations using convolutional neural networks." Proceedings of the IEEE conference on computer vision and pattern recognition. 2014.
5. Bengio, Yoshua, et al. "A neural probabilistic language model." journal of machine learning research 3. Feb (2003).

6. Collobert, Ronan, et al. "Natural language processing (almost) from scratch." Journal of Machine Learning Research 12. Aug (2011): 2493-2537.
7. Mikolov, Tomas, et al. "Efficient estimation of word representations in vectorspace." arXiv preprint arXiv:1301.3781 (2013).
8. Pennington, Jeffrey, Richard Socher, and Christopher D. Manning. "Glove: Global Vectors for Word Representation." EMNLP. Vol. 14. 2014.
9. Kim, Yoon. "Convolutional neural networks for sentence classification." EMNLP (2014).
10. Oquab, Maxime, et al. "Learning and transferring mid-level image representations using convolutional neural networks." *Proceedings of the IEEE conference on computer vision and pattern recognition*. 2014.
11. Kumar, Ankit, et al. "Ask me anything: Dynamic memory networks for natural language processing." arXiv preprint arXiv:1506.07285 (2015).
12. Sutskever, Ilya, Oriol Vinyals, and Quoc V. Le. "Sequence to sequence learning with neural networks." Advances in neural information processing systems. 2014.
13. Kalchbrenner, Nal, Edward Grefenstette, and Phil Blunsom. "A convolutional neural network for modelling sentences." ACL (2014).
14. Socher, Richard, et al. "Recursive deep models for semantic compositionality over a sentiment treebank." Proceedings of the conference on empirical methods in natural language processing (EMNLP). Vol. 1631. 2013.
15. Socher, Richard, et al. "Parsing with Compositional Vector Grammars." ACL. 2013.
16. Abadi, Martın, et al. "Tensorflow: Large-scale machine learning on heterogeneous distributed systems." arXiv preprint arXiv:1603.04467 (2016)

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Techno Campus, Mahalaxmi Vihar, Ghatikia, Bhubaneswar-751029.

Syllabus (Effective from 2023-24)

School/ Department: School of Computer Sciences
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PR 2	CS7641	Dissertation (Phase-I)	0	0	24	12

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Duration: 2 years (Four Semesters)

4th Semester

PR 3	CS7642	Dissertation (Phase-II)	0	0	32	16