VTU Centre for Distance and Online Education (VTU-CDOE)

MCA in Artificial Intelligence and Data Science

Scheme and Syllabus

Program Outcomes		
Sl No	**Description**	**POs**
1	Apply knowledge of computing fundamentals, computing specialization, mathematics, and domain knowledge appropriate for the computing specialization to the abstraction and conceptualization of computing models from defined problems and requirements..	**PO1**
2	Identify, formulate, research literature, and solve complex computing problems reaching substantiated conclusions using fundamental principles of mathematics, computing sciences, and relevant domain disciplines.	**PO2**
3	Design and evaluate solutions for complex computing problems, and design and evaluate systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.	**PO3**
4	Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	**PO4**
5	Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex computing activities, with an understanding of the limitations.	**PO5**
6	Understand and commit to professional ethics and cyber regulations, responsibilities, and norms of professional computing practices.	**PO6**
7	Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.	**PO7**
8	Demonstrate knowledge and understanding of the computing and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.	**PO8**
9	Communicate effectively with the computing community, and with society at large, about complex computing activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.	**PO9**
10	Understand and assess societal, environmental, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant top professional computing practices.	**PO10**

11	Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary environments.	**PO11**
12	Identify a timely opportunity and using innovation to pursue that opportunity to create value and wealth for the betterment of the individual and society at large.	**PO12**

Program Education Objectives (PEOs):

PEO 1: promote from current position to software architecture / administration.

PEO2: develop products using automation

PEO 3: demonstrate high moral professional ethics

PEO 4: exhibit lifelong adoption for change in technology.

SEMESTER-I

Sl. No	Code	Course Name	Type of the Course	Credits
1	OMCI101	Mathematical Foundation for Computer Application	CORE	4
2	OMCI102	Operating System	CORE	4
3	OMCI103	Database Management System	CORE / SKILL	4
4	OMCI104	Programming Using C	SKILL	4
5	OMCI105	C Programming Lab	SKILL	2
6	OMCI106	Database Management Lab	SKILL	2
Total Credits			**20**	

SEMESTER-II

Sl. No	Code	Course Name	Type of the Course	Credits
1	OMCI201	Data Structure and Algorithms	CORE	4
2	OMCI202	Object Oriented Programming Using Python	CORE / SKILL	4
3	OMCI203	Software Engineering with Agile Methodologies	CORE / SKILL	4
4	OMCI203	Fundamentals Of Artificial Intelligence and Machine Learning	SKILL	4
6	OMCI204	Data Structure Lab	SKILL	2
7	OMCI205	Python Lab	SKILL	2
Total Credits			**20**	

SEMESTER-III

Sl. No	Code	Course Name	Credit
1	OMCI301	Artificial Intelligence	4
2	OMCI302	Data Analytics Using Python	4
3	OMCI303x	Elective - I	4
4	OMCI304x	Elective - II	4
5	OMCI305	Artificial Intelligence Lab	2
6	OMCI306	Data Analytics Lab	2
TOTAL			20

Elective – I		
Sl. No.	**Course Code**	**Course Name**
1	OMCI303A	Big Data Analytics
2	OMCI303B	Data Mining
3	OMCI303C	Linear Algebra and applications

Elective - II		
Sl. No	**Course Code**	**Course Name**
1	OMCI304A	Data Visualization
2	OMCI304B	Agile Technologies
3	OMCI304C	Natural Language Processing

SEMESTER-IV

Sl. No	Code	Course Name	Credit
1	OMCI401	Deep Learning	4
2	OMCI402x	Elective - III	4
3	OMCI403	Major Project	12

Elective - IV		
Sl. No.	**Course Code**	**Course Name**
1	OMCI402A	Data and Web Mining
2	OMCI402B	Predictive analysis
3	OMCI402C	Artificial Intelligence in Cyber Security

Mathematical Foundation for Computer Applications		Semester	I
Course Code	OMCI101	CIE Marks	30
		SEE Marks	70
Credits	4	Total Marks	100
		Exam Hours	3
Examination nature (SEE)	Theory		

Course objectives:

- The Curriculum supports the prerequisites to enhance their Mathematical knowledge towards their understanding mathematical Concepts in the concerned fields.

MODULE-1

MATRICES Definition, Types of Matrices, Addition, Subtraction, Scalar Multiplication and Multiplication of Matrices, Adjoint, Inverse, Eigen values and Eigen Vectors of a Matrix, Caley-Hamilton Theorem (Statement only) Rank of a matrix, Row reduced echelon form and normal form Solution of homogeneous and non homogeneous system of linear equations.

MODULE-2

SETS: Sets, Subsets, Types of Sets, Operation on Sets, Cartesian product, Cardinality of sets and applications.

MODULE-3

RELATIONS AND FUNCTIONS:

RELATIONS: Definition with illustrations, Representation of relations to Zero-one matrix and digraphs.

FUNCTIONS: Definition, Domain and Range of function, Types of functions with illustrations.

MODULE-4

Random variable and probability distribution:

Concept of random variable, discrete probability distributions, continuous probability distributions, Mean, variance and co-variance and co-variance of random variables. Binomial and normal distribution, Exponential and normal distribution with mean and variables and problems

MODULE-5
Graph Theory: Graphs and Graphs models, Graph Terminology and Special Types of Graphs, Representing Graphs and Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest-Path Problems, Planar Graphs, Graph Colouring
Course Outcomes: **CO1**: Develop basic knowledge of matrices and to solve system of linear equations. CO2: Understand the basic concepts of sets, functions and relations.. **CO3**: Understand the concepts of representations of relations and functions.. **CO4**: Model the given problem by applying the concepts of graph theory.. **CO5:** Design strategy using gaming theory concepts for the given problem.
Suggested Learning Resources: **Text Books & Reference Books:** 1. Discrete Mathematics by Guru Raja Chaar. 2. B.S.Grewal: Higher Engineering Mathematics Khanna Publishers, 43rd Edition. 3. Richard A Johnson and C.B Gupta "Probability and statistics for engineers" Pearson Education 4. Kenneth H Rosen, "Discrete Mathematics and its Applications", McGraw Hill publications, 7th edition.

OPERATING SYSTEMS		Semester	I
Course Code:	**OMCI102**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Explore the need for OS and different types of OS

CLO 2. Explain the different techniques for management of resources

CLO 3. Learn the Use of processor, memory, storage and file system commands

Module-1

Introduction to operating systems [OS]: What operating systems do; Computer System organization; Computer System architecture; Operating System operations; Resource Management; Security and Protection; Virtualization; Distributed system; Computing environments.

Operating System Structures: Operating Services; User and Operating System interface; System calls; System Services; System programs; Operating system design and implementation; Operating System structure; System Building and Booting; Why Applications Are Operating-System Specific?

Process Management: Process concept; Process scheduling; Operations on processes; Inter process communication [IPC]; IPC Systems

Textbook 1: Chapter – 1, 2 and 3

Module-2

Threads and Concurrency: Multicore Programming, Multithreading models; Thread Libraries; Implicit Threading; Threading issues; OS-Threading examples.

CPU Scheduling: Basic concepts; Scheduling Criteria; Scheduling Algorithms; Multiple-processor scheduling; Thread scheduling; Multi-Processor Scheduling, Real-Time CPU Scheduling; OS CPU scheduling examples and Algorithm Evaluation

Process Synchronization: Background; The critical section problem; Peterson's solution; Hardware Support for Synchronization; Mutex Locks; Semaphores; Monitors; Classical problems of synchronization.

Textbook 1: Chapter – 4, 5, 6 and 7

Module-3
Deadlocks: System model; Deadlock in Multithreaded Applications; Deadlock characterization; Methods for handling deadlocks; Deadlock Prevention; Deadlock Avoidance; Deadlock detection and Recovery from Deadlock. **Memory Management:** Background; Contiguous memory allocation; Paging; Structure of page table; swapping; Example: Intel 32- and 64-bit Architectures. **Virtual Memory Management:** Background; Demand paging; Copy-on-write; Page replacement; Allocation of frames; Thrashing. **Textbook 1: Chapter – 7, 8, 9and 10**
Module-4
Mass-Storage Structure: Overview of Mass-Storage Structure; HDD Scheduling; NVM Scheduling; Storage Device Management; Swap-Space Management; Storage Attachment; RAID Structure. **File System:** File concept; Access methods; Directory structure; Protection; File system structure; File system operation; Directory implementation; Allocation methods; Free space management. File system mounting; File sharing. **Textbook 1: Chapter – 11, 12 and 13**
Module-5
Protection: Goals of protection, Principles of protection, Protection Rings; Domain of protection, Access matrix, Implementation of access matrix, Access control, Revocation of access rights, Capability- Based systems. **Case Study: The Linux Operating System:** Linux history; Design principles; Kernel modules; Process management; Scheduling; Memory Management; File systems, Input and output; Inter-process communication; Network Structure; Security **Textbook 1: Chapter – 17 and 20**

Course Outcomes (Course Skill Set)

At the end of the course the student will be able to:

CO 1. Identify the structure of an operating system and its scheduling mechanism.

CO 2. Demonstrate the allocation of resources for a process using scheduling algorithm.

CO 3. Interpret the root causes of deadlock and provide the solution for deadlock elimination

CO 4. Illustrate different memory management concepts and storage structures such as files , directories and functionalities provided in the Linux Operating system.

Suggested Learning Resources:

Textbooks & Reference Books

1. Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, Operating System Principles 10th edition, Wiley-India, 2018

2. D.M Dhamdhere, Operating Systems: A Concept Based Approach 3rd Ed, McGraw-Hill, 2013.

3. William Stallings Operating Systems: Internals and Design Principles, 9th Edition, Pearson.

4. Andrew S.Tanenbaum, "Modern operating Systems", fourth Edition, PHI Learning Pvt.Ltd., 2008

Database Management System		Semester	I
Course Code	OMCI103	CIE +SEE Marks	30 +70 =100
Credits	04	Exam Hours	3
Examination type (SEE)		Theory	

Course Objectives:

CLO 1. Practice SQL programming through a variety of database problems.
CLO 2. Explore the use of concurrency and transactions in database.
CLO 3. Build database applications for real world problems.

MODULE 1

Introduction: Characteristics of Database approach, Actors on the Scene, Workers behind the scene, Advantages of using DBMS approach, Data models, schemas and instances, Three -schema architecture and data independence, Database languages and interfaces, the database system environment, Centralized and client -server architectures, Classification of Database Management systems, Entity-Relationship Model: Conceptual Database using high level conceptual data models for Database Design, A Sample Database Application, Entity types, Entity sets Attributes and Keys Relationship types, Relationship Sets, Roles and Structural Constraints Weak Entity Types.

MODULE 2

Relational Model Relational Model and Relational Algebra: Relational Model Concepts, Relational Model Constraints and Relational Database Schema Update Operations, Transactions and Dealing with Constraint violations, Unary Relational operations, Relational Algebra Operations from Set Theory, Binary Relational Operations, JOIN and DIVISION, Additional Relational Operations, Examples of Queries in Relational Algebra Relational Database Design Using ER-to Relational Mapping .

MODULE 3

Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic structure of SQL Queries, Additional Basic Operations, Null values, Aggregate Functions, nested Sub queries, Modification of the Database, Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schemas, Authorization.

MODULE 4

Database Design: Informal Design Guidelines for Relation Schemas, Functional Dependencies, Normal Forms based on Primary Keys, General Definitions of 2nd and 3rd Normal Forms, Boyce Codd Normal Forms, Stored Procedures and functions, Triggers.

MODULE 5
Transaction Management: Transaction Concept, A Simple Transaction Model, Transaction Atomicity and Durability, Serializability, Transaction Isolation and Atomicity, Transaction Isolation Levels, Implementation of Isolation Levels. Concurrency Control: Lock Based Protocols, Deadlock Handling. Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm.
Course outcome (Course Skill Set): At the end of the course the student will be able to : **CO1:** Figure out the concepts of database objects, enforce integrity constraints on a database using RDBMS. **CO2**: Demonstrate Structured Query Language (SQL) for database manipulation and also the basic of query evaluation. **CO3**: Develop application to interact with databases, relational algebra expression, **CO4**: Construct an application using tuple and domain relation expression from queries. **Recommended Text and Reference Books:** **Text Books:** 1. Fundamentals of Database Systems, Ramez Elmasri and Shamkant B. Navathe, 7th Edition, 2017, Pearson. 2. Database management systems, Ramakrishnan, and Gehrke, 3rd Edition, 2014, McGraw Hill. 3. Abraham Silberschatz, Henry F. Korth and S. Sudarshan"s Database System Concepts 9th EditionTata Mcgraw Hill Education Private Limited-2013 4. Introduction to Database Management System ,Satinder bal Gupta,Aditiya Mittal,2nd Edition,An imprint of Laxmi publications Private Limited-2017

Programming Using C		Semester	I
Course Code	**OMCI104**	**CIE + SEE Marks**	**30 + 70 = 100**
Credits	**4**	**Exam Hours**	**03**
Examination type (SEE)	**Theory**		

Course objectives:

CLO1 : Explain user-defined data structures like arrays, structures,/unions and pointers in implementing solutions to problems
CLO2: Design and Develop Solutions to problems using modular programming constructs such as functions and procedures.

Teaching-Learning Process (General Instructions)

These are sample Strategies, which teachers can use to accelerate the attainment of the various course outcomes.

1. Lecturer method (L) need not be only a traditional lecture method, but alternative effective teaching methods could be adopted to attain the outcomes.
2. Use of Video/Animation to explain the functioning of various concepts.
3. Encourage collaborative (Group Learning) Learning in the class.
4. Ask at least three HOT (Higher-order Thinking) questions in the class, which promotes critical thinking.
5. Adopt Problem Based Learning (PBL), which fosters students' Analytical skills, develop design thinking skills such as the ability to design, evaluate, generalize, and analyse information rather than simply recall it.
6. Introduce Topics in manifold representations.
7. Show the different ways to solve the same problem and encourage the students to come up with their own creative ways to solve them.
8. Discuss how every concept can be applied to the real world - and when that's possible, it helps improve the students' understanding.

Module-1

Introduction to C: Structure of C Program, Compiling and executing C programs, Variables, Constants, IO statements in C, Operators in C

Module-2

Decision control and Looping statements: Introduction to decision control, Conditional branching statements, iterative statements, nested loops, break and continue statements, goto statement.

Module-3
Arrays: Declaration of arrays, accessing and storing of values in array, Operations on arrays, 2-D arrays, operations on two-dimensional arrays, multidimensional arrays, applications of arrays **Functions**: Introduction using functions, Function definition & declaration, function call, return statement, passing parameters to functions, Passing arrays to functions, scope of variables, storage classes, recursive functions.
Module-4
Strings: Introduction to strings, operations on strings, arrays of strings. **Pointers**: Introduction to pointers, declaring pointer variables, Types of pointers, Passing arguments to functions using pointers.
Module-5
Structure and Union: Introduction, structures and functions, Unions, unions inside structures. **Files**: Introduction to files, Operation of Files.
Course outcome (Course Skill Set) At the end of the course the student will be able to: **CO1**: Illustrate the fundamental programming constructs of C programming language to solve problem. **CO2**: Interpret the Use of functions and arrays in implementing solutions. **CO3**: Demonstrate the use of structures, unions and pointers to solve problems.
Suggested Learning Resources: Books 1. Computer Fundamentals and Programming in C – Reema Thareja, 2nd Edition, Oxford University, 2017. 2. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill 3. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of IndiaYashavanth Kanetkar, Let us C, Authentic Guide to C Programming Langauge, bpb publisher, 17th Edition, 2020 4. Yashavanth Kanetkar, Let us C, Authentic Guide to C Programming Langauge, bpb publisher, 17th Edition, 2020
Web links and Video Lectures (e-Resources):
• elearning.vtu.ac.in/econtent/courses/video/BS/15PCD23.html • https://nptel.ac.in/courses/106/105/106105171/ MOOC courses can be adopted for more clarity in und

C Programming Lab		Semester	I
Course Code	OMCI105	CIE + SEE Marks	30 +70 =100
Credits	02	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

CLO1 : Exploring an programs using constructs of C programming language
CLO2: Demonstrate the use of IDE, C Compiler, and identify and rectify the syntax and syntactic errors during programming.
CLO3: Learn to Reporting the observations and debug the program.

Laboratory Experiments:

Implement the following programs with WINDOWS / LINUX platform using appropriate C compiler

1. Implement a C program that takes three coefficients (a, b, and c) of a Quadratic equation ($ax^2+bx+c=0$) as input and compute all possible roots, output the roots with appropriate messages.
2. Write a C program to simulate a Simple Calculator using Switch case construct.
3. Develop a C Program to check whether a given number is PALINDROME or NOT. Ex: Num: 1221, Reverse: 1221, It is a Palindrome
4. Design and develop a C program to read a year as an input and find whether it is leap year or not.
5. Develop a C Program to search a Name in a list of names using Binary searching Technique (Use strcmp built-in function).
6. Write a C program that reads N integer numbers and arrange them in ascending order using Bubble Sort.
7. Develop, implement and execute a C program that reads two matrices A (m x n) and B (p x q) and Compute product of matrices A and B. Print both the input matrices and resultant matrix with suitable headings and output should be in matrix format only. Program must check the compatibility of orders of the matrices for multiplication. Report appropriate message in case of incompatibility.
8. Design and develop a C function isprime(num) that accepts an integer argument and returns 1 if the argument is prime, a 0 otherwise. Write a C program that invokes this function to generate prime numbers between the given range.
9. write a recursive C function to find the factorial of a number, n!, defined by fact(n)=1, if n=0. Otherwise fact(n)=n*fact(n-1). Using this function, write a C program to compute the binomial coefficient nCr . Tabulate the results for different values of n and r with suitable messages.
10. Write a C program to copy the contents of one file to another.
11. Write a C program that uses functions and structures to perform the following operations:

a. Reading a complex number
b. Displaying a complex number
c. Addition of two complex numbers
d. Multiplication of two complex numbers
Display the appropriate output.

12. Write a Program in c to swap two number using pointer.

Course outcome (Course Skill Set)

At the end of the course the student will be able to:
CO1: Make use of IDE for programming, identify and correct the syntax and syntactic errors using various programming constructs.
CO2: Demonstrate use of functions, recursive functions, arrays, strings, structures and pointers in problem solving.
CO3: Design and development of C programs to implement different searching and sorting techniques.

Suggested Learning Resources:
Books

1. Computer Fundamentals and Programming in C – Reema Thareja, 2nd Edition, Oxford Univeristy, 2017
2. E. Balaguruswamy, Programming in ANSI C, 7th Edition, Tata McGraw-Hill
3. Brian W. Kernighan and Dennis M. Ritchie, The 'C' Programming Language, Prentice Hall of India
4. Yashavanth Kanetkar, Let us C, Authentic Guide to C Programming Langauge, bpb publisher, 17th Edition, 2020

Web links and Video Lectures (e-Resources):

- elearning.vtu.ac.in/econtent/courses/video/BS/14CPL16.html
- https://nptel.ac.in/courses/106/105/106105171/

Database Management Lab		Semester	I
Course Code	OMCI106	CIE + SIE Marks	30 +70 = 100
Credits	02	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

CLO1: Create SQL queries for the small projects.

CLO2: Create database objects that include tables, constraints, indexes, and sequences.

1. Students should be allowed to choose appropriate DBMS software, install it, configure it and start working on it. Create sample tables, execute some queries, use SQLPLUS features, Use PL/SQL features like cursors on sample database. Students should be permitted to practice appropriate User interface creation tool and Report generation tool.

2. A college consists of number of employees working in different departments. In this context, create two tables' employee and department. Employee consists of columns empno, empname, basic, hra, da, deductions, gross, net, date-of-birth. The calculation of hra,da are as per the rules of the college. 1. Create tables department and employee with required constraints. 2. Initially only the few columns (essential) are to be added. Add the remaining columns separately by using appropriate SQL command 3. Basic column should not be null 4. Add constraint that basic should not be less than 5000. 5. Calculate hra,da,gross and net by using PL/SQL program.

3. Students may be divided into batches and the following experiments may be given to them to better understand the DBMS concepts. Students should gather the required information, draw ER diagrams, map them to tables, normalize, create tables, triggers, procedures, execute queries, create user interfaces, and generate reports.

- Student information system
- KSRTC reservation system
- Hostel management
- Library management
- Indian Railways reservation

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Design entity-relationship diagrams to solve given database applications.

CO2: Implement a database schema for a given problem.

CO3: Formulate SQL queries in Oracle for the given problem.

CO4: Design and Develop suitable database and verify for its appropriate normalization for any given problem.

Data Structures and Algorithms		Semester	II
Course Code	**OMCI201**	**CIE + SIE Marks**	**30 + 70 =100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)	**Theory**		

Course Learning objectives:

CLO1: Explore step by step and develop algorithms to solve real world problems.

CLO2: Evaluate the Expressions like postfix, prefix conversions.

CLO3: Implementing various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs.

CLO4: Define various searching & sorting techniques.

CLO5: Compare functions using asymptotic analysis and describe the relative merits of worst-, average-, and best-case analysis.

Module-1	
Classification of Data Structures: Primitive and Non- Primitive, Linear and Nonlinear; Data structure Operations, Stack: Definition, Representation, Operations and Applications: Polish and reverse polish expressions, Infix to postfix conversion, evaluation of postfix expression, infix to prefix, postfix to infix conversion.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-2	
Recursion - Factorial, GCD, Fibonacci Sequence, Tower of Hanoi. Queue: Definition, Representation, Queue Variants: Circular Queue, Priority Queue, Double Ended Queue; Applications of Queues. Programming Examples.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-3	
Linked List: Limitations of array implementation, Memory Management: Static (Stack) and Dynamic (Heap) Memory Allocation, Memory management functions. Definition, Representation, Operations: getnode() and Freenode() operations, Types: Singly Linked List. Linked list as a data Structure, Inserting and removing nodes from a list, Linked implementations of stacks, Header nodes, Array implementation of lists.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation

Module-4	
Trees: Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees- Evaluation of Expression, Programming Examples.	
Teaching-Learning Process	Chalk and talk method / PowerPoint Presentation
Module-5	
Graphs: Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search. Insertion Sort,. Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.	
Teaching Learning Process	Chalk and talk method / PowerPoint Presentation

Course outcome (Course Skill Set):

At the end of the course the student will be able to:
CO1: Illustrate the different data structures and operations.
CO2: Demonstrate the concept of stack and Queue data structures use
CO3: Infer the concept of Linked list, Trees and Graphs in problem solving
CO 4: Employ various data structures for solving various problems.

Suggested Learning Resources: Reference books:

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.
2. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.
3. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.
4. Introduction to Algorithms ,Thomas h.Cormen Charles E. Leiserson Ronald L. Rivest Clifford Stein,4th Edition,2022.MIT Press

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=BBpAmxU_NQo
- https://www.youtube.com/watch?v=8hly31xKli0
- https://archive.nptel.ac.in/courses/106/106/106106127/

Object Oriented Programming Using Python		Semester	II
Course Code	OMCI202	CIE + SIE Marks	30 + 70 =100
Credits	4	Exam Hours	3
Examination type (SEE)	Theory		

Course objectives:

CLO1: Study the importance of Object Oriented Programming
CLO2: Explore the Object Oriented Programming concepts
CLO3: Explain the concept of Polymorphism, Inheritance
CLO4: Understand the creation of modules ,packages and organization of modules and packages

Teaching-Learning Process (General Instructions)

Programming Exercises and mini project works.

Module-1

Python Basic Concepts and Programming

Parts of Python Programming Language, Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, The type( ) Function and Is Operator, Control Flow Statements, The if Decision Control Flow Statement, The if…else Decision Control Flow Statement, The if…elif…else Decision Control Statement, Nested if Statement, The while Loop, The for Loop, The continue and break Statements, Built-In Functions, Commonly Used Modules, Function Definition and Calling the Function, The return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command Line Arguments.

Module-2

Python Collection Objects, Strings- Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings, Lists-Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods. Sets, Tuples and Dictionaries. Files: reading and writing files

Module-3
Object-oriented Design :Introducing object-oriented ,Objects and classes, Specifying attributes and behaviours : Data describes objects , Behaviours are actions ,Hiding details and creating the public interface: Composition, Inheritance: Inheritance provides abstraction, Multiple inheritance Objects in Python : Creating Python classes , Adding attributes, Making a function work: passing arguments, Initializing the object, self argument
Module-4
Modules and packages: Organizing the modules, Absolute imports, Relative imports, Organizing module contents: Access control, Third-party libraries, Basic inheritance, Extending built-ins, Overriding and super, Multiple inheritance, The diamond problem, Different sets of arguments,
Module-5
Polymorphism , Abstract base classes, Using an abstract base class , Creating an abstract base class Exceptions: Raising exceptions, The effects of an exception , Handling exceptions, The exception hierarchy, Defining our own exceptions
Course outcome (Course Skill Set) At the end of the course the student will be able to: **CO1**: Demonstrate proficiency in handling loops and creation of functions **CO2**: Illustrate the methods to create and manipulate lists, tuples and dictionaries . CO3: Design and Develop programs for string processing and file organization. **CO4**: Interpret the concept of OOP as used in Python
Suggested Learning Resources: **Books** 1. Allen B. Downey, "Think Python: How to Think Like a Computer Scientist", 2nd edition,Updated for Python 3, Shroff/O'Reilly Publishers, 2016 2. Python 3 Object Oriented Programming, 2nd Edition, Unleash the power of Python 3 Objects by Dusty Phillips , PACKT Publishing. 3. Python Object–Oriented Programming :Build robust and maintainable Object-oriented python applications and libraries, Steven F. Lott, Dusty Philips,4th Edition, Packt Publishing Limited; 2021 4. Python the complete reference ,Martin C. Brown,4th Edition, McGraw Hill Education ,2018
Web links and Video Lectures (e-Resources):
• http://greenteapress.com/wp/thinkpython/

Software Engineering with Agile Methodologies		Semester	II
Course Code	OMCI203	CIE + SIE Marks	30 + 70 = 100
Credits	04	Exam Hours	03
Examination type (SEE)		Theory	

Course Learning objectives:

CLO1: Outline software engineering principles and activities involved in building large software programs.
CLO2: Identify ethical and professional issues and explain why they are of concern to software engineers.
CLO3: Explain the fundamentals of object oriented concepts.
CLO4: Describe the process of requirements gathering, requirements classification, requirements specification and requirements validation.
CLO5: Differentiate system models, use UML diagrams and apply design patterns.
CLO6: Discuss the distinctions between validation testing and defect testing.

MODULE 1

Introduction: Software Products and Software process, Process models: Waterfall modal, Evolutionary Development, Bohemia's Spiral model, Overview of risk management, Process Visibility, Professional responsibility. Computer based System Engineering: Systems and their environment, System Procurement, System Engineering Process, System architecture modelling. Human Factors, System reliability Engineering.

MODULE 2

Requirements and Specification: The requirement Engineering Process, The Software requirement document, Validation of Evolution of requirements, Viewpoint – oriented & method based analysis, system contexts, Social 7 organizational factors . Data flow, Semantic, Objects, models, Requirement Specification, Non functional requirement.

MODULE 3

Software Prototyping: Prototyping in software process, Prototyping techniques, User interface prototyping. Software Design: Design Process, Design Strategies, Design Quality, System Structuring control models, Modular decomposition, Domain Specific architecture.

MODULE 4
Agile Methodology : Theories for Agile Management – Agile Software Development – Traditional Model vs. Agile Model - Classification of Agile Methods – Agile Manifesto and Principles – Agile Project Management – Agile Team Interactions – Ethics in Agile Teams - Agility in Design, Testing – Agile Documentations – Agile Drivers, Capabilities and Values
MODULE 5
Agile Process: Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.
Course outcome (Course Skill Set) **At the end of the course the student will be able to :** **CO1:** Illustrate a software development process model, components or processes to meet desired needs within realistic constraints. **CO2**: Demonstrate the usage of techniques, skills, and modern engineering tools necessary for software engineering practice. CO3: Showcase the suitable prototyping concept, software design strategies and modular approaches in software design process. **CO5**: Explore the Agile Software Development, project management, Team Interactions etc., **Suggested Learning Resources:** **Reference books:** 1. Ian Sommerville: Software Engineering, 9th Edition, Pearson Education, 2012. 2. Michael Blaha, James Rumbaugh: Object Oriented Modelling and Design with UML,2nd Edition, Pearson Education,2005. 3. Roger S. Pressman: Software Engineering-A Practitioners approach, 7th Edition, Tata McGraw Hill. 4. Stephan R. Schach, "Object oriented software engineering", Tata McGrawHill,2008

Fundamentals of Artificial Intelligence and Machine Learning		Semester	II
Course Code	**OMCI204**	**CIE + SIE Marks**	**30 + 70 = 100**
Credits	**4**	**Exam Hours**	**03**
Examination type (SEE)	**Theory**		

Course Learning objectives:

CLO1. Explain the basic principles of Artificial Intelligence.
CLO2. Learn and design intelligent agents.
CLO3. Explore the basic areas of artificial intelligence including problem solving, knowledge representation, reasoning, decision making, planning, perception and action.
CLO4: Interpret the fundamental concepts of machine learning and its various algorithms.
CLO5: Implement various strategies of generating models from data and evaluating them

Module 1: Introduction to AI and Machine Learning (10 hours)

Introduction to AI and ML (2 hour): Definition of Artificial Intelligence (AI) and Machine Learning (ML), Historical context and key milestones, Applications of AI and ML in real-world scenarios, Types of Machine Learning (4 hour): Supervised learning, unsupervised learning, and reinforcement learning, Examples of applications for each type, Overview of supervised and unsupervised algorithms, Basics of Data and Feature Engineering (2 hours): Importance of data quality and pre-processing, Data representation and feature extraction, Handling missing data and categorical variables
Evaluation Metrics (2 hour): Accuracy, precision, recall, F1-score, ROC curve, AUC

Selecting appropriate metrics for different tasks, Trade-offs between different metrics

Module 2: Supervised Learning (10 hours)

Linear Regression (2 hours): Introduction to linear regression, Simple and multiple linear regressions, Model training, evaluation, and interpretation. Classification Algorithms (5 hours): Logistic regression, Decision trees and random forests, Naive Bayes classifier, Support Vector Machines (2 hours): Introduction to SVM, Linear SVM and kernel trick Hyperparameter tuning and model evaluation

Module 3: Unsupervised Learning	**(10 hours)**
Clustering (4 hours): K-means clustering, Hierarchical clustering, Evaluating cluster quality, Dimensionality Reduction (3 hours): Principal Component Analysis (PCA) t-Distributed Stochastic Neighbor Embedding (t-SNE), Applications and benefits of dimensionality reduction. Anomaly Detection (3 hours): Identifying anomalies in data, Approaches to anomaly detection, Real-world use cases.	
Module 4: Neural Networks and Deep Learning	**(10 hours)**
Introduction to Neural Networks (3 hours): Basics of artificial neurons, Activation functions and network architectures, Feed forward and back propagation, Convolutional Neural Networks (4 hours): Basics of CNNs, Image classification and object detection, Transfer learning and pre-trained models, Recurrent Neural Networks (3 hours) , Understanding RNNs, Applications in sequential data processing Long Short-Term Memory (LSTM) and Gated Recurrent Units (GRU).	
Module 5: Practical Applications and Future Trends	**(10 hours)**
Natural Language Processing (4 hours), Introduction to NLP and its challenges Text pre-processing and tokenization, Basics of sentiment analysis and text generation AI Ethics and Bias (3 hour), Ethical considerations in AI and ML, Addressing bias and fairness in algorithms, Responsible AI development, Future Trends in AI and ML (3 hour), Reinforcement learning advancements, Generative Adversarial Networks (GANs), Explainable AI and interpretable models.	
Course outcome (Course Skill Set): **At the end of the course the student will be able to :** **CO1**. Illustrate the foundational principles, mathematical tools and program paradigms of AI and fundamental principles of machine learning. **CO2**. Demonstrate the formal methods of knowledge representation and Formulation of a Machine Learning problem. **CO3**. Showcase the usage of intelligent agents for Artificial Intelligence programming techniques and Develop a model using supervised/unsupervised machine learning algorithms for classification/prediction/clustering. **CO4**. Interpret logic reasoning and problem solving techniques for AI applications	
Reference Book 1. AurolienGeron, "Hands-On Machine Learning with Scikit-Learn and TensorFlow, Shroff/O'Reilly",2017 2. Andreas Muller and Sarah Guido, "Introduction to Machine Learning with Python: A Guidefor Data Scientists", Shroff/O'Reilly, 2016 3. Andrew Ng, Machine learning yearning, https://www.deeplearning.ai/machine-learningyearning/ 4. Russell, Norvig, Artifificial Intelligence: A Modern Approach, Third edition, Prentice Hall,2010	

Data Structures Laboratory		Semester	II
Course Code	**OMCI205**	**CIE + SIE Marks**	**30 + 70 = 100**
Credits	**2**	**Exam Hours**	**03**
Examination type (SEE)	**Practical**		

Course objectives:

CLO1: Explain the Evaluation of Expressions like postfix, prefix conversions.

CLO2: Implementing various data structures viz. Stacks, Queues, Linked Lists, Trees and Graphs.

Sl. No	Experiments
1	Implement a Program in C for converting an Infix Expression to Postfix Expression.
2	Design, develop, and execute a program in C to evaluate a valid postfix expression using stack. Assume that the postfix expression is read as a single line consisting of non-negative single digit operands and binary arithmetic operators. The arithmetic operators are + (add), - (subtract), * (multiply) and / (divide).
3	Design, develop, and execute a program in C to simulate the working of a queue of integers using an array. Provide the following operations: a. Insert b. Delete c. Display
4	Write a C program to simulate the working of a singly linked list providing the following operations: a. Display & Insert b. Delete from the beginning/end c. Delete a given element
5	Write a C program to Implement the following searching techniques a. Linear Search b. Binary Search.
6	Write a C program to implement the following sorting algorithms using user defined functions: a. Bubble sort (Ascending order) b. Selection sort (Descending order).
7	Write a C program to implement the Binary Search Tree operations.
8	Write a C program to demonstrate the Binary Tree Traversals - Inorder, postorder, preorder

Course outcomes (Course Skill Set):

At the end of the course the student will be able to:

CO1: Design and Develop Data structure techniques for evaluating the given expression.

CO2: Demonstrate various sorting / searching techniques and validate input/output for the given problem.

CO3: Design data structures to show the operations on Stacks, Queues, Circular Queues, Linked Lists, and Trees.

CO4: Implement the suitable algorithm to find whether the given graph is connected or not and illustrate the performance of the technique implemented.

Python Lab		Semester	II
Course Code	OMCI206	CIE + SIE Marks	30 + 70 =100
Credits	02	Exam Hours	03
Examination type (SEE)		Practical	

Course Learning Objectives:

CLO1: To be able to introduce core programming basics and program design with functions using Python programming language.

CLO2: To understand a range of Object-Oriented Programming, as well as in-depth data and information processing techniques.

CLO3: To understand the high-performance programs designed to strengthen the practical expertise.

1. Write a program to sum all the elements from n1 to n2 where n1 and n2 are positive integers
2. Input an array of n numbers and find separately the sum of positive numbers and negative numbers.
3. Write a program to search an element using linear search
4. Write a program to search an element using binary search.
5. Write a program to simulate stack.
6. Using a stack evaluate an arithmetic expression.
7. Write a program to multiply two matrices
8. Write a program to find the roots of a quadratic equation
9. Write a program to Insert a number in a sorted array.
10. Write a Python Program to check whether the given string is palindrome or not using built in string manipulation methods.
11. Write a Python Program to read a word and prints the number of letters, vowels and percentage of vowels in the word using dictionary
12. Write a Python Program to check a given sentence is a pangram or not using function/Module.

Course Outcomes: At the end of the course the student will be able to:

CO1: Demonstrate proficiency in handling loops and creation of functions.

CO2: Illustrate the methods to create and manipulate lists, tuples and dictionaries in Python Programme.

CO3: Design and Develop programs for string processing and file organization and use the concept of OOP as used in Python.

SEMESTER-III

Artificial Intelligence		Semester	III
Course Code:	**OMCI301**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Illustrate the reasoning on Uncertain Knowledge

CLO 2. Explore the explanation-based learning in solving AI problems

CLO 3. To explore advanced career opportunities

CLO 4. Demonstrate the applications of soft computing and Evolutionary Computing algorithms

Module-1

Artificial Intelligence – Basics, The AI Problems – The Underlying Assumption – What is an AI technique – Criteria for Success. Problems, Problem Spaces and Search – Defining Problem as a State Space Search – Production Systems – Problem Characteristics – Production System Characteristics – Issues in the design of Search Programs.

Module-2

Heuristic Search Techniques - Generate – and – Test – Hill Climbing – Best-First Search – Problem Reduction – Constraint Satisfaction - Means - Ends Analysis. Knowledge Representation issues – Representations and Mapping - Approaches to knowledge Representation – Issues in knowledge Representation – The Frame Problem. Case study based on search algorithms.

Module-3

Using Predicate Logic – Representing simple facts in Logic – Representing Instance and Isa Relationship – Computable Functions and Predicates – Resolution – Natural Deduction. Representing Knowledge Using Rules – Procedural versus Declarative knowledge – Logic Programming – Forward versus Backward Reasoning – Matching – Control Knowledge. Case study based on reasoning

Module-4

Reasoning under Uncertainty – Introduction to Non-monotonic Reasoning – Augmenting a Problem Solver – Implementation: Depth - First Search, Fuzzy Logic. Game Playing - The Minimax Search Procedure – Adding Alpha-Beta Cut-offs. Applications of artificial intelligence- Case study on social networks using neural networks, DNA sequencing using AI techniques.

Textbooks / References:

1. Artificial Intelligence (Second Edition) – Elaine Rich, Kevin knight (Tata McGraw-Hill)
2. A Guide to Expert Systems – Donald A. Waterman (Addison-Wesley)
3. Principles of Artificial Intelligence – Nils J. Nilsson (Narosa Publishing House)
4. Introduction to Artificial Intelligence – Eugene Charnaik, Drew McDermott (Pearson Education Asia)

Course Outcomes

Cos	Description
CO1	To be aware of the basics of AI and its need along with the issues in designing search problems.
CO2	Understand and apply various search algorithms in real world problems.
CO3	To get a thorough idea about the fundamentals of knowledge representation, inference and theorem proving.
CO4	Express and comprehend the working knowledge of reasoning in the presence of incomplete and/or uncertain information.
CO5	To gain the aptitude to apply knowledge representation and reasoning to real-world problems

CO-PO Mapping:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	1					2	1	1	2
CO2	2	1	1			1		2	2	1	1	2
CO3	3	2	1	1					2	1		2
CO4	1	2	1	1		1	1	2	1	1	1	2
CO5	2	1	1	1			1	2	1	1	1	2

Data Analytics Using Python		Semester	III
Course Code:	**OMCI302**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

The objective of this course is to provide comprehensive knowledge of python programming paradigms required for Data Analytics.

Module-1
Revisiting Python: Strings- String Slicing and Joining, String Methods, Lists-Creating Lists, Indexing and Slicing in Lists, List Methods. Sets, Tuples and Dictionaries. Files: reading and writing files. Loading from CSV files, Accessing SQL databases.
Module-2
USING NUMPY: Basics of NumPy-Computation on NumPy-Aggregations-Computation on Arrays Comparisons, Masks and Boolean Arrays-Fancy Indexing-Sorting Arrays-Structured Data: NumPy's Structured Array.
Module-3
DATA MANIPULATION WITH PANDAS: Introduction to Pandas Objects - Data indexing and Selection - Operating on Data in Pandas Handling Missing Data - Hierarchical Indexing - Combining Data Sets - Aggregation and Grouping - Pivot Tables.
Module-4
Web Scraping And Numerical Analysis Data Acquisition by Scraping web applications –Submitting a form - Fetching web pages – Downloading web pages through form submission – CSS Selectors.
Module-5
VISUALIZATION AND MATPLOTLIB Basic functions of matplotlib - Simple Line Plot, Scatter Plot - Density and Contour Plots Histograms, Binnings and Density - Customizing Plot Legends, Colour Bars – Three Dimensional Plotting in Matplotlib.

Textbooks / References:

[1] Jake VanderPlas, Python Data Science Handbook - Essential Tools for Working with Data, O'Reily Media Inc., 2016.

[2] Zhang.Y, An Introduction to Python and Computer Programming, Springer Publications, 2016.

References :

[1] Joel Grus , Data Science from Scratch First Principles with Python, O'Reilly Media, 2016. [2] T.R.Padmanabhan, Programming with Python, Springer Publications, 2016.

Course Outcomes

Cos	Description
CO1	Demonstrate the use of built-in objects of Python
CO2	Demonstrate significant experience with python program development environment
CO3	Implement numerical programming, data handling and visualization through NumPy, Pandas and MatplotLib modules.

CO-PO Mapping:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1		1		2	2	2			1
CO2	3	3	2	1	1		2	2	1	1	1	2
CO3	3	3	2	1	1	1	2	2	1	1	1	2
CO4	3	3	3	1	1	2	2	2	1	1	1	2
CO5	3	3	2	1	1	2	2	2	1	1	1	2

Big Data Analytics		Semester	III
Course Code:	**OMCI303A**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. To provide an overview of an exciting growing field of big data analytics.

CLO 2. To introduce the tools required to manage and analyze big data like Hadoop, NoSQL, and Map-Reduce.

CLO 3. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability.

CLO 4. To enable students to have skills that will help them to solve complex real-world problems for decision support

Module-1

Introduction to Big Data: What is big data, why big data, the convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open-source technologies, cloud and big data, mobile business intelligence, Crowd-sourcing analytics, inter and trans firewall analytics.

Module-2

No SQL: Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema less databases, materialized views, distribution models, sharding, masterslave replication, peer-peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.

Module-3

Hadoop: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures.

Module-4

MapReduce: MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output formats.

Module-5
Recent Trends in Big Data Analytics: HBase, data model and implementations, HBase clients, HBase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration, Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries.

Textbooks / References:

1. Big Data Analytics, Introduction to Hadoop, Spark, and Machine-Learning, Raj Kamal, Preeti Saxena, McGraw Hill, 2018.

2. Big Data, Big Analytics: Emerging Business intelligence and Analytic Trends for Today's Business, Michael Minelli, Michelle Chambers, and Ambiga Dhiraj, John Wiley & Sons, 2013.

Reference Books:

1. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013
2. Hadoop: The Definitive Guide, Tom White, Third Edition, O'Reilly, 2012.
3. Hadoop Operations, Eric Sammer, O'Reilly, 2012.
4. Programming Hive, E. Capriolo, D. Wampler, and J. Rutherglen, O'Reilly, 2012.
5. HBase: The Definitive Guide, Lars George, O'Reilly, 2011.
6. Cassandra: The Definitive Guide, Eben Hewitt, O'Reilly, 2010.
7. Programming Pig, Alan Gates, O'Reilly, 2011.

E-Books:

1. http://index-of.co.uk/Big-DataTechnologies/Data%20Science%20and%20Big%20Data%20Analytics.pdf

Course Outcomes

Cos	Description
CO1	Describe big data and use cases from selected business domains.
CO2	Explain NoSQL big data management.
CO3	Install, configure, and run Hadoop and HDFS.
CO4	Perform map-reduce analytics using Hadoop.
CO5	Use Hadoop related tools such as HBase, Cassandra, and Hive for big data Analytics, and understanding the recent trends in Big Data analytics.

CO-PO Mapping:

PO/PSO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1		1			1			1	1	1
CO2	2	1	2	1	1		1					
CO3	1	2	3	1	1							
CO4	1	1	3	1	1							
CO5	2	2	3	1	1							

Data Mining		Semester	III
Course Code:	**OMCI303B**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. To understand concepts of pattern discovery

CLO 2. To familiarize yourself with data preprocessing and mining algorithms

CLO 3. To understand prediction algorithms and cluster analysis .

Module-1

Introduction: Evolution and Importance of Data Mining-Types of Data and Patterns Mined-Technologies Applications-Major Issues in Data Mining. Knowing about Data-Data Preprocessing: attribute type, Basic statistical descriptions of data, measuring data similarity and dissimilarity, Cleaning– Integration–Reduction– PCA, Data Transformation and Discretization.

Module-2

Data warehousing-basic concepts: data warehouse, Difference, Comparison, architecture-data warehouse modelling: datacube, star, snowflakes and fact constellations schemas, typical OLAP operations.

Module-3

Mining Frequent Patterns: Basic Concept – Frequent Item Set Mining Methods – Mining Association Rules – Association to Correlation Analysis.

Module-4

Classification and Prediction: Issues - Decision Tree Induction - Bayesian Classification – Rule-Based Classification – k-Nearest-Neighbor Classification - Linear SVM - Regression – Linear, Logistic - Accuracy and Error measures –Introduction to Ensemble methods.

Module-5

Clustering: Overview of Clustering – Types of Data in Cluster Analysis – Major Clustering Methods-Partitioning Methods- k-Means, k-Medoids. Hierarchical Methods-Agglomerative and Divisive hierarchical clustering single linkage, complete linkage ,average linkage. Density-Based Methods-DBSCAN, Graph-based clustering (CHAMELEON), Grid-based Clustering: CLIQUE, probabilistic Model-Based Clustering-EM algorithm. Datamining trends and research frontiers- Mining complex Data types- Mining other kinds of data-data mining applications. Lab :Implementation of Data mining algorithms using Latest Open Source Data mining Tools. TensorFlow, python, R

Textbooks / References:

1. Jiawei Han, Micheline Kamber and Jian Pei, "Data mining concepts and Techniques", Third Edition, Elsevier Publisher, 2006.

2. K.P.Soman, ShyamDiwakar and V.Ajay, "Insight into data mining Theory and Practice", Prentice Hall of India, 2006.

3. Yanchang Zhao, "R and Data Mining", Elsevier, 2013 4. AurélienGéron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, O'Reilly Media, 2017 5. Itay Lieder, YehezkelResheff, Tom Hope, Learning TensorFlow, O'Reilly Media, 2017.

Course Outcomes

Cos	Description
CO1	Recall important Knowledge discovery concepts, methods, and applications, in particular, the basic concepts of data preprocessing to prepare the data for mining
CO2	Recall the importance of warehouse, its schemas and OLAP operations
CO3	Identify efficient pattern mining association methods and rules, such as Apriori, and FP-growth
CO4	Learn pattern-based classifications and prediction, including all classifiers.
CO5	Recall basic concepts, methods, and applications of cluster analysis, including the concept of clustering, the requirements and challenges of cluster analysis, a multi-dimensional categorization of cluster analysis, and an overview of typical clustering methodologies.

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		2	1	2	1				
CO2	3	3	3	2	2	2	2	1		1		
CO3	3	3	3	2	2	1	2	1		1	1	1
CO4	3	3	3	2	2	1	2	1		1	1	1
CO5	3	3	3	2	2	1	2	1		1	1	1

LINEAR ALGEBRA AND APPLICATIONS		Semester	III
Course Code:	OMCI303C	CIE+SEE Marks	30 +70=100
Credits	04	Exam Hours	03
Examination type (SEE)		Theory	

Course Objectives:

CLO 1. To understand how physical nature, as described by quantum physics, can lead to algorithms that imitate human behavior

CLO 2. To explore possibilities for the realization of artificial intelligence by means of quantum computation

CLO 3. To learn computational algorithms as described by quantum computation .

Module-1
Vector space: Vectors, Vector spaces - Sub spaces , Four fundamental subspaces, Linear independence, Basis and Dimensions
Module-2
Linear Transformations: Linear Transformations, Matrix representation, Kernel, Range, Characteristic Roots, Characteristic Vector, Matrix of a Linear Transformation. Rank Nullity Theorem, Relation between matrices and linear transformations - Kernel and range of a linear transformation
Module-3
Norms, Inner product and Orthogonality Vector Norms, Matrix Norms, Inner product, Orthogonal vectors, Gram-Schmidt procedure, Orthogonal projection.
Module-4
Eigen values and Eigen vectors: Elementary properties of Eigen Systems, Diagonalization, Orthogonal Diagonalization, Functions of diagonalizable matrices, Normal Matrices

Textbooks:

1. Carl. D. Meyer, 'Matrix Analysis and Applied Linear Algebra', SIAM publications

References:

1. David C. Lay, Linear Algebra and its Applications, Pearson.

2. Gilbert Strang, "Linear Algebra and Its Applications", Fourth Edition, Cengage, 2006.

Course Outcomes

Cos	Description
CO1	Understand the basic concepts of vector space, Basis and Dimension
CO2	To understand linear transformation and its applications
CO3	To understand the concepts of inner products, orthogonality and projections
CO4	To understand the concepts of Eigen Values, Eigen Vectors & Diagonalization.

CO-PO Mapping:

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

DATA VISUALIZATION		Semester	III
Course Code:	**OMCI304A**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Develop skills to both design and review visualizations. .

CLO 2. Recognize the elements that go into visualising design.

CLO 3. Recognize how the type of visualisation is impacted by the type of data.

Module-1

What Is Visualization?, History of Visualization, Relationship between Visualization and Other Fields, The Visualization Process, Types of Data, Structure within and between Records, Data Preprocessing, Perception in Visualization, Metrics, The Visualization Process in Detail, Semiology of Graphical Symbols, The Eight Visual Variables, Taxonomies. Web resources: https://www.shiksha.com/it-software/data-visualizationchp

Module-2

Visualization Techniques for Spatial Data, Visualization Techniques for Geospatial Data, Visualization Techniques for Multivariate Data..
Web resources: https://www.shiksha.com/it-software/datavisualization-chp

Module-3

Visualization Techniques for Time-Oriented Data, Visualization Techniques for Trees, Graphs, and Networks, Text and Document Visualization.
Web resources:
http://www.ifs.tuwien.ac.at/~silvia/wien/vuinfovis/articles
/Chapter8_VisualizationTechniquesForTreesGraphsAndNetworks_271-290.pdf

Module-4

Interaction Concepts: Interaction Operators, Interaction Operands and Spaces, A Unified Framework, Interaction Techniques: Screen Space, Object Space (3D Surfaces), Data Space (Multivariate Data Values), Attribute Space (Properties of Graphical Entities), Data Structure Space (Components of Data Organization), Visualization Structure Space (Components of the Data Visualization), Animating Transformations, Designing Effective Visualizations: Steps in Designing Visualizations, Problems in Designing Effective Visualizations.

Module-5

Comparing and Evaluating Visualization Techniques, Visualization Systems, Research Directions in Visualization
Web Resources: https://libguides.rollins.edu/c.php?g=503927&p=8015000

Books

1. Interactive Data Visualization: Foundations, Techniques, and Applications, Matthew O. Ward, Georges Grinstein, Daniel Keim, CRC Press 2015

2. The Visual Display of Quantitative Information Edward Tufte Graphics Press 2001

Web links and Video Lectures (e-Resources): 1. 1.

https://www.classcentral.com/course/datavisualization-2737

2. https://www.shiksha.com/it-software/data-visualization-chp

3. https://www.youtube.com/watch?v=7kPqESo1vRw

Course Outcomes

Cos	Description
CO1	
CO2	
CO3	
CO4	

CO-PO Mapping:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												
CO1												
CO2												
CO3												
CO4												

Agile Technologies		Semester	III
Course Code:	**OMCI304B**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Develop To interpret the fundamental principles and practices associated with each of the agile development methods.

CLO 2. To apply the principles and practices of agile software development on a project of interest.

CLO 3. To interpret how agile methods reduce risk via incremental learning and delivery

Module-1

Why Agile?: Understanding Success, Beyond Deadlines, The Importance of Organizational Success, Enter Agility, How to Be Agile?: Agile Methods, Don't Make Your Own Method, The Road to Mastery, Find a Mentor

Module-2

Understanding XP: The XP Lifecycle, The XP Team, XP Concepts, Adopting XP: Is XP Right for Us?, Go!, Assess Your Agility

Module-3

Practicing XP: Thinking: Pair Programming, Energized Work, Informative Workspace, Root-Cause Analysis, Retrospectives, Collaborating: Trust, Sit Together, Real Customer Involvement, Ubiquitous Language, Stand-Up Meetings, Coding Standards, Iteration Demo, Reporting,Releasing:"Done Done", No Bugs, Version Control, TenMinute Build, Continuous Integration, Collective Code Ownership, Documentation. Planning: Vision, Release Planning, The Planning Game, Risk Management, Iteration Planning, Slack, Stories, Estimating. Developing: Incremental requirements, Customer Tests, TestDriven Development, Refactoring, Simple Design ,Incremental Design and Architecture, Spike Solutions, Performance Optimization, Exploratory Testing

Module-4

Mastering Agility: Values and Principles: Commonalities, About Values, Principles, and Practices, Further Reading, Improve the Process: Understand Your Project, Tune and Adapt, Break the Rules, Rely on People :Build Effective Relationships, Let the Right People Do the Right Things, Build the Process for the People, Eliminate Waste :Work in Small, Reversible Steps, Fail Fast, Maximize Work Not Done, Pursue Throughput

Module-5

Deliver Value: Exploit Your Agility, Only Releasable Code Has Value, Deliver Business Results, Deliver Frequently, Seek Technical Excellence :Software Doesn't Exist, Design Is for Understanding, Design Trade-offs, Quality with a Name, Great Design, Universal Design Principles, Principles in Practice, Pursue Mastery

Text Books:

1. The Art of Agile Development, James shore, Chromatic, O'Reilly 2007

Reference Books:

1. Agile Software Development, Principles, Patterns, and Practices, Robert C. Martin Prentice Hall 1st edition, 2002

2. Agile and Iterative Development A Manger's Guide, Craig Larman Pearson Education First Edition, India, 2004

Web links and Video Lectures (e-Resources):

- https://www.tutorialspoint.com/agile/index.htm
- https://www.javatpoint.com/agile
- https://www.udemy.com/topic/agile/free/

Course Outcomes

Cos	Description
CO1	Define XP Lifecycle, XP Concepts, Adopting XP
CO2	Examine on Pair Programming, Root-Cause Analysis, Retrospectives, Planning, Incremental Requirements, Customer Tests
CO3	Demonstrate concepts to Eliminate Waste

CO-PO Mapping:

PO/PSO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO												
CO1	x						x					
CO2		x			x							
CO3			x		x							

NATURAL LANGUAGE PROCESSING		Semester	III
Course Code:	**OMCI304C**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Students will be able to comprehend the importance of using natural language processing when resolving issues in the real world.

CLO 2. Enables students to apply and match the proper processing technique to a given situation

CLO 3. Students will be in a position to exhibit the necessary design abilities for large collection sets. Additionally, capable of understanding and presenting cutting-edge, sophisticated NLP research materials to an audience.

Module-1

Basics of Machine Learning, Python Programming language, Basics of Probability, Introduction - terminologies - empirical rules – Statistical Properties of words – Probability and NLP – Vector Space Models - Pre-processing Tokenization, Parts-Of-Speech (POS) tagging, chunking, syntax parsing, Dependency parsing.

Module-2

Vector Representation of words – Contextual Understanding of text – Cooccurrence of matrix – N-grams – Dense Word Vector. Word2Vec – CBOW and Skip-gram Models – One-word learning architecture- Forward pass for Word2Vec – Reduction of complexity – subsampling and negative sampling. Continuous Skip-Gram Model, GloVe, BERT, XLNet.

Module-3

NLP Applications: Named Entity Recognition, Sentiment analysis, Text categorization using Machine learning algorithms, SVD and Latent semantic Indexing, Probabilistic Latent Semantic Indexing (pLSI) and Latent Dirichlet Allocation (LDA). Deep Learning for NLP: Neural Networks Basics, Feedforward Neural Network, Recurrent Neural Networks, LSTM, An Introduction to Transformers and Sequence-to-Sequence Learning.

Module-4

Historical Approaches to Machine Translation – Statistical Machine Translation – Translation Models – Healthcare Data analysis and Text visualization: Summarizing lengthy blocks of narrative text, such as a clinical note or academic journal article. Answering unique free-text queries that require the synthesis of multiple data sources. Introduce Mathematical and programming tools to visualize a large collection of text documents.

Textbooks / References:

1. C.D. Manning et al, "Foundations of Statistical Natural Language Processing," MIT Press. MIT Press, 1999. isbn: 9780262133609.

2. James Allen, "Natural Language Processing with Python", O'Reilly Media, July 2009.

3. NiladriSekhar Dash and S. Arulmozi, Features of a Corpus. Singapore: Springer Singapore,2018, pp. 17–34. ISBN: 978-981-10-7458-5.

4. Ian Goodfellow, YoshuaBengio, and Aaron Courville, Deep Learning,

http://www.deeplearningbook.org. MIT Press, 2016.

5. NitinIndurkhya and Fred J Damerau, "Handbook of natural language processing," Chapman and Hall/CRC, 2010.

6. Daniel Jurafsky and James H. Martin "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition," 1st. Upper Saddle River, NJ, USA: Prentice Hall PTR, 2000. isbn: 0130950696.

Course Outcomes

Cos	Description
CO1	Discern the concept of POS tagging and CFG for the English language.
CO2	Cognize the Vector Representation of words and skip-gram models
CO3	Explore semantic analysis algorithms and deep learning techniques, to apply them in various NLP applications.
CO4	Acquainted with Mathematical and programming tools for implementing NLP applications.

CO-PO Mapping:

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

Artificial Intelligence Lab		Semester	III
Course Code	OMCI305	CIE + SEE Marks	30 +70 =100
Credits	02	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

CLO 1. Illustrate the reasoning on Uncertain Knowledge

CLO 2. Explore the explanation-based learning in solving AI problems

CLO 3. To explore advanced career opportunities

CLO 4. Demonstrate the applications of soft computing and Evolutionary Computing algorithms

Laboratory Experiments:

13. a) Write a Python Program to Solve N-Queen Problem without using Recursion.
    b) Write a Python Program to implement the Backtracking approach to solve N Queen's problem
2. Write a Python Program to implement Min-Max Algorithm
3. Write a Python Program to implement Alpha-Beta Pruning Algorithm
4. Write a Python Program to implement Depth First Search.
5. Write a Python Program to implement Best First Search.
6. Write a program for Family-tree.
7. Write Program for Monkey-banana Problem.
8. Write a program to implement Tic-Tac-Toe game

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1. Outline various Artificial Intelligence techniques.
CO2. Illustrate reasoning under uncertainty.
CO3. Apply search and knowledge representation techniques to solve AI problems.
CO4. Compare strengths and weaknesses of AI algorithms.
CO5. Combine various AI techniques to solve intelligent systems' problems.

Data Analytics Using Python Lab		Semester	III
Course Code	OMCAI06	CIE + SEE Marks	30 +70 =100
Credits	02	Exam Hours	03
Examination type (SEE)	Practical		

Course objectives:

CLO 1. Illustrate the reasoning on Uncertain Knowledge

CLO 2. Explore the explanation-based learning in solving AI problems

CLO 3. To explore advanced career opportunities

CLO 4. Demonstrate the applications of soft computing and Evolutionary Computing algorithms

Laboratory Experiments:

1. Write a Python program to insert an element into a sorted list
2. Write a python program using object oriented programming to demonstrate encapsulation, overloading and inheritance
3. Demonstrate Aggregation
4. Demonstrate handling of missing data
5. Demonstrate Indexing and Sorting
6. Implement a python program to demonstrate the following using NumPy - Array manipulation, Searching, Sorting and splitting.
7. Demonstrate hierarchical indexing
8. Demonstrate Scatter Plot
9. Demonstrate 3D plotting

Course outcome (Course Skill Set)

At the end of the course the student will be able to:

CO1. Demonstrate the use of built-in objects of Python

CO2. Demonstrate significant experience with python program development environment

CO3. Implement numerical programming, data handling and visualization through NumPy, Pandas and MatplotLib modules

SEMESTER-IV

Sl. No	Code	Course Name	Credit
1	OMCI401	Deep Learning	3
2	OMCI402	Elective - III	3
3	OMCI403x	Major Project	14

Elective - IV		
Sl. No.	**Course Code**	**Course Name**
1	OMCI402A	Data and Web Mining
2	OMCI402B	No-SQL Data base
3	OMCI402C	Artificial Intelligence in Cyber Security

Deep Learning		Semester	IV
Course Code:	**OMCI401**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Figure out the context of neural networks and deep learning.

CLO 2. Know how to use a neural network

CLO 3. Explore the data needs of deep learning

CLO 4: Have a working knowledge of neural networks and deep learning

CLO 5: Explore the parameters for neural networks

Module-1

Machine Learning Basics: Learning Algorithms, Capacity, Overfitting and Underfitting, Hyperparameters and Validation Sets, Estimator, Bias and Variance, Maximum Likelihood Estimation, Bayesian Statistics, Supervised Learning Algorithms, Unsupervised Learning Algorithms, Stochastic Gradient Decent, building a Machine Learning Algorithm, Challenges Motivating Deep Learning.

Module-2

Deep Feedforward Networks: Gradient-Based Learning, Hidden Units, Architecture Design, BackPropagation. Regularization: Parameter Norm Penalties, Norm Penalties as Constrained Optimization, Regularization and Under-Constrained Problems, Dataset Augmentation, Noise Robustness, SemiSupervised Learning, Multi-Task Learning, Early Stopping, Parameter Tying and Parameter Sharing, Sparse Representations, Bagging, Dropout.

Module-3

Optimization for Training Deep Models: How Learning Differs from Pure Optimization, Challenges in Neural Network Optimization, Basic Algorithms. Parameter Initialization Strategies, Algorithms with Adaptive Learning Rates. Convolutional Networks: The Convolution Operation, Motivation, Pooling, Convolution and Pooling as an Infinitely Strong Prior, Variants of the Basic Convolution Function, Structured Outputs, Data Types, Efficient Convolution Algorithms, Random or Unsupervised Features.

Module-4

Sequence Modelling: Recurrent and Recursive Nets: Unfolding Computational Graphs, Recurrent Neural Networks, Bidirectional RNNs, Encoder-Decoder Sequence-to-Sequence Architectures, Deep Recurrent Networks, Recursive Neural Networks. Long short-term memory

Module-5
Practical Methodology: Performance Metrics, Default Baseline Models, Determining Whether to Gather More Data, Selecting Hyperparameters, Debugging Strategies, Example: Multi-Digit Number Recognition. Applications: Vision, NLP, Speech.

Text Books:

1. Deep Learning , Ian Good fellow and YoshuaBengio MIT Press

https://www.deeplearn ingbook.org/2016.

Reference Books:

2. Neural Networks:Asystematic Introduction, Raúl Rojas 1996.

3. Pattern Recognition and machine Learning, Chirstopher Bishop 2007.

Web links and Video Lectures (e-Resources):

- https://www.simplilearn.com/tutorials/deep-learning-tutorial
- https://www.kaggle.com/learn/intro-to-deep-learning
- **https://www.javatpoint.com/deep-learning**

Course Outcomes

Cos	Description
CO1	Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
CO2	Implement deep learning algorithms and solve real-world problems.
CO3	Execute performance metrics of Deep Learning Techniques.

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X		X									
CO2	X	X										
CO3	X		X									

Data and Web Mining		Semester	IV
Course Code:	**OMCI402A**	**CIE+SEE Marks**	**30 +70=100**
Credits	**03**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. To describe web mining and understand the need for web mining .

CLO 2. To differentiate between Web mining and data mining

CLO 3. To explore different application areas for web mining

CLO 4: To identify different methods to introduce structure to web-based data

CLO 5: To describe Web mining, its objectives, and its benefits

CLO 6: To explore the methods of Web usage mining

Module-1

Introduction to Web Data Mining and Data Mining Foundations, Introduction – World Wide Web (WWW), A Brief History of the Web and the Internet, Web Data Mining- Data Mining, Web Mining. Data Mining Foundations – Association Rules and Sequential Patterns – Basic Concepts of Association Rules, Apriori Algorithm- Frequent Itemset Generation, Association Rule Generation, Data Formats for Association Rule Mining, Mining with multiple minimum supports – Extended Model, Mining Algorithm, Rule Generation, Mining Class Association Rules, Basic Concepts of Sequential Patterns, Mining Sequential Patterns on GSP, Mining Sequential Patterns on PrefixSpan, Generating Rules from Sequential Patterns.

Module-2

Supervised and Unsupervised Learning Supervised Learning – Basic Concepts, Decision Tree Induction – Learning Algorithm, Impurity Function, Handling of Continuous Attributes, Classifier Evaluation, Rule Induction – Sequential Covering, Rule Learning, Classification Based on Associations, Naïve Bayesian Classification , Naïve Bayesian Text Classification – Probabilistic Framework, Naïve Bayesian Model . Unsupervised Learning – Basic Concepts , K-means Clustering – K-means Algorithm, Representation of Clusters, Hierarchical Clustering – Single link method, Complete link Method, Average link method, Strength and Weakness.

Module-3

Information Retrieval and Web Search: Basic Concepts of Information Retrieval, Information Retrieval Methods – Boolean Model, Vector Space Model and Statistical Language Model, Relevance Feedback, Evaluation Measures, Text and Web Page Preprocessing – Stopword Removal, Stemming, Web Page Preprocessing, Duplicate, Detection, Inverted Index and Its Compression – Inverted Index, Search using Inverted Index, Index Construction, Index Compression, Latent Semantic Indexing – Singular Value Decomposition, Query and Retrieval, Web Search, Meta Search, Web Spamming.

Module-4
Link Analysis and Web Crawling: Link Analysis – Social Network Analysis, Co-Citation and Bibliographic Coupling, Page Rank Algorithm, HITS Algorithm, Community Discovery-Problem Definition, Bipartite Core Communities, Maximum Flow Communities, Email Communities. Web Crawling – A Basic Crawler Algorithm-Breadth First Crawlers, Preferential Crawlers, Implementation Issues – Fetching, Parsing, Stopword Removal, Link Extraction, Spider Traps, Page Repository, Universal Crawlers, Focused Crawlers, Topical Crawlers, Crawler Ethics and Conflicts.
Module-5
Opinion Mining and Web Usage Mining Opinion Mining – Sentiment Classification – Classification based on Sentiment Phrases, Classification Using Text Classification Methods, Feature based Opinion Mining and Summarization – Problem Definition, Object feature extraction, Feature Extraction from Pros and Cons of Format1, Feature Extraction from Reviews of Format 2 and 3, Comparative Sentence and Relation Mining, Opinion Search and Opinion Spam. Web Usage Mining – Data Collection and Preprocessing- Sources and Types of Data, Key Elements of Web usage Data Preprocessing, Data Modeling for Web Usage Mining, Discovery and Analysis of Web usage Patterns -Session and Visitor Analysis, Cluster Analysis and Visitor Segmentation, Association and Correlation Analysis, Analysis of Sequential and Navigation Patterns.

Text Books:

1. Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data by Bing Liu (Springer Publications)

References Books:

1. Data Mining: Concepts and Techniques, Second Edition Jiawei Han, Micheline Kamber (Elsevier Publications)

2. Web Mining:: Applications and Techniques by Anthony Scime

3. Mining the Web: Discovering Knowledge from Hypertext Data by Soumen Chakrabarti

Web links and Video Lectures (e-Resources):

- https://www.tutorialspoint.com/what-is-web-mining
- https://www.geeksforgeeks.org/web-mining/

Course Outcomes

Cos	Description
CO1	Analyse the characteristics of a data sets and their attributes, investigate what transformations and statistical operations can be carried out on each and identify factors that impact on data quality
CO2	Investigate a variety of data mining techniques, and identifying their practical applicability to various problem domains
CO3	Independently research current trends and developments in knowledge discovery related technologies and use this skill to critically analyse publications to assess the relative merits of various technologies
CO4	Investigate how web search engines crawl, index, rank web content, how the web is Structured
CO5	Develop an in-depth knowledge of the fundamental web data mining concepts and techniques, and how previously acquired knowledge of data mining applies to the web

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X	X										
CO2	X		X									
CO3	X		X									
CO4	X	X	X									
CO5	X	X	X									

Predictive analysis		Semester	IV
Course Code:	**OMCI402B**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Explore various classification and regression models.

CLO 2. Explore working of supervised and unsupervised algorithms.

CLO 3. Identify the best working models to solve real world problems.

Module-1

Overview of Supervised Learning: Introduction, Variable Types and Terminology, Two Simple Approaches to Prediction: Linear Methods for Regression and Classification: Introduction, Linear regression models and least squares, , Subset selection , Shrinkage Methods, A Comparison of the Selection and Shrinkage Methods, Linear Discriminant Analysis, Logistic regression.

Text Book 1:Chapters 2.1 – 2.3, 3.1 – 3.4, 3.6, 4.1, 4.3 – 4.4

Module-2

Model Assessment and Selection: Bias, Variance, and model complexity, The Bias-variance Decomposition, Optimism of the training error rate, Estimate of In-sample prediction error, The Effective number of parameters, Bayesian approach and BIC, Cross- validation, Boot strap methods, Conditional or Expected Test Error.

Text Book 1:Chapters 7.1 – 7.7, 7.10 – 7.12

Module-3

Additive Models, Trees, and Related Methods: Generalized additive models, Tree-Based Methods, Boosting and Additive Trees: Boosting Methods, Exponential Loss and AdaBoost, Example: Spam Data, Numerical Optimization via Gradient Boosting , Illustrations (California Housing , New Zealand Fish, Demographic Data)

Text Book 1: Chapters 9.1 – 9.2, 10.4, 10.8, 10.10, 10.13

Module-4

Neural Networks: Introduction, Fitting Neural Networks, Some Issues in Training Neural Networks Support Vector Machines: Introduction, The Support Vector Classifier, Support Vector Machines and Kernels Unsupervised Learning and Random forests: Association rules, Cluster analysis, Details of Random Forests, Random forests and analysis.

Text Book 1: Chapters 11.1, 11.3 – 11.5, 12.1 – 12.3, 14.1 – 14.3, 15.1 – 15.4

Module-5

Assessing Performance of a classification Algorithm (t-test, McNemar's test, Paired t-test, F-test), Analysis of Variance, Creating data for analytics through designed experiments.

Text Book 2: Chapter 19

Text Books:

1. The Elements of Statistical Learning-Data Mining, Inference, and Prediction Trevor Hastie, Robert Tibshirani, Jerome Friedman Springer 2009.
2. Introduction to Machine Learning, E. Alpaydin PHI 2010.

Reference Books:

1. Pattern Recognition and Machine Learning, Christopher M. Bishop Springer 2007.
2. All of statistics, L.Wasserman Springer 2004.
3. An Introduction to statistical learning with applications in R, G. James, D. Witten, T. Hastie, R. Tibshirani Springer 2017

Web links and Video Lectures (e-Resources):

- https://www.udemy.com/tutorial/become-a-python-data-analyst/introduction-to-predictiveanalytics-models/
- https://intellipaat.com/blog/what-is-predictive-analytics/
- https://www.youtube.com/watch?v=Kd0C-8q0HkI

Course Outcomes

Cos	Description
CO1	Apply Regression and classification models to solve real world problems
CO2	Identify and analyze different analytical models
CO3	Identify and apply Additive models to different data science related problems
CO4	Apply Supervised and Unsupervised learning techniques
CO5	Choose appropriate assessment evaluation criterion for different analytical methods

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X		X									
CO2	X	X										
CO3	X		X									
CO4	X		X									
CO5	X	X										

Artificial Intelligence in Cyber Security		Semester	IV
Course Code:	**OMCI402C**	**CIE+SEE Marks**	**30 +70=100**
Credits	**04**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

CLO 1. Explore cyber threats and limitations of machine learning in security

CLO 2. Apply supervised learning algorithms for anomaly detection

CLO 3: Explore feature generation and the theory of network defense

CLO 4 : Explore types of web abuse and supervised learning for abuse problems.

Module-1
Cyber threats and landscape, The cyber attack's economy, What is Machine learning?, Real-world uses of Machine learning in Security, Spam fighting: an iterative approach, Limitations of machine learning in Security, Training algorithms to learn.
Module-2
Supervised classification algorithms, Practical consideration in classification, Clustering, When to use anomaly detection versus supervised learning, Intrusion detection with Heuristics, data-driven methods, feature engineering for anomaly detection, anomaly detection with data and algorithms, Challenges of using machine learning in anomaly detection.
Module-3
Understanding malware, feature generation, from features to classification, Theory of Network defense, machine learning and network security, building a predictive model to classify network attacks.
Module-4
Monetizing the consumer web, types of abuse and the data that can stop them, Supervised learning for abuse problems, clustering abuse, further direction in clustering, defining machine learning system maturity and scalability.
Module-5
Data quality, model quality, performance, maintainability, monitoring and alerting, Security and reliability, feedback and usability.

Books:

1. Machine Learning and Securityby Clarence Chio, David Freeman ,Released February 2018 Publisher(s): O'Reilly Media, Inc.

References:

1. Hands-On Artificial Intelligence for Cybersecurity by Alessandro Parisi Released August 2019 Publisher(s): Packt Publishing.

Web links and Video Lectures (e-Resources):

- https://www.youtube.com/watch?v=lpa8uy4DyMo&list=PL9ooVrP1hQOGPQVeapGsJCktzIO4DtI4_
- https://www.youtube.com/watch?v=4jmsHaJ7xEA&list=PL9ooVrP1hQOGHNaCT7_fwe9AabjZI1RjI

Course Outcomes

Cos	Description
CO1	Identify cyber threats and limitations of machine learning in security
CO2	Apply machine learning methods to detect anomalies.
CO3	Apply feature generation and the theory of network defense.
CO4	Apply supervised learning for abuse problems.

CO-PO Mapping:

PO/PSO / CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	X		X	X			X					
CO2	X	X										
CO3	X		X		X							
CO4	X	X		X								

Major Project		Semester	IV
Course Code:	**OMCI403**	**CIE+SEE Marks**	**30 +70=100**
Credits	**12**	**Exam Hours**	**03**
Examination type (SEE)		**Theory**	

Course Objectives:

- To support independent learning.
- To guide to select and utilize adequate information from varied resources maintaining ethics.
- To guide to organize the work in the appropriate manner and present information (acknowledging the sources) clearly.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgement, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase :

- Students in consultation with the guide/s shall carry out literature survey/ visit industries to finalize the topic of the Project. Subsequently, the students shall collect the material required for the selected project, prepare synopsis and narrate the methodology to carry out the project work.
- Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.
- Follow the Software Development life cycle
- Data Collection ,Planning
- Design the Test cases
- Validation and verification of attained results
- Significance of parameters w.r.t scientific quantified data.
- Publish the project work in reputed Journal

Course outcomes: At the end of the course the student will be able to:

- Present the project and be able to defend it.
- Make links across different areas of knowledge and to generate, develop and evaluate ideas and information so as to apply these skills to the project task.
- Habituated to critical thinking and use problem solving skills
- Communicate effectively and to present ideas clearly and coherently in both the written and oral forms.
- Work in a team to achieve common goal.
- Learn on their own, reflect on their learning and take appropriate actions to improve it.