University of Madras

Chepauk, Chennai 600 005

[Est. 1857, State University, NAAC 'A^{++}' Grade, CGPA 3.59, NIRF 2019 Rank: 20]

Website: www.unom.ac.in, Tel. 044-2539 9561

Postgraduate Programme
in
M.Sc. Computer Science

Curriculum and Syllabus
(with effect from the Academic Year 2023-24)

June 2023

Learning Outcome Based Curriculum Framework

Note: The Board of Studies is designed Learning Outcomes Based Curriculum Framework of Post Graduate Computer Science Programme prescribed by UGC

REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION	
Programme	**M.Sc. Computer Science**
Programme Code	
Duration	**PG - Two Year**
Programme Outcomes (POs)	○ To possess advanced knowledge of Computing, Mathematical basics for contemporary Computing Specialization and Knowledge of defined problem domain ○ To identify a prospective domain, review research literature and analyze the problems using mathematical methods and suggest ○ To have the Ability to use design tools, design software as per needs and specifications ○ To apply acquired knowledge of the domain in investigating the software design, from design of experiments, analysis of data to provision of valid conclusions. ○ To possess the skills to use modern software and hardware tools to analyze problems. ○ To possess the knowledge of ethical and legal principles and cyber regulations ○ To Possess ability for self-education and attitude for life-long learning in the broadest context of technological change ○ To possess the ability to communicate scientific facts effectively in both verbal and written form to the society ○ To possess the ability to understand the impact of IT solutions in a global and societal context ○ To possess the skill to find out the right opportunity for entrepreneurship for the betterment of an individual and society at large
Programme Specific Outcomes (PSOs)	• Implement the concept of theory and technology with classical and modern techniques for solving the complex problems in Computer Science. • Be more curious towards learning new and emerging technologies that adapt quickly to changes. • Design, execute and evaluate computing projects in academia and industries using appropriate technologies. • Know the contextual knowledge in computing science research and communicate effectively with stakeholders with the society at large for enhancing the quality of life. • Be honest in upholding the ethical principles and social responsibilities along with socio-economic innovations.

PROGRAMME OUTCOMES (PO) - PROGRAMME SPECIFIC OUTCOMES (PSO) MAPPING

PROGRAMME SPECIFIC OUTCOMES (PSO)					
	PO1	**PO2**	**PO3**	**PO4**	**PO5**
PSO1	**3**	**3**	**3**	**3**	**3**
PSO2	**3**	**3**	**3**	**3**	**3**
PSO3	**3**	**3**	**3**	**3**	**3**
PSO4	**3**	**3**	**3**	**3**	**3**
PSO5	**3**	**3**	**3**	**3**	**3**

Level of Correlation between PO's and PSO's
(Suggested by UGC as per Six Sigma Tool – Cause and Effect Matrix)

Assign the value
1 – Low
2 – Medium
3 – High
0 – No Correlation

METHODS OF EVALUATION		
Internal Evaluation	Continuous Internal Assessment Test	**25 Marks**
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	**75 Marks**
Total		**100 Marks**

METHODS OF ASSESSMENT	
Remembering (K1)	● The lowest level of questions require students to recall information from the course content ● Knowledge questions usually require students to identify information in the textbook.
Understanding (K2)	● Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words. ● The questions go beyond simple recall and require students to combined together
Application (K3)	● Students have to solve problems by using / applying a concept learned in the classroom. ● Students must use their knowledge to determine a exact response.
Analyze (K4)	● Analyzing the question is one that asks the students to break down something into its component parts. ● Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.
Evaluate (K5)	● Evaluation requires an individual to make judgment on something. ● Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem. ● Students are engaged in decision-making and problem–solving. ● Evaluation questions do not have single right answers.
Create (K6)	● The questions of this category challenge students to get engaged in creative and original thinking. ● Developing original ideas and problem solving skills

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
Semester - I						
436C1A: Core – I Theory Advanced Data Structures and Algorithms	4	5	3	25	75	100
436C1B: Core – II Theory Advanced Python Programming	4	5	3	25	75	100
436C1C: Core – III Practical Advanced Data Structures and Algorithms Practical	3	5	3	40	60	100
436C1D: Core – IV Practical Advanced Python Programming Practical	3	5	3	40	60	100
Elective – I Theory (Any one) 436E1A: Cloud Computing 436E1B: Internet of Things 436E1C: Advanced Computer Architecture	3	5	3	25	75	100
Elective – II Theory (Any one) 436E1D: Principles of Complier Design 436E1E: Natural Language Processing 436E1F: Distributed Database Systems	3	5	3	25	75	100
	20	**30**				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
Semester - II						
436C2A: Core -V Theory Data Mining and Warehousing	4	5	3	25	75	100
436C2B: Core – VI Theory Web Technology and Advanced Java	4	5	3	25	75	100
436C2C: Core – VII Practical Data Mining and Warehousing Practical	4	5	3	40	60	100
436C2D: Core – VIII Practical Web Technology and Advanced Java Practical	3	4	3	40	60	100
Elective - III (Any one) 436E2A: Artificial Intelligence 436E2B: Software Development Technologies 436E2C: Artificial Neural Networks and Deep Learning	3	5	3	25	75	100
Elective – IV (Any one) 436E2D: Computer Vision 436E2E: Agile Software Engineering 436E2F: Human Computer Interaction	3	4	3	25	75	100
436S2A: SEC-I - Fundamentals of Human Rights	2	2	3	25	75	100
	23	**30**				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
Semester – III						
536C3A: Core IX Theory Data Science and Analytics	4	4	3	25	75	100
536C3B: Core X Theory Machine Learning	4	5	3	25	75	100
536C3C: Core XI Theory Theory of Computation	3	5	3	25	75	100
536C3D: Core XII Practical Data Science and Analytics Practical	3	5	3	40	60	100
536C3E: Core XIII Practical Machine Learning Practical	3	5	3	40	60	100
Elective –V (Any one) 536E3A: Network Security 536E3B: Cryptography 536E3C: Parallel and Distributed Computing	3	4	3	25	75	100
536S3A: SEC–II-Cyber Security	2	2	3	25	75	100
536S3B: Internship Industrial Activity	2	-	-	-	100	100
	24	**30**				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
Semester – IV						
536C4A: Core - XIV Theory Digital Image Processing	4	5	3	25	75	100
536C4B: Core - XV Project with Viva voce	14	18		20	60+20	100
Elective – VI (Any one) 536E4A: Robotic Process Automation For Business 536E4B: Block Chain Technology 536E4C: Embedded Systems	3	4	3	25	75	100
Skill Enhancement/ Professional Competency Skill (Any one) 536S4A: UML Practical 536S4B: Documentation and Interview skills for Software Engineers	2	3	3	40	60	100
536V4A: Extension Activity	1					
	24	**30**				
Total Credits	**91**					

Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
PartA	**14**	**15**	**17**	**18**	**64**
Part B **(i) Discipline– Centric/GenericSkill**	**6**	**6**	**5**	**3**	**20**
(ii)SoftSkill		**2**		**2**	**4**
(iii)SummerInternship/IndustrialTraining			**2**		2
PartC				**1**	**1**
Total	**20**	**23**	**24**	**24**	**91**

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Advanced Data Structures and Algorithms**		
Core–I – Theory	I Year & I Semester	Credit:4	436C1A

Objectives:

Define the basic concepts of algorithms and analyze the performance of algorithms.

Discuss various algorithm design techniques for developing algorithms.

Discuss various searching, sorting and graph traversal algorithms.

Understand NP completeness and identify different NP complete problems.

Discuss various advanced topics on algorithms.

Outcomes:

1.	Analyze programming problem statements.	K1, K2
2.	Comprehend and select algorithm design approaches in a problem specific manner.	K2, K3
3.	Choose appropriate data structures for a specific problem	K3, K4
4.	Utilize necessary mathematical abstractions to solve problems	K5, K6
5.	Come up with analysis of efficiency and proofs of correctness	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Introduction: Algorithm, Pseudo code for expressing algorithms, Performance Analysis-Space complexity, Time complexity, Asymptotic Notation- Big oh notation, Omega notation, Theta notation and Little oh notation, Probabilistic analysis, Amortized analysis.

UNIT II: Insertion and deletion and merging with 1) binary search tree, 2) AVL tree, 3) Red Black tree, 4) B tree, 5) B+ tree and Comparison of previous tree structures. Fibonacci Heap, Fibonacci Heap Operations: Find minimum, merge, insert, extract minimum, decrease key and delete, Complexity analysis of the above data structure operations.

UNIT III: Representations of Graphs, Minimum Spanning Trees: Growing a Minimum Spanning Tree – Kruskal and Prim- Single-Source Shortest Paths: The Bellman-Ford algorithm – Single-Source Shortest paths in Directed Acyclic Graphs – Dijkstra ‘s Algorithm, Divide and conquer: General method, applications - Quick sort, Merge sort, Strassen’s matrix multiplication, External Sort: External merge sort, K-Way Merge sorting

UNIT IV: Greedy method: General method, applications-Job sequencing with deadlines, 0/1, knapsack problem, Huffman Codes, Dynamic Programming: General method, applications-Matrix chain multiplication, 0/1 knapsack problem, Traveling salesperson problem, Reliability design.

UNIT V: Backtracking: General method, applications-n-queen problem, sum of subsets problem, graph coloring, Hamiltonian cycles. Branch and Bound: General method,applications - Traveling salesperson problem, 0/1 knapsack problem- LC Branch and Bound solution, FIFO Branch and Bound solution. NP-Hard and NP-Complete problems

Recommended Texts:

1. Peter Brass; Advanced Data Structures; CAMBRIDGE UNIVERSITY PRESS;2008
2. S. Dasgupta, C. Papadimitrou, U Vazirani; Algorithms; Mc Graw Hill;2022
3. J. Klienberg and E. Tardos, Algorithm Design, Pearson EducationLimited;2013.
4. Ellis Horowitz, Sartaj Sahni, Rajasekharan, Fundamentals of Algorithms, 2nd Edition, Universities Press, 2009.

Reference Books:

1. Sartaj Sahni, Data Structures Algorithms and Applications in C++, 2nd Edition, Universities Press, 2007.
2. Aho V Alfred, Hapcroft E John, Ullman D Jeffry, Data Structures and Algorithms, Pearson Education, 2001.
4. Adam Drozdek, Thomson, Data Structures and Algorithms in JAVA, 3rd Edition, Cengage Learning, 2008.
5. Horowitz, Sahni, Mehta, Fundamentals of Data Structures in C++, 2nd Edition, Universities Press, 2007.

Web References:

1. https://nptel.ac.in/courses/106102064

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	M	S	M	S	S	S	L	M
CO 2	S	L	S	M	S	L	M	M	S	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	L	S	M	S	L	S	M
CO 5	S	M	M	S	L	S	M	S	S	S

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Advanced Data Structures and Algorithms Practical**		
Core–III - Practical	I Year & I Semester	Credit:3	436C1C

Objectives:

To provide the foundations of the practical implementation and usage of Algorithms and Data Structures.

To ensure that the student evolves into a competent programmer capable of designing and analysing implementations of algorithms and data structures for different kinds of problems.

To expose the student to the algorithm analysis techniques,

To make the students understand the theory of reductions, and to the classification of problems.

To make the students to be sure of complexity classes like NP.

Outcomes:

1.	Design and analyse programming problem statements.	K1, K2
2.	Choose appropriate data structures and algorithms, understand the ADT/libraries, and use it to design algorithms for a specific problem.	K1, K2
3.	Be familiar with programming language constructs available for rapid application development,	K3, K4
4.	Understand the necessary programmatic abstraction to solve problems.	K4, K5
5.	Gain the capacity to solve real life problems by matching to the available algorithms.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Implement the following using Java or Python

1. Write a program to perform the following operations on a heterogeneous singly linked list. i) Creation ii) Insertion iii) Deletion iv) Traversal.

2. Write a program to perform the following operations on a heterogeneous doubly linked list. i) Creation ii) Insertion iii) Deletion iv) Traversal in both ways

3. Write a program that implements using java generic class, the stack (its operations)

4. Write a program that implements using java generic class, the queue (its operations)

5. Write a program that implements the Quick sort method.

6. Write a program that implement the Merge sort method.

7. Write a program that implement the SHELL sort method.

8. Write a program to perform the following: i) Creating a Binary Tree of integers ii) Traversing the above binary tree in preorder, inorder and postorder.

9. Write a program to perform the following: i) Creating a AVL Tree ii) insertion iii) deletion iv) Traversing the above AVL tree in preorder, inorder and postorder. 10. Write a program that uses functions to perform the following: i) Creating a SplayTree ii) traverse

11. Write a program to perform the following: i) Creating a B-Tree of integers ii) insertion iii) deletion

12. Write a program that implements Kruskal's algorithm using a disjoint set data structure. The program takes as input a file (data.txt), in which each line either represents a vertex or an edge. For the edge lines, the first integer on that line representing the starting vertex, the second the ending vertex, and the third the weight of the edge. Use this file to construct, line by line, the graph upon which Kruskal's algorithm will be run (do NOT hardcode this graph!).

13. Write a program to simulate various graph traversing algorithms.

14. Write a program to find the minimal spanning tree of a graph using the Prim's algorithm.

15. Write a program to find shortest path using Bellman Ford's Algorithm

Recommended Texts:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++:Pearson Education; 4th Edition,

Reference Books:

1. Sartaj Sahni, Data Structures Algorithms and Applications in C++, 2nd Edition, Universities Press, 2007.

2. Ellis Horowitz, Sartaj Sahni, Rajasekharan, Fundamentals of Algorithms, 2nd Edition, Universities Press, 2009.

3. Aho V Alfred, Hapcroft E John, Ullman D Jeffry, Data Structures and Algorithms, 1st Edition, Pearson Education, 2002.

4. Adam Drozdek, Thomson, Data Structures and Algorithms in JAVA, 3rd Edition, Cengage Learning, 2008.

5. Horowitz, Sahni, Mehta, Fundamentals of Data Structures in C++, 2nd Edition, Universities Press, 2007.

Web References:

1. https://nptel.ac.in/courses/106102064

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	M	S	M	S	L	S	L	M
CO 2	S	L	S	M	S	L	M	M	S	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	1	S	M	S	L	S	M
CO 5	S	M	M	S	L	S	M	S	L	S

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Advanced Python Programming**		
Core–II - Theory	I Year & I Semester	Credit:4	436C1B

Objectives:

To Provide advanced programming knowledge in python environment

To Make interactive Python programs.

To develop GUI based applications

To utilise libraries and APIs for rapid application development

To use python as an analytical tool for different mathematical models

Outcomes:

1.	Be able to program decorators, closures, lambda, iterators and generators comprehensions with in OOP.	K1, K2
2.	Learn modern data structures to include collections, array, and queues	K2, K3
3.	Use platform independent file manipulation, file pattern matching using CSV, HTML, XML, JASON	K3
4.	Be able to set up a client-server program and also multi-process applications.	K4, K5
5.	Be able to use python as an analytical and presentation tool	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Object Oriented Python – Class, Objects. member types (public. Private, protected) self, init method, method overloading. Inheritance, method overriding, Polymorphism, Encapsulation, Assertion, Decorators, Generators, Iterators.

UNIT II: Threading in Python: Thread, Starting a Thread, Daemon Threads, join() a Thread, Working With Many Threads, Using a Thread Pool Executor, Race Conditions, Basic Synchronization Using Lock, Deadlock, Producer-Consumer Threading, Producer Consumer Using Lock, Producer-Consumer Using Queue, Threading Objects, Semaphore, Timer

UNIT III: Database programming using Python: Connecting to a database (sqlite, mysql) using Python, Sending DML and DDL queries and processing the result from a Python Program. Network programming using Python: An introduction to client-server programming, Basics of TCP and UDP protocols, Introduction to socket programming, Building an HTTP client and server

UNIT IV: GUI in Python: Introduction to GUI building libraries, Widgets: Button - Canvas - Check button -Entry - Frame -Label – List box – Menu button - Menu - Message –Radio button - Scale - Scrollbar - Text – Top level – Spin box- Paned Window – Label Frame – Message Box

Basic image processing using Python: Introduction to digital image processing, Basic operations on an image: Crop - Scale - Rotate - Flip - Changing contrast, brightness and color - Edge detection, blur, sharpening

UNIT V: Basic numerical processing using Python: Introduction to numpy , Creation of vectors and matrices, Matrix manipulation Basic data analysis using Python: Introduction to Pandas ,Pandas data structures – Series and DataFrame , Data wrangling using pandas : Loading a dataset into a dataframe- Selecting Columns from a dataframe - Selecting Rows from a dataframe - Adding new data in a dataframe - Deleting data from a dataframe Basic data visualization using : Introduction to Matplotlib, Scatter plot , Line plot,Bar chart, Histogram, Box plot.

Recommended Texts:

1. John Hunt; Advanced Guide to Python 3 Programming; Springer Nature Switzerland AG; 2019

Reference Books:

2. Eric Matthes, Python Crash Course: A Hands-On, Project-Based Introduction to Programming, 2nd Edition, No starch Press, 2019.
3. Mark Lutz; Learning Python, 5th Edition; O'Reilly Media, 2013
4. Mark Lutz, “Programming Python”, 4th edition, O'Reilly Media, 2010.

Web References:

1. https://realpython.com/tutorials/advanced/

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	M	S	M	S	S	S	L	M
CO 2	S	L	S	M	S	L	M	M	S	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	L	S	M	S	L	S	M
CO 5	S	M	M	S	L	S	M	S	S	S

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Advanced Python Programming Practical**		
Core–IV - Practical	I Year & I Semester	Credit:3	436C1D

Objectives:

Design, implement and test readable, efficient programs that take advantage of Python built-in capabilities and follow Python best practices.

Understand implementation differences and performance tradeoffs associated with various Python data structures.

Develop Python applications using the modules and packages available in the Python standard library.

Develop Python applications using third party libraries.

Design, implement and test Python programs that include a graphical user interface, data analysis and visualization, web data extraction and web applications.

Outcomes:

1.	Apply exception handling and user defined exception(s) Develop Module(s) and Package(s) in python	K1, K2
2.	Possess an ability to write database applications in Python	K1, K2
3.	Implement Object Oriented concepts in programming Apply Collection modules for the data types	K3, K4
4.	Possess the Object-oriented programming skills in Python. and the skill of to design graphical-user interfaces (GUI) in Python.	K4, K5
5.	Make use of Pandas and Numpy Libraries	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

1) Exception

a) Write a python program to catch following exception i) Value Error ii) Index Error iii) Name Error iv) Type Error v) DivideZero Error

b) Write a python program to create user defined exceptions.

c) Write a python program to understand the use of else and finally block with try block.

d) Write a python program that uses raise and exception class to throw an exception.

2) Numpy Library

a) Create a numpy array from list, tuple with float type

b) Python program to demonstrate slicing, integer and boolean array indexing

c) Write a python program to find min, max, sum, cumulative sum of array.

d) Write a python program to demonstrate use of ndim, shape, size, dtype.

3) Numpy Library: Linear Algebra

a) Write a python program to find rank, determinant, and trace of an array. b) Write a python program to find eigenvalues of matrices

c) Write a python program to find matrix and vector products (dot, inner, outer, product), matrix exponentiation.

d) Write a python program to solve a linear matrix equation, or system of linear scalar equations.

e) Create a white image using NumPy in Python and

f) Convert a NumPy array to an image and Convert images to NumPy array?

g) Perform Sorting, Searching and Counting using Numpy methods.

h) Write a program to demonstrate the use of the reshape() method.

4) Pandas Library

a) Write a python program to implement Pandas Series with labels.

b) Create a Pandas Series from a dictionary.

c) Creating a Pandas DataFrame.

d) Write a program which make use of following Pandas methods i) describe() ii) head() iii) tail()

e) Write a program that converts Pandas DataFrame and Series into numpy.array.

f) Write a program that demonstrates the column selection, column addition, and column deletion.

g) Write a program that demonstrates the row selection, row addition, and row deletion.

h) Get n-largest and n-smallest values from a particular column in Pandas dataFrame

5) Visualization

a) Write a program which use pandas inbuilt visualization to plot following graphs: i. Bar plots ii. Histograms iii. Line plots iv. Scatter plots

b) Write a program to demonstrate use of groupby() method.

c) Write a program to demonstrate pandas Merging, Joining and Concatenating

d) Creating dataframes from csv and excel files.

6) Object Oriented Programming:

a) Write a Python class named Person with attributes name, age, weight (kgs), height (ft) and takes them through the constructor and exposes a method get_bmi_result() which returns one of "underweight", "healthy", "obese"

b) Write a python program to demonstrate various kinds of inheritance.

c) Write a python program to demonstrate operator overloading.

d) Write a python program to create abstract classes and abstract methods.

7) MULTITHREADING

a. Write a python program to create two threads to keep a count of number of even numbers entered by the user.

b. Write a JAVA program that creates threads by extending Thread class. First thread display “Good Morning “every 1 sec, the second thread displays “Hello “every 2 seconds and the third display “Welcome” every 3 seconds.

Recommended Texts:

1. Martin C. Brown (Author), “Python: The Complete Reference” McGraw Hill Education, Fourth edition , 2018

Reference Books:

1. R. Nageswara Rao , “Core Python Programming” Dreamtech Press India Pvt Ltd 2018.

Web References:

1. https://realpython.com/tutorials/advanced/
2. https://onlinecourses.nptel.ac.in/noc19_cs40/preview
3. https://onlinecourses.nptel.ac.in/noc19_cs41/preview

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	M	S	M	L	S	S	L	M
CO 2	S	L	S	L	S	L	M	M	M	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	L	S	M	S	L	S	M
CO 5	S	M	M	S	L	S	M	S	S	S

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Cloud Computing**		
Elective –I - Theory	I Year & I Semester	Credit:3	436E1A

Objectives:

- Gain knowledge on cloud computing, cloud services, architectures and applications.
- Enable the students to learn the basics of cloud computing with real time usage
- How to store and share, in and from cloud?

Outcomes:

1.	Understand the concepts of Cloud and its services	K1,K2
2.	Collaborate Cloud for Event & Project Management	K3,K4
3.	Analyze on cloud in Word Processing, Spread Sheets, Mail, Calendar, Database	K4,K5
4.	Analyze cloud in social networks	K5,K6
5.	Explore cloud storage and sharing	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I:INTRODUCTION Cloud Computing Introduction, From, Collaboration to cloud, Working of cloud computing, pros and cons, benefits, developing cloud computing services, Cloud service development, discovering cloud services.

UNIT II:CLOUD COMPUTING FOR EVERYONE Centralizing email communications, cloudcomputing for community, collaborating on schedules, collaborating on group projects and events, cloud computing for corporation, mapping, schedules, managing projects, presenting on road.

UNIT III:USING CLOUD SERVICES Collaborating on calendars, Schedules and task management, exploring on line scheduling and planning, collaborating on event management, collaborating on contact management, collaborating on project management, collaborating on word processing, spreadsheets, and databases.

UNIT IV:OUTSIDETHECLOUD Evaluating webmail services, evaluating instant messaging, Evaluating web conference tools, creating groups on social networks, Evaluating onlinegroupware, collaborating via blog sand wikis.

UNIT V:STORING AND SHARING Understanding cloud storage, evaluating on line file storage, exploring on-line book-marking services, exploring on line photo editing applications, exploring photo sharing communities, controlling it with web based desktops.

Text Books

Michael Miller, “Cloud Computing”, Pearson Education, New Delhi, 2009.

ReferenceBooks

Anthony T. Velte, “Cloud Computing: A Practical Approach”, 1st Edition, Tata McGraw Hill Education Private Limited, 2009.

Related Online Contents

[MOOC,SWAYAM,NPTEL,Websitesetc.]
https://nptel.ac.in/courses/106/105/106105167/
https://www.tutorialspoint.com/cloud_computing/index.htm
https://www.javatpoint.com/cloud-computing-tutorial

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	S	M	S	M	S	M	M	M	S
CO2	M	S	M	S	S	S	M	M	M	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	M	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Internet of Things**		
Elective –I - Theory	I Year & I Semester	Credit:3	436E1B

Objectives:

- AboutInternetofThingswherevariouscommunicatingentitiesarecontrolledandmanaged for decision making in the application domain.
- Enable students to learn the Architecture of IoT and IoT Technologies
- Developing IoT applications and Security in IoT, Basic Electronics for IoT, Arduino IDE, Sensors and Actuators Programming NodeMCU using Arduino IDE.

Outcomes:

1.	Understand about IoT, its Architecture and its Applications	K1,K2
2.	Understand basic electronics used in IoT &its role	K2,K3
3.	Develop applications with using Arduino IDE	K4
4.	Analyze about sensors and actuators	K5,K6
5.	Design IoT in real time applications using today's internet &wireless technologies	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT– Technologies for IoT – Developing IoT Applications – Applications of IoT – Industrial IoT – Security in IoT

UNIT II: Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.

UNIT III: Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.

UNIT IV: Sensors and Actuators: Analog and Digital Sensors–Interfacing temperature sensor, ultrasoundSensor and infrared (IR)sensor with Arduino– Interfacing LED and Buzzer with Arduino.

UNIT V: Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak).

Text Books

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-OnApproach”,2014. ISBN: 978-0996025515
2. Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017

Reference Books

1. Michael Margolis, “ArduinoCookbook”,O Reilly,2011
2. Marco Schwartz, “InternetofThingswithESP8266”, Packt Publishing, 2016.
3. DhivyaBala, “ESP8266:StepbyStepTutorialforESP8266IoT, ArduinoNODEMCU Dev. Kit”, 2018.

Related Online Contents

1. https://onlinecourses.nptel.ac.in/noc20_cs66/preview
2. https://www.javatpoint.com/iot-internet-of-things
3. https://www.tutorialspoint.com/internet_of_things/index.htm

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	M	S	M	S	M	M	S	M
CO2	M	S	M	S	M	S	M	S	S	S
CO3	S	S	S	S	M	S	M	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Advanced Computer Architecture**		
Elective –I - Theory	I Year & I Semester	Credit:3	436E1C

Objectives:

To introduce the students to the recent trends in the field of Computer Architecture and identify performance related parameters.

To learn the different multiprocessor issues.

To expose the different types of multicore architectures.

To understand the design of the memory hierarchy.

Outcomes:

1.	Identify the limitations of Instruction-level parallelism (ILP).	K1, K2
2.	Discuss the issues related to multiprocessing and suggest solutions	K2, K3
3.	Point out the salient features of different multicore architectures and how they exploit parallelism.	K3, K4
4.	Discuss the various techniques used for optimizing the cache performance	K4, K5
5.	Design hierarchical memory system and Point out how data level parallelism is exploited in architectures	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I FUNDAMENTALS OF COMPUTER DESIGN AND ILP

Fundamentals of Computer Design – Measuring and Reporting Performance – Instruction Level Parallelism and its Exploitation – Concepts and Challenges –Exposing ILP - Advanced Branch Prediction - Dynamic Scheduling - Hardware-Based Speculation - Exploiting ILP - Instruction Delivery and Speculation - Limitations of ILP - Multithreading

UNIT II MEMORY HIERARCHY DESIGN

Introduction – Optimizations of Cache Performance – Memory Technology and Optimizations – Protection: Virtual Memory and Virtual Machines – Design of Memory Hierarchies – Case Studies.

UNIT III MULTIPROCESSOR ISSUES

Introduction- Centralized, Symmetric and Distributed Shared Memory Architectures – Cache Coherence Issues – Performance Issues – Synchronization – Models of Memory Consistency – Case Study-Interconnection Networks – Buses, Crossbar and Multi-stage Interconnection Networks

UNIT IV MULTICORE ARCHITECTURES

Homogeneous and Heterogeneous Multi-core Architectures – Intel Multicore Architectures – SUN CMP architecture – IBM Cell Architecture. Introduction to Warehouse-scale computers

Architectures- Physical Infrastructure and Costs- Cloud Computing –Case Study- Google Warehouse-Scale Computer.

UNIT V VECTOR, SIMD AND GPU ARCHITECTURES
Introduction-Vector Architecture – SIMD Extensions for Multimedia – Graphics Processing Units – Case Studies – GPGPU Computing – Detecting and Enhancing Loop Level Parallelism- Case Studies.

Recommended Texts:

1. Darryl Gove ;Multicore Application Programming: For Windows, Linux, and Oracle Solaris, Pearson, 2011

Reference Books:

1. David B. Kirk, Wen-mei W. Hwu, ¯ Programming Massively Parallel Processors, Morgan Kauffman, 2010
2. David E. Culler, Jaswinder Pal Singh, ¯ Parallel computing architecture : A hardware/software approach , Morgan Kaufmann /Elsevier Publishers, 1999 3. John L. Hennessey and David A. Patterson, ¯ Computer Architecture – A Quantitative Approach, Morgan Kaufmann / Elsevier, 5th edition, 2012. 4. Kai Hwang and Zhi.Wei Xu, ¯ Scalable Parallel Computing, Tata McGraw Hill, NewDelhi, 2003

Web References:

1. https://www.youtube.com/watch?v=v7iefsovo9M&list=PLwdnzlV3ogoWJhBxBY u-K4l-q-nNHd24D

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	S	M	L	M	L	S
CO2	S	M	S	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	S	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Principles of Complier Design**		
Elective – II - Theory	I Year & I Semester	Credit:3	436E1D

Objectives:

To learn the various phases of compiler.
To learn the various parsing techniques.
To understand intermediate code generation and run-time environment.
To learn to implement the front-end of the compiler.
To learn to implement code generators.

Outcomes:

1.	Understand the different phases of the compiler.	K1, K2
2.	Design a lexical analyzer for a sample language.	K2, K3
3.	Apply different parsing algorithms to develop the parsers for a given grammar.	K3, K4
4.	Design and implement a scanner and a parser using LEX and YACC tools	K4, K5
5.	Learn to implement code optimization techniques and a simple code generator.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: INTRODUCTION TO COMPILERS: Structure of a compiler – Lexical Analysis – Role of Lexical Analyzer – Input Buffering – Specification of Tokens – Recognition of Tokens – Lex – Finite Automata – Regular Expressions to Automata – Minimizing DFA.

UNIT II: SYNTAX ANALYSIS: Role of Parser – Grammars – Error Handling – Context free grammars – Writing a grammar – Top Down Parsing - General Strategies Recursive Descent Parser Predictive Parser-LL(1) Parser-Shift Reduce Parser-LR Parser- LR (0)Item Construction of SLR Parsing Table - Introduction to LALR Parser - Error Handling and Recovery in Syntax Analyzer-YACC.

UNIT III: INTERMEDIATE CODE GENERATION: Syntax Directed Definitions, Evaluation Orders for Syntax Directed Definitions, Intermediate Languages: Syntax Tree, Three Address Code, Types and Declarations, Translation of Expressions, Type Checking.

UNIT IV: RUN-TIME ENVIRONMENT AND CODE GENERATION: Storage Organization, Stack Allocation Space, Access to Non-local Data on the Stack, Heap Management - Issues in Code Generation - Design of a simple Code Generator.

UNIT V: CODE OPTIMIZATION: Principal Sources of Optimization – Peep-hole optimization - DAG- Optimization of Basic Blocks- Global Data Flow Analysis - Efficient Data Flow Algorithm.

Recommended Texts:

1. Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers: Principles, Techniques and Tools; Pearson Education; Second Edition; 2013

Reference Books:

1. Randy Allen, Ken Kennedy, Optimizing Compilers for Modern Architectures: A Dependence based Approach, Morgan Kaufmann Publishers, 2002.
2. Steven S. Muchnick, Advanced Compiler Design and Implementation, Morgan Kaufmann Publishers - Elsevier Science, India, Indian Reprint 2003.
3. Keith D Cooper and Linda Torczon, Engineering a Compiler, Morgan Kaufmann Publishers Elsevier Science, 2004.
4. V. Raghavan, Principles of Compiler Design, Tata McGraw Hill Education Publishers, 2010.
5. Allen I. Holub, Compiler Design in C, Prentice-Hall Software Series, 1993.

Web References:

1.https://www.youtube.com/watch?v=k4QXWFZZq1E&list=PLENQMW_c1dimx H Uu6KjuBC2rOlAaoLozF

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	M	S	S	S	M	M	L	M	L
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	M	L	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Natural Language Processing**		
Elective – II - Theory	I Year & I Semester	Credit:3	436E1E

Objectives:

To learn the fundamentals of natural language processing
To understand the use of CFG and PCFG in NLP
To understand the role of semantics of sentences and pragmatics
To apply the NLP techniques to IR applications

Outcomes:

1.	To tag a given text with basic Language features	K1
2.	To design an innovative application using NLP components	K2
3.	To implement a rule-based system to tackle morphology/syntax of a language	K3, K4
4.	To design a tag set to be used for statistical processing for real-time applications	K4, K5
5.	To compare and contrast the use of different statistical approaches for different types of NLP applications.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I INTRODUCTION: Origins and challenges of NLP – Language Modeling: Grammar-based LM, Statistical LM - Regular Expressions, Finite-State Automata – English Morphology, Transducers for lexicon and rules, Tokenization, Detecting and Correcting Spelling Errors, Minimum Edit Distance

UNIT II WORD LEVEL ANALYSIS: Unsmoothed N-grams, Evaluating N-grams, Smoothing, Interpolation and Backoff – Word Classes, Part-of-Speech Tagging, Rule based, Stochastic and Transformation-based tagging, Issues in PoS tagging – Hidden Markov and Maximum Entropy models.

UNIT III SYNTACTIC ANALYSIS: Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar – Syntactic Parsing, Ambiguity, Dynamic Programming parsing – Shallow parsing – Probabilistic CFG, Probabilistic CYK, Probabilistic Lexicalized CFGs - Feature structures, Unification of feature structures.

UNIT IV SEMANTICS AND PRAGMATICS: Requirements for representation, First Order Logic, Description Logics – Syntax-Driven Semantic analysis, Semantic attachments – Word Senses, Relations between Senses, Thematic Roles, selection restrictions – Word Sense Disambiguation, WSD using Supervised, Dictionary & Thesaurus, Bootstrapping methods – Word Similarity using Thesaurus and Distributional methods.

UNIT V DISCOURSE ANALYSIS AND LEXICAL RESOURCES: Discourse segmentation, Coherence – Reference Phenomena, Anaphora Resolution using Hobbs and Centering Algorithm – Coreference Resolution – Resources: Porter Stemmer, Lemmatizer, Penn Treebank, Brill's Tagger, WordNet, PropBank, FrameNet, Brown Corpus, British National Corpus (BNC).

Recommended Texts:

1. Daniel Jurafsky, James H. Martin;Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics and Speech; Pearson Publication; 2014.
2. Steven Bird, Ewan Klein and Edward Loper, ¯ Natural Language Processing with Python , First Edition, OReilly Media, 2009.

Reference Books:

1. Breck Baldwin, ¯ Language Processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
2. Richard M Reese, ¯ Natural Language Processing with Java ,O Reilly Media, 2015.
3. Nitin Indurkhya and Fred J. Damerau, ¯ Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
4. Tanveer Siddiqui, U.S. Tiwary, ¯ Natural Language Processing and Information Retrieval, Oxford University Press, 2008.

Web References:

1. https://www.youtube.com/watch?v=oWsMIW 5xUc&list=PLLssT5z_DsK8HbD2sPcUlDfQ7zmBarMYv

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	M	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Distributed Database Systems**		
Elective – II - Theory	I Year & I Semester	Credit:3	436E1F

Objectives:

To introduction students to Distributed DBMS and associated problems.

To make students understand various algorithms and techniques for managing distributed database.

To understand theoretical and practical aspects of distributed database systems.

To study and identify various issues related to the development of distributed database system.

To make students understand Transaction Management & Compare various approaches to concurrency control in Distributed database

Outcomes:

1.	Apply various fragmentation techniques given a problem	K1
2.	Analyse and calculate the cost of enforcing semantic integrity control	K2, K3
3.	Use the steps of query processing	K4
4.	Apply optimization techniques are applies to Distributed Database	K4, K5
5.	Apply effectively Query Optimization Algorithms	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit-I: Introduction: Distributed Data Processing, Distributed Database Systems, Promises of DDBSs, Complicating factors, Problem areas Overview of RDBMS: Concepts, Integrity, Normalization - Distributed DBMS Architecture: Autonomy, Distribution, Heterogeneity DDBMS Architecture – Client/Server, Peer to peer, MDBS

Unit-II: Data Distribution Alternatives: Design Alternatives – localized data, distributed data Fragmentation – Vertical, Horizontal (primary & derived), hybrid, general guidelines, correctness rules Distribution transparency – location, fragmentation, replication Impact of distribution on user queries – No Global Data Dictionary (GDD), GDD containing location information Example on fragmentation

Unit-III: Semantic Data Control: View Management, Authentication – database authentication, OS authentication, Access Rights, Semantic Integrity Control – Centralized &Distributed , Cost of enforcing semantic integrity - : Query Processing: Query Processing Problem, Layers of Query Processing Query Processing in Centralized Systems – Parsing & Translation, Optimization, Code generation, Example Query Processing in Distributed Systems – Mapping global query to local, Optimization,

Unit-IV: Optimization of Distributed Queries: Query Optimization, Centralized Query Optimization, Join Ordering Distributed Query Optimization Algorithms - Distributed Transaction Management & Concurrency Control: Transaction concept, ACID property, Objectives of transaction management, Types of transactions, Objectives of Distributed Concurrency Control, Concurrency Control anomalies, Methods of concurrency control, Serializability and recoverability, Distributed Serializability, Enhanced lock based and timestamp based protocols, Multiple granularity, Multi version schemes, Optimistic Concurrency Control techniques

Unit-V: Distributed Deadlock & Recovery: Deadlock concept, Deadlock in Centralized systems, Deadlock in Distributed Systems – Detection, Prevention, Avoidance, Wait-Die Algorithm, Wound-Wait algorithm Recovery in DBMS - Types of Failure, Methods to control failure, Different techniques of recoverability, Write- Ahead logging Protocol, Advanced recovery techniques- Shadow Paging, Fuzzy checkpoint, ARIES, RAID levels, Two Phase and Three Phase commit protocols

Recommended Texts:

1. Ozsu; Principles of Distributed Database Systems; Springer; 4th edition;2020

Reference Books:

1. Rahimi &Haug; Distributed Database Management Systems;Wiley;2010
2. Distributed Database Systems, Chanda Ray, Pearson Publication
3. Sachin Deshpande; Distributed Databases; Dreamtech;2014

Web References:

1. https://www.youtube.com/watch?v=dlBVWMdGhqw&list=PLUJ7JmcrTifBROWODSG8wgyl20XgBuE-N

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	S	M	L	M	L	S
CO2	S	M	S	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	S	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Data Mining and Warehousing**		
Core–V - Theory	I Year & II Semester	Credit: 4	436C2A

Objectives:

- Enable the students to learn the concepts of Mining tasks, classification, clustering and Data Warehousing.
- Develop skills using recent datamining software for solving practical problems.
- Develop and apply critical thinking, problem-solving, and decision-making skills.

Outcomes:

1.	Understand the basic datamining techniques and algorithms	K1, K2
2.	Understand the Association rules, Clustering techniques and Data warehousing contents	K2, K3
3.	Compare and evaluate different datamining techniques like classification, prediction, Clustering and association rule mining	K4, K5
4.	Design data warehouse with dimensional modelling and apply OLAP operations	K5, K6
5.	Identify appropriate datamining algorithms to solve real world problems	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Basic data mining tasks – data mining versus knowledge discovery in databases – data mining issues – data mining metrics – social implications of data mining – data mining from a database perspective. Data mining techniques: Introduction – a statistical perspective on data mining – similarity measures – decision trees – neural networks – genetic algorithms.

UNIT II: Classification: Introduction –Statistical –based algorithms -distance–based algorithms - decision tree-based algorithms -neural network-based algorithms– rule-based algorithms– combining techniques.

UNIT III: Clustering: Introduction – Similarity and Distance Measures–Outliers–Hierarchical Algorithms - Partitional Algorithms. Association rules: Introduction - large item sets - basic algorithms – parallel &distributed algorithms – comparing approaches- incremental rules – advanced association rules techniques – measuring the quality of rules.

UNIT IV: Data warehousing: introduction – characteristics of a data ware house–data marts– other aspects of data mart. Online analytical processing: introduction -OLTP & OLAP systems Data modelling – star schema for multidimensional view –data modelling – multi fact star schema or snow flake schema – OLAP TOOLS – State of the market – OLAP TOOLS and the internet.

UNIT V: Developing a data WAREHOUSE: why and how to build a data warehouse –data warehouse architectural strategies and organization issues - design consideration – data content – metadata distribution of data – tools for data warehousing – performance considerations – crucial decisions in designing a data warehouse. Applications of data warehousing and data mining in government: Introduction - national data warehouses – other areas for data warehousing and data mining.

Text Books

1. Margaret H. Dunham, "Data Mining: Introductory and Advanced Topics", Pearson education,2003.
2. C.S.R. Prabhu, "Data Warehousing Concepts, Techniques, Products and Applications", PHI, Second Edition.

Reference Books

1. Arun K. Pujari, "Data Mining Techniques", Universities Press (India) Pvt. Ltd.,2003.
2. Alex Berson, Stephen J. Smith, "Data Warehousing, Data Mining and OLAP", TMCH, 2001.
3. Jiawei Han &Micheline Kamber, Academic press. "Data Mining Concepts & Techniques", 2001,

Related Online Contents

1. https://www.javatpoint.com/data-warehouse
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3. https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Data Mining and Warehousing Practical**		
Core–VII - Practical	I Year & II Semester	Credit: 4	436C2C

Objectives:

- To enable the students to learn the concepts of Data Mining algorithms namely classification, clustering, regression….
- To understand & write programs using the Data Mining algorithms
- To apply statistical interpretations for the solutions
- Able to use visualization techniques for interpretations

Outcomes:

1.	Able to write programs using python for Association rules, Clustering techniques	K1, K2
2.	To implement datamining techniques like classification, prediction	K2, K3
3.	Able to use different visualization techniques using python	K2, K4
4.	To apply different datamining algorithms to solve real world applications	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

LISTOF PROGRAMS

1. Implement Apriori algorithm to extract association rule of datamining.
2. Implement k-means clustering technique.
3. Implement any one Hierarchal Clustering.
4. Implement Classification algorithm.
5. Implement Decision Tree.
6. Linear Regression.
7. Data Visualization.

Text Books

1. Margaret H. Dunham, “Data Mining: Introductory and Advanced Topics”, Pearson education,2003.
2. C.S.R. Prabhu, “Data Warehousing Concepts,Techniques, Productsand Applications”, PHI, Second Edition

Reference Books

1. ArunK.Pujari,“DataMiningTechniques”,UniversitiesPress(India)Pvt. Ltd.,2003.
2. AlexBerson,StephenJ.Smith,“DataWarehousing,DataMiningandOLAP”,TMCH, 2001.

Related Online Contents

1. https://www.javatpoint.com/data-warehouse
2. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs12/
3. https://www.btechguru.com/training--it--database-management-systems--file-structures--introduction-to-data-warehousing-and-olap-2-video-lecture--12054--26--151.html

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	M	S	S
CO2	S	S	S	S	S	S	S	M	S	M
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Web Technology and Advanced Java**		
Core–VI - Theory	I Year & II Semester	Credit: 4	436C2B

Course Objectives

To provide knowledge and abilities to develop web sites for the internet

To provide basic design principles to present ideas, information, products, and services on websites

To induce basic programming principles to the construction of websites

To grasp the concepts on Java Beans, servlets, JSP

To comprehend the connection between Relational Database and Java.

Course Outcomes

1.	Design user interactions on web pages	K1, K2
2.	Develop back-end website applications	K1, K2
3.	Develop adaptive content for multiple devices (cell phone, tablets, etc.) Ensure cross-platform optimization for mobile phones	K2, K3
4.	Application of java beans, Servlets, JSP for designing Web based applications	K4, K5
5.	Usage of JDBC connectivity and implementation of the concept to get desired results from database	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit – I: Introduction to Dynamic Web Content-Three-tier architecture-architecture for client-server applications-Introduction to HTML5-Structural Elements-Paving the Way for Web Applications:HTML5 forms-The HTML5 Canvas-Audio and VideoIntroduction to CSS-Advanced CSS with CSS3-.

Unit – II: Accessing CSS from JavaScript Exploring JavaScript-Expressions and Control Flow in JavaScript-JavaScript Functions, Objects, and Arrays - HTML DOM – Modules – Forms – Includes – AJAX – Views – Scopes – Services -Dependency Injection - Custom Directives

Unit – III: Introduction to CGI - Understanding Environment Variables - Disadvantages and Limitations of CGI - Servlet as an improved CGI - Servlet Fundamentals / API - What is a Web-Container - Servlet Life Cycle / Architecture - HTTP GET and POST Request Methods - Processing Html Forms - Init Parameters - State Management - Using HTTP Session - Cookies session tracking

Unit- IV: Java Beans: Introduction - Advantages of Beans – Introspection - The JavaBeans API - A Bean - JSP Architecture - JSP Standard / Implicit Objects - Request - Response - Out - config - Application - Session - Page - Page Context - exception - JSP Page Implementation Class - JSP Basics & Syntax - JSP Directive Tags - Page Directive - Include Directive - Taglib Directive - JSP Action Tags- Forward Action Tag- Include Action Tag- JSP Script related Tags- Scriptlet Tag- Expression Tag- Declaration Tag - Using Java Beans from JSP - UseBean Tag - setProperty Tag- getProperty Tag

Unit – V

Network Programming: Working with URLs- Working with Sockets - Remote Method Invocation. Introduction to Database Management Systems - Tables, Rows, and Columns - Introduction to the SQL SELECT Statement - Inserting Rows - Updating and Deleting Existing Rows - Creating and Deleting Tables - Creating a New Database with JDBC - Scrollable Result Sets.

Text Books:

1. Java 6 Programming, Black Book, Dreamtech
2. Java Server Programming, Java EE6 (J2EE 1.6), Black Book, Dreamtech
3. Advanced Java Technology, By M.T. Savaliya, Dreamtech

Reference books :

1. Herbert Schildt, “Java the Complete Reference”, 10th edition, McGraw Hill Publishing Company Ltd, New Delhi, 2017.
2. Tony Goddis, “Starting out with Java from Control Structures Through Objects” 6th Edition, Pearson Education Limited, 2016
3. Herbert Schildt, Dale Skrien, “Java Fundamentals – A Comprehensive Introduction”, TMGH Publishing Company Ltd, New Delhi, 2013
4. John Dean, Raymond Dean, “Introduction to Programming with JAVA – A Problem Solving Approach”, TMGH Publishing Company Ltd, New Delhi,2012.

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	S	S	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	L	M	S
CO3	S	S	M	S	S	S	S	S	S	M	M	S
CO4	M	S	M	M	S	S	S	S	S	M	S	S
CO5	S	M	M	S	M	L	L	L	L	M	M	L

S- Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Web Technology and Advanced Java Practical**		
Core–VIII - Practical	I Year & II Semester	Credit:3	436C2D

COURSE OBJECTIVES:

Learn how to create a program in java beans.

Learn how to connect relational database to Java

Develop the program using concepts servlets and JSP

Course Outcomes

1.	Implement Remote method invocations.	K1, K2
2.	Apply servlet in web applications	K2, K3
3.	Develop Servlets for creating Web based applications using JDBC.	K3, K4
4.	Develop JSP for creating Web based applications using JDBC.	K5
5.	Test java beans and session tracking	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

List of Experiments:

Use CSS where ever applicable

1. Create a simple calculator application that demonstrates the use of RMI. You are not required to create GUI.
2. Create Servlet That Prints Hello World.
3. Create Servlet That Prints Today's Date
4. Create Servlet for login page, if the username and password is correct then prints message "Hello username" else a message" login failed".
5. Create Servlet that uses cookies to store the number of times a user has visited the servlet.
6. Create a Servlet for demo of KBC game.
7. There will be continuous two or three pages with different MCQs. Each correct answer
8. carries Rs. 10000. At the end as per user's selection of answers total prize he won should be declared. User should not be allowed to backtrack.
9. Create a Servlet filter that calculates server's response time and add it to response when giving it back to client.
10. Create a jsp that prints hello world.

11. Create jsp that prints current date and time.
12. Create a jsp that add and subtract two numbers.
13. Create a jsp for login module.
14. Create a web page that prints 1 to 10 using JSTL
15. Create a custom JSP tag that prints current date and time. Use this tag into JSP page.

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	S	S	S	S	S	S	M	M	M	M
CO2	S	S	S	S	S	S	S	S	S	S	M	M
CO3	S	S	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S	S	S

S- Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Artificial Intelligence**		
Elective –III - Theory	I Year & II Semester	Credit:3	436E2A

Objectives:

To impart knowledge about Artificial Intelligence.

To give understanding of the main abstractions and reasoning for intelligent systems.

To enable the students to understand the basic principles of Artificial Intelligence in various applications.

To identify the scope of Artificial Intelligence in real life applications

To enable decoding of human thinking process and find the ways of making the machine decide intelligently in lieu of number crunching

Outcomes:

1.	Solve basic AI based problems.	K1, K2
2.	Define the concept of Artificial Intelligence.	K2, K3
3.	Apply AI techniques to real-world problems to develop intelligent systems.	K3, K4
4.	Select appropriately from a range of techniques when implementing intelligent systems.	K4, K5
5.	Possess the basic knowledge of different machine learning techniques.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit- I: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

Unit -II Searching- Searching for solutions, uniformed search strategies – Breadth first search, depth first Search. Search with partial information (Heuristic search) Hill climbing, A*, AO* Algorithms, Problem reduction, Game Playing- adversarial search, Games, mini max algorithm, optimal decisions in multiplayer games, Problem in Game playing, Alpha Beta pruning, Evaluation functions.

Unit -III Knowledge representation issues, predicate logic- logic programming, semantic nets-frames and inheritance, constraint propagation, representing knowledge using rules, rules-based deduction systems. Reasoning under uncertainty, review of probability, Baye’s probabilistic interferences and dumpster Shafer theory.

Unit - IV First order logic. Inference in first order logic, propositional vs. first order inference, unification & lifts forward chaining, Backward chaining, Resolution, learning from observation Inductive learning, Decision trees, Explanation based learning, Statistical Learning methods, Reinforcement Learning.

Unit - V Expert systems:- Introduction, basic concepts, structure of expert systems, the human element in expert systems how expert systems works, problem areas addressed by expert systems, expert systems success factors, types of expert systems, expert systems and the internet interacts web, knowledge engineering, scope of knowledge, difficulties, in knowledge acquisition methods of knowledge acquisition, machine learning, intelligent agents, selecting an appropriate knowledge acquisition method, societal impacts reasoning in artificial intelligence, inference with rules, with frames: model based reasoning, case based reasoning, explanation & meta knowledge inference with uncertainty representing uncertainty.

Recommended Texts:

1. Elaine Rich, Kevin Knight and Shivshankar Nair; Artificial Intelligence ; McGraw Hill; Third Edition;2017
2. S. Russel and P. Norvig, “Artificial Intelligence – A Modern Approach”, Third Edition, Pearson Education;2010.

Reference Books:

1. David Poole, Alan Mackworth, Randy Goebel, ”Computational Intelligence : a logical approach”, Oxford University Press, 1998.
2. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem solving”, Fourth Edition, Pearson Education,2001.
3. J. Nilsson, “Artificial Intelligence: A new Synthesis”, Elsevier Publishers,1998.
4. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems by Pearson Education, 1995

Web References:

1. https://artint.info/index.html

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	S	M	M	L	S	L	L
CO2	S	M	S	M	S	S	M	L	M	L
CO3	M	S	S	S	M	S	L	M	L	M
CO4	S	L	M	M	S	L	L	M	M	S
CO5	S	S	M	S	L	M	M	L	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Software Development Technologies**		
Elective –III - Theory	I Year & II Semester	Credit:3	436E2B

Course Objectives

To learn and Implementing Micro services

To analysing the Azure Kubernetes Service

To learn and anlyse .NET DevOps for Azure and its applications

To building code for .NET core applications

To get familiarized with Azure pipelines

Course Outcomes

1.	To understand, apply and summarize the basic concepts of Micro services communication Microsoft Azure and Dev Ops for software development life cycle.	K1, K2
2.	To illustrate, and implement Azure Kubernetes Service tools for software development life cycle.	K2, K3
3.	To recognize, analyse and summarize the functionalities of .NET Dev Ops for Azure applications.	K3, K4
4.	To understand, design and evaluate the principles and architecture service tools for software development life cycle.	K4, K5
5.	To comprehend, implement and review the functionalities of API and API gateways for cloud and Azure applications.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit -I

Implementing Microservices: Client to microservices communication, Interservice communication, data considerations, security, monitoring, microservices hosting platform options. Azure Service Fabric: Introduction, core concepts, supported programming models, service fabric clusters, develop and deploy applications of service fabric. Monitoring Azure Service Fabric Clusters: Azure application, resource manager template, Adding Application Monitoring to a Stateless Service Using Application Insights, Cluster monitoring, Infrastructure monitoring.

Unit-II

Azure Kubernetes Service -AKS): Introduction to kubernetes and AKS, AKS development tools, Deploy applications on AKS. Monitoring AKS: Monitoring, Azure monitor and analytics, monitoring AKS clusters, native kubernetes dashboard, Prometheus and Grafana. Securing Microservices: Authentication in microservices, Implenting security using API gateway pattern,

Creating application using Ocrlot and securing APIs with Azure AD. Database Design for Microservices: Data stores, monolithic approach, Microservices approach, harnessing cloud computing, database options on MS Azure, overcoming application development challenges. Building Microservices on Azure Stack: Azure stack, Offering IaaS, PaaS on-premises simplified, SaaS on Azure stack.

Unit-III

.NET DevOps for Azure: DevOps introduction, Problem and solution. Professional Grade DevOps Environment: The state of DevOps, professional grade DevOps vision, DevOps architecture, tools for professional DevOps environment, DevOps centered application. Tracking work: Process template, Types of work items, Customizing the process, Working with the process. Tracking code: Number of repositories, Git repository, structure, branching pattern, Azure repos configuration, Git and Azure.

Unit-IV

Building the code: Structure of build, using builds with .NET core and Azure pipelines, Validating the code: Strategy for defect detection, Implementing defect detection. Release candidate creation: Designing release candidate architecture, Azure artifacts workflow for release candidates, Deploying the release: Designing deployment pipeline, Implementing deployment in Azure pipelines. Operating and monitoring release: Principles, Architectures for observability, Jumpstarting observability.

Unit-V

Introduction to APIs: Introduction, API economy, APIs in public sector. API Strategy and Architecture: API Strategy, API value chain, API architecture, API management. API Development: Considerations, Standards, kick-start API development, team orientation. API Gateways: API Gateways in public cloud, Azure API management, AWS API gateway. API Security: Request-based security, Authentication and authorization.

Text Book

1. Harsh Chawla and Hemant Kathuria, Building Microservices Applications on Microsoft Azure- Designing, Developing, Deploying, and Monitoring, Apress, 2019.

2. Jeffrey Palermo , NET DevOps for Azure A Developer’s Guide to DevOps Architecture the Right Way, Apress, 2019.

3. Thurupathan and Vijayakumar, Practical API Architecture and Development with Azure and AWS - Design and Implementation of APIs for the Cloud, Apress, 2018.

Reference Books

1. Karl Matthias and Sean P. Kane, Docker: Up and Running, O'Reilly Publication, Second Edition 2018.

2. Len Bass,IngoWeber,LimingZhu,"DevOps, A Software Architects Perspective", AddisonWesley-Pearson Publication, First Ediiton 2015.

3. John Ferguson Smart,"Jenkins, The Definitive Guide", O'Reilly Publication, First Ediiton 2011.

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	-	M	-	-	-	S	-	-	-
CO2	S	S	M	-	M	-	-	-	S	-	-	-
CO3	S	S	S	-	S	-	-	-	S	S	S	S
CO4	S	S	M	-	M	-	-	-	S	-	-	-
CO5	S	S	M	-	M	-	-	-	S	-	-	-

S- Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Artificial Neural Networks and Deep Learning**		
Elective –III - Theory	I Year & II Semester	Credit:3	436E2C

Objectives:

To understand the theoretical foundations, algorithms and methodologies of Neural Network

To design and develop an application using specific deep learning models

To provide practical knowledge in handling and analyzing real world applications.

To recognize the characteristics of deep learning models that are useful to solve real-world problems.

To introduce Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.

Outcomes:

1.	Understand different methodologies to create applications using deep nets.	K1, K2
2.	Identify and apply appropriate deep learning algorithms for analyzing the data for a variety of problems.	K2, K3
3.	Implement different deep learning algorithms	K3, K4
4.	Design the test procedures to assess the efficacy of the developed model.	K4, K5
5.	Combine several models in to gain better results	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit I: Basics of artificial neural networks (ANN): Artificial neurons, Computational models of neurons, Structure of neural networks, Functional units of ANN for pattern recognition tasks Feedforward neural networks: Pattern classification using perceptron, Multilayer feedforward neural networks (MLFFNNs), Backpropagation learning, Empirical risk minimization, Regularization, Autoencoders

Unit II: Deep neural networks (DNNs): Difficulty of training DNNs, Greedy layer wise training, Optimization for training DNNs, Newer optimization methods for neural networks (AdaGrad, RMSProp, Adam), Second order methods for training, Regularization methods (dropout, drop connect, batch normalization)

Unit III: Convolution neural networks (CNNs): Introduction to CNNs – convolution, pooling, Deep CNNs, Different deep CNN architectures – LeNet, AlexNet, VGG, PlacesNet, training a CNNs: weights initialization, batch normalization, hyperparameter optimization, Understanding and visualizing CNNs.

Unit IV: Recurrent neural networks (RNNs): Sequence modeling using RNNs, Backpropagation through time, Long Short Term Memory (LSTM), Bidirectional LSTMs, Bidirectional RNNs, Gated RNN Architecture - Generative models: Restricted Boltzmann Machines (RBMs), Stacking RBMs, Belief nets.

Unit V: Learning sigmoid belief nets, Deep belief nets Under complete - Auto encoder, Regularized Auto encoder, stochastic Encoders and Decoders, Contractive Encoders. Applications: Applications in vision, speech and natural language processing

Recommended Texts:

1. S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2016
2. Ian Goodfellow, Yoshua Bengio and Aaron Courville, " Deep Learning", MIT Press, 2017

Reference Books:

1. Satish Kumar, Neural Networks - A ClassRoom
2. B. Yegnanarayana, Artificial Neural Networks, Prentice- Hall of India, 1999
3. Giancarlo Zaccone, Md. RezaulKarim, Ahmed Menshawy "Deep Learning with TensorFlow: Explore neural networks with Python", Packt Publisher, 2017.
4. Antonio Gulli, Sujit Pal "Deep Learning with Keras", Packt Publishers, 2017.
5. Francois Chollet "Deep Learning with Python", Manning Publications, 2017.

Web References:

1. https://www.youtube.com/watch?v=aPfkYu_qiF4&list=PLEAYkSg4uSQ1r 2XrJ_GBzzS6I-f8yfRU

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	S	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	L	S	L	M	L	M	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Computer Vision**		
Elective – IV - Theory	I Year & II Semester	Credit:3	436E2D

Objectives:

Understanding the Basics of Computer Vision.

Acquiring skills to develop computer vision-based applications. To introduce students the fundamentals of image formation

To introduce students the major ideas, methods, and techniques of computer vision and pattern recognition

To develop an appreciation for various issues in the design of computer vision and object recognition systems

To provide the student with programming experience from implementing computer vision and object recognition applications

Outcomes:

1.	Ability to understand the computer vision pipeline. Ability to build solutions using computer vision algorithms.	K1, K2
2.	Identify basic concepts, terminology, theories, models and methods in the field of computer vision	K2, K3
3.	Describe known principles of human visual system	K4
4.	Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition	K4, K5
5.	Suggest a design of a computer vision system for a specific problem	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit I: Cameras - Pinhole Cameras - Cameras with Lenses - The Human Eye - Sensing Geometric Camera Models - Elements of Analytical Euclidean Geometry - Camera Parameters & Perspective projection - Affine Cameras and Affine Projection equations

Unit II: Geometric Camera Calibration - Least squares parameter estimation - A Linear Approach to Camera Calibration - Taking Radial Distortion into Account - Analytical Photogrammetry - Radiometry - Light in Space - Light at Surfaces -

Unit III: Sources, Shadows and shading - Qualitative Radiometry - Sources and Their Effects - Local Shading Model - Color- The Physics of Color - Human Color Perception - Representing Color - Surface Color from Image Color

Unit IV: Linear filters - Convolution - Shift Invariant Linear Systems - Spatial Frequency and Fourier Transforms- Sampling and Aliasing - Scale and Image Pyramids

Unit V: Edge detection - Noise - Detecting Edges - Texture - Representing Texture - Analysis (and Synthesis) Using Oriented Pyramids - Synthesizing Textures for Rendering- Shape from Texture for Planes

Recommended Texts:

1. D. Forsyth and J. Ponce; Computer Vision - A modern approach; Pearson India;2015

Reference Books:

1. Richard Szeliksy "Computer Vision: Algorithms and Applications" (http://szeliski.org/Book/)
2. Haralick& Shapiro, "Computer and Robot Vision", Vol II
3. G_erardMedioni and Sing Bing Kang "Emerging topics in computer vision" 4. Emanuele Trucco and AllessandroVerri "Introductory Techniques for 3-D Computer Vision", Prentice Hall, 1998.
5. Olivier Faugeras, "Three-Dimensional Computer Vision", The MIT Press, 1993

Web References:

1. https://www.youtube.com/watch?v=3LaVxEX3F0o&list=PLwdnzlV3ogoVsma5G mBSsgJM6gHv1QoAo

Mapping with Programme Outcomes:

CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	L	M	S	L	M	S	M	L	S	M
CO4	S	L	L	M	M	L	L	S	M	S
CO5	M	S	M	L	S	M	M	L	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Agile Software Engineering**		
Elective – IV - Theory	I Year & II Semester	Credit:3	436E2E

Objectives:

To provide students with a theoretical as well as practical understanding of agile software development practices and how small teams can apply them to create high-quality software.

To provide a good understanding of software design and a set of software technologies and APIs.

To do a detailed examination and demonstration of Agile development and testing techniques.

To understand the benefits and pitfalls of working in an Agile team.

To understand Agile development and testing.

Outcomes:

1.	Realize the importance of interacting with business stakeholders in determining the requirements for a software system	K1, K2
2.	Perform iterative software development processes: how to plan them, how to execute them.	K2, K3
3.	Point out the impact of social aspects on software development success. develop techniques and tools for improving team collaboration and software quality.	K3, K4
4.	Perform Software process improvement as an ongoing task for development teams.	K4, K5
5.	Show how agile approaches can be scaled up to the enterprise level.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I 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

UNIT II AGILE PROCESSES: Lean Production - SCRUM, Crystal, Feature Driven Development- Adaptive Software Development - Extreme Programming: Method Overview – Lifecycle – Work Products, Roles and Practices.

UNIT III AGILITY AND KNOWLEDGE MANAGEMENT: Agile Information Systems – Agile Decision Making - Earl S Schools of KM – Institutional Knowledge Evolution Cycle – Development, Acquisition, Refinement, Distribution, Deployment, leveraging –

KM in Software Engineering – Managing Software Knowledge – Challenges of Migrating to Agile Methodologies – Agile Knowledge Sharing – Role of Story-Cards – Story-Card Maturity Model (SMM).

UNIT IV AGILITY AND REQUIREMENTS ENGINEERING: Impact of Agile Processes in RE–Current Agile Practices – Variance – Overview of RE Using Agile – Managing Unstable Requirements – Requirements Elicitation – Agile Requirements Abstraction Model – Requirements Management in Agile Environment, Agile Requirements Prioritization – Agile Requirements Modeling and Generation – Concurrency in Agile Requirements Generation.

UNIT V AGILITY AND QUALITY ASSURANCE: Agile Product Development – Agile Metrics – Feature Driven Development (FDD) – Financial and Production Metrics in FDD – Agile Approach to Quality Assurance - Test Driven Development – Agile Approach in Global Software Development.

Recommended Texts:

1. David J. Anderson and Eli Schragenheim; Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results; Prentice Hall; 2003.
2. Hazza and Dubinsky; Agile Software Engineering, Series: Undergraduate Topics in Computer Science ; Springer; 2009.

Reference Books:

1. Craig Larman, Agile and Iterative Development: A Managers Guide, Addison Wesley, 2004.
2. Kevin C. Desouza, Agile Information Systems: Conceptualization, Construction, and Management, Butterworth-Heinemann, 2007.

Web References:

1. https://www.youtube.com/watch?v=x90kIAFGYKE&t=8s

Mapping with Programme Outcomes:

CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	L	M	S	L	M	S	M	L	S	M
CO4	S	L	L	M	M	L	L	S	M	S
CO5	M	S	M	L	S	M	M	L	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Human Computer Interaction**		
Elective – IV - Theory	I Year & II Semester	Credit:3	436E2F

Objectives:

To learn the foundations of Human Computer Interaction.

To become familiar with the design technologies for individuals and persons with disabilities.

To be aware of mobile HCI.

To learn the guidelines for user interface.

To encourage to design certain tools for blind or differently abled people

Outcomes:

1.	Design effective dialog for HCI	K1, K2
2.	Design effective HCI for individuals and persons with disabilities.	K2, K3
3.	Assess the importance of user feedback.	K4, K5
4.	Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Web sites.	K5, K6
5.	Develop a meaningful user interface.	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I FOUNDATIONS OF HCI The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices – Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles – elements – interactivity Paradigms. - Case Studies

UNIT II DESIGN & SOFTWARE PROCESS Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT III MODELS AND THEORIES HCI Models: Cognitive models: Socio Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV MOBILE HCI Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements of Mobile Design, Tools. - Case Studies

UNIT V WEB INTERFACE DESIGN Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies

Recommended Texts:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale;Human Computer Interaction; Pearson Education; 3rd Edition; 2004
2. Brian Fling;Mobile Design and Development;First Edition; O'Reilly Media Inc.;2009
3. Bill Scott and Theresa Neil;Designing Web Interfaces; First Edition; O'Reilly, 2009.

Reference Books:

1. Designing the user interface. 3rd Edition Ben Shneidermann, Pearson Education Asia.
2. Interaction Design Prece, Rogers, Sharps. Wiley Dreamtech.
3. User Interface Design, Soren Lauesen , Pearson Education.
4. Human –Computer Interaction, D. R. Olsen, Cengage Learning.
5. Human –Computer Interaction, Smith - Atakan, Cengage Learning.

Web References:

1. https://www.youtube.com/watch?v=q81KXc54Ozs&list=PLxtKZf9nLWO3d2a6M8l2BU8WTJKzHC4HJ

Mapping with Programme Outcomes:

CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	M	M	S	M	M	S	L	M	L
CO3	L	M	S	L	M	S	M	L	S	M
CO4	S	L	L	M	M	L	L	S	M	S
CO5	M	S	M	L	S	M	M	L	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Fundamentals of Human Rights**		
SEC - I	I Year & II Semester	Credit:2	436S2A

Unit I: Introduction:
Meaning and Definitions of Human Rights – Characteristics and Importance of Human Rights – Evolution of Human Rights – Formation, Structure and Functions of the UNO - Universal Declaration of Human Rights – International Covenants – Violations of Human Rights in the Contemporary Era.

Unit II:
Human Rights in India: Development of Human Rights in India – Constituent Assembly and Indian Constitution – Fundamental Rights and its Classification – Directive Principles of State Policy – Fundamental Duties.

Unit III:
Rights of Marginalized and other Disadvantaged People: Rights of Women – Rights of Children – Rights of Differently Abled – Rights of Elderly - Rights of Scheduled Castes – Rights of Scheduled Tribes – Rights of Minorities – – Rights of Prisoners – Rights of Persons Living with HIVAIDS – Rights of LGBT.

Unit IV:
Human Rights Movements: Peasant Movements (Tebhaga and Telangana) – Scheduled Caste Movements (Mahar and Ad-Dharmi) – Scheduled Tribes Movements (Santhal and Munda) – Environmental Movements (Chipko and Narmada BachaoAndolan) – Social Reform Movements (Vaikom and Self Respect).

Unit V:
Redressal Mechanisms: Protection of Human Rights Act, 1993 (Amendment 2019) – Structure and Functions of National and State Human Rights Commissions – National Commission for SCs – National Commission for STs – National Commission for Women – National Commission for Minorities – Characteristics and Objectives of Human Rights Education.

References

1. SudarshanamGankidi, Human Rights in India: Prospective and Retrospective, Rawat Publications, Jaipur, 2019.
2. SatvinderJuss, Human Rights in India, Routledge, New Delhi, 2020.
3. Namita Gupta, Social Justice and Human Rights in India, Rawat Publications, Jaipur, 2021.
4. Mark Frezo, The Sociology of Human Rights, John Willy & Sons, U.K. 2014.
5. Chiranjivi J. Nirmal, Human Rights in India: Historical, Social and Political Perspectives, Oxford University Press, New York, 2000.

6. Dr. S. Mehartaj Begum, Human Rights in India: Issues and perspectives, APH Publishing Corporation, New Delhi, 2010.
7. Asha Kiran, The History of Human Rights, Mangalam Publications, Delhi, 2011.
8. Bani Borgohain, Human Rights, Kanishka Publishers & Distributors, New Delhi-2, 2007.
9. Jayant Chudhary, A Textbook of Human Rights, Wisdom Press, New Delhi, 2011.

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S	S	M	S	M	S	S	S	S	M	S	S
CO2	S	S	S	M	S	S	S	S	S	S	M	S
CO3	S	M	S	S	M	S	M	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S	M	S
CO5	S	S	S	S	S	S	S	S	S	M	M	S

S – Strong, M – Medium, L - Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Data Science and Analytics**		
Core–IX - Theory	II Year & III Semester	Credit: 4	536C3A

Objectives:

- Understand the Big Data Platform and its Use cases
- Provide an overview of Apache Hadoop
- Provide HDFS Concepts and Interfacing with HDFS
- Understand Map Reduce Jobs
- Provide hands on Hodoop Eco System

Outcomes:

1.	Identify Big Data and its Business Implications.	K1, K2
2.	List the components of Hadoop and Hadoop Eco-System	K2, K3
3.	Access and Process Data on Distributed File System	K3, K4
4.	Manage Job Execution in Hadoop Environment	K4, K5
5.	Develop Big Data Solutions using Hadoop Eco System	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I:INTRODUCTION TO BIG DATA AND HADOOP

Types of Digital Data, Introduction to Big Data, Big Data Analytics, History of Hadoop, Apache Hadoop, AnalysingData with Unix tools, Analysing Data with Hadoop, Hadoop Streaming, Hadoop Echo System, IBM Big DataStrategy, Introduction to Infosphere BigInsights and Big Sheets.

UNIT II:HDFS(Hadoop Distributed File System)

The Design of HDFS, HDFS Concepts, Command Line Interface, Hadoop file system interfaces, Data flow, DataIngest with Flume and Scoop and Hadoop archives, Hadoop I/O: Compression, Serialization, Avro and File-BasedData structures

UNIT III: Map Reduce: Anatomy of a Map Reduce Job Run, Failures, Job Scheduling, Shuffle and Sort, Task Execution, Map Reduce Typesand Formats, Map Reduce Features.

UNIT IV: Hadoop Eco System**:** Pig : Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User DefinedFunctions, Data Processing operators.Hive : Hive Shell, Hive Services, Hive Metastore, Comparison with Traditional Databases, HiveQL, Tables, QueryingData and User Defined Functions.

UNIT V: Hbase: HBasics, Concepts, Clients, Example, Hbase Versus RDBMS.Big SQL: Introduction - Machine Learning: Introduction, Supervised Learning, Unsupervised Learning, Collaborative Filtering.

Text Books

1. Tom White " Hadoop: The Definitive Guide" Third Edit on, O'reily Media, 2012.
2. Seema Acharya, Subhasini Chellappan, "Big Data Analytics" Wiley 2015.

References

1. Michael Berthold, David J. Hand, "Intelligent Data Analysis", Springer, 2007.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. Anand Rajaraman and Jefrey David Ulman, "Mining of Massive Datasets", Cambridge University Press,2012.
4. Bill Franks, "Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced
5. Analytics", John Wiley & sons, 2012.
6. Glen J. Myat, "Making Sense of Data", John Wiley & Sons, 2007
7. Pete Warden, "Big Data Glossary", O'Reily, 2011.
8. Michael Mineli, Michele Chambers, Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley Publications, 2013.
9. ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012
10. Paul Zikopoulos ,DirkDeRoos , Krishnan Parasuraman , Thomas Deutsch , James Giles , David Corigan ,
11. "Harness the Power of Big Data The IBM Big Data Platform ", Tata McGraw Hill Publications, 2012.

Related Online Contents

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	M	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong;M-Medium;L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Titleof the Paper	**Machine Learning**		
Core–X - Theory	IIYear&IIISemester	Credit: 4	536C3B

Objectives:

To provide mathematical base for Machine learning

To provide theoretical knowledge on setting hypothesis for pattern recognition.

To impart Knowledge of machine learning techniques for data handling

To provide the skill to evaluate the performance of algorithms and to provide solution for various real-world applications.

To impart the knowledge of identifying similarities and differences in various patterns of data

Outcomes:

1.	Recognize the characteristics of machine learning strategies. Apply various supervised learning methods to appropriate problems.	K1, K2
2.	Identify and integrate more than one technique to enhance the performance of learning.	K2, K3
3.	Analyze the co-occurrence of data to find interesting frequent patterns.	K3, K4
4.	Preprocess the data before applying to any real-world problem and can evaluate its performance.	K4, K5
5.	Create probabilistic and unsupervised learning models for handling unknown pattern.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit I: BASIC MATHEMATICS FOR MACHINE LEARNING: Regression Correlation and Regression, types of correlation – Pearson's, Spearman's correlations –Ordinary Least Squares, Fitting a regression line, logistic regression, Rank Correlation Partial and Multiple correlation-Multiple regression, multicollinearity. Gradient descent methods, Newton method, interior point methods, active set, proximity methods, accelerated gradient methods, coordinate descent, cutting planes, stochastic gradient descent. Discriminant analysis, Principal component analysis, Factor analysis, k means.

Unit II: INTRODUCTION TO MACHINE LEARNING: Introduction, Examples of various Learning Paradigms, Perspectives and Issues, Version Spaces, Finite and Infinite Hypothesis Spaces, PAC Learning, VC Dimension.

Unit III: SUPERVISED LEARNING ALGORITHMS Learning a Class from Examples, Linear, Non-linear, Multi-class and Multi-label classification, Decision Trees: ID3, Classification and Regression Trees (CART), Regression: Linear Regression, Multiple Linear Regression, Logistic Regression. Neural Networks: Introduction, Perceptron, Multilayer Perceptron, Support vector machines: Linear and Nonlinear, Kernel Functions, K-Nearest Neighbors

Unit IV: ENSEMBLE LEARNING: Ensemble Learning Model Combination Schemes, Voting, Error-Correcting Output Codes, Bagging: RandomForest Trees, Boosting: Adaboost, Stacking:

UNSUPERVISED LEARNING: Introduction to clustering, Hierarchical: AGNES, DIANA, Partitional: K-means clustering, K-Mode Clustering, Self Organizing Map, Expectation Maximization, Gaussian Mixture Models, Principal Component Analysis (PCA), Locally Linear Embedding (LLE), Factor Analysis

Unit V: PROBABILISTIC LEARNING: Bayesian Learning, Bayes Optimal Classifier, Naïve Bayes Classifier, Bayesian Belief Networks, Mining Frequent Patterns: MACHINE LEARNING IN PRACTICE: Design, Analysis and Evaluation of Machine Learning Experiments, Other Issues: Handling imbalanced data sets

Recommended Texts:

1. EthemAlpaydin, "Introduction to Machine Learning", MIT Press, Prentice Hall of India, Third Edition 2014.
2. MehryarMohri, Afshin Rostamizadeh, Ameet Talwalkar "Foundations of Machine Learning", MIT Press, 2012.

Reference Books:

1. Tom Mitchell, "Machine Learning", McGraw Hill, 3 rd Edition,1997.
2. Charu C. Aggarwal, "Data Classification Algorithms and Applications", CRC Press, 2014.
3. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", 2 nd Edition, CRC Press, 2015.
4. Kevin P. Murphy "Machine Learning: A Probabilistic Perspective", The MIT Press, 2012
5. Jiawei Han and MichelineKambers and Jian Pei, "Data Mining –Concepts and Techniques", 3 rdEdition,Morgan Kaufman Publications, 2012.
6. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2019.

Web References:

1. https://www.youtube.com/watch?v=r4sgKrRL2Ys&list=PL1xHD4vteKYVpaIiy295pg6_SY5qznc77

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	S	M	S	M	L	M	S	L	L
CO 2	S	M	S	L	S	L	M	L	M	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	L	S	M	S	L	S	M
CO 5	S	L	M	S	L	L	M	S	M	S

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Theory of Computation**		
Core–XI - Theory	II Year & III Semester	Credit: 3	536C3C

Objectives:

To give an overview of the theoretical foundations of computer science from the perspective of formal languages

To illustrate finite state machines to solve problems in computing

To explain the hierarchy of problems arising in the computer sciences.

To familiarize Regular grammars, context frees grammar.

To use basic concepts of formal languages of finite automata techniques

Outcomes:

1.	Use the concepts and techniques of discrete mathematics for theoretical computer science	K1
2.	Design Finite Automata for different Regular Expressions and Languages	K2
3.	Identify and use different formal languages and their relationship.	K3,K4
4.	To solve various problems of applying normal form techniques, push down automata and Turing Machines	K4,K5
5.	Analyze various concepts of undecidability and Computable Function and Discuss analytically and intuitively for problem-solving situation	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit I: Review of Mathematical Theory

Combinatorics: Review of Permutation and Combination - Mathematical Induction - Pigeon hole principle - Principle of Inclusion and Exclusion - generating function - Recurrence relations. Statements – Connectives – Truth Tables – Normal forms – Predicate calculus – Inference – Theory for Statement Calculus and Predicate Calculus

Unit-II: Regular Languages and Finite Automata

Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output - Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union- intersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, ??- Non Deterministic Finite Automata, Conversion of NFA- ? to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.

Unit-III: Context free grammar (CFG)

Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity , Unambiguous CFG and Algebraic Expressions, Backus Naur Form (BNF), Normal Form – CNF.

Unit-IV: Pushdown Automata, CFL And NCFL
Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.

Unit-V: Turing Machine (TM)
TM Definition, Model Of Computation, Turing Machine as Language Acceptor, TM that Compute Partial Function, Church Turing Thesis, Combining TM, Variations Of TM, Non Deterministic TM, Universal TM, Recursively and Enumerable Languages, Context sensitive languages and Chomsky hierarchy.

Recommended Texts:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman ; Introduction to Automata Theory Languages andComputation; Pearson Education, India; 3rd edition;2008
2. KENNETH H. ROSEN ; Discrete Mathematics and Its Applications (SIE) 8th Edition ;2021

Reference Books:

1. K. L. P Mishra, N. Chandrashekaran (2003), Theory of Computer Science Automata Languages and Computation, 2nd edition, Prentice Hall of India, India.

Web References:

1. https://www.youtube.com/playlist?list=PLbtzT1TYeoMjNOGEiaRmm_vMIwUAidnQz
2. https://nptel.ac.in/courses/106106049

Mapping with Programme Outcomes:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S	M	M	S	M	L	S	S	L	M
CO 2	S	M	S	L	S	L	M	L	M	S
CO 3	M	S	L	M	M	S	L	S	L	S
CO 4	L	S	S	L	S	M	S	L	S	M
CO 5	S	L	M	S	L	L	M	S	M	S

S-Strong M-Medium L-Low

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M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Data Science and Analytics Practical**		
Core–XII - Practical	II Year & III Semester	Credit:3	536C3D

Objectives:

- Understand Hadoop Distributed File System and examine MapReduce Programming.
- Explore Hadoop tools and manage Hadoop with Ambari.
- Appraise the role of Business intelligence and its applications across industries.
- Assess core data mining techniques for data analytics
- Identify various Text Mining techniques

Outcomes:

1.	To Describe the key issues in Big Data Management and experiment with the Hadoop framework.	K1, K2
2.	To Explain the structure and unstructured data by using NoSQL commands.	K2, K3
3.	To Apply scientific computing algorithms for finding similar items and clustering.	K3, K4
4.	To Test fundamental enabling techniques and scalable algorithms for data stream mining.	K4, K5
5.	To Develop problem solving and critical thinking skills in fundamental enable techniques like Hadoop & MapReduce	K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

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LISTOF PROGRAMS

1. Installation of Hadoop Framework, it‘s components and study the HADOOP ecosystem
2. Write a program to implement word count program using MapReduce
3. Experiment on Hadoop Map-Reduce / PySpark: -Implementing simple algorithms in Map-Reduce: Matrix multiplication
4. Install and configure MongoDB/ Cassandra/ HBase/ Hypertable to execute NoSQL Commands.
5. Implementing DGIM algorithm using any Programming Language/ Implement Bloom Filter using any programming language
6. Implement and Perform Streaming Data Analysis using flume for data capture, PYSpark / HIVE for data analysis of twitter data, chat data, weblog analysis etc.
7. Implement any one Clustering algorithm (K-Means/CURE) using Map-Reduce.
8. Implement Page Rank Algorithm using Map-Reduce.

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M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Machine Learning Practical**		
Core–XIII - Practical	II Year & III Semester	Credit:3	536C3E

Objectives:

Make use of Data sets in implementing the machine learning algorithms

Implement the machine learning concepts and algorithms in any suitable language of choice.

The programs can be implemented in either JAVA or Python.

For Problems 1 to 6 and 10, programs are to be developed without using the builtin classes or APIs of Java/Python.

Data sets can be taken from standard repositories (https://archive.ics.uci.edu/ml/datasets.html) or constructed by the students.

Outcomes:

1.	Understand the implementation procedures for the machine learning algorithms.	K1, K2
2.	Design Java/Python programs for various Learning algorithms.	K2, K3
3.	Apply appropriate data sets to the Machine Learning algorithms.	K3, K4
4.	Identify and apply Machine Learning algorithms to solve real world problems.	K4, K5
5.	be capable of confidently applying common Machine Learning algorithms in practice and implementing their own;	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
4. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in the program.
9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem.
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Recommended Texts:

1. Dr. Kamlesh Namdev, LAP LAMBERT ; Lab manual of Machine Learning: Machine Learning Practicals in Python; Academic Publishing; 2021

Reference Books:

1. Introduction to Machine Learning with Python by Andreas C. Müller, Sarah Guido ReleasedOctober 2016 Publisher(s): O'Reilly Media, Inc. ISBN: 9781449369415

Web References:

1. https://www.youtube.com/watch?v=RnFGwxJwx-0

Mapping with Programme Outcomes:

Mapping with Programmers outcomes*										
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	L	S	M	L	M	L	L
CO2	S	M	S	S	S	M	M	L	M	L
CO3	M	S	M	M	S	S	L	L	L	M
CO4	S	L	M	M	M	L	M	L	M	S
CO5	S	S	M	S	L	M	M	L	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Network Security**		
Elective –V - Theory	II Year & III Semester	Credit:3	536E3A

Objectives:

- Enable students to learn the Introduction to Cryptography, Web Security and Case studies in Cryptography.
- To gain knowledge on classical encryption techniques and concepts of modular arithmetic and number theory.
- To explore the working principles and utilities of various cryptographic algorithms including secret key cryptography, hashes and message digests, and public key algorithms.
- To explore the design issues and working principles of various authentication Applications and various secure communication standards including Kerberos, IPsec, and SSL/TLS and email.

Outcomes:

1.	Understand the process of the cryptographic algorithms	K1, K2
2.	Compare and apply different encryption and decryption techniques to solve problems related to confidentiality and authentication	K2, K3
3.	Applyandanalyzeappropriatesecuritytechniquestosolvenetworksecurity problem	K3, K4
4.	Explore suitable crypto graphic algorithms	K4, K5
5.	Analyze different digital signature algorithms to achieve authentication and design secure applications	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Introduction to Cryptography – Security Attacks – Security Services –Security Algorithm- Stream cipher and Block cipher - Symmetric and Asymmetric-key Cryptosystem Symmetric Key Algorithms: Introduction – DES – Triple DES – AES – IDEA – Blowfish – RC5.

UNIT II: Public – keyCryptosystem:IntroductiontoNumberTheory – RSAAlgorithm– KeyManagement-Diffie – HellmanKeyexchange– EllipticCurveCryptographyMessageAuthenticationand Hash functions – Hash and Mac Algorithm – Digital Signatures and Authentication Protocol.

UNIT III: NetworkSecurityPractice:AuthenticationApplications–Kerberos–X.509Authentication services and Encryption Techniques. E-mail Security – PGP – S / MIME – IP Security.

UNIT IV: Web Security – Secure Socket Layer–Secure Electronic Transaction. System Security - Intruders and Viruses – Firewalls– Password Security.

UNIT V: CaseStudy:ImplementationofCryptographicAlgorithms–RSA–DSA–ECC (C/JAVA Programming).Network Forensic – Security Audit - Other Security Mechanism: Introduction to: Stenography –Quantum Cryptography – Water Marking - DNA Cryptography

Text Books

1. William Stallings, "Cryptography and Network Security", PHI/Pearson Education.
2. Bruce Schneir, "Applied Cryptography", CRC Press.

Reference Books

1. A Menezes, P Van Oorschot and S. Vanstone, "Hand Book of Applied Cryptography", CRC Press, 1997
2. Ankit Fadia, "Network Security", MacMillan.

Related Online Contents

1. https://nptel.ac.in/courses/106/105/106105031/
2. http://www.nptelvideos.in/2012/11/cryptography-and-network-security.html
3. https://www.tutorialspoint.com/cryptography/index.htm

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	L	S	M	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

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M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Cryptography**		
Elective –V - Theory	II Year & III Semester	Credit:3	536E3B

Objectives:

To learn the emerging concepts of cryptography and algorithms

To defend the security attacks on information systems using secure algorithms and Authentication process

To categorize and analyze the key concepts in network and wireless security

To Infer the need of security to introduce strong cryptosystems.

Outcomes:

1.	Analyze the cryptographic algorithms for information security.	K1, K2
2.	Identify the authentication schemes for membership authorization.	K2, K3
3.	Identify computer and network security threats, classify the threats and develop a security model for detect and mitigate the attacks.	K3, K4
4.	Identify the requirements for secure communication and challenges related to the secure web services	K4, K5
5.	Ability to identify the need of ethical and professional practices, risk management Using emerging security solutions.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit I: Introduction and Symmetric Key Cryptographic Systems : Introduction to Cryptography, Types of Attacks, Symmetric Key Cryptography, Data Encryption Standard (DES), Differential and Linear cryptanalysis, Advanced Encryption Standard(AES), Modes of operation, Stream Ciphers: Feedback shift registers, Stream ciphers based on LFSRs.

Unit II: Asymmetric Key Cryptosystems: Applications of asymmetric Cryptosystems – RSA Rabin, Elgamal, Probabilistic Cryptosystems, Elliptic Curve Cryptography (ECC), Diffie-Hellman key exchange protocol, Chinese Remainder Theorem (CRT).

Unit III: Data Integrity and Authentication: Message Authentication Code (MAC), Hash function properties, General model for iterated hash functions -MD5, Secure Hash algorithms, HMAC, Attacks on hash functions.

Unit IV: Digital Signature algorithm, Public key infrastructure: X. 509 digital certificate, Kerberos, Zero-Knowledge Protocol.

Unit V: Advanced Cryptographic Techniques: Multiparty Computation and Secret Sharing, Introduction - Indistinguishability - Secret - Sharing Simulation - Based Security-Security against Active Corruption-BGW Protocol (Active, Honest Majority)- Homomorphic Encryption-Lattice Cryptography

Recommended Texts:

1. J. Katz and Y. Lindell, Introduction to Modern Cryptography. Chapman & Hall/CRC Press, 2014
2. W. Stallings, Cryptography and Network Security: Principles and Practice, 7th Ed. Pearson Publishers, 2017.
3. C. Paar and J Pelzl, Understanding Cryptography, Springer, 2010
4. Behrouz A. Forouzan, Cryptography and Network Security:6th Ed. McGraw Hill,2017
5. Dan Boneh and Victor Shoup, A Graduate Course in Applied Cryptography, Jan 2020

Reference Books:

1. Kaufman, Perlman and Speciner. Network Security: Private Communication in a Public World., 2 nd edition,2002 , Pearson Publishers (ISBN No.:978-01-3-04601- 96)
2. Alfred J. Menezes, Paul C. van Oorschot and Scott A. Vanstone,Handbook of Applied Cryptography,5th edition,2001,CRC Press,(ISBN No:0-8493-8523-7)
3. D. R. Stinson, Cryptography: Theory and Practice, 3 rd Ed. Boca Raton, FL: Chapman &Hall/CRC, 2005. (ISBN No.:978-1-58-488508-5)J. H. Silverman, A Friendly
4. Introduction to Number Theory, 4th Ed. Boston: Pearson, 2012. (ISBN No.:978-0- 321-81619-1)
5. Ronald Cramer, Ivan BjerreDamgård, JesperBuus Nielsen, “Secure Multiparty Computation and Secret Sharing”, ISBN 9781107043053, Cambridge University Press, 2015
6. Philip N. Klein, “A Cryptography Primer-Secrets and Promises”, ISBN 9781107603455, Cambridge University Press, 2014

Web References:

1. https://www.youtube.com/watch?v=iTVyKbDCJrA&list=PLgMDNELGJ1CbdGLyn7OrVAP-IKg-0q2U2

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	S	M	L	M	L	S
CO2	S	S	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	L	S	L	M	L	M	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Titleof the Paper	**Parallel and Distributed Computing**		
Elective –V - Theory	II Year & III Semester	Credit:3	536E3C

Objectives:

To analyze the current popular distributed systems such as peer-to-peer (P2P) systems will also be analyzed.

To learn and apply knowledge of parallel and distributed computing techniques and methodologies

To learn the architecture and parallel programming in graphics processing units (GPUs).

To understand the memory hierarchy and cost-performance tradeoffs.

To gain experience in the design, development, and performance analysis of parallel and distributed applications

Outcomes:

1.	Develop and apply knowledge of parallel and distributed computing techniques and methodologies.	K1, K2
2.	Apply design, development, and performance analysis of parallel and distributed applications.	K2, K3
3.	Use the application of fundamental Computer Science methods and algorithms in the development of parallel applications.	K4, K5
4.	Explain the design, testing, and performance analysis of a software system, and to be able to communicate that design to others.	K5
5.	Understand the requirements for programming parallel systems and how they can be used to facilitate the programming of concurrent systems.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT-I Introduction to Parallel Computing: The Idea of Parallelism, Power and potential of parallelism, examining sequential and parallel programs, Scope and issues of parallel and distributed computing, Goals of parallelism, Parallelism and concurrency using multiple instruction streams.

UNIT-II Parallel Architecture: Pipeline architecture, Array processor, Multi-processor architecture, Systolic architecture, Dataflow architecture, Architectural classification schemes, Memory access classification, Memory Issues: Shared vs. distributed, Symmetric multiprocessing (SMP), SIMD, Vector processing, GPU co-processing, Flynn's Taxonomy, Instruction Level support for parallel programming, Multiprocessor caches and Cache Coherence, Non-Uniform Memory Access (NUMA).

UNIT-III Parallel Algorithm Design Principles and Programming: Need for communication and coordination/synchronization, Scheduling and contention, Independence and partitioning, Task-Based Decomposition, Data Parallel Decomposition, Characteristics of task and interaction, Load balancing, Data Management, parallel

algorithm models, Sources of overhead in parallel programs, Performance metrics for parallel algorithm implementations, Parallel algorithmic patterns like divide and conquer, Map and Reduce, Specific algorithms like parallel Merge Sort, Parallel graph Algorithms.

UNIT-IV : Architectures Of Distributed Systems - Architectural Styles – System Architectures - Architectures Versus Middleware - Self-Management In Distributed Systems - Processes - Threads - Virtualization - Clients -Servers - Communication - Remote Procedure Call - Message-Oriented Communication - Stream-Oriented Communication - Multicast Communication

UNIT-V : Distributed Object Based Systems - Architecture - Processes - Communication - Naming - Synchronization - Fault Tolerance - Security - Distributed System Examples - File Systems And Web Based Systems

Recommended Texts:

1. Ananth Grama, Anshul Gupta, and George Karypis, Vipin Kumar; Introduction to Parallel Computing; Addition Wesley; 2nd Edition;2003
2. A.S. Tanenbaum; Distributed Operating Systems; Create Space Independent Publishing Platform; 3rd edition;2017

Reference Books:

1. Introduction To Parallel Programming, Steven Brawer, Academic Press
2. Introduction To Parallel Processing, M. Sasikumar, Dinesh Shikhare and P. Ravi Prakash,PHI
3. Randy Chow, T. Johnson, Distributed Operating Systems and Algorithms, Addison Wesley
4. Ian Foster: Designing and Building Parallel Programs – Concepts and tools for Parallel Software Engineering, Pearson Publisher, 1st Edition, 2019.
5. Parallel Programming in C with MPI and OpenMP Michael J. Quinn, McGrawHill Higher Education

Web References:

1. https://www.youtube.com/watch?v=qbQCQ0U6H0o&list=PLbMVogVj5nJQRvzENlvMKA9q70ScSRZBQ

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	S	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Cyber Security**		
SEC - II	II Year & III Semester	Credit:2	536S3A

Objectives:

To understand various types of cyber-attacks and cyber-crimes
To learn threats and risks within context of the cyber security
To have an overview of the cyber laws & concepts of cyber forensics
To study the defensive techniques against these attacks
To describe various legal responses to cybercrime

Outcomes:

1.	Analyze cyber-attacks, types of cybercrimes, cyber laws and also how to protect them self and ultimately the entire Internet community from such attacks.	K1, K2
2.	Interpret and forensically investigate security incidents	K2, K3
3.	Apply policies and procedures to manage Privacy issues	K4, K5
4.	Design and develop secure software modules	K5
5.	Understand different forms of hacking techniques	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT -I Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics

UNIT - III Cybercrime: Mobile and Wireless Devices: Introduction, Proliferation of Mobile and Wireless Devices, Trends in Mobility, Credit card Frauds in Mobile and Wireless Computing Era, Security Challenges Posed by Mobile Devices, Registry Settings for Mobile Devices, Authentication service Security, Attacks on Mobile/Cell Phones, Organizational security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media marketing: security risks and perils for organizations, social computing and the associated challenges for organizations

UNIT - V Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Datalinking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains- medical, financial, etc Cybercrime: Case study on recent threats and attacks.

Recommended Texts:

1. Nina Godbole and SunitBelpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley

Reference Books:

1. B.B. Gupta, D.P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335,2018.
2. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson,CRC Press.
3. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRC Press T&F Group.

Web References:

1.https://www.youtube.com/watch?v=6wi5DI6du4&list=PL_uaeekrhGzJlB8XQBxU3zhDwT95xlk

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	S	M	L	M	L	S
CO2	S	M	S	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	S	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Digital Image Processing**		
Core–XIV - Theory	II Year & IV Semester	Credit: 4	536C4A

Objectives:

To become familiar with digital image fundamentals

To get exposed to simple image enhancement techniques in Spatial and Frequency domain.

To learn concepts of degradation function and restoration techniques.

To study the image segmentation and representation techniques.

To become familiar with image compression and recognition methods

Outcomes:

1.	Know and understand the basics and fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.	K1, K2
2.	Operate on images using the techniques of smoothing, sharpening and enhancement.	K2, K3
3.	Perform the restoration concepts and filtering techniques.	K4, K5
4.	Demonstrate the segmentation, features extraction, compression and recognition methods for color models.	K5
5.	Compress images and use tools for image recognition.	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I DIGITAL IMAGE FUNDAMENTALS: Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT II IMAGE ENHANCEMENT: Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT III IMAGE RESTORATION: Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

UNIT IV IMAGE SEGMENTATION: Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

UNIT V IMAGE COMPRESSION AND RECOGNITION: Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.

Recommended Texts:

1. Rafael C. Gonzalez, Richard E. Woods; Digital Image Processing; Pearson, Fourth Edition;2018.
2. Anil K. Jain; Fundamentals of Digital Image Processing; Pearson;2015.

Reference Books:

1. Kenneth R. Castleman, Digital Image Processing ‘, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins,; Digital Image Processing using MATLAB ; Pearson Education, Inc., 2011.
3. D E. Dudgeon and RM. Mersereau; Multidimensional Digital Signal Processing; Prentice Hall; 1990.
4. William K. Pratt; Digital Image Processing ; John Wiley; 2002
5. Milan Sonka et al; Image processing, analysis and machine vision; Brookes/Cole, Vikas Publishing House; 2nd edition; 1999.

Web References:

1. https://www.youtube.com/watch?v=DSGHkvQBMbs&list=PLuv3GM6-gsE08DuaC6pFUvFaDZ7EnWGX8

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	L	S	M	L	M	L	L
CO2	S	M	M	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	M	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Project with Viva Voce**		
Core–XV - Project	II Year & IV Semester	Credit: 14	536C4B

Objectives:

To make the project an extended piece of individual work.

To work on a topic that interests the student

To have regular meetings with their supervisor and/or external project provider to discussprogress

To produce dissertations that contain some element of original work.

To encourage and reward individual inventiveness and application of effort

Outcomes:

1.	Plan, schedule, monitor and control their own work;	K1,K2
2.	Defend their ideas in discussions and presentations;	K2,K3
3.	Use libraries and other information resources;	K4,K5
4.	Apply tools and techniques from taught courses	K5
5.	Communicate their findings through a written report.	K5,K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Project: The project work is to be carried out either in a software industry or in an academic institution for the entire semester and the report of work done is to be submitted to the University.

Mapping with Programme Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	S	S	M	L	M	L	S
CO2	S	M	S	L	M	L	M	L	M	S
CO3	S	S	L	M	S	S	L	M	L	M
CO4	M	L	S	M	M	L	S	L	M	S
CO5	S	S	M	S	L	M	L	M	S	L

S-Strong M-Medium L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Robotic Process Automation for Business**		
Elective – VI - Theory	II Year & IV Semester	Credit:3	536E4A

Objectives:

- Learn the concepts of RPA, its benefits, types and models.
- Gain the knowledge in application of RPA in Business Scenarios.
- Identify measures and skills required for RPA

Outcomes:

1.	Demonstrate the benefits and ethics of RPA	K1, K2
2.	Understand the Automation cycle and its techniques	K2
3.	Draw inferences and information processing of RPA	K3, K4
4.	Implement & Apply RPA in Business Scenarios	K5
5.	Analyze on Robots & leveraging automation	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: IntroductiontoRPA –Overview of RPA –Benefits of RPA in a business environment - Industries & domains fit for RPA - Identification of process for automation - Types of Robots - Ethics of RPA & Best Practices - Automation and RPA Concepts - Different business models for implementing RPA –Centre of Excellence –Types and their applications –Building an RPA team-Approach for implementing RPA initiatives.

UNIT II: Role of a Business Manager in Automation initiatives – Skills required by a Business Manager for successful automation - The importance of a Business Manager in automation - Analyzing different business processes - Process Mapping frameworks - Role of a Business Manager in successful implementation – Part 1 - Understanding the Automation cycle – First 3 automation stages and activities performed by different people.

UNIT III: Evaluating the Automation Implementation Detailed description of last 3 stages and activities performed by different people - Role of a Business Manager in successful completion – Part 2 - Activities to be performed post-implementation - Guidelines for tracking the implementation success - Metrics/Parameters to be considered for gauging success - Choosing the right licensing option - Sending emails - Publishing and Running Workflows.

UNIT IV: Ability to process information through scopes/systems - Understand the skill of information processing and its use in business - Leveraging automation - Creating a Robot - New Processes. Establish causality by variable behaviour - Understand the skill of drawing inference or establishing causality by tracking the behaviour of a variable as it varies across time/referenced variable - Leveraging automation for this skill - Robot & new process creation.

UNIT V: Inference from snapshots of curated terms – Omni-source data curation - Multisource trend tracking - Understand the skill of drawing inference from the behaviour of curated terms by taking snapshots across systems in reference to time/variable(s) - Leveraging automation for this skill – Robot creation and new process creation for this skill.

Text Books

1. Alok Mani Tripathi" Learning Robotic Process Automation: Create Software robots and automate business processes with the leading RPA tool" Packt Publishing Limited March 2018.
2. TomTaulli"TheRoboticProcessAutomationHandbook" Apress,February2020.

Reference Books

1. Steve Kaelble "Robotic Process Automation" John Wiley &Sons, Ltd., 2018

Related Online Contents

1. https://www.tutorialspoint.com/uipath/uipath_robotic_process_automation_introduction.htm
2. https://www.javatpoint.com/rpa
3. https://onlinecourses.nptel.ac.in/noc19_me74/preview

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	S
CO2	S	S	S	S	S	S	S	M	S	S
CO3	S	S	S	S	S	S	S	M	S	S
CO4	S	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	S	S	S	M	S	S

*S-Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Block chain Technology**		
Elective –VI - Theory	II Year & IV Semester	Credit:3	536E4B

Objectives:

- Understand the fundamentals of block chain and cryptocurrency.
- Understand the influence and role of block chain in various other fields.
- Learn security features and its significance.
- Identify problems & challenges posed by Block Chain.

Outcomes:

1.	Demonstrate block chain technology and crypto currency	K1, K2
2.	Understand the mining mechanism in block chain	K2
3.	Apply and identify security measures, and various types of services that allow people to trade and transact with bitcoins	K3, K4
4.	Apply and analyze Block chain in health care industry	K5 ,K6
5.	Analyze security, privacy, and efficiency of a given Blockchain system	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I: Introduction to Blockchain - The big picture of the industry – size, growth, structure, players. Bitcoin versus Cryptocurrencies versus Blockchain - Distributed Ledger Technology (DLT). Strategic analysis of the space – Blockchain platforms, regulators, application providers. The major application: currency, identity, chain of custody.

UNIT II: Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Blockchain 1.0, 2.0 and 3.0 – transition, advancements and features. Privacy, Security issues in Blockchain.

UNIT III.Cryptocurrency - History, Distributed Ledger, Bitcoin protocols -Symmetric-key cryptography - Public-key cryptography - Digital Signatures -High and Low trust societies - Types of Trust model: Peer-to-Peer, Leviathan, and Intermediary. Application of Cryptography to Blockchain

UNIT IV: CryptocurrencyRegulation-Stakeholders,RootsofBitcoin,Legalviews-exchangeof cryptocurrency-BlackMarket-GlobalEconomy.Cyrptoeconomics– assets,supplyanddemand,inflationanddeflation – Regulation.

UNIT V: Opportunities and challenges in Block Chain – Application of block chain: Industry 4.0 – machinetomachinecommunication –Datamanagementinindustry4.0–futureprospects.Block chain in Health 4.0 - Blockchain properties - Healthcare Costs - Healthcare Quality - Healthcare Value - Challenges for using blockchain for healthcare data

Text Books

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press (July 19, 2016).
2. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”

Reference Books

1. Satoshi Nakamoto, “Bitcoin: A Peer-to-Peer Electronic Cash System”
2. Rodrigoda Rosa Righi, Antonio Marcos Alberti, Madhusudan Singh, “Blockchain Technology for Industry 4.0” Springer 2020.

Related Online Contents

1. https://www.javatpoint.com/blockchain-tutorial

2. https://www.tutorialspoint.com/blockchain/index.htm

3. https://nptel.ac.in/noc/courses/noc20/SEM1/noc20-cs01/

Cos	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	M	S	M
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong;M-Medium;L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Embedded Systems**		
Elective –VI - Theory	II Year & IV Semester	Credit:3	536E4C

Objectives:

- Present the introduction to 8051Microcontroller Instruction Set, concepts on RTOS & Software tools.
- Gain the knowledge about the embedded software development.
- Learn about Microcontroller and software tools in the embedded systems.

Outcomes:

1.	Understandtheconceptof8051microcontroller	K1, K2
2.	Understand the Instruction Set and Programming	K2
3.	Analyze the concepts of RTOS	K3, K4
4.	Analyze and design various real time embedded systems using RTOS	K5
5.	Debug the malfunctioning system using various debugging techniques	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

UNIT I:8051Microcontroller:Introduction-8051Architecture-Input/OutputPins,PortsandCircuits-External Memory - Counters / Timers - Serial Data Input / Output –Interrupts

UNIT II: Instruction Set and Programming Moving Data-Addressing Modes-Logical operations-Arithmetic Operation-Jump and Call Instructions-Simple Program. Applications: Keyboard Interface- Display Interface-Pulse Measurements-DIA and AID Conversions-Multiple Interrupts.

UNIT III:CONCEPTS ON RTOS: Introduction to RTOS-Selecting an RTOS-Task and Task states - Tasks and data- Semaphores and shared data. MORE operating systems services: Interrupt Process communication - Message Queues, Mailboxes and pipes- Timer Functions-Events - Memory Management-Interrupt Routines in an RTOS Environment.

UNIT IV: Basic Design using a RTOS: Principles - Encapsulating semaphores and Queues-Hard real time scheduling considerations-Saving memory space and power- introductions to RTL &QNX.

UNIT V:SOFTWARETOOLS: Embedded software Development Tools: Hosts and Target Machines - Linker/Locators for Embedded software-getting Embedded software into the Target systems. Debugging Techniques: Testing on your Host machine -Instruction set simulators- The assert macro- using laboratory tools.

Text Books

1. DavidE.Simon,“AnEmbeddedSoftwareprimer”PearsonEducationAsia, 2003.
2. KennethJAyala,“The8051MicrocontrollerandArchitectureprogrammingand application”, Second Edition, Penram International.

Reference Books

1. RajKamal,"Embedded Systems –Architecture,programminganddesign",TataMcGraw–Hill, 2003.

Related Online Contents

1. https://onlinecourses.nptel.ac.in/noc20_cs14/preview
2. https://www.javatpoint.com/embedded-system-tutorial
3. https://www.tutorialspoint.com/embedded_systems/index.htm

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	L	L	L	S	M	S	S	M	M	S
CO2	M	M	S	S	M	S	M	S	S	S
CO3	M	S	S	S	S	S	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	S	S	S	S	S	S	S	S

*S-Strong; M-Medium; L-Low

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**UML Practical**		
Skill Enhancement/ Professional Competency Skill	II Year & IV Semester	Credit:2	536S4A

Objectives:

- To capture the requirements specification for an intended software system
- To draw the UML diagrams for the given specification
- To map the design properly to code
- To test the software system thoroughly for all scenarios
- To improve the design by applying appropriate design patterns.

Outcomes:

1.	Identify use cases and develop the Use Case model.	K1
2.	Identify the conceptual classes and develop a Domain Model and also derive a Class Diagram from that.	K2
3.	Using the identified scenarios, find the interaction between objects and represent them	K3, K4
4.	Using UML Sequence and Collaboration Diagrams and Draw relevant State Chart and Activity Diagrams for the same system.	K5, K6
5.	Implement the modified system and test it for various scenarios	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

SUGGESTED DOMAINS:

1. Passport automation system.
2. Book bank
3. Exam registration
4. Stock maintenance system.
5. Online course reservation system
6. Airline/Railway reservation system
7. Software personnel management system
8. Credit card processing
9. e-book management system
10. Recruitment system
11. Foreign trading system
12. Conference management system
13. BPO management system
14. Library management system
15. Student information system

UNIVERSITY OF MADRAS

M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	**Documentation and Interview skills for Software Engineers**		
Skill Enhancement/ Professional Competency Skill	II Year & IV Semester	Credit:2	536S4B

Objectives:

- Ensure that you understand what the job involves, and that you have the necessary skills
- Make sure you do want to work for the company
- Check that the philosophy/values of the company match your personal requirements
- Find out more about the job, training, career structure etc.

Outcomes:

1.	Understand the purpose of interviews	K1
2.	Be aware of the processes involved in different types of interviews	K2
3.	Know how to prepare for interview	K3, K4
4.	Be clear about the importance of self-presentation	K5, K6
5.	Be clear about the importance of documentation	K5, K6
K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

Unit 1: Job Interviews: The Gateway to the Job Market

Types of Interviews - Groundwork Before the Interview - Abide by the Dress Code - Importance of Body Language in Interviews - Need for Proper Articulation - **Probable Interview Questions**: Tell Us about Yourself - Would You Call Yourself a Team Player? - **Few Tricky Questions and Possible Answers:**Why Should We Employ You? - Do You Have Off ers from Other Companies? - What Salary are You Expecting? - How Much do You ink You are Worth? - What Kind of a Culture are You Comfortable with? - What is More Important to You—Salary or Growth Opportunities? - What do You Know about Our Company? - Tell Us about Your Strengths and Weaknesses - Where do You See Yourself in 5 or 10 Years? - What are Your Plans for Higher Studies? - When Leading a Team, How Will You Motivate Your Team Members and Resolve Any Differences between them? - What Has Been the Biggest Challenge You Have Faced, and How Did You Handle It? - What Do You ink are the Essential Qualities of a Good Employee? - You Claim to be Computer-savvy. Can You Mention Any Innovative Way to Enhance the Sales of the Company Using Your Computer Knowledge and Skills? — Concluding an Interview - Telephonic or Video Interview—A Growing Trend - Disadvantages of Telephonic or Video Interview - **A Mock Interview:** Why did the Interview Team Select Vikram? - Why did the Interview Team not Select Chandra and Amit?

Unit 2:Body Language: Reveals Your Inner Self and Personality

Emotions Displayed by Body Language: Aggressive - Submissive - Attentive - Nervous - Upset -

Bored - Relaxed - Power - Defensive—Handshake—The Most Common Body Language—Eyes— A Powerful Reflection of One's Inner Self —Entry to My Space— Personal Zones May Vary: Intimate Zone - Personal Zone - Social Zone - Public Zone - Typical Body Language when Zones are Intruded — Body Language Exhibited During Different Professional Interactions - Interview - Manager's Discussions with a Subordinate Employee - Discussions with Supervisor - Presentation to a Large Audience - Group Discussions - Video-conference

Unit 3: Enhance Your Writing Skill to Create an Impression

Fifteen Principles to Increase Clarity of Communication - Use Short, Simple and Clear Words - Use Short Sentences - Do not Cram Di erent Points into One Sentence - Using Compact Substitutes for Wordy Phrases - Remove Redundant Words and Expressions - Avoid Use of Mixed Metaphors - Avoid Hackneyed and Stilted Phrases - Avoid Verbosity in the Use of Common Prepositions - Do not Twist the Word Order - Present Similar Ideas in a Sentence with Same Structural and Grammatical Form - Make Positive Statements Without Being Hesitant or Non-committal - e Statements Without Being Hesitant or Non committal - Avoid Pompous Words and Phrases - Use Active Instead of Passive Voice - Ensure Correct Spelling and Grammar in the Text - Substitute Easily-understood Words for Words Imported from Other Fields - Edit-Edit-Edit - The Reader's Perspective - Clarity of Thought - Clarity of Text - Example of Poorly and Well-written Texts

Unit 4: Fog Index: Provides Guidance for Proper Writing

Fog Index or Clarity Index -Examples of Passages with High and LowFog Index - Infogineering Clarity Rating - Flesch Kincaid Reading Ease Index - Other Readability Indices - Checking Grammar, Spelling and Voice - Clarity of Verbal Communication –

Case 1 - Case 2

Recommended Texts:

1. Personality Development and SOFT SKILLS, BARUN K. MITRA, Oxford University Press

Reference Books:

1. **C**ommunicating Effectively in English, Book-I by Revathi Srinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.

Web References:

1. http://www.mindtools.com
2. http://www.letstalk.com.in
3. http://www.englishlearning.com
4. http://learnenglish.britishcouncil.org/en/
5. http://swayam.gov.in

Mapping with Programme Outcomes:

CO1	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO2	L	L	M	S	M	S	L	S	S	M
CO3	S	M	L	M	L	L	M	S	M	S
CO4	M	S	S	L	M	S	L	M	S	M
CO5	S	L	S	M	S	L	L	M	M	S

S-Strong M-Medium L-Low