



# University of Madras

**Chepauk, Chennai 600 005**

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

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## 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**

<b>REGULATIONS ON LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK FOR POSTGRADUATE EDUCATION</b>	
<b>Programme</b>	<b>M.Sc. Computer Science</b>
<b>Programme Code</b>	
<b>Duration</b>	<b>PG - Two Year</b>
<b>Programme Outcomes (POs)</b>	<ul style="list-style-type: none"> <li>○ To possess advanced knowledge of Computing, Mathematical basics for contemporary Computing Specialization and Knowledge of defined problem domain</li> <li>○ To identify a prospective domain, review research literature and analyze the problems using mathematical methods and suggest</li> <li>○ To have the Ability to use design tools, design software as per needs and specifications</li> <li>○ To apply acquired knowledge of the domain in investigating the software design, from design of experiments, analysis of data to provision of valid conclusions.</li> <li>○ To possess the skills to use modern software and hardware tools to analyze problems.</li> <li>○ To possess the knowledge of ethical and legal principles and cyber regulations</li> <li>○ To Possess ability for self-education and attitude for life-long learning in the broadest context of technological change</li> <li>○ To possess the ability to communicate scientific facts effectively in both verbal and written form to the society</li> <li>○ To possess the ability to understand the impact of IT solutions in a global and societal context</li> <li>○ To possess the skill to find out the right opportunity for entrepreneurship for the betterment of an individual and society at large</li> </ul>
<b>Programme Specific Outcomes (PSOs)</b>	<ul style="list-style-type: none"> <li>● Implement the concept of theory and technology with classical and modern techniques for solving the complex problems in Computer Science.</li> <li>● Be more curious towards learning new and emerging technologies that adapt quickly to changes.</li> <li>● Design, execute and evaluate computing projects in academia and industries using appropriate technologies.</li> <li>● Know the contextual knowledge in computing science research and communicate effectively with stakeholders with the society at large for enhancing the quality of life.</li> <li>● Be honest in upholding the ethical principles and social responsibilities along with socio-economic innovations.</li> </ul>

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

<b>PROGRAMME SPECIFIC OUTCOMES (PSO)</b>					
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>
<b>PSO1</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO2</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO4</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>
<b>PSO5</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>

**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**

<b>METHODS OF EVALUATION</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	<b>25 Marks</b>
	Assignments / Snap Test / Quiz	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	<b>75 Marks</b>
<b>Total</b>		<b>100 Marks</b>
<b>METHODS OF ASSESSMENT</b>		
<b>Remembering (K1)</b>	<ul style="list-style-type: none"> <li>• The lowest level of questions require students to recall information from the course content</li> <li>• Knowledge questions usually require students to identify information in the textbook.</li> </ul>	
<b>Understanding (K2)</b>	<ul style="list-style-type: none"> <li>• Understanding of facts and ideas by comprehending organizing, comparing, translating, interpolating and interpreting in their own words.</li> <li>• The questions go beyond simple recall and require students to combined together</li> </ul>	
<b>Application (K3)</b>	<ul style="list-style-type: none"> <li>• Students have to solve problems by using / applying a concept learned in the classroom.</li> <li>• Students must use their knowledge to determine a exact response.</li> </ul>	
<b>Analyze (K4)</b>	<ul style="list-style-type: none"> <li>• Analyzing the question is one that asks the students to break down something into its component parts.</li> <li>• Analyzing requires students to identify reasons causes or motives and reach conclusions or generalizations.</li> </ul>	
<b>Evaluate (K5)</b>	<ul style="list-style-type: none"> <li>• Evaluation requires an individual to make judgment on something.</li> <li>• Questions to be asked to judge the value of an idea, a character, a work of art, or a solution to a problem.</li> <li>• Students are engaged in decision-making and problem-solving.</li> <li>• Evaluation questions do not have single right answers.</li> </ul>	
<b>Create (K6)</b>	<ul style="list-style-type: none"> <li>• The questions of this category challenge students to get engaged in creative and original thinking.</li> <li>• Developing original ideas and problem solving skills</li> </ul>	

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
<b>Semester - I</b>						
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 Compiler Design 436E1E: Natural Language Processing 436E1F: Distributed Database Systems	3	5	3	25	75	100
	<b>20</b>	<b>30</b>				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
<b>Semester - II</b>						
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
	<b>23</b>	<b>30</b>				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
<b>Semester – III</b>						
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
	<b>24</b>	<b>30</b>				

Course	Number of Credits	Hours Per Week	Examination Duration (hrs)	Marks		
				I. A	ESE	Total
<b>Semester – IV</b>						
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					
	<b>24</b>	<b>30</b>				
<b>Total Credits</b>	<b>91</b>					

#### Component wise Credit Distribution

Credits	Sem I	Sem II	Sem III	Sem IV	Total
<b>Part A</b>	<b>14</b>	<b>15</b>	<b>17</b>	<b>18</b>	<b>64</b>
<b>Part B</b>					
<b>(i) Discipline– Centric/Generic Skill</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>3</b>	<b>20</b>
<b>(ii) Soft Skill</b>		<b>2</b>		<b>2</b>	<b>4</b>
<b>(iii) Summer Internship/Industrial Training</b>			<b>2</b>		<b>2</b>
<b>Part C</b>				<b>1</b>	<b>1</b>
<b>Total</b>	<b>20</b>	<b>23</b>	<b>24</b>	<b>24</b>	<b>91</b>

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M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE  
SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Advanced Data Structures and Algorithms</b>		
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.

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**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 Education Limited;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 Jeffrey, 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**

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Title of the Paper	<b>Advanced Python Programming</b>		
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

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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

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Title of the Paper	<b>Advanced Data Structures and Algorithms Practical</b>		
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

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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.

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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

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Title of the Paper	<b>Advanced Python Programming Practical</b>		
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.

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- 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

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**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](https://onlinecourses.nptel.ac.in/noc19_cs40/preview)
3. [https://onlinecourses.nptel.ac.in/noc19\\_cs41/preview](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**  
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**SYLLABUS WITH EFFECT FROM 2023-2024**

Title of the Paper	<b>Cloud Computing</b>		
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.

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SYLLABUS WITH EFFECT FROM 2023-2024

**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.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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Principles of Compiler Design</b>		
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.

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**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\\_c1dimxH Uu6KjuBC2rOlAaoLozF](https://www.youtube.com/watch?v=k4QXWFZZq1E&list=PLENQMW_c1dimxH 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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Data Mining and Warehousing</b>		
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.

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**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>

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

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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Web Technology and Advanced Java</b>		
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

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**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”, 10<sup>th</sup> 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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Data Mining and Warehousing Practical</b>		
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.

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**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**

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

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

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Title of the Paper	<b>Web Technology and Advanced Java Practical</b>		
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.

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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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Artificial Intelligence</b>		
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.

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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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Computer Vision</b>		
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

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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 AlessandroVerri “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=PLwdnzlV3ogoVsma5GmBSsgJM6gHv1QoAo>

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

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Title of the Paper	<b>Fundamentals of Human Rights</b>		
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 Able – Rights of Elderly - Rights of Scheduled Castes – Rights of Scheduled Tribes – Rights of Minorities – – Rights of Prisoners – Rights of Persons Living with HIV/AIDS – 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. Sudarshanam Gankidi, Human Rights in India: Prospective and Retrospective, Rawat Publications, Jaipur, 2019.
2. Satvinder Juss, 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.

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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

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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Data Science and Analytics</b>		
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 Hadoop 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.

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**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 Jeffrey 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 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**

	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>	<b>PO9</b>	<b>PO10</b>
<b>CO1</b>	S	S	S	S	S	S	S	M	M	S
<b>CO2</b>	S	S	S	S	S	S	S	M	S	S
<b>CO3</b>	S	S	S	S	S	S	S	M	S	S
<b>CO4</b>	S	S	S	S	S	S	S	M	S	S
<b>CO5</b>	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	<b>Machine Learning</b>		
Core–X - Theory	II Year & III Semester	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:

# UNIVERSITY OF MADRAS

## M.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE SYLLABUS WITH EFFECT FROM 2023-2024

**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=PL1xHD4vteKYVpaliy295pg6\\_SY5qznc77](https://www.youtube.com/watch?v=r4sgKrRL2Ys&list=PL1xHD4vteKYVpaliy295pg6_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	<b>Theory of Computation</b>		
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 free 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.

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**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 and Computation; 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. Chandrashekar (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](https://www.youtube.com/playlist?list=PLbtzT1TYeoMjNOGEiaRmm_vMIwUAidnQz)
2. <https://nptel.ac.in/courses/106106049>

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	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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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Theory of Computation</b>		
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 free 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
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K1-Remember;K2-Understand;K3-Apply;K4-Analyze;K5-Evaluate; K6-Create		

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**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.

**UNIVERSITY OF MADRAS**  
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**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.

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1. [https://www.youtube.com/playlist?list=PLbtzT1TYeoMjNOGEiaRmm\\_vMIwUAidnQz](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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SYLLABUS WITH EFFECT FROM 2023-2024

Title of the Paper	<b>Data Science and Analytics Practical</b>		
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		

**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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Title of the Paper	<b>Machine Learning Practical</b>		
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.

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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  
 Released October 2016 Publisher(s): O'Reilly Media, Inc. ISBN: 9781449369415

**Web References:**

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

Mapping with Programme Outcomes:

<b>Mapping with Programmers outcomes*</b>										
	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

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Title of the Paper	<b>Cryptography</b>		
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

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**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

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Title of the Paper	<b>Cyber Security</b>		
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.

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**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\\_uaekrhGzJIB8XQBxU3zhDwT95xIk](https://www.youtube.com/watch?v=6wi5DI6du4&list=PL_uaekrhGzJIB8XQBxU3zhDwT95xIk)

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

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Title of the Paper	<b>Digital Image Processing</b>		
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

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**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

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Title of the Paper	<b>Project with Viva Voce</b>		
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 discuss progress
- 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

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Title of the Paper	<b>Block chain Technology</b>		
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.Cyrptoconomics– 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

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**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/>

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

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

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Title of the Paper	<b>Documentation and Interview skills for Software Engineers</b>		
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 Offers from Other Companies? - What Salary are You Expecting? - How Much do You think 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 think 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 -

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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 Different 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. Communicating 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.

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**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