University of Madras

Chepauk, Chennai 600 005
[Est. 1857, State University, NAAC 'A^{++}' Grade, CGPA 3.59, NIRF 2019 Rank: 20]
Website: www.unom.ac.in, Tel. 044-2539 9561

Undergraduate Programme
in
Computer Science with Artificial Intelligence

Syllabus for
B.Sc. Computer Science with Artificial Intelligence
(With effect from the Academic Year 2023 -24)

Learning Outcome Based Curriculum Framework

Note: The Committee is designed Learning Outcome Based Curriculum Framework of Undergraduate Computer Science Programmes prescribed by UGC

I Preamble

Bachelor of Computer Science with Artificial Intelligence is a 3 – Year Undergraduate Programme spread over six semesters. The course is designed to achieve a high degree of technical skills in Problem solving and Modern application development. The course develops requisite professional skills and problem solving along with developing the analytical abilities for pursuing a successful career in software industry and forms the required basics for further higher studies in Computer Science specifically in the area of Artificial Intelligence.

II Eligibility

A pass in the Higher secondary Examination (Academic Stream) conducted by the Government of Tamil Nadu with Mathematics as one of the subjects.

III Programme Objectives

PO1	Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study
PO2	Communication Skills: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.
PO3	Critical thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO4	Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
PO5	Analytical reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.

PO6	Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-andeffect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation
PO7	Cooperation/Team work: Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team
PO8	Scientific reasoning: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.
PO9	Reflective thinking: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society.
PO10	Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

IV Programme Specific Objectives

PSO1	To enable students to apply basic microeconomic, macroeconomic and monetary concepts and theories in real life and decision making.
PSO2	To sensitize students to various economic issues related to Development, Growth, International Economics, Sustainable Development and Environment.
PSO3	To familiarize students to the concepts and theories related to Finance, Investments and Modern Marketing.
PSO4	Evaluate various social and economic problems in the society and develop answer to the problems as global citizens.
PSO5	Enhance skills of analytical and critical thinking to analyze effectiveness of economic policies.

B.Sc. COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

COURSE STRUCTURE

YEAR – I SEMESTER – I

Part	Sub. Code	List of Courses	Credit	Hrs	Int.	Ext.	Total
Part-I	----	Language Paper-I	3	6	25	75	100
Part-II	100L1Z	English Paper-I	3	6	25	75	100
Part-III	126C1A	CC - I: Python Programming **@#$%&**	5	4	25	75	100
	126C11	CC - II: Python Programming Practical **@#$%&**	5	5	40	60	100
	126E1A 126E1B 126E1C	EC - I Generic / Discipline Specific: Mathematics I **@#$%& /** Statistics I **@#$%& /** Physics I **#$%**	3 2	5 3	25 25	75 75	100 100
	---	Physics-I Practical **#$%**	---	2	---	---	---
Part-IV	126S1A	SEC - I: Office Automation **@#$%&** *	2	2	25	75	100
	100S1A	Basic Tamil-I (Other Language Students) *					
	100S1B	Advanced Tamil-I (Other Language Students) *					
	126B1A	FC: Fundamentals of Computers **@#$%&**	2	2	25	75	100
			22/23	30			

*** PART-IV: SEC-1 / Basic Tamil / Advanced Tamil (Any one)**

1. Students who have studied Tamil up to XII STD and also have taken Tamil in Part I shall take SEC-I.
2. Students who have not studied Tamil up to XII STD and have taken any Language other than Tamil in Part-I shall take Basic Tamil comprising of Two Courses (level will be at 6th Std.).
3. Students who have studied Tamil up to XII STD and have taken any Language other than Tamil in Part-I shall take Advanced Tamil comprising of Two Courses.

YEAR – I SEMESTER – II

Part	Sub. Code	List of Courses	Credit	Hrs	Int.	Ext.	Total
Part-I	----	Language Paper-II	3	6	25	75	100
Part-II	100L2Z	English Paper-II	3	6	25	75	100
Part-III	126C2A	CC - III: Java Programming **@#$%&**	5	4	25	75	100
	126C21	CC - IV: Java Programming Practical **@#$%&**	5	5	40	60	100
	126E2A 126E2B 126E2C	EC - II Generic / Discipline Specific Mathematics II **@#$%&**/ Statistics II **@#$%&**/ Physics II **#$%**	3 2	5 3	25 25	75 75	100 100
	126E21	Physics I & II (Practicals) **#$%**	2	2	40	60	100
Part-IV	126S21	SEC-II: Office Automation Practical **@#%&** *	2	2	40	60	100
	100S2A	Basic Tamil-II (Other Language Students) *			25	75	100
	100S2B	Advanced Tamil-II *			25	75	100
	126S2A	SEC - III: Quantitative aptitude **@#$%&**	2	2	25	75	100
			23/24	30			

YEAR – II SEMESTER – III

Part	Sub. Code	List of Courses	Credit	Hrs	Int.	Ext.	Total
Part-I	----	Language Paper-III	3	6	25	75	100
Part-II	200L3Z	English Paper-III	3	6	25	75	100
Part-III	226C3A	CC - V: Data Structures **@%&**	5	4	25	75	100
	226C31	CC - VI: Data Structures Practical **@%&**	5	5	40	60	100
	226E3A 226E3B 226E3C	EC - III Generic / Discipline Specific : Mathematics I **@#$%&**/ Statistics I **@#$%&**/ Physics-I **#$%**	3 2	5 3	25 25	75 75	100 100
	---	Physics-I Practical **#$%**	---	2	---	---	---
Part-IV	226S31	SEC - IV: Web Page Design Practical **@#$%&**	1	1	40	60	100
	226S32	SEC - V: Desktop publishing Practical **@#$%&**	2	2	40	60	100
	----	Environmental Science	--	1	--	--	--
			21/22	30			

YEAR – II SEMESTER – IV

Part	Sub. Code	List of Courses	Credit	Hrs	Int.	Ext.	Total
Part-I	----	Language Paper-IV	3	6	25	75	100
Part-II	200L4Z	English Paper-IV	3	6	25	75	100
Part-III	226C4A	CC - VII: Introduction to Artificial Intelligence **%**	5	4	25	75	100
	226C41	CC -VIII: Prolog Practical **%**	5	4	40	60	100
	226E4A 226E4B 226E4C	EC - IV Generic / Discipline Specific: Mathematics II **@#$%&**/ Statistics II **@#$%&**/ Physics-II **#$%**	3 2	5 3	25 25	75 75	100 100
	226E41	Physics I & II (Practicals) **#$%**	2	2	40	60	100
Part-IV	226S4A	SEC -VI: Emotional Intelligence **@#$%&**	2	2	25	75	100
	226S4B	SEC -VII: Technical Writing **@#$%&**	2	2	25	75	100
	---	Environmental Science	2	1	25	75	100
			25	30			

YEAR – III SEMESTER – V

Part	Sub. Code	List of Courses	Credit	Hrs	Int.	Ext.	Total
Part- III	326C5A	CC - IX: Computer Vision **%**	4	5	25	75	100
	326C51	CC - X: Computer Vision Practical **%**	4	5	40	60	100
	326C5B	CC - XI: Natural Language Processing **%&**	4	5	25	75	100
	326C52	CC - XII: Natural Language Processing Practical **%**	4	5	40	60	100
	326E5A 326E5B 326E5C	EC -V: Computer Networks **#$%&**/ Software Engineering **@#$%&**/ Computing System Fundamentals **#%&**	3	4	25	75	100
	326E5D 326E5E 326E5F	EC -VI: Cloud Computing **@#$%&**/ Big Data Analytics **@#$%&**/ Expert System **%**	3	4	25	75	100
Part-IV	---	Value Education	2	2	25	75	100
	---	Internship / Industrial Training (During summer vacation at the end of IV semester)	2	--	--	--	--
			26	30			

YEAR – III SEMESTER – VI

Part	Sub. Code	List of Courses	Credit	Hrs	Int.	Ext.	Total
Part- III	326C6A	CC - XIII: Machine Learning **%**	4	6	25	75	100
	326C61	CC - XIV: Machine Learning Practical **%**	4	6	40	60	100
	326C6B	Core Paper - XV: Fuzzy Logic **%**	4	6	25	75	100
	326E6A 326E6B 326E6C	EC Course -VII: Mobile Ad-hoc Network **@#$%&**/ Data Mining and Warehousing **@#$%&** / Artificial Neural Networks **%&**	3	5	25	75	100
	326E6D 326E6E 326E6F	EC -VIII: Internet of Things and its Applications **@#$%&**/ Robotics and Its Applications **@#%&** / Information Security **%&**	3	5	25	75	100
Part-IV	326S61	Professional Competency Skill Course: Mini Project **@%&**	2	2	40	60	100
	---	Extension Activity	1	--	--	--	--
			21	30			

@ - Common to B.C.A.
 # - Common to B.Sc. Software Applications
$ - Common to B.Sc. Computer Science
% - Common to B.Sc. Computer Science with Artificial Intelligence
& - Common to B.Sc. Computer Science with Data Science

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UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: I **Semester:I**

Core-I: Python Programming (Common to B.Sc.-CS, CS with DS, Software Appl. & BCA)	**126C1A**

Credits 5 **Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Describe the core syntax and semantics of Python programming language.
- Discover the need for working with the strings and functions.
- Illustrate the process of structuring the data using lists, dictionaries, tuples and sets.
- Understand the usage of packages and Dictionaries

Course Outcomes: (for students: To know what they are going to learn)

CO1: Develop and execute simple Python programs

CO2: Write simple Python programs using conditionals and looping for solving problems

CO3: Decompose a Python program into functions

CO4: Represent compound data using Python lists, tuples, dictionaries etc.

CO5: Read and write data from/to files in Python programs

UNITS	CONTENTS
I	Introduction: The essence of computational problem solving – Limits of computational problem solving-Computer algorithms-Computer Hardware-Computer Software-The process of computational problem solving-Python programming language - Literals - Variables and Identifiers - Operators - Expressions and Data types, Input / output.
II	Control Structures: Boolean Expressions - Selection Control - If Statement-Indentation in Python- Multi-Way Selection -- Iterative Control- While Statement- Infinite loops- Definite vs. Indefinite Loops- Boolean Flag. String, List and Dictionary, Manipulations Building blocks of python programs,Understanding and using ranges.
III	Functions: Program Routines- Defining Functions- More on Functions: Calling Value-Returning Functions- Calling Non-Value-Returning Functions- Parameter Passing - Keyword Arguments in Python - Default Arguments in Python-Variable Scope. Recursion: Recursive Functions.
IV	Objects and their use: Software Objects - Turtle Graphics – Turtle attributes-Modular Design: Modules - Top-Down Design - Python Modules - Text Files: Opening, reading and writing text files – Exception Handling.
V	Dictionaries and Sets: Dictionary type in Python - Set Data type. Object Oriented Programming using Python: Encapsulation - Inheritance – Polymorphism. Python packages: Simple programs using the built-in functions of packages matplotlib, NumPy, pandas etc.

Learning Resources:

Recommended Texts

1. Charles Dierbach, "Introduction to Computer Science using Python - A computational Problem-solving Focus", Wiley India Edition, 2015.
2. Wesley J. Chun, "Core Python Applications Programming", 3rd Edition , Pearson Education, 2016

Reference Books

1. Mark Lutz, "Learning Python Powerful Object Oriented Programming", O'reilly Media 2018, 5th Edition.
2. Timothy A. Budd, "Exploring Python", Tata MCGraw Hill Education Private Limited 2011, 1 st Edition.
3. John Zelle, "Python Programming: An Introduction to Computer Science", Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1590282410
4. Michel Dawson, "Python Programming for Absolute Beginers" , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-143545500

Web resources

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

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SYLLABUS WITH EFFECT FROM 2023-2024

Year: I **Semester:I**

Core-II: Python Programming Practical (Common to B.Sc.-CS, CS with DS, Software Appl. & BCA)	**126C11**
Credits 5	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Acquire programming skills in core Python.
- Acquire Object-oriented programming skills in Python.
- Develop the skill of designing graphical-user interfaces (GUI) in Python.
- Develop the ability to write database applications in Python.
- Acquire Python programming skills to move into specific branches

Course Outcomes: (for students: To know what they are going to learn)

CO1: To understand the problem solving approaches

CO2: To learn the basic programming constructs in Python

CO3: To practice various computing strategies for Python-based solutions to real world problems

CO4: To use Python data structures - lists, tuples, dictionaries.

CO5: To do input/output with files in Python.

List of Programs

1. Program to convert the given temperature from Fahrenheit to Celsius and vice versa depending upon user's choice.
2. Write a Python program to construct the following pattern, using a nested loop

```
*
**
***
****
*****
****
***
**
*
```

3. Program to calculate total marks, percentage and grade of a student. Marks obtained in each of the five subjects are to be input by user. Assign grades according to the following criteria:
   Grade A: Percentage >=80 Grade B: Percentage >=70 and 80
   Grade C: Percentage >=60 and <70 Grade D: Percentage >=40 and <60
   Grade E: Percentage < 40
4. Program, to find the area of rectangle, square, circle and triangle by accepting suitable input parameters from user.
5. Write a Python script that prints prime numbers less than 20.

6. Program to find factorial of the given number using recursive function.
7. Write a Python program to count the number of even and odd numbers from array of N numbers.
8. Write a Python class to reverse a string word by word.
9. Given a tuple and a list as input, write a program to count the occurrences of all items of the list in the tuple. (Input: tuple = ('a', 'a', 'c', 'b', 'd'), list = ['a', 'b'], Output: 3)
10. Create a Savings Account class that behaves just like a Bank Account, but also has an interest rate and a method that increases the balance by the appropriate amount of interest (Hint: use Inheritance).
11. Read a file content and copy only the contents at odd lines into a new file.
12. Create a Turtle graphics window with specific size.
13. Write a Python program for Towers of Hanoi using recursion
14. Create a menu driven Python program with a dictionary for words and their meanings.
15. Devise a Python program to implement the Hangman Game.

Learning Resources:

Recommended Texts

1. Charles Dierbach, “Introduction to Computer Science using Python - A computational Problem-solving Focus”, Wiley India Edition, 2015.
2. Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016

Reference Books

1. Mark Lutz, “Learning Python Powerful Object Oriented Programming”, O’reilly Media 2018, 5th Edition.
2. Timothy A. Budd, “Exploring Python”, Tata MCGraw Hill Education Private Limited 2011, 1 st Edition.
3. John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410
4. Michel Dawson, “Python Programming for Absolute Beginers”, Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009

UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: I **Semester: II**

Java Programming Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**126C2A**
Credits 5	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To provide fundamental knowledge of object-oriented programming.
- To equip the student with programming knowledge in Core Java from the basics up.
- To enable the students to use AWT controls, Event Handling and Swing for GUI.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Understand the basic Object-oriented concepts. Implement the basic constructs of Core Java

CO2: Implement inheritance, packages, interfaces and exception handling of Core Java.

CO3: Implement multi-threading and I/O Streams of Core Java

CO4: Implement AWT and Event handling.

CO5: Use Swing to create GUI.

Units	**Contents**
I	Introduction: Review of Object-Oriented concepts - Java buzzwords (Platform independence, Portability, Threads)- JVM architecture –Java Program structure - – Java main method - Java Console output(System.out) - simple java program - Data types - Variables - type conversion and casting- Java Console input: Buffered input - operators - control statements - Static Data - Static Method - String and String Buffer Classes
II	Java user defined Classes and Objects – Arrays – constructors - Inheritance: Basic concepts - Types of inheritance - Member access rules - Usage of this and Super key word - Method Overloading - Method overriding - Abstract classes - Dynamic method dispatch - Usage of final keyword -Packages: Definition - Access Protection - Importing Packages - Interfaces: Definition – Implementation – Extending Interfaces
III	Exception Handling: try – catch - throw - throws –- finally – Built-in exceptions - Creating own Exception classes - garbage collection, finalise -Multithreaded Programming: Thread Class - Runnable interface – Synchronization – Using synchronized methods – Using synchronized statement - Interthread Communication – Deadlock.
IV	The AWT class hierarchy - Swing: Introduction to Swing - Hierarchy of swing components. Containers - Top level containers - JFrame - JWindow - JDialog - JPanel - JButton - JToggleButton - JCheckBox - JRadioButton - JLabel,JTextField - JTextArea - JList - JComboBox – JscrollPane - Event Handling: Events - Event sources - Event Listeners - Event Delegation Model (EDM) - Handling Mouse and Keyboard Events
V	Adapter classes - Inner classes -Java Util Package / Collections Framework:Collection & Iterator Interface- Enumeration- List and ArrayList- Vector- Comparator

Learning Resources:

Recommended Texts

Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010.

Gary Cornell, Core Java 2 Volume I – Fundamentals, Addison Wesley, 1999.

Reference Books

Head First Java, O'Rielly Publications, Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson Education India, 2010.

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: I **Semester: II**

Java Programming Practical Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**126C21**
Credits 5	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To gain practical expertise in coding Core Java programs
- To become proficient in the use of AWT, Event Handling and Swing.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Code, debug and execute Java programs to solve the given problems
CO2: Implement multi-threading and exception-handling
CO3: Implement functionality using String and StringBuffer classes
CO4: Demonstrate Event Handling.
CO5: Create applications using Swing and AWT

List of Programs

1. Write a Java program that prompts the user for an integer and then prints out all the prime numbers up to that Integer?
2. Write a Java program to multiply two given matrices.
3. Write a Java program that displays the number of characters, lines and words in a text?
4. Generate random numbers between two given limits using Random class and print messages according to the range of the value generated.
5. Write a program to do String Manipulation using Character Array and perform the following string operations:
   a) String length
   b) Finding a character at a particular position
   c) Concatenating two strings
6. Write a program to perform the following string operations using String class:
   a) String Concatenation
   b) Search a substring
   c) To extract substring from given string
7. Write a program to perform string operations using StringBuffer class:
   a) Length of a string
   b) Reverse a string
   c) Delete a substring from the given string
8. Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the number.

9. Write a threading program which uses the same method asynchronously to print the numbers 1 to 10 using Thread1 and to print 90 to 100 using Thread2.

10. Write a program to demonstrate the use of following exceptions.

a) Arithmetic Exception

b) Number Format Exception

c) Array Index Out of Bound Exception

d) Negative Array Size Exception

11. Write a Java program that reads on file name from the user, then displays information about whether the file exists, whether the file is readable, whether the file is writable, the type of file and the length of the file in bytes?

12. Write a program to accept a text and change its size and font. Include bold italic options. Use frames and controls.

13. Write a Java program that handles all mouse events and shows the event name at the center of the window when a mouse event is fired. (Use adapter classes).

14. Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

15. Write a Java program that simulates a traffic light. The program lets the user select one of three lights: red, yellow, or green with radio buttons. On selecting a button, an appropriate message with “stop” or “ready” or “go” should appear above the buttons in a selected color. Initially there is no message shown.

Learning Resources:

Recommended Texts

Herbert Schildt, The Complete Reference, Tata McGraw Hill, New Delhi, 7th Edition, 2010.

Gary Cornell, Core Java 2 Volume I – Fundamentals, Addison Wesley, 1999.

Reference Books

Head First Java, O’Rielly Publications, Y. Daniel Liang, Introduction to Java Programming, 7th Edition, Pearson Education India, 2010.

Web resources: Web resources from NDL Library, E-content from open-source libraries

UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: II **Semester: III**

Data Structures Practical Common for B.C.A. , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**226C31**
Credits 5	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To understand and implement basic data structures using C++
- To apply linear and non-linear data structures in problem solving.
- To learn to implement functions and recursive functions by means of data structures
- To implement searching and sorting algorithms

Course Outcomes: (for students: To know what they are going to learn)

CO1: Implement data structures using C++
CO2: Implement various types of linked lists and their applications
CO3: Implement Tree Traversals
CO4: Implement various algorithms in C++

List of Programs

Implement the following exercises using Java Programming language:

1. Array implementation of stacks
2. Array implementation of Queues
3. Linked list implementation of stacks
4. Linked list implementation of Queues
5. Covert infix expression to postfix.
6. Binary Tree Traversals (Inorder, Preorder, Postorder)
7. Implementation of Linear search and binary search
8. Implementation of Depth-First Search & Breadth-First Search of Graphs.
9. Finding single source shortest path of a Graph.

Learning Resources:

Learning Resources:

Recommended Texts

1. Ellis Horowitz , Sartaj Sahni, Susan Anderson Freed, Second Edition , "Fundamentals of Data in C", Universities Press
2. E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition ,"Fundamentals of Computer Algorithms " Universities Press

Reference Books

1. Seymour Lipschutz ,"Data Structures with C", First Edition, Schaum's outline series in computers, Tata McGraw Hill.
2. R.Krishnamoorthy and G.Indirani Kumaravel, Data Structures using C, Tata McGrawHill – 2008.
3. A.K.Sharma, Data Structures using C , Pearson Education India,2011.
4. G. Brassard and P. Bratley, "Fundamentals of Algorithms", PHI, New Delhi, 1997.

UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: II **Semester: III**

Data Structures Common for B.C.A. , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**226C3A**
Credits 5	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To impart the basic concepts of data structures and algorithms.
- To acquaint the student with the basics of the various data structures
- This course also gives insight into the various algorithm design techniques

Course Outcomes: (for students: To know what they are going to learn)

CO1: To introduce the concepts of Data structures and to understand simple linear data structures.

CO2: Learn the basics of stack data structure, its implementation and application

CO3: Use the appropriate data structure in context of solution of given problem and demonstrate a familiarity with major data structures.

CO4: To introduce the basic concepts of algorithms

CO5: To give clear idea on algorithmic design paradigms like Divide and conquer and Backtracking,

Units	**Contents**
I	**INTRODUCTION TO DATA STRUCTURES:** Representation of arrays, Applications of arrays, sparse matrix and its representation - Linear list: Singly linked list implementation, insertion, deletion and searching operations on linear list
II	Circular linked list: implementation, Double linked list implementation, insertion, deletion and searching operations. **STACKS and QUEUES:** Operations, array and linked representations of stack, stack applications, infix to postfix conversion, postfix expression evaluation
III	Queues: operations on queues, array and linked representations - Circular Queue: operations, applications of queues. **TREES & GRAPHS:** **Trees:** Definitions and Concepts- Representation of binary tree, Binary tree traversals (Inorder, Postorder, preorder), Binary search trees in arrays
IV	Heaps - AVL Trees – B Trees **Graphs:** Representation of Graphs- Types of graphs
V	**Graph Applications:** Breadth first traversal – Depth first traversal- -Single source shortest path – Minimal spanning trees – prim's and kruskal's algorithms

Learning Resources:

Recommended Texts

1. Ellis Horowitz , Sartaj Sahni, Susan Anderson Freed, Second Edition , "Fundamentals of Data in C", Universities Press
2. E. Horowitz, S. Sahni and S. Rajasekaran, Second Edition ,"Fundamentals of Computer Algorithms " Universities Press

Reference Books

1. Seymour Lipschutz ,"Data Structures with C", First Edition, Schaum's outline series in computers, Tata McGraw Hill.
2. R.Krishnamoorthy and G.Indirani Kumaravel, Data Structures using C, Tata McGrawHill – 2008.
3. A.K.Sharma, Data Structures using C , Pearson Education India,2011.
4. G. Brassard and P. Bratley, "Fundamentals of Algorithms", PHI, New Delhi, 1997.
5. A.V. Aho, J.E. Hopcroft, J.D. Ullmann,, "The design and analysis of ComputerAlgorithms", Addison Wesley, Boston, 1974
6. Thomas H. Cormen, C.E. Leiserson, R L.Rivest and C. Stein, Introduction to Algorithms, Third edition, MIT Press, 2009
7. Sanjoy Dasgupta, C.Papadimitriou and U.Vazirani , Algorithms , Tata McGraw-Hill, 2008.

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: II **Semester: IV**

Introduction to Artificial Intelligence	**226C4A**
Credits 5	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Gain a historical perspective of AI and its foundations.
- Become familiar with basic principles of AI toward problem solving, inference, perception,Knowledge representation, and learning.
- Experience AI development tools such as an Prolog
- Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Demonstrate fundamental understanding of the history of artificial intelligence (AI) and its foundations.

CO2: Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation, and learning.

CO3: Demonstrate awareness and a fundamental understanding of various applications of AI techniques

CO4: Demonstrate proficiency developing applications in Prolog.

CO5: Demonstrate an ability to share in discussions of AI, its current scope and limitations, and societal implications

Units	**Contents**
I	Introduction, growth and Applications of AI What Is Artificial Intelligence?: Brain Science and Problem Solving, The Turing Test and Chatterbots-TheHistory of AI: The First Beginnings,Logic Solves (Almost) All Problems, The NewConnectionism,Reasoning Under Uncertainty,Distributed; Autonomous and Learning Agents,AI GrowsUp-The AI Revolution: AI and Society, Does AI Destroy Jobs? - Agents Knowledge - Based Systems
II	Propositional logic: Reasoning in Daily Life-Inference Patterns, Validity, and Invalidity-Classification, Consequence, andUpdate-The Language of Propositional Logic: From natural language to logical notation, Inclusive andexclusive disjunction, implications, Double implications, Ambiguity - Semantic Situations, Truth Tables,Binary Arithmetic, Tautology, Contradiction, conjunctive normal form, equivalence of propositions
III	First-Order Predicate Logic Inference rules: Modus Ponens, Modus Tollens, Hypothetical Syllogism, Disjunctive Syllogism, Addition,Simplification, Resolution - Quantifiers in First-order logic-Properties of Quantifiers-Free and BoundVariables-Inference in First-Order Logic:FOL inference rules for quantifier: Universal Generalization,Universal Instantiation, Existential Instantiation, Existential introduction - Unification: Conditions forUnification, Unification Algorithm- Resolution: Steps for Resolution-Forward Chaining and backwardchaining
IV	Prolog: Why prolog for AI- Rules- Syntax- Constants- variables- characters-operators- Equality & unification -Arithmetics - Satisfying goals

V	Data structures in Prolog: Trees- lists- Recursive search- Mapping- Recursive Comparison- Joining Structures - Accumulators (VS)Difference structures- Backtrack: Multiple solutions- The 'Cut':- Uses of Cut- problems with Cut

Learning Resources:

TEXT BOOK:

1. Introduction to Artificial Intelligence, Wolfgang Erte, Springer, Cham
2. Programming in Prolog,W.F. Clocksin, C.S. Mellish.-5th ed,Springer

REFERENCES:

1. Artificial Intelligence For Dummies,John Paul Mueller,Luca Massaron;Dummies
2. Artificial Intelligence: A Modern Approach.Stuart Russell,Peter Norvig;Prentice Hall
3. PROLOG: Programming for Artificial Intelligence, BRATKO,Pearson
4. Prolog by Example: by Helder Coelho , Jose C. Cotta ,Springer

WEB REFERENCES:

1. https://logicinaction.org/docs/ch2.pdf

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SYLLABUS WITH EFFECT FROM 2023-2024

Year: II **Semester: IV**

Prolog Practical	**226C41**
Credits 5	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Understand Formal logic and associated forms of programming
- Understand Reasoning modelling
- Interpret the logical consequences and validity of formulae using the rules of propositional and predicate logic
- Assess the completeness of Resolution Procedure, Soundness and completeness of Linear Resolution, Unification and Selective Linear Definite Resolution.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Demonstrate Logic Programming Paradigm, Prolog execution models, Prolog's basic and advancedprolog concepts such as LIST, CUT, and Fail using illustrative programming examples.

CO2: Convert world knowledge into FOPL formula and construct well-crafted prolog programmes ofmoderate size

CO3: Apply truth functional propositional Logic(PL) and first order predicate logic (FOPL) to worldknowledge

CO4: Describe the basic predicates to manipulate list data structure and sorting algorithms using PROLOGprogramming

Contents

1. Check if the predicate functor(Term, F, A) succeeds if Term has functor F and arity A by defining afunctor
2. Find the number of elements of a list (with size >1) and remove the middle element (at positionsize//2)
3. Create a list containing all integers within a given range and Reverse the list
4. Write a function append to concatenate elements of two lists into a third list
5. Write a predicate table/3 which prints the truth table of a given logical expressionin two variables.
6. Write a Prolog program using (;) operator to decide whether or not any number was between twoother numbers (i.e., to check if number N is between two numbers N1 and N2 if either N is greaterthan N1 and N is less than N2 or N is less than N1 or N is greater than N2.)
7. Write a Prolog function to find the factorial of a number
8. Query if an element is a member of a list, (using member predicate). To the in-built select functionpass a member of the list and return the remainder of the list
9. Demonstrate the use of built-in predicate function findall in a program
10. Evaluate mathematical expressions involving power(**), integer division(//), mod, sqrt and the otherbasic math operations(+,-,*,%)
11. Use conditions to check the greatest of given two numbers in the stdin/input (not using the maxoperator)
12. Check the negation of the goal using \+ operator
13. Define a new infix operator is_bigger to compare the size of two animals mentioned in the facts

14. Check whether a given term represents a binary tree
15. Construct a completely balanced binary tree in Prolog

Learning Resources:
https://sites.google.com/site/prologsite/prolog-problems/
https://ocw.upj.ac.id/files/Textbook-TIF212-Prolog-Tutorial-3.pdf
http://www.cse.unsw.edu.au/~billw/dictionaries/prolog/
https://www.dai.ed.ac.uk/groups/ssp/bookpages/quickprolog/
https://www.educba.com/prolog-programming/

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SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: V**

Computer Vision Practical	**326C51**
Credits 4	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Understand What Is A Digital Image and what is Manipulating Images
- Understand Manipulating Images One Pixel At a Time, Pixel Transformations, geometric Operations

Course Outcomes: (for students: To know what they are going to learn)

CO1: Implement Spatial Operations in Image Processing

CO2: Implement the Image Gradients and Edge Detection Techniques

CO3: Implement Extraction of desired features

CO4: Implement object detection

Contents

1. Perform the image transformations that include the geometric and morphological transformations.
2. Perform the image enhancement by applying contrast limited adaptive histogram Equalization
3. Perform the Contours and Region based segmentation in images
4. Perform the Wavelet Transforms on image using PyWavelets.
5. Perform the K-Means clustering for Image segmentation using CV2 library.
6. Perform basic motion detection and tracking using python and OpenCV
7. Perform face detection using OpenCV library
8. Perform Foreground Extraction in an image
9. Perform Pedestrian Detection using OpenCV and Python.

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Year: III **Semester: V**

Computer Vision	**326C5A**
Credits 4	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

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

Course Outcomes: (for students: To know what they are going to learn)

CO1: Identify basic concepts, terminology, theories, models and methods in the field of computer vision

CO2: Describe known principles of human visual system

CO3: Describe basic methods of computer vision related to multi-scale representation, edge detection and detection of other primitives, stereo, motion and object recognition

CO4: Suggest a design of a computer vision system for a specific problem

Units	Contents
I	**Introduction:** Image Processing, Computer Vision and Computer Graphics, what is Computer Vision - Low-level, Mid-level, High-level, Overview of Diverse Computer Vision Applications: Document Image Analysis, Biometrics, Object Recognition, Tracking, Medical Image Analysis, Content-Based Image Retrieval, Video Data Processing, Multimedia, Virtual Reality and Augmented Reality
II	**Digital Image Formation and low-level processing:** Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing.
III	**Feature Extraction & Image Segmentation:** Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Gabor Filters and DWT; Image Segmentation: Contour based representation, Region based representation, Level set representations, Fourier and wavelet descriptors, Multi resolution analysis
IV	**Pattern & Motion Analysis:**Clustering: K-Means, K-Medoids, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: Bayes, KNN, Dimensionality Reduction: LDA, ICA, Background Subtraction and Modeling, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation.
V	**Applications:** Photo album – Face detection – Face recognition – Active appearance and 3D shape models of faces Application: Surveillance – foreground-background separation – particle filters – tracking and occlusion – combining views from multiple cameras – human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians

Learning Resources:

TEXT BOOK:

1. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.

REFERENCE BOOK:

1. Computer Vision: A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, 2003.
2. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
3. Christopher M. Bishop; Pattern Recognition and Machine Learning, Springer, 2006
4. E. R. Davies, Computer & Machine Vision, Fourth Edition, Academic Press, 2012
5. Simon J. D. Prince, Computer Vision: Models, Learning, and Inference, Cambridge University Press, 2012
6. Mark Nixon and Alberto S. Aquado, Feature Extraction & Image Processing for Computer Vision, Third Edition, Academic Press, 2012.

WEB REFERENCES:

1. https://viso.ai/blog/
2. https://learnopencv.com/
3. https://www.analyticsvidhya.com/blog/
4. https://www.rsipvision.com/rsip-vision-learns/

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: V**

Natural Language Processing Practical	**326C52**
Credits 4	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To understand the algorithms available for the processing of linguistic information and computational properties of natural languages.
- To conceive basic knowledge on various morphological, syntactic and semantic NLP tasks.
- To familiarize various NLP software libraries and datasets publicly available.
- To develop systems for various NLP problems with moderate complexity.
- To learn various strategies for NLP system evaluation and error analysis.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Describe the concepts of morphology, syntax, semantics, discourse & pragmatics of natural language.

CO2: Demonstrate understanding of the relationship between NLP and statistics & machine learning.

CO3: Discover various linguistic and statistical features relevant to the basic NLP task, namely, spelling correction, morphological analysis, parts-of-speech tagging, parsing and semantic analysis.

CO4: Develop systems for various NLP problems with moderate complexity

Contents

1. How to tokenize a given text?
2. How to get the sentences of a text document ?
3. How to tokenize text with stop words as delimiters?
4. How to remove stop words and punctuations in a text ?
5. How to perform stemming?
6. How to lemmatize a given text ?
7. How to extract usernames from emails ?
8. How to find the most common words in the text excluding stopwords?
9. How to do spell correction in a given text ?
10. How to classify a text as positive/negative sentiment?
11. How to extract Noun and Verb phrases from a text ?
12. How to find the ROOT word of any word in a sentence?
13. Write a Python program to load the iris data from a given csv file into a Data frame and print the shape of the data, type of the data and first 3 rows.
14. Write a Python NLTK program to find the sets of synonyms and antonyms of a given word.
15. Write a Python NLTK program to print the first 15 random combine labelled male and labelled female names from names corpus.

Learning Resources:

TEXT BOOKS:

1. Jurafsky Dan and Martin James H. "Speech and Language Processing" ,3rdEdition, 2018.

REFERENCE BOOKS:

1. Jurafsky D. and Martin J. H., "Speech and language processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", 2nd Edition, Upper Saddle River, NJ: Prentice-Hall, 2008.
2. Goldberg Yoav "A Primer on Neural Network Models for Natural LanguageProcessing".
3. Natural Language Processing with Python, Steven Bird, Ewan Klein, and EdwardLoper

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Year: III **Semester: V**

Natural Language Processing Common for B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326C5B**
Credits 4	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To grasp the significance of natural language processing in solving real-world problems.
- To map the appropriate processing technique to a problem and implement the technique.
- To demonstrate required design skills for large collection sets.
- To appreciate the theoretical formulation of the natural language processing techniques.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Describe the fundamental concepts and techniques of natural language processing.

CO2: Distinguish among the various techniques, taking into account the assumptions, strengths, and weaknesses of each.

CO3: Use appropriate descriptions, visualizations, and statistics to communicate the problems and their solutions.

CO4: Analyse large volume text data generated from a range of real-world applications.

Units	Contents
I	**Introduction:** Overview: Origins and challenges of NLP- Theory of Language - Features of Indian Languages – Issues in Font –Models and Algorithms- NLP Applications.
II	**MORPHOLOGY AND PARTS-OF-SPEECH:** Phonology – Computational Phonology - Words and Morphemes – Segmentation – Categorization and Lemmatisation – Word Form Recognition – Valency - Agreement - Regular Expressions – Finite State Automata – Morphology- Morphological issues of Indian Languages – Transliteration.
III	**PROBABILISTIC MODELS:** Probabilistic Models of Pronunciation and Spelling – Weighted Automata – N- Grams – Corpus Analysis – Smoothing – Entropy - Parts-of-Speech – Taggers – Rule based – Hidden Markov Models – Speech Recognition.
IV	**SYNTAX:** Basic Concepts of Syntax – Parsing Techniques – General Grammar rules for Indian Languages – Context Free Grammar – Parsing with Context Free Grammars – Top Down Parser – Earley Algorithm – Features and Unification - Lexicalised and Probabilistic Parsing.
V	**SEMANTICS AND PRAGMATICS:**Representing Meaning – Computational Representation – Meaning Structure of Language – Semantic Analysis – Lexical Semantics – WordNet – Pragmatics – Discourse – Reference Resolution – Text Coherence – Dialogue Conversational Agents.

Learning Resources:

TEXT BOOK:

Ronald Hausser, "Foundations of Computational Linguistics", Springer-Verleg, 1999.

REFERENCES:

1. Daniel Jurafskey and James H. Martin "Speech and Language Processing", Prentice Hall, 2009.
2. Christopher D.Manning and Hinrich Schutze, "Foundation of Statistical Natural Language Processing", MIT Press, 1999.
3. James Allen, "Natural Language Understanding", Benjamin/Cummings Publishing Co. 1995.
4. Applied Natural Language Processing with Python: Implementing Machine Learning and Deep Learning Algorithms for Natural Language Processing, By Taweh Beysolow II, September 2018

WEB REFERENCES:

1. https://blog.algorithmia.com/introduction-natural-language-processingnlp/
2. https://www.udacity.com/course/natural-language-processingnanodegree--nd892. https://www.coursera.org/learn/language-processing
3. https://towardsdatascience.com/a-practitioners-guide-to-naturallanguage-processing-part-i-processing-understanding-text-9f4abfd13e72
4. https://www.edx.org/course/natural-language-processing

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SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Fuzzy Logic	**326C6B**
Credits 4	**Lecture Hours:6 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To familiarize various components of soft computing like fuzzy logic
- To give an overview of fuzzy Logic and to understand the concepts and terminologies offuzzy systems

Course Outcomes: (for students: To know what they are going to learn)

CO1: Identify and describe soft computing techniques and their roles in building intelligent Machines.

CO2: Apply fuzzy logic and reasoning to handle uncertainty and solve engineering problems

CO3: Recognize the feasibility of applying a soft computing methodology for a particular Problem.

Units	Contents
I	**Introduction, Classical Sets and Fuzzy Sets:** Background, Uncertainty and Imprecision, Statistics and Random Processes, Uncertainty in Information, Fuzzy Sets and Membership, Chance versus Ambiguity. Classical Sets - Operations on Classical Sets, Properties of Classical (Crisp) Sets, Mapping of Classical Sets to Functions Fuzzy Sets - Fuzzy Set operations, Properties of Fuzzy Sets. Sets as Points in Hypercubes
II	**Classical Relations and Fuzzy Relations:** Cartesian Product, Crisp Relations-Cardinality of Crisp Relations, Operations on Crisp Relations, Properties of Crisp Relations, Composition. Fuzzy Relations - Cardinality of Fuzzy Relations, Operations on Fuzzy Relations, Properties of Fuzzy Relations, Fuzzy Cartesian Product and Composition, Non-interactive Fuzzy Sets. Tolerance and Equivalence Relations - Crisp Equivalence Relation, Crisp Tolerance Relation, Fuzzy Tolerance and Equivalence Relations. Value Assignments - Cosine Amplitude, Max-min Method, Other Similarity methods
III	**Fuzzy-to-Crisp Conversions, Fuzzy Arithmetic:** Lambda-Cuts for Fuzzy Sets, Lambda-Cuts for Fuzzy Relations, Defuzzification Methods Extension Principle - Crisp Functions, Mapping and Relations, Functions of fuzzy Sets – Extension Principle, Fuzzy Transform (Mapping), Practical Considerations, Fuzzy Numbers Interval Analysis in Arithmetic, Approximate Methods of Extension - Vertex method, DSW Algorithm, Restricted DSW Algorithm, Comparisons, Fuzzy Vectors
IV	**Classical Logic and Fuzzy Logic:** Classical Predicate Logic – Tautologies, Contradictions, Equivalence, Exclusive OR and Exclusive NOR, Logical Proofs, Deductive Inferences. Fuzzy Logic, Approximate Reasoning, Fuzzy Tautologies, Contradictions, Equivalence and Logical Proofs, Other forms of the Implication Operation, Other forms of the Composition Operation

V	**Fuzzy Rule- Based Systems:**Natural Language, Linguistic Hedges, Rule-Based Systems - Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules, Graphical Techniques of Inference

Learning Resources:

Text Book:

1. Lin C. T. and C.S. G. Lee, Neural Fuzzy Systems, Prentice Hall, 1996

References:

1. Ibrahim A. M., Introduction to Applied Fuzzy Electronics, PHI, 2013
2. J. Yen and R. Langari, Fuzzy Logic, Intelligence, Control and Information, Pearson Education
3. K.H.Lee, First Course on Fuzzy Theory and Applications, Springer-Verlag

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Year: III **Semester: VI**

Machine Learning Practical	**326C61**
Credits 4	**Lecture Hours:6 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)
Understand the mathematical and statistical perspectives of machine learning algorithms through python programming.
Understand the basic concepts of deep neural network models and design the same.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Design and evaluate the unsupervised models through python in built functions.

CO2: Evaluate the machine learning model algorithms by python programming.

CO3: Design and apply various reinforcement algorithms to solve real time complex problems.

CO4: Design and develop the code for the recommender system using Natural Language processing.

Contents

1. Write a program to implement the Simple and Multiple Linear Regression
2. Write a program to implement the Polynomial Regression
3. Write a program to implement the Bagging Technique
4. Write a program to implement the Adaboost Methods
5. Write a program to implement Logistic Regression algorithm
6. Write a program to demonstrate the workflow of Decision Tree Classification
7. Write a program to implement the Random Forest Classification
8. Write a program to implement the SVM Classification
9. Write a program to perform the K Means Clustering
10. Write a program to perform the Density based Clustering
11. Write a program to implement the Apriori algorithm for market basket analysis
12. Write a program to compare the Supervised Machine Learning algorithms.

Learning Resources:

1. Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
2. Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
3. Tom Mitchell, "Machine Learning", McGraw-Hill, 1997.
4. Sebastian Raschka, Vahid Mirjilili,” Python Machine Learning and deep learning”, 2nd edition, kindle book, 2018
5. Carol Quadros,” Machine Learning with python, scikit-learn and Tensorflow”, Packet Publishing, 2018
6. Gavin Hackeling,” Machine Learning with scikit-learn”, Packet publishing, O'Reilly, 2018
7. Stanford Lectures of Prof. Andrew Ng on Machine Learning

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SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: V**

Computer Networks Common for B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E5A**
Credits 3	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To understand the concept of Data communication and Computer network
- To get a knowledge on routing algorithms.
- To impart knowledge about networking and inter networking devices
- To gain the knowledge on Security over Network communication

Course Outcomes: (for students: To know what they are going to learn)

CO1: To Understand the basics of Computer Network architecture, OSI and TCP/IP reference models

CO2: To gain knowledge on Telephone systems and Satellite communications

CO3: To impart the concept of Elementary data link protocols

CO4: To analyse the characteristics of Routing and Congestion control algorithms

CO5: To understand network security and define various protocols such as FTP, HTTP, Telnet, DNS

Units	Contents
I	Introduction – Network Hardware – Software – Reference Models – OSI and TCP/IP Models – Example Networks: Internet, ATM, Ethernet and Wireless LANs - Physical Layer – Theoretical Basis for Data Communication - Guided Transmission Media
II	Wireless Transmission - Communication Satellites – Telephone System: Structure, Local Loop, Trunks and Multiplexing and Switching. Data Link Layer: Design Issues – Error Detection and Correction.
III	Elementary Data Link Protocols - Sliding Window Protocols – Data Link Layer in the Internet - Medium Access Layer – Channel Allocation Problem – Multiple Access Protocols – Bluetooth
IV	Network Layer - Design Issues - Routing Algorithms - Congestion Control Algorithms – IP Protocol – IP Addresses – Internet Control Protocols.
V	Transport Layer - Services - Connection Management - Addressing, Establishing and Releasing a Connection – Simple Transport Protocol – Internet Transport Protocols (ITP) - Network Security: Cryptography.

Learning Resources:

Recommended Texts

1. S. Tanenbaum, “Computer Networks”, 4th Edition, Prentice-Hall of India, 2008.

Reference Books

1. B. A. Forouzan, “Data Communications and Networking”, Tata McGraw Hill, 4th Edition, 2015.
2. F. Halsall, “Data Communications, Computer Networks and Open Systems”, Pearson Education, 2008.
3. D. Bertsekas and R. Gallagher, “Data Networks”, 2nd Edition, PHI, 2008.
4. Lamarca, “Communication Networks”, Tata McGraw- Hill, 2002

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Year: III **Semester: V**

Software Engineering Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E5B**
Credits 3	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To introduce the software development life cycles
- To introduce concepts related to structured and objected oriented analysis & design co
- To provide an insight into UML and software testing techniques

Course Outcomes: (for students: To know what they are going to learn)

1. The students should be able to specify software requirements, design the software using tools
2. To write test cases using different testing techniques.

Units	Contents
I	Introduction – Evolution – Software Development projects – Emergence of Software Engineering.Software Life cycle models – Waterfall model – Rapid Application Development – Agile Model – SpiralModel
II	Requirement Analysis and Specification – Gathering and Analysis – SRS – Formal System Specification
III	Software Design – Overview – Characteristics – Cohesion & Coupling – Layered design – Approaches Function Oriented Design – Structured Analysis – DFD – Structured Design – Detailed design
IV	Object Modeling using UML – OO concepts – UML – Diagrams – Use case, Class, Interaction, Activity, State Chart – Postscript
V	Coding & Testing – coding – Review – Documentation – Testing – Black-box, White-box, Integration, OO Testing, Smoke testing.

TEXT BOOK:

1. Rajib Mall, “Fundamentals of Software Engineering”, PHI 2018, 5th Edition.

REFERENCE BOOKS:

1. Roger S. Pressman, “Software Engineering - A Practitioner’s Approach”, McGraw Hill 2010, 7thEdition.

2. Pankaj Jalote, “An Integrated Approach to Software Engineering”, Narosa Publishing House 2011,3rd Edition.

WEB REFERENCES:

NPTEL online course – Software Engineering - https://nptel.ac.in/courses/106105182/

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Year: III **Semester: V**

Computing System Fundamentals Common for B.Sc.-SA , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	326E5C
Credits 3	**Lecture Hours: 4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To understand the fundamental concepts and role of Operating System.
- To learn the Process Management and Scheduling Algorithms
- To understand the Memory Management policies
- To gain insight on I/O and File management techniques

Course Outcomes: (for students: To know what they are going to learn)

1. Understand the structure and functions of Operating System
2. Compare the performance of Scheduling Algorithms
3. Analyse resource management techniques

Units	**Contents**
I	Introduction to System Views and Types - Basics of OS Structure, Operations, and Services - Process Management: Processes, Scheduling, Inter-process Communication
II	CPU Scheduling: Schedulers, Criteria, Algorithms - Process Synchronization: Critical-Section Problem, Semaphores
III	Classical Problems of Synchronization: Monitors - Deadlock Characterization, Handling Methods: Prevention, Avoidance, Detection, Recovery
IV	Memory Management: Hardware, Address Binding, Space Allocation - Virtual Memory: Demand Paging, Page Replacement, Thrashing - File System Concepts: Access Methods, Directory Structure, Protection
V	Overview of I/O Hardware, Application Interface - Kernel I/O Subsystem: Handling I/O Requests - System Protection: Goals, Domain, Access Matrix - System Security: Threats, Encryption, User Authentication

TEXT BOOK:

1. Abraham Silberschatz, Peter B Galvin, Greg Gagne, “Operating System Concepts”, Wiley India Pvt. Ltd 2018, 9th Edition,.

REFERENCES:

1. William Stallings, “Operating Systems Internals and Design Principles”, Pearson, 2018, 9th Edition.
2. Andrew S. Tanenbaum, Herbert Bos, “Modern Operating Systems”, Pearson 2014, 4th Edition.

WEB REFERENCES:

NPTEL & MOOC courses titled Operating Systems ¬ https://nptel.ac.in/courses/106106144/

UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: V**

Cloud Computing Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E5D**
Credits 3	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To impart fundamental concepts of Cloud Computing.
- To impart a working knowledge of the various cloud service types and their uses and pitfalls.
- To enable the students to know the common features and differences in the service offerings of the three major Cloud Computing service providers, namely Amazon, Microsoft and Google.
- To provide know-how of the various aspects of application design, benchmarking and security on the Cloud.

Course Outcomes: (for students: To know what they are going to learn)

CO1: To understand the concepts and technologies involved in Cloud Computing.
CO2: To understand the concepts of various cloud services and their implementation in the Amazon, Microsoft and Google cloud computing platforms.
CO3: To understand the aspects of application design for the Cloud.
CO4: To understand the concepts involved in benchmarking and security on the Cloud.
CO5: To understand the way in which the cloud is used in various domains.

Units	**Contents**
I	Introduction to Cloud Computing: Definition of Cloud Computing – Characteristics of Cloud Computing – Cloud Models – Cloud Service Examples – Cloud-based Services and Applications. Cloud Concepts and Technologies: Virtualization – Load balancing – Scalability and Elasticity – Deployment – Replication – Monitoring – Software Defined Networking – Network Function Virtualization – MapReduce – Identity and Access Management – Service Level Agreements – Billing.
II	Compute Services: Amazon Elastic Computer Cloud - Google Compute Engine - Windows Azure Virtual Machines. Storage Services: Amazon Simple Storage Service - Google Cloud Storage - Windows Azure Storage Database Services: Amazon Relational Data Store - Amazon Dynamo DB - Google Cloud SQL - Google Cloud Data Store - Windows Azure SQL Database - Windows Azure Table Service Application Services: Application Runtimes and Frameworks - Queuing Services - Email Services - Notifiction Services - Media Services Content Delivery Services: Amazon CloudFront - Windows Azure Content Delivery Network Analytics Services: Amazon Elastic MapReduce - Google MapReduce Service - Google BigQuery - Windows Azure HDInsight Deployment and Management Services: Amazon Elastic Beanstack - Amazon CloudFormation

	Identity and Access Management Services: Amazon Identiy and Access Management - Windows Azure Active Directory Open Source Private Cloud Software: CloudStack – Eucalyptus - OpenStack
III	Cloud Application Design: Introduction – Design Consideration for Cloud Applications – Scalability – Reliability and Availability – Security – Maintenance and Upgradation – Performance – Reference Architectures for Cloud Applications – Cloud Application Design Methodologies: Service Oriented Architecture (SOA), Cloud Component Model, IaaS, PaaS and SaaS Services for Cloud Applications, Model View Controller (MVC), RESTful Web Services – Data Storage Approaches: Relational Approach (SQL), Non-Relational Approach (NoSQL).
IV	Cloud Application Benchmarking and Tuning: Introduction to Benchmarking – Steps in Benchmarking – Workload Characteristics – Application Performance Metrics – Design Consideration for Benchmarking Methodology – Benchmarking Tools and Types of Tests – Deployment Prototyping. Cloud Security: Introduction – CSA Cloud Security Architecture – Authentication (SSO) – Authorization – Identity and Access Management – Data Security : Securing data at rest, securing data in motion – Key Management – Auditing.
V	Case Studies: Cloud Computing for Healthcare – Cloud Computing for Energy Systems - Cloud Computing for Transportation Systems - Cloud Computing for Manufacturing Industry - Cloud Computing for Education.

Learning Resources:

Recommended Texts

1. Arshdeep Bahga, Vijay Madisetti, *Cloud Computing – A Hands On Approach*, Universities Press (India) Pvt. Ltd., 2018.

Reference Books

1. Anthony T Velte, Toby J Velte, Robert Elsenpeter, *Cloud Computing: A Practical Approach*, Tata McGraw-Hill, 2013.
2. Barrie Sosinsky, *Cloud Computing Bible*, Wiley India Pvt. Ltd., 2013.
3. David Crookes, *Cloud Computing in Easy Steps*, Tata McGraw Hill, 2012.
4. Dr. Kumar Saurabh, *Cloud Computing*, Wiley India, Second Edition 2012.

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: V**

Big Data Analytics Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E5E**
Credits 3	**Lecture Hours: 4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To know the fundamental concepts of big data and analytics.
- To explore tools and practices for working with big data.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Work with big data tools and its analysis techniques.
CO2: Analyse data by utilizing clustering and classification algorithms.
CO3: Learn and apply different mining algorithms and recommendation systems for large volumes of data.
CO4: Perform analytics on data streams.
CO5: Learn NoSQL databases and management.

Units	Contents
I	INTRODUCTION TO BIG DATA : Evolution of Big data — Best Practices for Big data Analytics — Big data characteristics — Validating — The Promotion of the Value of Big Data — Big Data Use Cases- Characteristics of Big Data Applications — Perception and Quantification of Value -Understanding Big Data Storage — A General Overview of High-Performance Architecture — HDFS — MapReduce and YARN — Map Reduce Programming Model
II	CLUSTERING AND CLASSIFICATION: Advanced Analytical Theory and Methods: Overview of Clustering — K-means — Use Cases — Overview of the Method — Determining the Number of Clusters — Diagnostics — Reasons to Choose and Cautions. - Classification: Decision Trees — Overview of a Decision Tree — The General Algorithm — Decision Tree Algorithms — Evaluating a Decision Tree — Decision Trees in R — Naïve Bayes — Bayes? Theorem — Naïve Bayes Classifier
III	ASSOCIATION AND RECOMMENDATION SYSTEM:Advanced Analytical Theory and Methods: Association Rules — Overview — Apriori Algorithm — Evaluation of Candidate Rules — Applications of Association Rules — Finding Association& finding similarity — Recommendation System: Collaborative Recommendation- Content Based Recommendation — Knowledge Based Recommendation- Hybrid Recommendation Approaches
IV	STREAM MEMORY: Introduction to Streams Concepts — Stream Data Model and Architecture — Stream Computing, Sampling Data in a Stream — Filtering Streams — Counting Distinct Elements in a Stream — Estimating moments — Counting oneness in a Window — Decaying Window — Real time Analytics Platform (RTAP) applications — Case Studies — Real Time Sentiment Analysis, Stock Market Predictions. Using Graph Analytics for Big Data: Graph Analytics

V	NOSQL DATA MANAGEMENT FOR BIG DATA AND VISUALIZATION: NoSQL Databases: Schema-less Models- Increasing Flexibility for Data Manipulation-Key Value Stores- Document Stores — Tabular Stores — Object Data Stores — Graph Databases Hive — Sharding —Hbase — Analyzing big data with twitter — Big data for E-Commerce Big data for blogs — Review of Basic Data Analytic Methods using R.

Learning Resources:

Recommended Texts

1. Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, CambridgeUniversity Press, 2012.

Reference Books

1. David Loshin, “Big Data Analytics: From Strategic Planning to Enterprise Integration withTools, Techniques, NoSQL, and Graph”, Morgan Kaufmann/El sevier Publishers, 2013.

2. EMC Education Services, “Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data”, Wiley publishers, 2015.

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: V**

Expert System	**326E5F**
Credits 3	**Lecture Hours:4 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)
To Understand

- Basic Concept of Expert Systems
- Components of expert systems, and development of an expert system
- The need for Expert Systems and Applications
- Knowledge Representation in expert systems
- Classes of Expert Systems
- Rule-based expert systems
- Frame-based expert systems
- Expert Systems Characteristics and Application

Course Outcomes: (for students: To know what they are going to learn)
CO1: Clear understanding of Expert Systems
CO2: Explain about AI techniques for knowledge representation, planning and uncertainty Management.
CO3: Develop knowledge of decision making and learning methods.
CO4: Describe the use of AI to solve English Communication problems.
CO5: Explain the concept of Knowledge Representation.

Units	**Contents**
I	The meaning of an expert system, problem domain and knowledge domain, the advantages of an expertsystem, general stages in the development of an expert system, general characteristics of an expertsystem, history and uses of expert systems today, rule-based expert systems, procedural andnonprocedural paradigms, characteristics of artificial neural systems. -The study of logic, differencebetween formal logic and informal logic, meaning of knowledge, how knowledge can be represented,semantic nets, how to translate semantic nets into PROLOG, limitations of semantic nets, schemas,frames and their limitations, how to use logic and set symbols to represent knowledge,
II	The meaning ofpropositional and first order predicate logic, quantifiers, limitations of propositional and predicate logicTrees, lattices, and graphs, state and problem spaces, AND-OR trees and goals, methods of inference,rules of inference, limitations of propositional logic, logic systems, resolution rule of inference,resolution systems, and deduction, shallow and causal reasoning, applying resolution to first-orderpredicate logic, forward and backward chaining,
III	Additional methods of reference, Meta knowledge, theMarkov decision process.The meaning of uncertainty and theories devised to deal with it, types of errors attributed touncertainty, errors associate, with induction, features of classical probability, experimental andsubjective probabilities, compound and conditional probabilities,

IV	hypothetical reasoning and backwardinduction, temporal reasoning, Markov chains, odds of belief, sufficiency and necessity, role ofuncertainty in inference chains, implications of combining evidence, role of inference nets in expertsystems, how probabilities are propagated.
V	Sources of uncertainty in rules, methods of dealing with uncertainty, Dempster-Shafer theory, theory ofuncertainty based on fuzzylogic, commercial applications of fuzzy logic. How to select an appropriateproblem, the stages in the development of an expert system, types of errors to expect in thedevelopment stages, the role of the knowledge engineer in the building of expert systems, the expectedlife cycle of an expert system, how to do a life cycle model.

Learning Resources:

1. J. Giarratano and G. Riley, "Expert Systems -- Principles and Programming". 4th Edition, PWSPublishing Company, 2004.

2. Durkin, J., Expert systems Design and Development, Macmillan, 1994 2. Elias M. Awad, BuildingExpert Systems, West Publishing Company 1996

3. Peter Jackson, Introduction to Expert Systems, Addison Wesley Longman, 1999.ISBN 0-20187686-8.

4. Gonzalez and D. Dankel, "The Engineering of Knowledge-Based Systems", Prentice Hall, 1994.

5. Nikolopoulos, "Expert Systems", Marcel Dekker Inc. 1997. ISBN 0 8247 9927 5

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Mobile Ad-hoc Network Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E6A**
Credits 3	**Lecture Hours: 5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To develop the skills to gain a basic understanding of neural network theory and fuzzy logic theory.
- To introduce students to artificial neural networks and fuzzy theory from a theoretical perspective

Course Outcomes: (for students: To know what they are going to learn)

CO1: Understand the basic concepts ad-hoc networks and ad-hoc mobility models.

CO2: Acquire knowledge about Medium access protocols and standards like IEEE 802.11a and HIPERLAN.

CO3: Identify the significance of Routing protocols and analyze about routing Algorithm.

CO4: Understand about the applications of end-end delivery and security issues in ad-hoc networks

CO5: Analyze and understand the concept of cross-layer design and parameter optimization techniques.

Units	**Contents**
I	Introduction: Introduction to ad-hoc networks – definition, characteristics features, applications. Characteristics of wireless channel, ad-hoc mobility models indoor and out-door models.
II	Medium Access Protocol: MAC Protocols: Design issues, goals and classification. Contention based protocols – with reservation, scheduling algorithms, protocols using directional antennas. IEEE standards: 802.11a, 802.11b, 802.11g, 802.15. HIPERLAN.
III	Network Protocols : : Routing Protocols: Design issues, goals and classification. Proactive Vs reactive routing, unicast routing algorithms, Multicast routing algorithms, hybrid routing algorithm, energy aware routing algorithm, hierarchical routing, QoS aware routing.
IV	End – end delivery and security: Transport Layer: Issues in designing – Transport layer classification, ad-hoc transport protocols. Security issues in ad-hoc networks: issues and challenges, network security attacks, secure routing protocols.
V	CROSS -LAYER DESIGN: Need for cross layer design, cross layer optimization, parameter optimization techniques, cross layer cautionary perspective. Integration of ad-hoc with Mobile IP networks.

Learning Resources:

Recommended Texts

1. C. Siva Ram Murthy and B. S. Manoj, Ad hoc Wireless Networks Architecture and Protocols II edition, Pearson Edition, 2007.
2. Charles E. Perkins, Ad hoc Networking, Addison – Wesley, 2000.

Reference Books

1. Stefano Basagni, Marco Conti, Silvia Giordano and Ivan stojmenovic, Mobile ad-
2. hoc networking, Wiley-IEEE press, 2004.
3. Mohammad Ilyas, The handbook of ad-hoc wireless networks, CRC press, 2002.
4. T. Camp, J. Boleng, and V. Davies “A Survey of Mobility Models for Ad-hoc Network”
5. Research, “Wireless Commn. and Mobile Comp - Special Issue on Mobile Ad-
6. hoc networking Research, Trends and Applications”, Vol. 2, no. 5, 2002, pp. 483 – 502.
7. A survey of integrating IP mobility protocols and Mobile Ad-hoc networks, Fekri
8. M. bduljalil and Shrikant K. Bodhe, IEEE communication Survey and tutorials, no:12007.

Web resources

UNIVERSITY OF MADRAS

B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Data Mining and Warehousing Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E6B**
Credits 3	**Lecture Hours: 5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To provide the knowledge on Data Mining and Warehousing concepts and techniques.
- To study the basic concepts of cluster analysis
- To study a set of typical clustering methodologies, algorithms, and applications

Course Outcomes: (for students: To know what they are going to learn)

CO1: To understand the basic concepts and the functionality of the various data mining and data warehousing component

CO2: To know the concepts of Data mining system architectures

CO3: To analyse the principles of association rules

CO4: To get analytical idea on Classification and prediction methods.

CO5: To Gain knowledge on Cluster analysis and its methods.

Units	Contents
I	Introduction: Data mining – Functionalities – Classification – Introduction to Data Warehousing – Data Pre-processing: Pre-processing the Data – Data cleaning – Data Integration and Transformation – Data Reduction
II	Data Mining, Primitives, Languages and System Architecture: Data Mining – Primitives – Data Mining Query Language, Architecture of Data mining Systems. Concept Description, Characterization and Comparison: Concept Description, Data Generalization and Summarization, Analytical Characterization, Mining Class Comparison – Statistical Measures
III	Mining Association Rules: Basic Concepts – Single Dimensional Boolean Association Rules From Transaction Databases, Multilevel Association Rules from transaction databases – Multi dimension Association Rules from Relational Database and Data Warehouses
IV	Classification and Prediction: Introduction – Issues – Decision Tree Induction – Bayesian Classification – Classification of Back Propagation. Classification based on ConceptsfromAssociationRuleMining–OtherMethods. Prediction – Introduction – Classifier Accuracy.
V	Cluster Analysis: Introduction – Types of Data in Cluster Analysis, Petitioning Methods – Hierarchical Methods-Density Based Methods – GRID Based Method – Model based Clustering Method

Learning Resources:

Recommended Texts

1. Han and M. Kamber, "Data Mining Concepts and Techniques", 2001, Harcourt India Pvt. Ltd, New Delhi.

Reference Books

1. K.P. Soman, Shyam Diwakar, V. Ajay "Insight into Data Mining Theory and Practice ",Prentice Hall of India Pvt. Ltd, New Delhi
2. Parteek Bhatia, 'Data Mining and Data Warehousing: Principles and Practical Techniques',Cambridge University Press, 2019

Web resources: Web resources from NDL Library, E-content from open-source libraries

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Artificial Neural Networks Common for B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E6C**
Credits 3	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To understand the biological neural network and to model equivalent neuron models.
- To understand the architecture, learning algorithms
- To know the issues of various feed forward and feedback neural networks.
- To explore the Neuro dynamic models for various problems.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Upon completing this course, the student will be able to
CO2: Understand the similarity of Biological networks and Neural networks
CO3: Perform the training of neural networks using various learning rules.
CO4: Understanding the concepts of forward and backward propagations.
CO5: Understand and Construct the Hopfield models

Units	Contents
I	Introduction: A Neural Network, Human Brain, Models of a Neuron, Neural Networks viewed as Directed Graphs, Network Architectures, Knowledge Representation, Artificial Intelligence and Neural Networks Learning Process: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Credit Assignment Problem, Memory, Adaption, Statistical Nature of the Learning Process
II	Single Layer Perceptrons: Adaptive Filtering Problem, Unconstrained Organization Techniques, Linear Least Square Filters, Least Mean Square Algorithm, Learning Curves, Learning Rate Annealing Techniques, Perceptron – Convergence Theorem, Relation Between Perceptron and Bayes Classifier for a Gaussian Environment Multilayer Perceptron: Back Propagation Algorithm XOR Problem, Heuristics, Output Representation and Decision Rule, Computer Experiment, Feature Detection
III	Back Propagation: Back Propagation and Differentiation, Hessian Matrix, Generalization, Cross Validation, Network Pruning Techniques, Virtues and Limitations of Back Propagation Learning, Accelerated Convergence, Supervised Learning
IV	Self-Organization Maps (SOM): Two Basic Feature Mapping Models, Self-Organization Map, SOM Algorithm, Properties of Feature Map, Computer Simulations, Learning Vector Quantization, Adaptive Patter Classification
V	Neuro Dynamics: Dynamical Systems, Stability of Equilibrium States, Attractors, Neuro Dynamical Models, Manipulation of Attractors as a Recurrent Network ParadigmHopfield Models – Hopfield Models, restricted boltzmen machine.

Learning Resources:

Text Books

1. Neural Networks a Comprehensive Foundations, Simon S Haykin, PHI Ed.,.
2. Introduction to Artificial Neural Systems Jacek M. Zurada, JAICO Publishing House Ed. 2006.

Reference Books

1. Neural Networks in Computer Inteligance, Li Min Fu TMH 2003
2. Neural Networks -James A Freeman David M S Kapura Pearson Ed., 2004.
3. Artificial Neural Networks – B. Vegnanarayana Prentice Hall of India P Ltd 2005

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Internet of Things and its Applications Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E6D**
Credits 3	**Lecture Hours:5 per week**
Learning Objectives: (for teachers: what they have to do in the class/lab/field) To understand the concepts of Internet of Things and the application of IoT	
Course Outcomes: (for students: To know what they are going to learn) CO1: Use of Devices, Gateways and Data Management in IoT. CO2: Design IoT applications in different domain and be able to analyse their performance CO3: Implement basic IoT applications on embedded platform CO4: To gain knowledge on Industry Internet of Things CO5: To Learn about the privacy and Security issues in IoT	

Units	**Contents**
I	IoT & Web Technology, The Internet of Things Today, Time for Convergence, Towards the IoT Universe, Internet of Things Vision, IoT Strategic Research and Innovation Directions, IoT Applications, Future Internet Technologies, Infrastructure, Networks and Communication, Processes, Data Management, Security, Privacy & Trust, Device Level Energy Issues, IoT Related Standardization, Recommendations on Research Topics.
II	M2M to IoT – A Basic Perspective– Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT-An Architectural Overview– Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations.
III	IoT Architecture -State of the Art – Introduction, State of the art, Architecture. Reference Model- Introduction, Reference Model and architecture, IoT reference Model, IoT Reference Architecture- Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views
IV	IoT Applications for Value Creations Introduction, IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications, Four Aspects in your Business to Master IoT, Value Creation from Big Data and Serialization, IoT for Retailing Industry, IoT For Oil and GasIndustry, Opinions on IoT Application and Value for Industry, Home Management, eHealth.
V	Internet of Things Privacy, Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Contribution from FP7 Projects, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smartie Approach. Data Aggregation for the IoT in Smart Cities, Security

Learning Resources:

Recommended Texts

1. Vijay Madisetti and Arshdeep Bahga, “Internet of Things: (A Hands-on Approach)”, Universities Press (INDIA) Private Limited 2014, 1st Edition.

Reference Books

1. Michael Miller, “The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World”, kindle version.
2. Francis daCosta, “Rethinking the Internet of Things: A Scalable Approach to Connecting Everything”, Apress Publications 2013, 1st Edition,.
3. WaltenegusDargie, ChristianPoellabauer, "Fundamentals of Wireless Sensor Networks: Theory and Practice” 4..CunoPfister, “Getting Started with the Internet of Things”, O‟Reilly Media 2011

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Robotics and Its Applications Common for B.C.A. , B.Sc.-SA , B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E6E**
Credits 3	**Lecture Hours: 5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- To make the students familiar with the various drive systems of robots, sensors and their applications in robots
- To introduce the parts of robots, basic working concepts and types of robots

Course Outcomes: (for students: To know what they are going to learn)

CO1: Describe the different physical forms of robot architectures
CO2: Kinematically model simple manipulator and mobile robots
CO3: Mathematically describe a kinematic robot system.
CO4: Analyse manipulation and navigation problems using knowledge of coordinate frames,

Units	Contents
I	Introduction: Introduction, brief history, components of robotics, classification, workspace, work-envelop, motion of robotic arm, end-effectors and its types, service robot and its application, Artificial Intelligence in Robotics.
II	Actuators and sensors: Types of actuators, stepper-DC-servo-and brushless motors-model of a DC servo motor-types of transmissions-purpose of sensor-internal and external sensor-common sensors-encoders tachometers-strain gauge-based force torque sensor-proximity and distance measuring sensors Kinematics of robots: Representation of joints and frames, frames transformation, homogeneous matrix, D-H matrix, Forward and inverse kinematics: two link planar (RR) and spherical robot (RRP). Mobile robot Kinematics: Differential wheel mobile robot
III	Localization: Self-localizations and mapping - Challenges in localizations – IR based localizations – vision-based localizations – Ultrasonic based localizations - GPS localization systems.
IV	Path Planning: Introduction, path planning-overview-road map path planning-cell decomposition path planningpotential field path planning-obstacle avoidance-case studies Vision system: Robotic vision systems-image representation-object recognition-and categorization-depth measurement- image data compression-visual inspection-software considerations
V	Application: Ariel robots-collision avoidance robots for agriculture-mining-exploration-underwater-civilian- and military applications-nuclear applications-space applications-Industrial robots-artificial intelligence in robots-application of robots in material handling-continuous arc welding-spot welding-spray painting-assembly operation-cleaning-etc.

Learning Resources:

Recommended Texts

1. RicharedD.Klafter. Thomas Achmielewski and MickaelNegin, Robotic Engineering and Integrated Approach, Prentice Hall India-Newdelhi-2001
2. SaeedB.Nikku, Introduction to robotics, analysis, control and applications, Wiley-India, 2 nd edition 2011

Reference Books

1. Industrial robotic technology-programming and application by M.P.Groover et.al, McGrawhill2008
2. Robotics technology and flexible automation by S.R.Deb, THH-2009

Web resources

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B.Sc. DEGREE PROGRAMME IN COMPUTER SCIENCE WITH ARTIFICIAL INTELLIGENCE

SYLLABUS WITH EFFECT FROM 2023-2024

Year: III **Semester: VI**

Information Security Common for B.Sc.-CSc-wAI , B.Sc.-CSc-wDS	**326E6F**
Credits 3	**Lecture Hours:5 per week**

Learning Objectives: (for teachers: what they have to do in the class/lab/field)

- Learn fundamentals of cryptography and its application to network security.
- Understand network security threats, security services, and countermeasures.
- Understand vulnerability analysis of network security.
- Acquire background on hash functions; authentication; firewalls; intrusion detection techniques.
- Gain hands-on experience with programming and simulation techniques for security protocols.

Course Outcomes: (for students: To know what they are going to learn)

CO1: Understand and explain the risks faced by computer systems and networks.
CO2: Identify and analyse security problems in computer systems and networks.
CO3: Explain how standard security mechanisms work.
CO4: Develop security mechanisms to protect computer systems and networks.
CO5: Write programs that are more secure.
CO6: Use cryptography algorithms and protocols to achieve computer security.

Units	Contents
I	Introduction to Information Security : Attacks, Vulnerability, Security Goals, Security Services and mechanisms
II	Conventional Cryptographic Techniques : Conventional substitution and transposition ciphers, One-time Pad, Block cipher and Stream Cipher, Steganography
III	Symmetric and Asymmetric Cryptographic Techniques :DES, AES, RSA algorithms Authentication and Digital Signatures : Use of Cryptographyfor authentication, Secure Hash function, Key management – Kerberos
IV	Program Security : Nonmalicious Program errors – Bufferoverflow, Incomplete mediation, Time-of-check to Time-of- use Errors, Viruses, Trapdoors, Salami attack, Man-in-the- middle attacks, Covert channels
V	Security in Networks : Threats in networks, Network SecurityControls – Architecture, Encryption, Content Integrity, StrongAuthentication, Access Controls, Wireless Security, Honeypots, Traffic flow security, Firewalls – Design andTypes of Firewalls, Personal Firewalls, IDS, Email Security – PGP,S/MIME

Learning Resources:

1. Security in Computing, Fourth Edition, by Charles P. Pfleeger, Pearson Education
2. Cryptography And Network Security Principles And Practice, Fourth or Fifth Edition, William Stallings, Pearson
3. Modern Cryptography: Theory and Practice, by Wenbo Mao, Prentice Hall.
4. Network Security Essentials: Applications and Standards, by William Stallings. Prentice Hall.