Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

Two Year M.Sc. Degree Program in Computer Science

(Faculty of Science & Technology)

CBCS Syllabus

M.Sc.(Computer Science) Sem- II

For Department of Computer Science

Tuljaram Chaturchand College of Arts, Science & Commerce, Baramati

Anekant Education Society's

Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati, (Autonomous)

M.Sc.(Computer Science)Academic Year 2019-2020

M.Sc. (Computer Science) I - Credit Structure

Subject	Semester I	Semester II	Total
Paper – I	4	4	8
Paper – II	4	4	8
Paper – III	4	4	8
Paper - IV	4	4	8
Paper – V	4	4	8
Practical	4	4	8
Practical (Project)	---	4	4
Intro. to Cyber Security – I& II	2	2	4
Human Rights	2	--	2
Certificate Course- I	--	**2**	**2**
Total ====	**28**	**32**	**60**

M.Sc. (Computer Science) II - Credit Structure

Subject	Semester III	Semester IV	Total
Paper – I	4	**Industrial Training Project / Internship (IT) 16**	4
Paper – II	4		4
Paper – III	4		4
Paper - IV	4		8
Paper – V	4		8
Practical / Paper VI (Sem IV)	4		8
Practical (Project)	4		8
Certificate Course- II	2	-------	2
Skill Development I & II	2	2	4
			2
Total ====	**32**	**18**	**50**

Extra Credits:

1	Human Rights	2 Credits
2	Cyber Security Module I & II	4 Credits
3	Certificate Courses I & II	4 Credits
4	Skill Development I & II	4 Credits
Total Extra Credits =		14 Credits

Total Credits: Academic Credits (24+28+28+16 = 96) + Extra Credits (14) =110

Paper wise Course Structure For M.Sc. (Computer Science) (2019 Pattern)

No	Class	Sem	Code	Paper	Paper Title	Credit	Exam	Marks
1	M.Sc. - I	I	COMP4101	Theory	Principles of Programming Languages (C)	4	I / E	60 + 40
2			COMP4102	Theory	Cryptography and Network Security (C)	4	I / E	60 + 40
3			COMP4103	Theory	Database Technologies (C)	4	I / E	60 + 40
4			COMP4104	Theory	Design and Analysis of Algorithms (C)	4	I / E	60 + 40
5			COMP4105	Theory	Programming with DOT NET (C)	4	I / E	60 + 40
6			COMP4106	Pract.	Lab Course on DOT NET, PPL & Database Technologies (C)	4	I / E	60 + 40
7			HR-101	----	Human Rights – I	2	----	----
8			CYS-101	----	Introduction to Cyber Security – I	2	----	----
Note: Credit: 24. Core subjects is compulsory and Extra credits (2+2=4) is also compulsory.								
9	M.Sc. - I	II	COMP4201	Theory	Digital Image Processing (C)	4	I / E	60 + 40
10			COMP4202	Theory	Data Mining and Data Warehousing (C)	4	I / E	60 + 40
11			COMP4203	Theory	Python Programming (C)	4	I / E	60 + 40
12			COMP4204	Theory	**Advanced Operating System (EI)**	4	I / E	60 + 40
13			COMP4205	Pract.	Lab Course on Python Programming and Advance Operating System (C)	4	I / E	60 + 40
14			COMP4206	Pract.	**Project (EII)**	4	I / E	60 + 40
15			COMP4207	Theory	**Artificial Intelligence (EIII)**	4	I / E	60 + 40
16			CC-12	----	Certificate Course – I	2	----	---
17			CYS-102	----	Introduction to Cyber Security – II	2	----	----
Note: : Credit: 28. Core subjects is compulsory and Extra credits (4) is also compulsory.								
18	M.Sc. - II	III	COMP5301	Theory	Mobile Technologies (C)	4	I / E	60 + 40
19			COMP5302	Theory	Soft Computing (C)	4	I / E	60 + 40
20			COMP5303	Theory	Web Services (C)	4	I / E	60 + 40
21			COMP5304	Theory	**Software Architecture& Design Pattern (EI)**	4	I / E	60 + 40
22			COMP5305	Pract.	Lab Course-on Mobile Technologies and Web Services (C)	4	I / E	60 + 40
23			COMP5306	Pract.	**Project (EII)**	4	I / E	60 + 40
24			COMP5307	Theory	**Recent Trends in IT (Internet of Things) (EIII)**	4	I / E	60 + 40
25			CC-23	----	Certificate Course – II	2	----	----

26			SD-23	----	Skill Development – I	2	----	----
Note: Credit: 28. Core subjects is compulsory and Extra credits (2+2) is also compulsory.								
27	M.Sc. - II	IV	COMP5401	Project	Industrial Training/ Institutional Project **(IT) (Core)**	16	I / E	60 + 40
28			SD-23	----	Skill Development – II	2	----	----
Note: Credit:16. Core subject is compulsory, **Total Credits:Academic Credits(24+28+28+16 = 96) + Extra Credits (14) = 110**								

M.Sc. (Computer Science)- I

Semester-II Syllabus

A.Y. - 2019 -20 (2019 Pattern)

Class: M.Sc.I (Computer Science) Semester-II Paper Code: COMP4201
Title of Paper : Digital Image Processing Paper: I
Credit : 04 No. Of Lecture: 48

Learning Objectives:

- To understand the relation between human visual system and machine perception and processing of digital images.
- To provide a detailed approach towards image processing applications like enhancement, segmentation, and compression.

Learning outcome:

CO1- Review the fundamental concepts of a digital image processing system
CO2-Develop and implement algorithms for digital image processing.
CO3-Analyze images in the frequency domain using various transforms.
CO4-Evaluate the techniques for image enhancement and image restoration
CO5- Categorize various compression techniques.
CO6- Interpret Image compression standards
CO7-Interpret image segmentation and representation techniques.

Unit No.	Contents	No. Of Lectures
1	**Introduction to DIP** • Introduction to Digital Image Processing • The origins of Digital Image Processing • Examples of Fields that use Digital Image Processing • Gamma-Ray Imaging • X-Ray Imaging • Imaging in the Ultraviolet Band • Imaging in the Visible and Infrared Bands • Imaging in the Microwave Band • Imaging in the Radio Band • Fundamental steps in Digital Image Processing • Components of an Image Processing System	03
2.	**Digital Image Fundamentals** • Elements of Visual Perception • Light and the Electromagnetic Spectrum • Image sensing and Acquisition • Image Sampling and Quantization • Some Basic Relationships between Pixels • An Introduction to the Mathematical Tools Used in Digital Image Processing o Array versus Matrix Operations o Linear versus Nonlinear Operations o Arithmetic Operations o Set and Logical Operations	06
3.	**Intensity Transformation and Spatial Filtering**	07

	• Background
	• Some Basic Intensity Transformation Functions
	• Histogram Processing
	  ○ Histogram Equalization
	  ○ Histogram Matching (Specification)
	  ○ Local Histogram Processing
	• Fundamentals of Spatial Filtering
	• Smoothing Spatial Filters
	• Sharpening Spatial Filters
	• Combining Spatial Enhancement Methods	

4.	**Filtering in the Frequency Domain** • Background • Preliminary Concepts • Sampling and the Fourier Transform of Sampled Functions • The Discrete Fourier Transform (DFT) of One variable • Extension to Functions of Two Variables • Some Properties of the 2-D Discrete Fourier Transform • The Basics of Filtering in the Frequency Domain • Image Smoothing Using Frequency Domain Filters • Image Sharpening Using Frequency Domain Filters • Selective Filtering	10

5.	**Image Restoration and Reconstruction**
	• A Model of the Image Degradation / Restoration Process
	• Noise Models
	• Restoration in the Presence of Noise Only- Spatial Filtering
	• Periodic Noise Reduction by Frequency Domain Filtering
	  ○ Bandreject Filters
	  ○ Bandpass Filters
	  ○ Notch Filters
	• Estimating the Degradation Function
	• Inverse Filtering
	• Minimum Mean Square Error(Wiener) Filtering
	• Geometric Mean Filter
		06

6.	**Morphological Image Processing**
	• Preliminaries
	• Erosion and Dilation
	• Opening and Closing
	• The Hit-or-Miss Transformation
	• Some Basic Morphological Algorithms
	  ○ Boundary Extraction
	  ○ Hole Filling
		05

	○ Extraction of Connected Components ○ Convex Hull ○ Thinning ○ Thickening ○ Skeletons ○ Pruning ○ Morphological Reconstruction	
7.	**Image Segmentation** • Fundamentals • Point, Line, and Edge Detection ○ Background ○ Detection of Isolated Points ○ Line Detection ○ Edge Models ○ Basic Edge Detection ○ Edge Linking and Boundary Detection • Thresholding ○ Foundation ○ Basic Global Thresholding ○ Optimum Global Thresholding Using Otsu's Method ○ Using Image Smoothing to Improve Global Thresholding ○ Using Edges to Improve Global Thresholding • Region-Based Segmentation	07
8.	**Representation and Description** • Representation ○ Boundary (Border) Following ○ Chain Codes ○ Polygonal Approximations Using Minimum-Perimeter Polygons ○ Other Polygonal Approximation Approaches ○ Signatures ○ Boundary Segments ○ Skeletons • Boundary Descriptors ○ Some Simple Descriptors ○ Shape Numbers ○ Fourier Descriptors • Regional Descriptors ○ Some Simple Descriptors ○ Topological Descriptors ○ Texture	04

Reference Books:

1. Sonka, M., Hlavac, V., Boyle, R. [1999]. Image Processing, Analysis and Machine Vision
(2nd edition),PWS Publishing, or (3rd edition) Thompson Engineering, 2007

2. Gonzalez, R. C., Woods, R. E., and Eddins, S. L. [2009]. Digital Image Processing Using
MATLAB, 2nded., Gatesmark Publishing, Knoxville, TN.
3. Anil K. Jain [2001], Fundamentals of digital image processing (2nd Edition), Prentice-Hall, NJ
4. Willian K. Pratt [2001], Digital Image Processing (3rd Edition), , John Wiley & Sons, NY
5. Burger, Willhelm and Burge, Mark J. [2008]. Digital Image Processing: An Algorithmic
IntroductionUsing Java, Springer
6. Digital Image Analysis (With CD-ROM), Kropatsch, Springer, ISBN 978038795066
7. Digital Image Processing, 6e (With CD), Jähne, Springer, ISBN:978-3-540-24035-8 2

Mapping of this course with Programme Outcomes

Course Outcomes	Programme Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	2	2	2	1	1	2	1
CO2	3	3	3	3	1	3	3
CO3	2	2	2	1	1	2	1
CO4	2	2	2	1	1	2	1
CO5	1	1	1	1	1	1	1
CO6	1	1	1	1	1	1	1
CO7	1	1	1	1	1	1	1

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

Course Objectives (CO) and Program Outcomes (PO) Mapping:

1 Justification of PO1 to ALL COs :

CO1- (Weightage: 2 - Moderately Related)Justification: Reviewing the fundamental concepts of a digital image processing system involves understanding algorithms, programming languages, and potentially mobile technologies, moderately related to the diverse knowledge areas specified in PO1.

CO2- (Weightage: 3 - Strongly Related)Justification: Developing and implementing algorithms for digital image processing directly aligns with the knowledge enrichment goals specified in PO1, particularly in the areas of algorithms and programming languages.

CO3- (Weightage: 2 - Moderately Related)Justification: Analyzing images in the frequency domain involves a foundation in algorithms and potentially advanced operating systems, moderately related to the knowledge enrichment goals in PO1.

CO4- (Weightage: 2 - Moderately Related)Justification: Evaluating image enhancement and restoration techniques requires understanding algorithms and potentially database technologies, moderately related to the specified knowledge areas in PO1.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques may not directly align with every aspect of PO1 but involves elements of algorithmic understanding.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards may involve aspects of algorithmic understanding, aligning partially with the specified knowledge areas in PO1.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques may involve algorithmic understanding, aligning partially with the specified knowledge areas in PO1.

2 Justification of PO2 to ALL COs :

CO1- (Weightage: 2 - Moderately Related)Justification: Reviewing fundamental concepts of a digital image processing system contributes to the understanding of software applications and projects, connecting moderately with the multidimensional aspects emphasized in PO2.

CO2- (Weightage: 3 - Strongly Related)Justification: Developing and implementing algorithms for digital image processing directly aligns with understanding the dimensions of software applications and projects, reflecting a strong relationship with the goals of PO2.

CO3- (Weightage: 2 - Moderately Related)Justification: Analyzing images in the frequency domain involves concepts relevant to software applications, contributing moderately to the understanding of all dimensions of software application concepts and projects in PO2.

CO4- (Weightage: 2 - Moderately Related)Justification: Evaluating image enhancement and restoration techniques provides insights into aspects relevant to software application concepts, connecting moderately with the multidimensional understanding emphasized in PO2.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques may not directly align with all dimensions of software applications and projects but involves aspects of technical understanding relevant to software, establishing a partial connection with PO2.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards contributes partially to understanding software concepts but may not cover all dimensions emphasized in PO2.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques has a partial connection to software application concepts, contributing to the multidimensional understanding highlighted in PO2.

3 Justification of PO3 to ALL COs :

CO1- (Weightage: 2 - Moderately Related)Justification: Reviewing fundamental concepts of a digital image processing system involves understanding algorithms and programming concepts, contributing moderately to the goal of demonstrating computer subjects with the use of ICT in PO3.

CO2- (Weightage: 3 - Strongly Related)Justification: Developing and implementing algorithms for digital image processing directly aligns with demonstrating programming concepts with the use of ICT, reflecting a strong relationship with the goals of PO3.

CO3- (Weightage: 2 - Moderately Related)Justification: Analyzing images in the frequency domain involves theoretical concepts and application of transforms, moderately contributing to the demonstration of computer subjects with the use of ICT in PO3.

CO4- (Weightage: 2 - Moderately Related)Justification: Evaluating image enhancement and restoration techniques involves theoretical concepts and assessment, contributing moderately to the goal of demonstrating computer subjects with the use of ICT in PO3.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques may not directly align with all aspects of computer subjects but involves elements of theoretical understanding relevant to ICT, establishing a partial connection with PO3.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards contributes partially to understanding theoretical concepts related to ICT, though it may not cover all dimensions emphasized in PO3.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques has a partial connection to theoretical concepts relevant to computer subjects and ICT, contributing to the demonstration highlighted in PO3.

4 Justification of PO4 to ALL COs :

CO1- (Weightage: 1 - Partially Related)Justification: Reviewing fundamental concepts of a digital image processing system may contribute partially to the development of in-house applications, as understanding these concepts forms a foundational knowledge base for potential application development.

CO2- (Weightage: 3 - Strongly Related)Justification: Developing and implementing algorithms for digital image processing directly aligns with the goal of developing in-house applications, reflecting a strong relationship with the objectives of PO4.

CO3- (Weightage: 1 - Partially Related)Justification: Analyzing images in the frequency domain may have a partial connection to the development of in-house applications, as the theoretical understanding gained can be applied in specific contexts.

CO4- (Weightage: 1 - Partially Related)Justification: Evaluating image enhancement and restoration techniques may contribute partially to the development of in-house applications, as the assessment of techniques can inform decision-making during project development.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques may have a partial connection to the development of in-house applications, as it involves understanding and classifying techniques that can be utilized in specific projects.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards may contribute partially to the development of in-house applications, as standards understanding can guide the implementation of compression in projects.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques may have a partial connection to the development of in-house applications, as these techniques may be applied in specific project contexts.

5 Justification of PO5 to ALL COs :

CO1- (Weightage: 1 - Partially Related)Justification: Reviewing fundamental concepts of a digital image processing system may have a partial connection to interacting with IT experts during visits, as it provides a foundational understanding that can be discussed or elaborated upon during such interactions.

CO2- (Weightage: 1 - Partially Related)Justification: Developing and implementing algorithms for digital image processing may contribute partially to interactions with IT experts, as it involves practical aspects that can be discussed or shared during IT visits.

CO3- (Weightage: 1 - Partially Related)Justification: Analyzing images in the frequency domain may have a partial connection to interactions with IT experts, as the knowledge gained can be relevant in discussions or presentations during IT visits.

CO4- (Weightage: 1 - Partially Related)Justification: Evaluating image enhancement and restoration techniques may contribute partially to interactions with IT experts, as the assessment of techniques can be discussed or shared during IT visits.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques may have a partial connection to interactions with IT experts, as understanding different techniques can be discussed or shared during IT visits.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards may contribute partially to interactions with IT experts, as knowledge of standards can be relevant in discussions or presentations during IT visits.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques may have a partial connection to interactions with IT experts, as the understanding of these techniques can be discussed or shared during IT visits.

6 Justification of PO6 to ALL COs :

CO1- (Weightage: 2 - Moderately Related)Justification: Reviewing fundamental concepts of a digital image processing system moderately contributes to industrial exposure, providing a foundational understanding that may be applicable during the internship but does not fully encompass the practical exposure gained in an industrial setting.

CO2- (Weightage: 3 - Strongly Related)Justification: Developing and implementing algorithms for digital image processing strongly aligns with the goal of industrial exposure, as it involves practical skills highly sought after in the IT industry.

CO3- (Weightage: 2 - Moderately Related)Justification: Analyzing images in the frequency domain moderately contributes to industrial exposure, as it provides a specific skill set that may be applicable in certain industrial contexts during the internship.

CO4- (Weightage: 2 - Moderately Related)Justification: Evaluating image enhancement and restoration techniques moderately aligns with industrial exposure, as it involves critical assessment skills that may be relevant in an industrial setting.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques has a partial connection to industrial exposure by providing technical knowledge, but it may not fully capture the practical experiences gained during the internship.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards partially contributes to industrial exposure by enhancing knowledge of industry standards, but it may not fully encompass the practical aspects encountered in an industrial setting.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques has a partial connection to industrial exposure, providing specialized knowledge that may be applicable but does not fully represent the overall industrial experience.

7 Justification of PO7 to ALL COs :

CO1- (Weightage: 1 - Partially Related)Justification: Reviewing fundamental concepts of a digital image processing system may contribute partially to employability by providing a foundational knowledge base, but it may not directly address the broader employability and citizenship goals.

CO2- (Weightage: 3 - Strongly Related)Justification: Developing and implementing algorithms for digital image processing directly aligns with the goal of making students employable, as it enhances practical skills in demand in the IT industry.

CO3- (Weightage: 1 - Partially Related)Justification: Analyzing images in the frequency domain may have a partial connection to employability, as it provides specialized knowledge but may not directly address the broader employability goals or responsible citizenship.

CO4- (Weightage: 1 - Partially Related)Justification: Evaluating image enhancement and restoration techniques contributes partially to employability by building critical assessment skills, but it may not directly address the broader employability and citizenship goals.

CO5- (Weightage: 1 - Partially Related)Justification: Categorizing compression techniques may have a partial connection to employability by providing technical knowledge, but it may not directly address broader employability and citizenship aspects.

CO6- (Weightage: 1 - Partially Related)Justification: Interpreting image compression standards may contribute partially to employability by enhancing knowledge of industry standards, but it may not directly address the broader employability and citizenship goals.

CO7- (Weightage: 1 - Partially Related)Justification: Interpreting image segmentation and representation techniques may have a partial connection to employability, providing specialized knowledge but not directly addressing broader employability and citizenship aspects.

Class : M.Sc. (Computer Science)(Semester – II) Paper Code :COMP4202
Title of Paper : Data Mining and Data Warehousing Paper: II
Credit : 4 No. of Lectures :55

Prerequisites :

- Basic Knowledge of databases handling.

Learning Objectives :

- To study different data preprocessing techniques.
- To introduce the core concepts of data warehousing techniques and implementation.
- To introduce the core concepts of data mining techniques and applications.
- To study advanced data mining techniques.
- To use data mining software on various data sets by using proper algorithms.

Learning Outcomes :

1) CO1. Students will understand both the theoretical and practical aspects data mining.
2) CO2. Understand basic data mining algorithms, methods, and tools
3) CO3. Understand data mining principles and techniques:
4) CO4.Understanding the basic concepts of OLAP.
5) CO5. Understanding the basic concepts of Data Warehouse.
6) CO6. Understand the functionality of the various data mining and data warehousing component
7) CO7. Appreciate the strengths and limitations of various data mining and data warehousing models

Unit	Title and Contents	No. of Lectures
Unit – I	**1. Data Preprocessing** 1.1 Introduction 1.2 Data Processing prerequisites 1.3 Data Objects and Attribute Types 1.3.1 Attribute 1.3.2 Nominal Attributes 1.3.3 Binary Attributes 1.3.4 Ordinal Attributes 1.3.5 Numeric Attributes 1.3.6 Discrete Attributes 1.3.7 Continuous Attributes 1.4 Need for Preprocessing 1.5 Major Tasks in Data Preprocessing 1.5.1 Data Cleaning 1.5.2 Data Integration 1.5.3 Data Reduction 1.5.4 Data Transformation 1.5.5 Data Discretization 1.6 Missing Values 1.7 Noisy Data	**4**
Unit – II	**2. Introduction to Data Warehousing**	**7**

	2.1 Introduction 2.2 Data Warehouse: Basic Concepts 2.2.1 Datawarehouse definition 2.2.2 Comparison of OLTP and OLAP 2.2.3 Datamart 2.2.4 Metadata Repository 2.3 Architecture of Data Warehouse 2.4 Data Warehouse Models 2.4.1 Enterprise Warehouse 2.4.2 Data Mart 2.4.3 Virtual Warehouse 2.5 Data Cube and OLAP 2.5.1 Dimension 2.5.2 Fact 2.5.3 Measures 2.5.4 Dimension Table 2.5.5 Fact Table 2.5.6 Data Cube 2.5.7 Cuboid, Apex Cuboid, Base Cuboid 2.5.8 OLAP operations 2.6 Dimensional Data Modeling 2.6.1 Star Schema 2.6.2 Snowflake Schema 2.6.3 Fact Constellation Schema	
Unit – III	**3. Introduction to Data Mining** 3.1 Introduction 3.2 Data Mining : Basic Concepts 3.3 Knowledge Discovery in Databases Process 3.4 Data Mining Tasks 3.4.1 Descriptive 3.4.2 Predictive 3.5 Data Mining Issues 3.6 Data Mining Metrics 3.7 Social Implications of Data Mining 3.8 Applications of Data Mining	**6**
Unit – IV	**4. Data Mining Techniques** 4.1 Introduction 4.2 Frequent item-sets and association rule mining 4.2.1 Itemset 4.2.2 Frequent Pattern 4.2.3 Support 4.2.4 Confidence 4.2.5 Downward-Closure Property 4.2.6 Market Basket Analysis 4.2.7 Horizontal Data format 4.2.8 Vertical Data format 4.2.9 Apriori algorithm 4.3 FP-Tree algorithm 4.4 Graph Mining	**8**

	4.4.1 Frequent Sub-graph mining 4.4.2 Apriori-based Approach 4.4.3 Pattern growth Approach 4.6 Tree mining	
Unit - V	**5. Classification & Prediction** 5.1 Introduction 5.2 Decision Tree Learning 5.2.1 Construction 5.2.2 Basic Decision Tree Algorithm 5.2.3 Performance 5.2.4 Attribute Selection 5.2.5 Issues 5.2.6 Classification and Regression Tree(CART) 5.3 Bayesian Classification 5.3.1 Bays Theorem 5.3.2 NavieBaysianClassfier 5.3.3 Bayesian Network 5.3.4 Inference 5.3.5 Parameter Learning 5.3.6 Structure Learning 5.4 Linear Classification 5.4.1 Least Squares 5.4.2 Perceptron 5.4.3 Support Vector Machine(SVM) 5.5 Prediction 5.5.1 Linear Regression 5.5.2 Nonlinear Regression	**12**
Unit – VI	**6. Accuracy Measures** 6.1 Introduction 6.2 Precision 6.3 Recall 6.4 F-measure 6.5 Confusion Matrix 6.6 Cross Validation 6.7 Bootstrap	**3**
Unit – VII	**7. Clustering** 7.1 Introduction 7.2 K-means 7.3 Expectation Maximization (EM) algorithm 7.4 Hierarchical clustering 7.5 Correlation clustering	**5**
Unit - VIII	**8. Data Mining Trends and Research Frontiers** 8.1 Introduction 8.2 Text mining 8.2.1 Text Mining Approaches 8.2.2 Text Mining Applications 8.3 Web Mining 8.3.1 Web Mining Tasks	**6**

	8.3.2 Web Mining Applications 8.3.3 Basic introduction of Mining Sequence Data a) Mining of Time-Series Data b) Mining of Symbolic Sequences Data c) Mining of Biological Sequences Data d) Mining of Spatial Data e) Mining of Visual and Audio Data	
Unit – IX	**9. Software for data mining** 9.1 Introduction 9.2 The Explorer 9.3 The Knowledge flow interface 9.4 Experimenter 9.5 Command Line Interface 9.6 Decision Tree with the help of weka 9.7 Apriori Algorithm with the help of weka	**4**

References :

1. Data Mining: Concepts and Techniques , Jiawei Han, Micheline Kamber, Jian Pei, Elsevier Morgan Kaumann Publishers.
2. Introduction to data mining : Pang Ning Tan, Michael Steinbach, Vipin Kumar
3. The WEKA Workbench Eibe Frank, Mark A. Hall, and Ian H. Witten Online Appendix for "Data Mining: Practical Machine Learning Tools and Techniques" Morgan Kaufmann, Fourth Edition, 2016
4. [Research-Papers]: Some of the relevant research papers that contain recent results and developments in data mining field

1.

Mapping of this course with Programme Outcomes

Course Outcomes	Programme Outcomes (POs)						
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**
CO1	3	2	3	3	2	2	3
CO2	3	2	3	3	2	2	3
CO3	2	2	3	3	2	2	3
CO4	2	2	3	3	2	2	3
CO5	2	2	3	3	2	2	3
CO6	3	2	3	3	2	2	3
CO7	3	2	3	3	2	2	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

Justification of above mapping:

PO1 – CO1: foundational to the program's knowledge, and a strong understanding is crucial.
PO1 – CO2: Knowledge of algorithms is a key aspect of program knowledge, contributing significantly.
PO1 – CO3: Understanding protocols is essential in demonstrating broad knowledge of the program.

PO1 – CO4: Knowledge of systems is vital for a comprehensive understanding of the program.
PO1 – CO5: Incident response and forensics knowledge enhances the practical understanding of the program's knowledge.
PO1 – CO6: Understanding protocols.
PO1 – CO7: Applying in real-world scenarios demonstrates a deep understanding of program knowledge.

PO2 – CO1, CO2, CO3, CO4, CO5, CO6, CO7 (communication aspects): Communication and collaboration skills are essential for social competence, making these outcomes significant.

PO3 – CO1, CO2, CO3, CO4, CO5, CO6, CO7(analytical skills) : Critical thinking is exercised in problem-solving, making these course outcomes crucial for PO3.

PO4 - CO1, CO2, CO3, CO4, CO5, CO6, CO7 (individual and team work): Personal and professional competence is directly linked to individual and collaborative performance, emphasizing these outcomes.

PO5 - CO1, CO2, CO3, CO4, CO5, CO6, CO7 (research and ethics): Emphasizing academics, research property rights align with scientific temper.
PO6 - CO1, CO2, CO3, CO4, CO5, CO6, CO7 (technology-oriented): Continuous learning in the context of technological changes is crucial, making these outcomes directly align with PO6.

PO7 - CO1, CO2, CO3, CO4, CO5, CO6, CO7 (social concern, ethics): Demonstrating empathetic social concern, fair national development.

Class : M.Sc. (Computer Science)(Semester – II)Paper Code :COMP4203
Title of Paper :Python Programming Paper: III
Credit : 4 No. of Lectures : 50

Course Outcomes:

CO 1 -To understand why Python is a useful scripting language for developers.
CO 2 -To learn how to use lists, tuples, and dictionaries in Python programs.
CO 3 -To learn how to use indexing and slicing to access data in Python programs.
CO 4 -To learn how to write functions and pass arguments in Python.
CO 5 -To learn how to build and package Python modules for reusability.
CO 6 -To learn how to read and write files in Python.
CO 7 -To learn how to design object-oriented programs with Python classes

Prerequisites:

- To introduce various concepts of programming to the students using Python.
- Students should be able to apply the problem solving skills using Python

Learning Objectives: Student successfully computing this course will be able to understand and gain the knowledge of the subject

Units	Title and Contents	No. of Lectures
Unit -I	**Introduction to Python Scripting** • Why Scripting is Useful in Computational Science • Classification of Programming Languages • Productive Pairs of Programming Languages • Gluing Existing Applications • Scripting Yields Shorter Code, Efficiency • Type-Specification (Declaration) of Variables • Flexible Function Interfaces • Interactive Computing • Creating Code at Run Time • Nested Heterogeneous Data Structures • GUI Programming • Mixed Language Programming • When to Choose a Dynamically Typed Language • Why Python? Script or Program? • Application of Python • Concept (immutable)	**06**
Unit -II	**Basic Python** • Python identifiers and reserved words • Lines and indentation, multi-line statements • Comments • Input/output with print and input functions, • Command line arguments and processing command line arguments • Standard data types - basic, none, Boolean (true & False),	**06**

	numbers • Python strings • Data type conversion • Python basic operators (Arithmetic, comparison, assignment, bitwise logical) • Python membership operators (in & not in) • Python identity operators (is & is not) • Operator precedence • Control Statements, Python loops, Iterating by • subsequence index, loop control statements (break, continue, pass) • Mathematical functions and constants (import math), Random number functions	
Unit – III	**Python strings** • Concept, escape characters • String special operations • String formatting operator • Single quotes, Double quotes, Triple quotes • Raw String, Unicode strings, Built-in String methods. • Python Lists - concept, creating and accessing elements, updating & deleting lists, basic list operations, reverse • Indexing, slicing and Matrices • built-in List functions • Functional programming tools - filter(), map(), and reduce() • Using Lists as stacks and Queues, List comprehensions	**06**
Unit - IV	**Python tuples and sets** • Creating & deleting tuples • Accessing values in a tuple • Updating tuples, delete tuple elements • Basic tuple operations • Indexing, slicing and Matrices, built- in tuple functions. • Sets - Concept, operations.	**06**
Unit – V	**Python Dictionary** • Concept (mutable) • Creating and accessing values in a dictionary • Updating dictionary, delete dictionary elements • Properties of dictionary keys • built-in dictionary functions and methods.	**04**
Unit – VI	**Functions** • Defining a function (def) • Calling a function • Function arguments - Pass by value, Keyword Arguments, default arguments • Scope of variable - basic rules • Documentation Strings	**08**

	• Variable Number of Arguments • Call by Reference • Order of arguments (positional, extra & keyword) • Anonymous functions • Recursion • Treatment of Input and Output Arguments • Unpacking argument lists • Lambda forms • Function Objects • function ducktyping& polymorphism • Generators (functions and expressions) and iterators, list comprehensions	
Unit – VII	**Files and Directories** • Creating files • Operations on files (open, close, read, write) • File object attributes, file positions, Listing Files in a Directory • Testing File Types • Removing Files and Directories • Copying and Renaming Files • Splitting Pathnames • Creating and Moving to Directories • Traversing Directory Trees • Illustrative programs: word count, copy file	**06**
Unit – VIII	**Python Classes / Objects** • Object oriented programming and classes in Python - creating classes, instance objects, accessing members • Data hiding (the double underscore prefix) • Built-in class attributes • Garbage collection : the constructor • Overloading methods and operators • Inheritance - implementing a subclass, overriding methods • Recursive calls to methods • Class variables, class methods, and static methods	**08**
Unit – IX	**Python Exceptions** • Exception handling : assert statement • Except clause - with no exceptions and multiple exceptions • Try - finally, raising exceptions, user-defined exceptions.	**02**

Reference Books:

1. Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O,,Reilly Publication
2. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress
3. Practical Programming: An Introduction to Computer Science Using Python 3, Paul Gries, et al., Pragmatic Bookshelf, 2/E 2014

4. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python “, Green Tea Press, 2002
5. E-Books :python_tutorial. pdf, python_book_01.pdf
6. Beginning Programming with Python for Dummies Paperback – 2015 by John Paul Mueller
7. A Beginner‟s Python Tutorial: http://en.wikibooks.org/wiki/A Beginner%27s Python Tutorial.
4. Introduction to Artificial Intelligence and Expert System, Prentice Hall of India Pvt. Ltd., New Delhi, 1997, 2nd Printing, by Dan Patterson

Course Outcomes	**Programme Outcomes (POs)**						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	3	2	3	3
CO2	3	3	3	3	2	3	3
CO3	2	3	3	3	2	3	3
CO4	3	3	3	3	2	3	3
CO5	2	3	3	3	2	3	3
CO6	2	3	3	3	2	3	3
CO7	3	3	3	3	2	3	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related
Course Objectives (CO) and Program Outcomes (PO) Mapping:
1. Justification of PO1 to ALL COs :
CO 1: Partially Related (Weightage: 1) - Understanding Python's scripting utility provides foundational knowledge, but its direct impact on specified areas may vary.
CO 2: Strongly Related (Weightage: 3) - Proficiency with lists, tuples, and dictionaries is fundamental for AI, web services, and other core computing subjects.
CO 3: Moderately Related (Weightage: 2) - Indexing and slicing skills are important for efficient data access, moderately contributing to various areas.
CO 4: Strongly Related (Weightage: 3) - Writing functions and passing arguments is crucial across algorithms, AI, and software project management.
CO 5: Moderately Related (Weightage: 2) - Building reusable modules is beneficial, with a moderate impact on several areas.
CO 6: Moderately Related (Weightage: 2) - File handling skills contribute moderately to data management in different computing domains.
CO 7: Strongly Related (Weightage: 3) - Designing object-oriented programs aligns well with software project management and mobile technologies.
2. Justification of PO2 to ALL COs :
PO2: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) provides a comprehensive foundation for understanding software applications and projects across various dimensions.
3. Justification of PO3 to ALL COs :
PO3: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) ensures a holistic understanding of computer subjects, combining theoretical concepts and practical

programming, facilitated by the use of ICT.

4. Justification of PO4 to ALL COs :

PO4: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) directly contributes to the development of in-house applications by providing essential scripting, data manipulation, modularization, and object-oriented programming skills.

5. Justification of PO5 to ALL COs :

PO5: Moderately Related (Weightage: 2) - Proficiency in Python (CO1-CO7) provides a foundational skill set for engaging with IT experts during visits, offering insights into scripting, data handling, modularization, and object-oriented programming aspects.

6. Justification of PO6 to ALL COs :

PO6: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) enhances the effectiveness of the 6 months Industrial Internship by providing essential scripting, data manipulation, modularization, and object-oriented programming skills crucial in the IT industry.

7. Justification of PO7 to ALL COs :

PO7: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) enhances employability by providing essential scripting, data manipulation, modularization, and object-oriented programming skills aligned with current IT industry demands, fostering responsible citizenship.

Class: M.Sc. (Computer Science) (Semester-II) **PAPER CODE: COMP4204**
Title of paper: Advanced Operating System **PAPER –IV**
Credit -4 **No. of Lectures 50**

Prerequisites:

- Working knowledge of C programming.
- Basic Computer Architecture concepts.
- Basic algorithms and data structure concepts.

Learning Objectives:

Students successfully computing this course will be able to:

- Teaches Advanced Operating Systems Concepts using Unix/Linux and Windows as
  Representative examples.
- Strikes a delicate balance between theory (covered in TextBook-2,3) and practical applications (covered in TextBook-1, 4).
- In fact, most Units start with the theory and then switches focus on how the concepts are implemented in a C program.
- Describes the programming interface to the Unix/Linux system - the system call interface.
- It is intended for anyone writing C programs that run under Unix/Linux.it concludes with an overview of Windows Threads Management.
- Finally it includes with an overview of Android Operating System.

Learning Outcome:

CO1: Understand advanced concepts in Operating System
CO2: Understand execution of system calls
CO3: Explore and innovate in the field of advanced operating systems.
CO4: Understand advanced resource management techniques, including CPU and memory allocation, process management, and I/O optimization.
CO5: Understand the working of Threads
CO6: Understand Kernel Structure.
CO7: Understand advanced memory mapping techniques.

Unit	Title and Contents	No. of lectures
Unit-1	**Introduction to UNIX/Linux Kernel** • System Structure, User Perspective, Assumptions about Hardware, Architecture of UNIX Operating System, • Introduction to kernel, Types of kernel (monolithic, micro) • Concepts of Linux Programming- Files and the Filesystem, Processes, Users and Groups, Permissions, Signals, Interprocess Communication.	**03**
Unit-2	**File and Directory I/O** • Buffer headers, structure of the buffer pool, scenarios for retrieval of a	**13**

	buffer, reading and writing disk blocks, inodes, structure of regular file, open, read, write, lseek, close, pipes, dup ,creat, file sharing, atomic operations, dup2, sync, fsync, and fdatasync, fcntl, /dev/fd,stat, fstat, lstat, file types, Set-User-ID and Set-Group-ID, file access permissions, ownership of new files and directories, access function, umask function, chmod and fchmod, sticky bit, chown, fchown, and lchown, file size,file truncation, file systems, link, unlink, remove, and rename functions, symbolic links, symlink and readlink functions, file times, utime, mkdir and rmdir, reading directories, chdir, fchdir, and getcwd, device special files. • Mapping Files into Memory, Advice for Normal File I/O, I/O Schedulers and I/O Performance, Directories, Copying and Moving files.	
Unit-3	**Process Environment, Process Control and Process Relationships** • Process states and transitions, layout of system memory, the context of a process, saving the context of a process, sleep, process creation, signals, process termination, awaiting process termination, invoking other programs, the user id of a process, changing the size of the process, The Shell, Process Scheduling • Process termination, environment list, memory layout of a C program, shared libraries,environment variables, setjmp and longjmp, getrlimit and setrlimit, process identifiers, fork,vfork, exit, wait and waitpid, waitid, wait3 and wait4, race conditions, exec, changing user IDs and group IDs,system function, user identification, process times • The Process ID, Running a New Process, Terminating a Process, Waiting for Terminated Child Processes, Users and Groups, Daemons, Process Scheduling, Yielding the Processor, Process Priorities, Processor Affinity	**13**
Unit 4	**Memory Management** • The Process Address Space, Allocating Dynamic Memory, Managing Data Segment, Anonymous Memory Mappings, Advanced Memory Allocation, Debugging Memory Allocations, Stack-Based Allocations, Choosing a Memory Allocation Mechanism, Manipulating Memory, Locking Memory, Opportunistic Allocation, Swapping, Demand Paging. • Disk Management- Disk Structure ,Disk Scheduling algorithm, Numerical exercise based on Disk algorithms, Disk management, Swap Space concept and Management, RAID structure, Disk performance issues	**09**
Unit 5	**Signal Handling** • Signal concepts, signal function, unreliable signals, interrupted system calls,SIGCLD semantics, reliable-signal technology, kill and raise, alarm and pause, signal sets, sigprocmask, sigpending, sigsetjmp and siglongjmp, sigsuspend, abort, system function revisited,sleep • Basic Signal Management, Sending a Signal, Signal Sets, Blocking Signals, Advanced Signal Management, Sending a Signal with a Payload.	**05**

Unit 6	**Windows Thread Management** • Thread Internals ✓ Data Structures, Kernel Variables, Performance Counters, Relevant Functions, Birth of a Thread Examining Thread Activity : Limitations on Protected Process Threads, Worker Factories (Thread Pools) • Thread Scheduling ✓ Overview of Windows Scheduling, Priority Levels, Windows Scheduling APIs, Relevant Tools, Real-Time Priorities, Thread States, Dispatcher Database, Quantum, Scheduling Scenarios, Context Switching,	**03**
Unit 7	**Android Operating System** • Architecture of the Android Operating System:- ✓ The Android Software Stack, The Linux Kernel – its functions, essential hardware drivers. Libraries - Surface Manager, Media framework, SQLite, WebKit, OpenGL. Android Runtime - Dalvik Virtual Machine, Core Java Libraries. Application Framework - Activity Manager, Content Providers, Telephony Manager, Location Manager, Resource Manager. Android Application – Activities and Activity Lifecycle, applications such as SMS client app, Dialer, Web browser, Contact manager	**04**

References:

1.Operating System Concepts, 8th Edition by GREG GAGNE, PETER BAER GALVIN, ABRAHAM SILBERSCHATZ
2. Linux System Programming, O'Reilly, by Robert Love.
3. Windows Internals, Microsoft Press, by Mark E. Russinovich and David A. Soloman.
4. The Design of the UNIX Operating System, PHI, by Maurice J. Bach.
5. Advanced Programming in the UNIX Environment, Addison-Wesley, by Richard Stevens

Web links:

Kernel:
https://github.com/nu11secur1ty/Kernel-and-Types-of kernels/blob/master/Kernel%20and%20Types%20of%20kernels.md
Android Developers:
https://www.edgefxkits.com/blog/android-operating-system-advantages/
https://developer.android.com/index.html

Mapping of CO with PO

Course Outcomes	Program Outcomes						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	3	2	3	2
CO2	2	2	2	2	1	2	1
CO3	3	3	3	3	3	3	2
CO4	3	2	3	3	2	3	2
CO5	2	1	2	2	1	2	1
CO6	3	2	3	3	2	3	2
CO7	3	2	3	3	2	3	2

PO1 with all COs
CO1: PO1: Strongly Related (3) - This competency aligns directly with the broader knowledge of the program, emphasizing a deep understanding of advanced operating system concepts.
CO2: PO1: Moderately Related (2) - While this competency is connected to the program's knowledge, it focuses more on specific technical aspects related to system calls.
CO3: PO1: Strongly Related (3) - This competency directly aligns with the program's goal of demonstrating a strong theoretical and practical understanding by encouraging exploration and innovation in advanced operating systems.
CO4: PO1: Strongly Related (3) - This competency directly aligns with the program's emphasis on understanding advanced resource management techniques within the context of operating systems.
CO5: PO1: Moderately Related (2) - While understanding the working of threads is important in the context of operating systems, it is not the sole focus of the program, hence the moderate relationship.
CO6: PO1: Strongly Related (3) - This competency is directly related to the program's goal of demonstrating a strong theoretical and practical understanding of operating systems, focusing on the kernel structure.
CO7: PO1: Strongly Related (3) - This competency aligns well with the program's objective of broad knowledge, emphasizing advanced memory mapping techniques in the context of operating systems.
PO2 with all COs
CO1: PO2: Moderately Related (2) - While understanding advanced OS concepts has relevance to social competence, the direct link to sustainable development is not as strong.
CO2: PO2: Moderately Related (2) - Knowledge of system calls contributes to technical competence, but the direct impact on social competence and sustainable development is moderate.
CO3: PO2: Strongly Related (3) - Innovation in advanced operating systems aligns with social competence and sustainable development, showcasing a strong connection between program knowledge and broader societal goals.
CO4: PO2: Moderately Related (2) - While resource management is essential, the direct link to social competence and sustainable development is moderate.
CO5: PO2: Partially Related (1) - While understanding threads is crucial for technical competence, the direct link to social competence and sustainable development is limited.
CO6: PO2: Moderately Related (2) - Knowledge of kernel structure contributes to technical competence, with a moderate impact on social competence and sustainable development.
CO7: PO2: Moderately Related (2) - Knowledge of memory mapping techniques is relevant for technical competence, with a moderate connection to social competence and sustainable development.
PO3 with all COs
CO1: PO3: Strongly Related (3) - Advanced understanding of operating system concepts directly contributes to critical thinking and problem-solving skills.
CO2:PO3: Moderately Related (2) - While knowledge of system calls is important, its direct impact on critical thinking and problem-solving is moderate.

CO3:PO3: Strongly Related (3) - Exploration and innovation in advanced operating systems demonstrate a high level of critical thinking and problem-solving ability.
CO4: PO3: Strongly Related (3) - Understanding advanced resource management techniques requires critical thinking skills for effective problem-solving in the realm of operating systems.
CO5: PO3: Moderately Related (2) - While understanding threads is important, its direct impact on critical thinking and problem-solving is moderate.
CO6: PO3: Strongly Related (3) - Understanding the kernel structure demands critical thinking skills, contributing significantly to effective problem-solving in operating systems.
CO7: PO3: Strongly Related (3) - Knowledge of advanced memory mapping techniques is closely tied to critical thinking and problem-solving abilities in the field of operating systems.
PO4 with all Cos
CO1: PO4: Strongly Related (3) - A strong understanding of advanced OS concepts is integral to personal and professional competence in the field.
CO2: PO4: Moderately Related (2) - Knowledge of system calls contributes to technical competence but has a moderate impact on personal and professional competence.
CO3: PO4: Strongly Related (3) - Exploration and innovation in advanced operating systems are directly linked to enhancing personal and professional competence.
CO4:PO4: Strongly Related (3) - Understanding advanced resource management techniques is crucial for personal and professional competence in the realm of operating systems.
CO5: PO4: Moderately Related (2) - While understanding threads is important for technical competence, its direct impact on personal and professional competence is moderate.
CO6: PO4: Strongly Related (3) - Understanding the kernel structure is fundamental to personal and professional competence in operating systems.
CO7: PO4: Strongly Related (3) - Knowledge of advanced memory mapping techniques is directly tied to personal and professional competence in operating systems.
PO5 with all Cos
CO1: PO5: Moderately Related (2) - While understanding advanced OS concepts is valuable for research, the direct connection to scientific temper and research ethics is moderate.
CO2: PO5: Partially Related (1) - Knowledge of system calls is crucial for technical competence but has limited direct impact on scientific temper and research ethics.
CO3: PO5: Strongly Related (3) - Exploration and innovation in advanced operating systems align with scientific temper, emphasizing research and intellectual property rights.
CO4: PO5: Moderately Related (2) - Understanding resource management techniques contributes to research, but the direct link to scientific temper is moderate.
CO5: PO5: Partially Related (1) - While understanding threads is important for technical competence, its direct impact on scientific temper and research ethics is limited.
CO6: PO5: Moderately Related (2) - Understanding the kernel structure is relevant for research, but the direct connection to scientific temper is moderate.
CO7: PO5: Moderately Related (2) - Knowledge of advanced memory mapping techniques contributes to research, with a moderate link to scientific temper and research ethics.
PO6 with all Cos

CO1: PO6: Strongly Related (3) - A strong understanding of advanced OS concepts is integral to self-motivated continuous technology-oriented learning.
CO2: PO6: Moderately Related (2) - Knowledge of system calls contributes to technical competence and has a moderate impact on self-motivated continuous learning.
CO3: PO6: Strongly Related (3) - Exploration and innovation in advanced operating systems align with self-motivated continuous learning in technology.
CO4: PO6: Strongly Related (3) - Understanding advanced resource management techniques is crucial for self-motivated continuous learning in the field of operating systems.
CO5: PO6: Moderately Related (2) - While understanding threads is important, its direct impact on self-motivated continuous learning is moderate.
CO6: PO6: Strongly Related (3) - Understanding the kernel structure is fundamental to self-motivated continuous learning in operating systems.
CO7: PO6: Strongly Related (3) - Knowledge of advanced memory mapping techniques is directly tied to self-motivated continuous learning in the field of operating systems.
PO7 with all COs
CO1: PO7: Moderately Related (2) - While a strong understanding of advanced OS concepts is valuable, the direct link to effective citizenship and ethics is moderate.
CO2: PO7: Partially Related (1) - Knowledge of system calls is essential for technical competence but has limited direct impact on effective citizenship and ethics.
CO3: PO7: Moderately Related (2) - Exploration and innovation in advanced operating systems contribute to technical competence but have a moderate link to effective citizenship and ethics.
CO4: PO7: Moderately Related (2) - Understanding resource management techniques is relevant for technical competence, with a moderate connection to effective citizenship and ethics.
CO5: PO7: Partially Related (1) - While understanding threads is important for technical competence, its direct impact on effective citizenship and ethics is limited.
CO6: PO7: Moderately Related (2) - Understanding the kernel structure is relevant for technical competence but has a moderate connection to effective citizenship and ethics.
CO7: PO7: Moderately Related (2) - Knowledge of advanced memory mapping techniques contributes to technical competence, with a moderate link to effective citizenship and ethics.

Class: M.sc.(Computer science) (Semester-II) Paper Code: COMP4205
Title of Paper: Practical On Python Programming & AOS Paper: V (Lab Course)
Credit:4(3 Hr. Practical/week/batch) No.of Practicals:12

Course Outcomes:

CO 1 - To understand why Python is a useful scripting language for developers.
CO 2 - To learn how to use lists, tuples, and dictionaries in Python programs.
CO 3 -To learn how to use indexing and slicing to access data in Python programs.
CO 4 - To learn how to write functions and pass arguments in Python.
CO 5 - To learn how to build and package Python modules for reusability.
CO 6 - To learn how to read and write files in Python.
CO 7 - To learn how to design object-oriented programs with Python classes

Python Assignments	
Assignment 1	Basic python programs
Assignment 2	Strings
Assignment 3	Tuples and sets
Assignment 4	Dictionary
Assignment 5	Functions
Assignment 6	Files and Directories
Assignment 7	Classes/objects
Assignment 8	Exception Handling
AOS Assignments	
Assignment 1	Process management
Assignment 2	Memory Management
Assignment 3	Signal Handling
Assignment 4	Disk Scheduling

Course Outcomes	Programme Outcomes (POs)						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	3	2	3	3
CO2	3	3	3	3	2	3	3
CO3	2	3	3	3	2	3	3
CO4	3	3	3	3	2	3	3
CO5	2	3	3	3	2	3	3
CO6	2	3	3	3	2	3	3
CO7	3	3	3	3	2	3	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

Course Objectives (CO) and Program Outcomes (PO) Mapping:

1. Justification of PO1 to ALL COs :

CO 1: Partially Related (Weightage: 1) - Understanding Python's scripting utility provides foundational knowledge, but its direct impact on specified areas may vary.

CO 2: Strongly Related (Weightage: 3) - Proficiency with lists, tuples, and dictionaries is fundamental for AI, web services, and other core computing subjects.

CO 3: Moderately Related (Weightage: 2) - Indexing and slicing skills are important for efficient data access, moderately contributing to various areas.

CO 4: Strongly Related (Weightage: 3) - Writing functions and passing arguments is crucial across algorithms, AI, and software project management.

CO 5: Moderately Related (Weightage: 2) - Building reusable modules is beneficial, with a moderate impact on several areas.

CO 6: Moderately Related (Weightage: 2) - File handling skills contribute moderately to data management in different computing domains.

CO 7: Strongly Related (Weightage: 3) - Designing object-oriented programs aligns well with software project management and mobile technologies.

2. **Justification of PO2 to ALL COs :**

PO2: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) provides a comprehensive foundation for understanding software applications and projects across various dimensions.

3. Justification of PO3 to ALL COs :

PO3: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) ensures a holistic understanding of computer subjects, combining theoretical concepts and practical programming, facilitated by the use of ICT.

4. Justification of PO4 to ALL COs :

PO4: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) directly contributes to the development of in-house applications by providing essential scripting, data manipulation, modularization, and object-oriented programming skills.

5.Justification of PO5 to ALL COs :

PO5: Moderately Related (Weightage: 2) - Proficiency in Python (CO1-CO7) provides a foundational skill set for engaging with IT experts during visits, offering insights into scripting, data handling, modularization, and object-oriented programming aspects.

6.Justification of PO6 to ALL COs :

PO6: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) enhances the effectiveness of the 6 months Industrial Internship by providing essential scripting, data manipulation, modularization, and object-oriented programming skills crucial in the IT industry.

7.Justification of PO7 to ALL COs :

PO7: Strongly Related (Weightage: 3) - Proficiency in Python (CO1-CO7) enhances employability by providing essential scripting, data manipulation, modularization, and object-oriented programming skills aligned with current IT industry demands, fostering responsible citizenship.

Class: M.sc.(Computer science) (Semester-II) **Paper Code: COMP4206**

Title of Paper: Project **Paper: VI (Lab Course) Credit: 4(3 Hr. Practical/week/batch)** **No. of Practicals:12**

Instructions for Project:

- The Project can be platform, language and technology independent.
- Project will be evaluated by the project guide.
- Assessment will be done weekly in the respective batch.
- Evaluation will be on the basis of weekly progress of project work, progress report, oral, results and documentation and demonstration.
- You should fill your status of project work on the progress report and get the signature of project guide regularly.
- Progress report should sharply focus how much time you have spent on specific task? You should keep all sign progress report.
  Project will not be accepted, if progress report is not submitted and all the responsibilities remain with student.

Course Outcome:

CO1: The Project can be platform, language and technology independent.
CO2: Project will be evaluated by the project guide.
CO3: Assessment will be done weekly in the respective batch.
CO4: Evaluation will be on the basis of weekly progress of project work, progress report, oral, results and documentation and demonstration.
CO5: You should fill your status of project work on the progress report and get the signature of project guide regularly.
CO6: Progress report should sharply focus how much time you have spent on specific task ? You should keep all sign progress report.
CO7: Project will not be accepted, if progress report is not submitted and all the responsibilities remain with student

The format of Progress Report is:

Roll No. & Name of Student:	
Title of the Project:	
Project Guide Name:	

Sr. No.	**Date**	**Details ofProject Work**	**Project Guide Sign (With Date)**
1			
2			
3			
4			

5			
6			
7			
8			
9			
10			
11			
12			

Head
Department of Computer Science

Course Outcomes	**Programme Outcomes (POs)**						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	1	1	2	2
CO2	3	3	3	3	2	3	3
CO3	2	2	2	2	2	2	2
CO4	3	3	3	3	2	3	3
CO5	1	1	1	1	1	1	1
CO6	1	1	1	1	1	1	1
CO7	1	1	1	1	1	1	1

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

Course Objectives (CO) and Program Outcomes (PO) Mapping:

1. Justification of PO1 to ALL COs :

CO1: Partially Related (Weightage: 1) - While the project's independence aligns with diverse IT knowledge (PO1), the direct relationship is partial.

CO2: Strongly Related (Weightage: 3) - The project guide's evaluation directly contributes to understanding project-related subjects (PO1).

CO3: Moderately Related (Weightage: 2) - Weekly assessments correlate with a comprehensive grasp of various IT areas (PO1).

CO4: Strongly Related (Weightage: 3) - Evaluation based on progress, oral, and documentation aligns with enriched knowledge and practical skills (PO1).

CO5: Partially Related (Weightage: 1) - Regular status updates somewhat connect with understanding IT trends and subjects (PO1).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to enriched IT knowledge (PO1).

CO7: Partially Related (Weightage: 1) - non-submission consequences partially align with the responsibility aspect of enriched IT knowledge (PO1).

2. **Justification of PO2 to ALL COs :**

CO1: Strongly Related (Weightage: 3) - The platform and technology independence aligns with the comprehensive understanding of software application concepts (PO2).

CO2: Strongly Related (Weightage: 3) - Project evaluation by the guide directly contributes to students' grasp of software application and project concepts (PO2).

CO3: Moderately Related (Weightage: 2) - Weekly assessments correlate moderately with understanding various dimensions of software application concepts (PO2).

CO4: Strongly Related (Weightage: 3) - Evaluation based on weekly progress aligns with the depth of understanding software application and project dimensions (PO2).

CO5: Partially Related (Weightage: 1) - Regular status updates have a partial connection with understanding software application concepts (PO2).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to the depth of understanding software application concepts (PO2).

CO7: Partially Related (Weightage: 1) - Non-submission consequences partially align with the responsibility aspect of understanding software application concepts (PO2).

3. Justification of PO3 to ALL COs :

CO1: Strongly Related (Weightage: 3) - The project's platform independence aligns strongly with students' understanding of computer subjects and programming concepts (PO3). CO2: Strongly Related (Weightage: 3) - Project evaluation by the guide directly contributes to students' understanding of computer subjects and programming (PO3).

CO3: Moderately Related (Weightage: 2) - Weekly assessments moderately align with demonstrating theoretical and programming concepts (PO3).

CO4: Strongly Related (Weightage: 3) - Evaluation based on weekly progress, oral, and documentation aligns strongly with demonstrating computer subjects and programming concepts (PO3).

CO5: Partially Related (Weightage: 1) - Regular status updates have a partial connection with demonstrating computer subjects and programming (PO3).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to demonstrating computer subjects and programming (PO3).

CO7: Partially Related (Weightage: 1) - Non-submission consequences partially align with the responsibility aspect of understanding computer subjects and programming (PO3).

4. Justification of PO4 to ALL COs :

CO1: Strongly Related (Weightage: 3) - The project's platform independence aligns strongly with the goal of developing in-house applications and projects (PO4).

CO2: Strongly Related (Weightage: 3) - Project evaluation by the guide directly contributes to the development of in-house applications (PO4).

CO3: Moderately Related (Weightage: 2) - Weekly assessments moderately align with the continuous development of in-house applications (PO4).

CO4: Strongly Related (Weightage: 3) - Evaluation based on weekly progress, oral, and documentation aligns strongly with the development of in-house applications (PO4).

CO5: Partially Related (Weightage: 1) - Regular status updates have a partial connection with the development of in-house applications (PO4).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to the development of in-house applications (PO4).

CO7: Partially Related (Weightage: 1) - Non-submission consequences partially align with the responsibility aspect of developing in-house applications (PO4).

5.Justification of PO5 to ALL COs :

CO1: Partially Related (Weightage: 1) - Platform independence, while important for projects, has a partial connection with IT visits and interactions with experts (PO5).

CO2: Moderately Related (Weightage: 2) - Project evaluation aligns moderately with the goal of interacting with IT experts during visits (PO5).

CO3: Moderately Related (Weightage: 2) - Weekly assessments moderately correlate with gaining knowledge through IT visits and interactions with experts (PO5).

CO4: Moderately Related (Weightage: 2) - Evaluation based on weekly progress aligns moderately with the objectives of IT visits and knowledge interaction (PO5).

CO5: Partially Related (Weightage: 1) - Regular status updates have a partial connection with the interaction with IT experts during visits (PO5).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to the goals of IT visits and knowledge interaction (PO5).

CO7: Partially Related (Weightage: 1) - Non-submission consequences partially align with the responsibility aspect of IT visits and knowledge interaction (PO5).

6.Justification of PO6 to ALL COs :

CO1: Moderately Related (Weightage: 2) - Platform independence, while crucial for projects, has a moderate connection with the objectives of industrial exposure through internships (PO6).

CO2: Strongly Related (Weightage: 3) - Project evaluation aligns strongly with the goals of gaining industrial exposure during the internship (PO6).

CO3: Moderately Related (Weightage: 2) - Weekly assessments moderately correlate with the objectives of industrial exposure through internships (PO6).

CO4: Strongly Related (Weightage: 3) - Evaluation based on weekly progress aligns strongly with the goals of industrial exposure through internships (PO6).

CO5: Partially Related (Weightage: 1) - Regular status updates have a partial connection with the objectives of industrial exposure during the internship (PO6).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to the goals of industrial exposure through internships (PO6).

CO7: Partially Related (Weightage: 1) - Non-submission consequences partially align with the responsibility aspect of industrial exposure during the internship (PO6).

7.Justification of PO7 to ALL COs :

CO1: Moderately Related (Weightage: 2) - Platform independence is moderately connected to the employability goal and responsibility as a citizen (PO7).

CO2: Strongly Related (Weightage: 3) - Project evaluation aligns strongly with making students employable and responsible citizens (PO7).

CO3: Moderately Related (Weightage: 2) - Weekly assessments moderately correlate with the employability objective and responsibility as a citizen (PO7).

CO4: Strongly Related (Weightage: 3) - Evaluation based on weekly progress aligns strongly with the goals of employability and responsibility as a citizen (PO7).

CO5: Partially Related (Weightage: 1) - Regular status updates have a partial connection with employability and responsibility as a citizen (PO7).

CO6: Partially Related (Weightage: 1) - Time tracking in progress reports has a partial link to the goals of employability and responsibility as a citizen (PO7).

CO7: Partially Related (Weightage: 1) - non-submission consequences partially align with the responsibility aspect of employability and being a responsible citizen (PO7).

Class: M.sc.(Computer science) (Semester-II) Paper Code:COMP4207
Title of Paper: Artificial Intelligence Paper: VII
Credit:4 No. of lectures:48

Learning Objectives: Student successfully completing this course will be able to

- Understand and gain the knowledge of the subject

Learning Outcome:

CO1: Understand the Working knowledge of C programming.
CO2: Understand Basic Computer Architecture concepts.
CO3: Know the Basic algorithms and data structure concepts
CO4: Analyze Solve basic AI based problems
CO5: Define the concept of Artificial Intelligence
CO6: Apply AI techniques to real-world problems to develop intelligent systems.
CO7: Select appropriately from a range of techniques when implementing intelligent systems.

Units	Title and Contents	No. of Lectures
Unit –I	**Introduction** - What is AI -Goals of AI -AI & related fields -AI technique -Introduction to robotics -Robot components (embodiment, sensors, states, action, brains & brawn, autonomy, arms, legs, wheels, tracks) -languages use in robotics. -latest trends (ASIMO,SOPHIA…..)	**8**
Unit –II	**Problem,Problem Spaces & Search** -state space search -production system -search & control strategies -problem characteristics -issues in the design of search program.	**6**
Unit – III	**Heuristics Search Techniques** -Heuristics search technique -Generate and test algorithm -Hill climbing(Simple hill climbing, Steepest hill climbing, Simulated annealing) -Best First Search(A* algorithm) -Problem Reduction(AND-OR-Graphs,AO* algorithm) -Constraint Satisfaction -Mean-Ends Analysis	**8**
Unit - IV	**Knowledge Representation** -Knowledge representation and mapping -Approaches to knowledge representation -Types of knowledge -Propositional Logic	**8**

	-Predicate Logic -CNF -Resolution -Forward & Backward chaining system	
Unit – V	**Slot & Filler Structures** -Introduction ✓ Semantic network ✓ Inference in semantic net ✓ Partitioned semantic net-Frames -CD(conceptual dependency) -Script -CYC(CYC Motivation,CYCL)	**6**
Unit – VI	**Game Playing** -Introduction -Min-Max algorithm -Adding alpha-beta cutoff -Uncertainty Reasoning(Basic probability axioms, Baye's rule,Certaintytheory,Bayesianclassification,Dempster-Shafer Theory)	**6**
Unit – VII	**Learning** -Introduction -Rote learning -Learning by Taking Advice -Learning in problem solving(Learning by parameter adjustment,Learning by macro operators,Learning by chunking) -Learning from Example-Induction -Winston Learning Program(Version Spaces,Decision trees) -Explanation Based Learning(EBL)(EBL Architecture,EBL System Schematic)	**6**

References:

1. Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832
2. Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901
3. Artificial Intelligence, Tata McGraw Hill, 2nd Edition, by Elaine Rich and Kevin Knight
4. Introduction to Artificial Intelligence and Expert System, Prentice Hall of India Pvt. Ltd., New Delhi, 1997, 2nd Printing, by Dan Patterson

Mapping of this course with Program Outcomes

Course Outcomes	**Programme Outcomes (POs)**						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2	3	2	1	3	3
CO2	2	1	3	1	1	3	3
CO3	3	3	3	3	1	3	3
CO4	3	2	3	3	1	3	3
CO5	3	2	2	1	2	2	3
CO6	3	3	3	3	2	3	3
CO7	2	3	3	3	2	3	3

Weight: 1 - Partially related 2 - Moderately Related 3 - Strongly related

1. **Justification of PO1 to ALL CO's:**

CO1: Understand the Working knowledge of C programming.
PO1: Enrich the knowledge in the areas like Programming Language Paradigms.
Mapping: 3 (Strongly related) - C programming is a fundamental aspect of programming languages.

CO2: Understand Basic Computer Architecture concepts.
PO1: Enrich the knowledge in the areas like Paradigm of Programming language.
Mapping: 2 (Moderately related) - Understanding computer architecture concepts are relevant to programming language paradigms.

CO3: Know the Basic algorithms and data structure concepts.
PO1: Enrich the knowledge in the areas like Design and Analysis of Algorithms.
Mapping: 3 (Strongly related) - Basic algorithms and data structures are directly related to the design and analysis of algorithms.

CO4: Analyze Solve basic AI-based problems.
PO1: Define the concept of Artificial Intelligence.
Mapping: 3 (Strongly related) - Solving AI-based problems are directly related to understanding the concept of Artificial Intelligence.

CO5: Define the concept of Artificial Intelligence.
PO1: Define the concept of Artificial Intelligence.
Mapping: 3 (Strongly related) - This directly aligns with the goal of defining the concept of Artificial Intelligence.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO6: Apply AI techniques to real-world problems to develop intelligent systems.
Mapping: 3 (Strongly Related) - Direct alignment with the goal of applying AI techniques to real-world problems.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.
PO6: Apply AI techniques to real-world problems to develop intelligent systems.
Mapping: 2 (Moderately related) - This is related to applying AI techniques, but the emphasis is on the selection of appropriate techniques.

In summary:
CO1, CO3, CO4, CO5, CO6, and CO7 are strongly related to the program outcomes.
CO2 is moderately related to the program outcomes.

This mapping indicates the alignment of course outcomes with program outcomes, providing a framework for understanding how the individual components contribute to the broader educational goals.

2. Justification of PO2 to ALL CO's:

CO1: Understand the Working knowledge of C programming.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 2 (Moderately related) - C programming is a foundational skill for software applications and projects, but it's not the only dimension.

CO2: Understand Basic Computer Architecture concepts.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 1 (Partially Related) - While computer architecture is important for software applications, it may not cover all dimensions of software application concepts and projects.
CO3: Know the Basic algorithms and data structure concepts.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 3 (Strongly related) - Understanding algorithms and data structures are crucial for various dimensions of software applications and projects.

CO4: Analyze Solve basic AI based problems.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 2 (Moderately related) - a Solving AI-based problem contributes to understanding software applications, but it may not cover all dimensions.

CO5: Define the concept of Artificial Intelligence.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 2 (Moderately related) - Defining the concept of AI is part of understanding software concepts, but it's not exhaustive.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 3 (Strongly related) - Applying AI techniques to real-world problems aligns well with understanding software applications and projects.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.
PO2: Students understand all dimensions of the concepts of software application and projects.
Mapping: 3 (Strongly related) - Selecting appropriate techniques when implementing intelligent systems is directly related to understanding software application concepts and projects.

In summary:
CO3, CO6, and CO7 are strongly related to the program outcome.

CO1, CO2, CO4, and CO5 are moderately related to the program outcome.

3. Justification of PO3 to ALL CO's:

CO1: Understand the Working knowledge of C programming.
PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 3 (Strongly related) - C programming is a fundamental programming concept, and understanding it with the use of ICT aligns with the program outcome.

CO2: Understand Basic Computer Architecture concepts.
PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 3 (Strongly related) - Understanding computer architecture concepts with the use of ICT aligns with the program outcome.

CO3: Know the Basic algorithms and data structure concepts.
PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 3 (Strongly related) - Demonstrating algorithms and data structure concepts with the use of ICT aligns with the program outcome.

CO4: Analyze Solve basic AI based problems.
PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 3 (Strongly related) - a Solving AI-based problem with the use of ICT aligns with the program outcome.

CO5: Define the concept of Artificial Intelligence.
PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 2 (Moderately related) - Defining the concept of AI may not necessarily require extensive use of ICT, but it still aligns to some extent.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 3 (Strongly related) - Applying AI techniques to real-world problems with the use of ICT aligns with the program outcome.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.

PO3: Students understand the computer subjects with the demonstration of all programming and theoretical concepts with the use of ICT.
Mapping: 3 (Strongly related) - Selecting techniques when implementing intelligent systems with the use of ICT aligns with the program outcome.
In summary:

CO1, CO2, CO3, CO4, CO6, and CO7 are strongly related to the program outcome.
CO5 is moderately related to the program outcome.

4.Justification of PO4 to ALL CO's:
CO1: Understand the Working knowledge of C programming.
PO4: Developed in-house applications in terms of projects.
Mapping: 2 (Moderately related) - C programming is a foundational skill for application development, but it's just one aspect of developing in-house applications.

CO2: Understand Basic Computer Architecture concepts.
PO4: Developed in-house applications in terms of projects.
Mapping: 1 (Partially Related) - While understanding computer architecture is important, it may not directly contribute to the development of in-house applications in terms of projects.

CO3: Know the Basic algorithms and data structure concepts.
PO4: Developed in-house applications in terms of projects.
Mapping: 3 (Strongly related) - Knowing basic algorithms and data structures is crucial for the development of in-house applications.

CO4: Analyze Solve basic AI based problems.

PO4: Developed in-house applications in terms of projects.
Mapping: 3 (Strongly related) - Analyzing and solving AI-based problems directly contributes to the development of in-house applications involving AI.

CO5: Define the concept of Artificial Intelligence.
PO4: Developed in-house applications in terms of projects.
Mapping: 1 (Partially related) - Defining the concept of AI is foundational but may not be directly related to the development of in-house applications.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO4: Developed in-house applications in terms of projects.
Mapping: 3 (Strongly related) - Applying AI techniques to real-world problems aligns directly with the development of intelligent systems for in-house applications.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.

PO4: Developed in-house applications in terms of projects.
Mapping: 3 (Strongly related) - Selecting techniques when implementing intelligent systems is directly related to the development of in-house applications.
In summary:

CO1 is moderately related to the program outcome.
CO2 and CO5 are partially related to the program outcome.
CO3, CO4, CO6, and CO7 are strongly related to the program outcome.

5.Justification of PO5 to ALL CO's:
CO1: Understand the Working knowledge of C programming.
PO5: Interact with IT experts & knowledge by IT visits.
Mapping: 1 (Partially related) - Understanding C programming is essential, but it may not be the primary focus of interactions during IT visits.

CO2: Understand Basic Computer Architecture concepts.
PO5: Interact with IT experts & knowledge by IT visits.
Mapping: 1 (Partially related) - Understanding computer architecture is important, but the depth of interaction during IT visits may vary.

CO3: Know the Basic algorithms and data structure concepts.
PO5: Interact with IT experts & knowledge by IT visits.
Mapping: 1 (Partially related) - While knowledge of algorithms and data structures is valuable, it may not be the primary focus of interactions during IT visits.

CO4: Analyze Solve basic AI based problems.
PO5: Interact with IT experts & knowledge by IT visits.
Mapping: 1 (Partially related) - Analyzing and solving AI problems may not be the primary focus of interactions during IT visits, but it can contribute to discussions with experts.

CO5: Define the concept of Artificial Intelligence.
PO5: Interact with IT experts & knowledge by IT visits.
Mapping: 2 (Moderately related) - Discussing and defining AI concepts can be a part of interactions during IT visits.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO5: Interact with IT experts & knowledge by IT visits.
Mapping: 2 (Moderately related) - Applying AI techniques may be discussed during IT visits, especially if they involve real-world applications.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.
PO5: Interact with IT experts & knowledge by IT visits.

Mapping: 2 (Moderately related) - Selecting techniques when implementing intelligent systems can be a topic of discussion during IT visits.
In summary:

CO1, CO2, CO3, CO4, CO6, and CO7 are partially related to the program outcome.
CO5 is moderately related to the program outcome.

6.Justification of PO6 to ALL CO's:
CO1: Understand the Working knowledge of C programming.
PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.
Mapping: 3 (Strongly related) - Understanding C programming is foundational and is likely to be applied during an industrial internship.

CO2: Understand Basic Computer Architecture concepts.
PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.
Mapping: 3 (Strongly related) - Understanding computer architecture is essential for real-world applications, and this knowledge can be applied during an industrial internship.

CO3: Know the Basic algorithms and data structure concepts.
PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.
Mapping: 3 (Strongly related) - Knowledge of algorithms and data structures is crucial in real-world projects, and this can be applied during an industrial internship.

CO4: Analyze Solve basic AI based problems.
PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.
Mapping: 3 (Strongly related) - Analyzing and solving AI problems can be part of industrial exposure, especially if the internship involves AI applications.

CO5: Define the concept of Artificial Intelligence.
PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.
Mapping: 2 (Moderately related) - Defining the concept of AI may not be the primary focus during an internship, but understanding AI concepts could be useful.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.
Mapping: 3 (Strongly related) - Applying AI techniques to real-world problems aligns directly with the goal of an industrial internship.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.

PO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.

Mapping: 3 (Strongly related) - Selecting techniques for implementing intelligent systems can be a key aspect of industrial exposure.
In summary:

CO1, CO2, CO3, CO4, CO6, and CO7 are strongly related to the program outcome.
CO5 is moderately related to the program outcome.

7.Justification of PO7 to ALL CO's:

CO1: Understand the Working knowledge of C programming.
PO7: To make them employable according to the current demand of IT Industry and responsible citizens.
Mapping: 3 (Strongly related) - Understanding C programming is crucial for employability in the IT industry.

CO2: Understand Basic Computer Architecture concepts.
PO7: To make them employable according to the current demand of IT Industry and responsible citizens.
Mapping: 3 (Strongly related) - Understanding computer architecture is important for employability in the IT industry.

CO3: Know the Basic algorithms and data structure concepts.
PO7: To make them employable according to the current demand of IT Industry and responsible citizens.
Mapping: 3 (Strongly related) - Knowing basic algorithms and data structures is fundamental for employability in the IT industry.

CO4: Analyze Solve basic AI based problems.
PO7: To make them employable according to the current demand of IT Industry and responsible citizens.
Mapping: 3 (Strongly related) - Analyzing and solving AI problems is relevant for employability in the IT industry.

CO5: Define the concept of Artificial Intelligence.
PO7: To make them employable according to the current demand of IT Industry and responsible citizens.
Mapping: 3 (Strongly related) - Defining the concept of AI contributes to employability in the IT industry.

CO6: Apply AI techniques to real-world problems to develop intelligent systems.
PO7: To make them employable according to the current demand of IT Industry and responsible citizens.

Mapping: 3 (Strongly related) - Applying AI techniques to real-world problems enhances employability in the IT industry.

CO7: Select appropriately from a range of techniques when implementing intelligent systems.

PO7: To make them employable according to the current demand of IT Industry and responsible citizens.
Mapping: 3 (Strongly related) - Selecting techniques for implementing intelligent systems is relevant for employability in the IT industry.

In summary:
All COs (CO1 through CO7) are strongly related to PO7.
Additionally, considering PS08, the focus on publishing work in reputed journals could be related to various COs, particularly CO6 and CO7, where students are applying and implementing advanced techniques.