Anekant Education Society's

Tuljaram Chaturchand College, Baramati

(Autonomous)

M.Sc. Degree Program in Computer Science

(Faculty of Science & Technology)

Syllabus

M .Sc.(Computer Science) Semester -II

For Department of Computer Science

Tuljaram Chaturchand College, Baramati

Choice Based Credit System Syllabus (2022 Pattern)

To be implemented from Academic Year 2022-2023

Programme Specific Outcomes (PSOs)

For M.Sc. (Computer Science)

After completing M.Sc. Computer Science Program students will be able to:

PSO1: Enrich the knowledge in the areas like Artificial Intelligence, Web Services, Cloud Computing, Paradigm of Programming language, Design and Analysis of Algorithms, Database Technologies Advanced Operating System, Mobile Technologies, Software Project Management and core computing subjects. Choose to study any one subject among recent trends in IT provided in the optional subjects.

PSO2: Students understand all dimensions of the concepts of software application and projects.

PSO3: Students understand the computer subjects with demonstration of all programming and theoretical concepts with the use of ICT.

PSO4: Developed in-house applications in terms of projects.

PSO5: Interact with IT experts & knowledge by IT visits.

PSO6: Get industrial exposure through the 6 months Industrial Internship in IT industry.

PSO7: To make them employable according to current demand of IT Industry and responsible citizen.

M.Sc. (Computer Science) I (Sem I)

2019Pattern		2022Pattern	
Subject	**Paper Code**	**Paper Code**	**Paper Title**
Principles of Programming Languages	COMP4101	PSCS111	Principles of Programming Language (C)
Cryptography & Network Security	COMP4102	PSCS112	Cryptography and Cyber Forensics(C)
Database Technologies	COMP4103	PSCS113	Database Technologies (C)
Design and Analysis of Algorithms	COMP4104	PSCS114	Design and Analysis of Algorithms(C)
Programming with DOTNET	COMP4105	PSCS115	Dot Net Framework& C# (C)
Lab Course on DOT NET, PPL and Database Technologies	COMP4106	PSCS116	Lab Course on Dot Net, PPL,DBT&DAA(C)
Human Rights–I	HR-101	HR1	Human Rights – I
Introduction to Cyber Security–I	CYS-101	CYS1	Introduction to Cyber Security–I

M.Sc. (Computer Science) I (Sem II)

2019Pattern		2022 Pattern	
Paper Title	**Paper Code**	**Paper Code**	**Paper Title**
Digital Image Processing	COMP4201	PSCS121	Digital Image Processing
Data Mining and Data Warehousing	COMP4202	PSCS122	Data Mining and Data Warehousing
Python Programming	COMP4203	PSCS123	Emerging Technologies: Python Programming
Advanced Operating System	COMP4204	PSCS124	Dot Net (Advanced): ASP.NET Core using MVC.
Lab Course on Python Programming & Advance Operating System	COMP4205	PSCS125	Lab course on Dot Net and Python
Project	COMP4206	PSCS126	Project
Artificial Intelligence	COMP4206	PSCS127(A) Or PSCS127(B)	Artificial Intelligence Or Advanced Operating System
Introduction to Cyber Security–I	CYS-101	CYS-102	Introduction to Cyber Security–II

M. Sc. (Computer Science)

Semester-II

Class: M.Sc. (Computer Science) Semester-II Paper Code:PSCS121
Title of Paper: Digital Image Processing Paper: I
Credit: 4 No. of lectures:48

Learning Outcomes:

- To study the image fundamentals and mathematical transforms necessary for image processing.
- To study the image enhancement techniques
- To study image restoration procedures.
- To study the image compression procedures

Course Objectives:

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
Unit – I	**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	03
Unit – II	**Digital Image Fundamentals** Motivation and Perspective, Applications Components of Image Processing System Fundamentals Steps in Image Processing, Image Sampling and Quantization Some Basic Relationships like Neighbors, Connectivity, Distance Measures between pixels.	10
Unit – III	**Image Enhancement in the Spatial and Frequency Domain** Image enhancement point and neighborhood processing, Basic Gray Level Transformation, Histogram Processing, Enhancement Using Arithmetic and Logic Operations, Zooming Basics of Spatial Filters, Smoothening and Sharpening Spatial Filters Combining Spatial Enhancement Methods. Introduction to Fourier Transform and the frequency Domain, Smoothing and Sharpening Frequency Domain Filters, Homomorphic Filtering.	10

Unit – IV	**Image Restoration** Models of Image Degradation / Restoration Process, Noise Models, Restoration in presence of Noise using Spatial Filters Linear Position-Invariant Degradations, Estimation of Degradation Function, Inverse filtering, Wiener filtering Constraint Least Square Filtering Geometric Mean Filter and Geometric Transformations	08
Unit – V	**Image Segmentation and Morphological Image Processing** Discontinuity based Segmentation, similarity-based segmentation Edge linking and boundary detection Threshold, Region based Segmentation Introduction to Morphology, Dilation, Erosion Some basic Morphological Algorithms	7
Unit – VI	**Object Representation and description** Representation, Boundary Descriptors, Regional Descriptors, Chain Code, Structural Methods. Different Application Areas of Digital Image Processing.	10

NOTE: Internal Evaluation of this Subject includes Case Studies on different application areas.
NOTE: 48 LECTURES FOR CURRICULUM (TEACHING) &12 LECTURES FOR LEARNING

Reference Books:

1) Rafael C. Gonzalez and Richard E. Woods, "Digital Image processing", 2Nd edition, Pearson Education.
2) David A. Forsyth, jean ponce, "computer Vision: A Modern Approach",Prentice Hall
3) A.K. Jain "Fundamental of Digital Image processing", PHI.

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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (Weightage: 1 - Partially Related)
Justification: Categorizing compression techniques may not directly align with every aspect of PO1 but involves elements of algorithmic understanding.
CO6- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (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- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (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- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (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- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (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- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (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- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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- Review the fundamental concepts of a digital image processing system (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- Develop and implement algorithms for digital image processing (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- Analyze images in the frequency domain using various transforms (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- Evaluate the techniques for image enhancement and image restoration (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- Categorize various compression techniques (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- Interpret Image compression standards (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- Interpret image segmentation and representation techniques (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: PSCS122**
Title of Paper: Data Mining and Data Warehousing **Paper: II**
Credit:4 **No. of Lectures:60**

Prerequisites:

- Basic Knowledge of databases handling.

Learning Objectives:

- To study different data preprocessing techniques.
- Tointroducethecoreconceptsofdatawarehousingtechniquesandimplementation.
- Tointroducethecoreconceptsofdataminingtechniquesandapplications.
- To study advanced data mining techniques.
- Tousedataminingsoftwareonvariousdatasetsbyusingproperalgorithms.

Learning Outcomes:

- Studentswillunderstandboththetheoreticalandpracticalaspectsdatamining.
- Understand basic data mining algorithms, methods, and tools
- Understand data mining principles and techniques:
- Understanding the basic concepts of OLAP.
- Understanding the basic concepts of Data Warehouse.
- Understand the functionality of the various data mining and data warehousing component
- Appreciate the strengths and limitations of various data mining and data warehousing models

Unit	Title and Contents	No. of Lectures
Unit– I	**1.DataPreprocessing** 1) Introduction 2) Data Processing prerequisites 3) Data Objects and AttributeT ypes i) Attribute ii) Nominal Attributes iii) Binary Attributes iv) Ordinal Attributes v) Numeric Attributes vi) Discrete Attributes vii) Continuous Attributes 4) Need for Preprocessing 5) Major Tasks in Data Preprocessing i) Data Cleaning ii) Data Integration iii) Data Reduction iv) Data Transformation v) Data Discretization 6) Missing Values 7) Noisy Data	**4**
	2.IntroductiontoDataWarehousing 1) Introduction 2) DataWarehouse:BasicConcepts i) Datawarehousedefinition ii) ComparisonofOLTPandOLAP	**7**

Unit– II	iii) Datamart 3) Meta data Repository 4) Architecture of Data Warehouse 1) Data Warehouse Models a) Enterprise Warehouse b) DataMart c) Virtual Warehouse 2) Data Cube and OLAP i) Dimension ii) Fact iii) Measures iv) Dimension Table v) Fact Table vi) Data Cube vii) Cuboid, Apex Cuboid, Base Cuboid 3) OLA operations 4) Dimensional Data Modeling a) Star Schema b) Snow flake Schema 5) Fact Constellation Schema	
Unit– III	**3.IntroductiontoDataMining** 1) Introduction 2) Data Mining: Basic Concepts 3) Knowledge Discovery in Data bases Process 4) Data Mining Tasks i) Descriptive ii) Predictive 5) Data Mining Issues 6) Data Mining Metrics 7) Social Implications of Data Mining Applications of Data Mining	6
Unit– IV	**4.DataMiningTechniques** 1) Introduction 2) Frequent item-sets and association rule mining a) Itemset b) Frequent Pattern c) Support d) Confidence e) Downward-Closure Property f) Market Bakst Analysis g) Horizontal Data format h) Vertical Data format 3) Apriori algorithm 4) FP-Tree algorithm 5) Graph Mining a) Frequent Sub-graph mining b) Apriori-based Approach c) Pattern growth Approach 6) Treemining	**8**

Unit-V	**5.Classification&Prediction** 1) Introduction 2) Decision Tree Learning i) Construction ii) Basic Decision Tree Algorithm iii) Performance iv) Attribute Selection v) Issues 3) Classification and Regression Tree(CART) 4) Bayesian Classification i) Bays Theorem ii) Navie Baysian Classfier iii) Bayesian Network iv) Inference v) Parameter Learning vi) Structure Learning 5) Linear Classification a) Least Squares b) Perceptron c) Support Vector Machine(SVM) 6) Prediction a) Linear Regression b) Non linear Regression	**8**
Unit–VI	**6.AccuracyMeasures** 1) Introduction 2) Precision 3) Recall 4) F-measure 5) Confusion Matrix 6) Cross Validation 7) Bootstrap	4
Unit– VII	**7.Clustering** 1) Introduction 2) K-means 3) Expectation Maximization(EM)algorithm 4) Hierarchical clustering Correlation clustering	4
Unit– VIII	**8.DataMiningTrendsandResearchFrontiers** 1) Introduction 2) Text mining i) Text Mining Approaches ii) Text Mining Applications 3) Web Mining a) Web Mining Tasks b) Web Mining Applications 4) 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 Visualand AudioData	4

Unit– IX	**9.Softwarefordatamining** 1) Introduction 2) The Explorer 3) The Knowledge flowinter face 4) Experimenter 5) Command Line Interface 6) Decision Tree with the help of weka 7) Apriori Algorithm with the helpofweka	**3**

NOTE:*48Lecturefor curriculum(teaching)&12 lecturesforlearning*

References:

1. DataMining: Conceptsand Techniques, JiaweiHan,MichelineKamber,JianPei,ElsevierMorganKaumannPublishers.
2. Introduction to datamining: Pang Ning Tan, Michael Steinbach, Vipin Kumar
3. The WEKA Workbench Eibe Frank, Mark A. Hall, and Ian H. Witten Online Appendix for "DataMining:PracticalMachineLearningToolsandTechniques"MorganKaufmann,FourthEdition,2016
4. [Research-Papers]: Some of the relevant research papers that contain recent results and developmentsindata mining field.

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: PSCS123**
Title of Paper: Emerging Technologies – Python Programming **Paper: III**
Credit :4 **No. of Lectures: 48**

Prerequisites:

- TointroducevariousconceptsofprogrammingtothestudentsusingPython.
- Students should be able to apply the problem-solving skillsusing Python

Course Objectives: Student successfully computing this course will be able

- To understand and gain the knowledge of the all types of programming.
- To understand and solve the functional and procedural problems.

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

Units	Title and Contents	No. of Lectures
Unit-I	**Introduction to Python** • What can Python do? • Why Python? • Good to know • Python Syntax compared to other programming languages • Python Install • The print Statement • Comments • Python Data Structures & Data Types, Dictionary • String Operations in Python • Simple Input & Output • Simple Output Formatting • Operators in python • If Statement, Loop Statement, range, Break & Continue Statement	**10**

Unit-II	**Function and Modules** • Create your own functions • Functions Parameters • Variable Arguments • Scope of a Function • Function Documentations • Lambda Functions& map • n Exercise with functions • Create a Module • Standard Modules	**08**
Unit –III	**Python Exception and File Handling** • Errors • Exception handling with try • handling Multiple Exceptions • Writing your own Exception • File handling Modes • Reading Files • Writing& Appending to Files • Handling File Exceptions The with statement	**08**
Unit -IV	**Python Classes** • Creating Classes • Instance Methods • Inheritance • Interface • Polymorphism • Exception Classes & Custom Exceptions Constructor	**08**
Unit– V	**Threads ESSENTIAL** • Class and threads • Multi-threading • Synchronization • Treads Life cycle • use cases	**08**
Unit –VI	**Mail and Scheduler** • How to Send Mail • How to Send Mail with attachment How to Schedule the mail	**06**

NOTE: 48 LECTURES FOR CURRICULUM (TEACHING) &12 LECTURES FOR LEARNING

Reference Books:

1. Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O,,Reilly Publication
2. Beginning Python: From Noviceto Professional, Magnus LieHetland, Apress
3. Practical Programming: AnIntroductiontoComputerScienceUsingPython3,PaulGries,etal., Pragmatic Bookshelf, 2/E2014
4. Introduction to Computer Science Using Python-Charles Dierbach,WileyPublicationLearningwith Python“,Green TeaPress, 2002
5. E-Books:python_tutorial.pdf,python_book_01.pdf
6. Beginning Programming with Python for Dummies Paperback – John PaulMueller, 2015
7. ABeginner‟sPythonTutorial:http://en.wikibooks.org/wiki/ABeginner%27sPy thonTutorial.

Course Outcomes	**Programme Outcomes (POs)**						
	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	1	3	3	3	2	3	3
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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:

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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: PSCS125
Title of Paper: Lab Course On Dot Net and Python Paper: V (Lab Course)
Credit:4(3Hr.Practical/week /batch) No. of Practicals:12

Learning Objectives:

- Student successfully computing this course will be able to understand and gain the knowledge of the Practical.
- To Understand and create an ability to use current techniques, skills, and tools necessary for Python and Dot Net Programming.

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	
Assignment1	Basic python programs
Assignment2	Tuples and sets
Assignment3	Dictionary
Assignment4	Functions
Assignment5	Files and Directories
Assignment6	Classes/objects
Assignment7	Exception Handling
Assignment8	Threads
Dot Net (Advanced)Assignments	
Assignment1	Basic Programs
Assignment2	Exceptions & Static Files
Assignment3	Attribute Routes
Assignment4	Results, Views, DB Context
Assignment5	Razor View
Assignment6	MVC Basic Programs
Assignment7	MVC Databases
Assignment8	MVC Web API

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: PSCS126**
Title of Paper: Project **Paper: VI (Lab Course)**
Credit:4 (3 Hr. Practical/week/batch) **No. of Practicals:12**

Objectives:

1)Provides students with an opportunity to develop understanding of the operations of a computer system and computer applications software.

2)To develop the skill of using computer applications software for solving problems.

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 of Project 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: PSCS124**
Title of Paper: Dot Net (Advanced) – ASP.NET Core Using MVC **Paper : IV**
Credit :4 **No. of lectures :60**

Prerequisites :

- Knowledge of Dot.Net Framework.
- Familiarity with programming language C #.

Learning Objectives:

- Able to understand the ASP. NET Core.
- To Learn MVC Framework and use it with ASP.Net Code.

Learning Outcome:

CO1. Ability to write the Web application using ASP.Net Core MVC.
CO2. Able to code different web-based applications.
CO3. Learners will be able to design web applications using ASP.NET
CO4. Learners will be able to use ASP.NET controls in web applications.
CO5. Learners will be able to create database driven ASP.NET web applications and web services.
CO6. To learn about basic features of ASP.NET and its controls.
CO7. To create an ASP.NET application.

1.	**ASP.NET MVC** **a.** Pattern **b.** Environment Setup **c.** Getting Started **d.** Life Cycle	**06**
2.	**ASP.NET MVC - Databases** a) Validation b) Security c) Caching **d)** Razor **e)** Data Annotations	**10**
3.	**ASP.NET MVC - Web API** a) Scaffolding b) Bootstrap c) Unit Testing d) Deployment e) Self-hosting	**08**
4.	**Introduction to ASP.Net Core** a) Overview b) Environment Setup c) New Project d) Project Layout e) Project Json f) Configuration g) Middleware h) Exceptions i) Static Files	**10**

5.	**ASP.NET Core - Routing** a) Attribute Routes b) Action Results c) Views d) Setup Entity Framework e) DB Context	**08**
6.	**ASP.NET Core - Razor View Start** a) Razor View Import b) Razor Tag Helpers c) Razor Edit Form d) Identity Overview **e)** Authorize Attribute	**06**

NOTE: 48 LECTURE FOR CURRICULUM (TEACHING) &12 LECTURES FOR LEARNING

Reference Books:

1. Programming ASP.NET Core by Dino Esposito, PHI LEARNING PVT. LTD. | MICROSOFT
2. ASP.NET Core for Jobseekers by Kemal Birer, bpb publication
3. Asp.Net Core Application Development :: Building An Application In Four Sprints, David (Author), PHI Learning
4. Learning ASP.NET Core MVC Programming (English, Paperback, Ragupathi Mugilan T. S.

Mapping of this course outcomes with Programme outcomes

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

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

Justification

PO1 with all CO's

PO1: CO1, CO2, CO3, CO5 & CO7 (Strongly related3)Emphasizing the application of fundamental principles and methods of Computer Science, encompassing web application development, coding, design, database-driven applications, and specific ASP.NET application development.

PO1:CO4 & CO6 **(**Moderately related 2**)** They involve applying fundamental principles through the use of ASP.NET controls and learning about basic features, with a focus that may not be as comprehensive or extensive as writing entire applications.

PO2 with all CO's

PO2:CO1, CO2&CO7 (Moderately related 2) They involve design and implementation, with varying emphasis on documentation for computational problem solutions, web-based applications, and ASP.NET application development.
PO2:CO3&CO5 (Strongly related 3) they involve both the design and implementation of computational solutions, emphasizing the key aspect of designing web applications and creating database-driven applications.
PO2:CO4&CO6 (Partially related 1) Focusing more on the implementation aspects and less on the design and documentation of significant computational problems in the context of using ASP.NET controls and learning about basic features and controls.

PO3 with all CO's

PO3:CO1, CO2, CO3&CO4 (Moderately related 2) Emphasize understanding the basics of ASP.NET Core MVC, web development, ASP.NET, and framework controls, contributing significantly to the basics of the discipline.
PO3:CO5, CO6&CO7 (Strongly related 3) They entail a deeper understanding of ASP.NET, web development basics, and the application of ASP.NET features, contributing directly to the foundational knowledge of the discipline.

PO4 with all CO's

PO4:CO1, CO2, CO3, CO5, CO6&CO7 (Moderately related 2) They contribute to professional development, but the direct link to preparation for continued professional development may vary or be moderate across different aspects of the curriculum.
PO4:CO4 (Partially related 1) Using ASP.NET controls is more about implementation and less about preparation for continued professional development.

PO5 with all CO's

PO5:CO1, CO2, CO3, CO5 & CO7 (Moderately related 2) They contribute to understanding IT solutions, but the explicit connection to societal and environmental impacts may vary or be moderate across different aspects of the curriculum.
PO5:CO4&CO6 (Partially related 1) Using ASP.NET controls and learning about basic features and controls are more focused on implementation rather than emphasizing a comprehensive understanding of the broader impact on society and the environment

PO6 with all CO's

PO6: CO1, CO2, CO5 & CO7 (Strongly related 3) They involve practical implementation, directly contributing to the development of proficiency in computing practices.
PO6: CO3&CO4 (Moderately related 2) Designing web applications contributes to proficiency in computing with a slightly lesser emphasis on practice compared to coding, while using ASP.NET controls is more about practical implementation, contributing to developing proficiency in computing practices.
PO6:CO6 (Partially related 1) Learning about basic features and controls is more theoretical and may not directly emphasize practical proficiency in computing.

PO7 with all CO's

PO7: CO1, CO2, CO5 & CO7 (Strongly related 3) They involve independent study and research, significantly contributing to the capacity for a smooth transition to employment.
PO7: CO3, CO4 & CO6 (Moderately related 2) Involving some independent study and research, fostering a moderate impact on the capacity for a smooth transition to employment, focusing on design, practical implementation, and foundational learning about features and controls.

Class: M.Sc. (Computer Science) Semester-II **Paper Code: PSCS127 (A)**
Title of Paper: Artificial Intelligence **Paper: VII (A) Elective**
Credit: 4 **No. of lectures: 48**

Course objective:

I) Students successfully completing this course will be able to:

- Understand and gain the knowledge of AI's fundamental concepts and methods.

Course Outcomes:

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 to Artificial Intelligence** • About AI ✓ History of AI ✓ What is AI ✓ Goals of AI • Ethics and Privacy issues • AI & Society • AI & related fields • AI technique	**04**
Unit–II	**Problem, Problem Spaces & Heuristics Search Techniques** • State space search • Production Systems • Search & Control Strategies • Problem Characteristics • Issues in the design of search programs. • Additional Problems • 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	**14**
Unit –III	**Knowledge Representation** • Knowledge representation and mapping	**12**

	• Approaches to knowledge representation • Types of knowledge • Propositional Logic • Predicate Logic(FOL) • Logic Programming using Prolog. • CNF • Resolution • Forward & Backward chaining system	
Unit -IV	**Slot & Filler Structures** • Weak Structure ✓ Semanticnetwork ✓ Frames • Strong Structure ✓ CD(conceptual dependency) ✓ Script • CYC(CYC Motivation, CYC)	**08**
Unit -V	**Concepts of Game Playing** • Introduction • Min-Max algorithm • Adding alpha-beta cutoff • Uncertainty Reasoning (Basic probability axioms, Baye's rule, Certainty theory, Bayesian classification, Dempster - Shafer Theory)	**04**
Unit –VI	**Natural Language Processing & Neural Network** • Introduction to NLP. • Stages in NLP • NLP models • Use cases of NLP. • Types of ArtificialNeural network ✓ Feed forward ✓ Feedback • Deep Neural Network	**06**

Note: Mandatory study tour to AI related organization/Company.

References:

1. Eberhart, "Computational Intelligence", Elsevier, ISBN9788131217832
2. Nils J. Nilsson, "Artificial Intelligence: ANewSynthesis", Morgan Kaufmann Publishers, ISBN9788181471901.

3. Elaine Rich, Kevin Knight, “Artificial Intelligence”, Third Edition, Tata McGraw Hill,
2017.
4. Dan Patterson, “Introduction to Artificial Intelligence and Expert System” , Prentice Hall of India Pvt. Ltd., 1997.
5. Wolfgang Ertel, “Introduction to Artificial Intelligence”, Second Edition, Springer, 2017.
6. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India) Pvt. Ltd., 2013.

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.

Class: M. Sc.I (Comp. Sci.) Sem-II **Paper: PSCS127 (B)**
Title: Advanced Operating System **Paper: VII**
Credit: 4 **No. of Lectures: 48**

Prerequisites:

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

Course Objectives:

Students successfully computing this course will be able to:

1. Teaches Advanced Operating Systems Concepts using Unix/Linux and Windows as Representative examples.
2. Strikes a delicate balance between theory and practical applications.
3. In fact, most Units start with the theory and then switches focus on how the concepts are implemented in a C program.
4. Describes the programming interface to the Unix/Linux system - the system call interface.
5. Finally it includes with an overview of Android Operating System.
6. This course provides an understanding of the functions of Operating Systems. It also provides an insight into functional modules of Operating Systems.
7. To introduce file system structures, file operations, and file organization.

Course Outcomes:

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 - I	**Introduction to UNIX/Linux Kernel** • Introduction of an Operating System ➢ Objectives of Operating System and Functions of O.S. • Unix as an Operating System ➢ History and Architecture of Unix Operating System • Introduction to kernel, Types of kernels (monolithic, micro) • Concepts of Linux Programming • Files, Filesystem, Processes, Users and Groups Permissions • Signals & Inter-process Communication • System Programming ➢ Foundation of System Programming ➢ System calls for I/O • User Perspective • Assumptions about Hardware	**03**

Unit - II	**File and Directory I/O** • Introduction to File and Directory • Buffer Headers • Structure of the Buffer Pool • Scenarios for retrieval of a buffer • Reading and Writing disk blocks • Inodes (Accessing inodes and Releasing inodes) • Structure of Regular File • Directories • Pipes & Dup • Mounting and Unmounting of File Systems • File Sharing • Atomic Operations : stat, fstat, lsat functions, file types, file access permissions • Ownership of new Files and Directories ➢ Functions : Access, umask. chmode, fchmode • Sticky Bit • Functions : chown, fchown, lchown • File Size • File Truncation • File Systems ➢ Functions : link, unlink, remove, rename ➢ symbolic links, Functions : symlink and readlink ➢ File Times and utime Function • Functions : mkdir and rmdir ➢ Reading Directories ➢ Functions : chdir, fchdir, getcwd • Advanced File I/O • Mapping Files into Memory • Advice for Normal File I/O • I/O Schedulers and I/O Performance • Files and their Metadata • Copying and Moving files • Out of Band Communication	**13**
	Process Environment, Process Control and Process Relationships • Introduction • Process States and transitions • Context of a Process • Process Creation • Process Termination • Process Control Block ➢ Process Id ➢ Obtaining the Process ID and Parent Process ID ➢ Changing Size of the Process ➢ The Shell ➢ Running a New Process	

Unit - III	• Environment List
	  ➢ Memory layout of a C program
	  ➢ Functions : setjump() and longjump()
	  ➢ Functions : getrlimit() and setrlimit()
	  ➢ Rules for Changing the Resource Limits
	• System Functions
	• Launching and Waiting for a New Process
	• Race Conditions
	• Changing User IDs and Group IDs
	• Daemons
	• Process Scheduling
	• Classification of Process
	• Yielding the Processor
	• Threads
	• Process Priorities
	• Processor Affinity
		13

Unit - IV	**Memory Management**
	• Introduction to Memory Management
	• Process Address Space
	  ➢ Pages and Memory Regions
	• Allocating Dynamic Memory
	  ➢ Allocating Arrays
	  ➢ Resizing Allocation
	  ➢ Freeing Dynamic Memory
	• Alignment
	• Data Segment
	• Anonymous Memory Mappings
	• Advanced Memory Allocation
	• Debugging Memory Allocations
	• Stack-Based Allocations
	• Choosing a Memory Allocation Mechanism
	• Manipulating Memory
	• Locking and Unlocking Memory
	• Locking Limits
	• Opportunistic Allocation
	• Swapping and Demand Paging
	• Disk Management
	  ➢ Disk Structure & Disk Scheduling algorithm
	  ➢ Numerical exercise based on Disk algorithms
	  ➢ Disk management
	  ➢ RAID structure
	  ➢ Disk performance issues
		10

	Signal Handling • Introduction to Signal Handling • Signal Concepts and signal Function • Unreliable Signals	

Unit - V	• Interrupted system calls • Reentrant Functions and SIGCLD semantics • Reliable-Signal Terminology ad Semantic • Functions : kill() , raise() , alarm() , pause() • Process Blocking Signal Mask Using sigpromask() • Signal Sets • Retrieving Pending Signals • sigaction Function and Some More Functions • Nonlocal Braching • Advanced Signal Management • Sending a Signal with a Payload	**05**
Unit - VI	**Windows Thread Management** • Thread Internals ➢ Birth of a Thread and Examining a Thread Activity • Worker Factory • Thread Scheduling ➢ Overview of Windows Scheduling API ➢ Priority Levels ➢ Windows API Function ➢ Relevant Tools ➢ Real Time Priorities ➢ Thread States ➢ Dispatcher Database ➢ Scheduling Scenarios ➢ Preemption • Context Switching ➢ Priority Boosts ➢ Job Objects	**04**

Note : 48 hours for theory lectures and 12 hours for internal assessment and learning.

References:

1. Silberschatz A. ,Galvin P.B. & Gagne G. (2008). *Operating System Concepts, 8th Edition.*
   Wiley.
2. Robert L.(2007). *Linux System Programming*. O'Reilly Media, Inc.
3. Russinovich M.E. & Soloman D.A. (2009). *Windows Internals*. Microsoft Press.
4. Bach M.J. .*The Design of the UNIX Operating System*. Prentice-Hall, Inc.Stevens W.R.
5. Rago S.A. .*Advanced Programming in the UNIX Environment*. Addison-Wesley.

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

1. 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.

2. 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.

3. 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.

4. 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.

5. 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.

6. 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.

7. 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.