TKM COLLEGE OF ENGINEERING

(Government Aided and Autonomous)

celebrating 60 years of excellence

S3 & S4 MCA Syllabus

Semester III

23MCAJ301	Machine Learning	L	T	P	J	S	C	Year of Introduction
		2	0	2	2	5	5	2023

Preamble: This is an introductory course on basic concepts behind various machine learning techniques. Machine learning is the study of adaptive computational systems that improve their performance with experience. At the end of the course the students should be able to design and implement machine learning solutions to classification, regression, and clustering problems and to evaluate and interpret the efficiency of the algorithms.

Prerequisite: Python programming

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the basics of machine learning and data visualization techniques.
CO2	Apply the principle behind lazy learning and probabilistic learning algorithms to solve real life problems.
CO3	Apply the principle behind decision trees & regression methods to solve data science problems.
CO4	Solve real life problems using neural networks and support vector machines.
CO5	Analyse the performance of various machine learning models.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3			3							
CO2	3	3	2		3	3	3	3	3		3	
CO3	3	3	2	2	3	3	3	3	3		3	
CO4	3	3	3	2	3	3	3	3	3		3	
CO5	3	3	3	2	3	3	3	3	3		3	

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember		✓	✓	✓
Understand		✓	✓	✓
Apply		✓	✓	✓
Analyse			✓	
Evaluate			✓	
Create			✓	

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓
Evaluate		
Create		

Assessment Pattern for Project Component			
Bloom's Category	**Continuous Assessment Tools**		
	Evaluation1	**Evaluation2**	**Report**
Remember			
Understand	✓	✓	
Apply	✓	✓	
Analyse	✓	✓	
Evaluate	✓	✓	
Create		✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]		Practical [P]	Project [J]			Total Marks
		Assignment	**Test-2**	**Class work**	**Evaluation 1**	**Evalaution-2**	**Report**	
2-0-2-2	5	10	15	10	5	10	5	**60**

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	60	40	2.5 hours

SYLLABUS

MODULE I: Introduction to Machine learning (5hrs)

Introduction to Machine Learning - How do machines learn – Understanding data:- mean, median, mode, Measuring spread. Review of distributions: Uniform and normal. Data Visualization- Histogram, Box plot, Scatter plot. Evaluating model performance: Confusion matrices, Precision and recall, Sensitivity and specificity, F-measure, ROC curves, Cross validation - K-fold cross validation, Bootstrap sampling.

MODULE II : Lazy Learning and Probabilistic Learning (5hrs)

Lazy learning: Classification using K-Nearest Neighbour algorithm - Measuring similarity with distance, Choice of k, Preparing data for use with k-NN.
Probabilistic learning: Understanding Naive Bayes - Conditional probability and Bayes theorem, Naive Bayes algorithm for classification, The Laplace estimator, Using numeric features with Naive Bayes.

MODULE III : Decision trees and Regression (5hrs)

Classification Using Decision Trees and Rules- Divide and conquer strategy. Decision tree algorithm.
Regression Methods - Simple linear regression - Ordinary least squares estimation Correlations - Multiple linear regression.

MODULE IV : Neural Networks and SVM (5hrs)

Neural network learning: Artificial neurons, Activation functions, Network topology, Training neural networks with back propagation.
Support vector machines: Hyperplanes, Classification using hyperplanes, Maximum margin hyperplanes in linearly separable data, Using kernels for non-linear spaces.

MODULE V : Clustering and Model Evaluation (4hrs)
Clustering: The k-means clustering algorithm, Using distance to assign and update clusters, Choosing number of clusters. Evaluate the performance of different machine learning algorithms. Improving model performance - Bagging, Boosting, Random forests.

Text books

1. Brett Lantz, Machine Learning with R, Second edition, PackT publishing 2015
2. Vijay Kotu, Bala Deshpande, Data Science Concepts and Practice, Morgan Kaufmann Publishers 2018
3. Machine Learning- Course Materials http://cs229.stanford.edu/materials.html

Suggested MOOC

1. https://www.coursera.org/learn/machine-learning
2. https://onlinecourses.nptel.ac.in/noc23_cs87/preview

Reference books

1. Michael Steinbach, Pang-Ning Tan, and Vipin Kumar, Introduction to Data Mining, Pearson 2016.
2. Jiawei Han, Micheline Kamber and Jian Pei, Data mining Concepts and techniques, Morgan Kaufmann Publishers 2012.
3. Peter Harrington, Machine Learning in action, Dreamtech publishers 2012.
4. Dr M Gopal, Applied Machine learning, McGraw Hill Education Private Limited
5. E. Alpayidin, Introduction to Machine Learning, Prentice Hall of India (2005)
6. T. Hastie, RT Ibrashiran and J. Friedman, The Elements of Statistical Learning, Springer 2001.
7. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, First edition, 2015.
8. Introduction Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016.

COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
	MODULE 1	
1.1	Basics of Machine learning-How do Machine learn	1
1.2	Understanding data:- numeric variables – mean, median, mode, categorical variables. Measuring spread. Review of distributions: Uniform and normal.	1
1.3	Data Visualization- Histogram, Box plot, Scatter plot.	1
1.4	Evaluating model performance: Confusion matrices, Precision and recall, Sensitivity and specificity.	1
1.5	F-measure, ROC curves, Cross validation - K-fold cross validation, Bootstrap sampling.	1
	MODULE II	
2.1	Lazy learning: Classification using K-Nearest Neighbor algorithm, Measuring similarity with distance	1
2.2	Choice of k, Preparing data for use with k-NN.	1
2.3	Probabilistic learning: Understanding Naive Bayes - Conditional	1

	probability and Bayes theorem	
2.4	Naive Bayes algorithm for classification	1
2.5	The Laplace estimator, Using numeric features with Naive Bayes.	1
	MODULE III	
3.1	Classification Using Decision Trees and Rules- Divide and conquer strategy.	1
3.2	Decision tree algorithm.	1
3.3	Decision tree algorithm –Solving examples	1
3.4	Regression Methods - Simple linear regression - Ordinary least squares estimation	1
3.5	Solving problems- Correlations - Multiple linear regression	1
	MODULE IV	
4.1	Neural network learning- Artificial neurons, Activation functions, Network topology	1
4.2	Training neural networks with back propagation.	1
4.3	Solving problems	1
4.4	Support vector machines-Hyperplanes, Classification using hyperplanes, Maximum margin hyperplanes in linearly separable data.	1
4.5	Using kernels for non-linear spaces	1
	MODULE V	
5.1	Clustering: The k-means clustering algorithm, Using distance to assign and update clusters, Choosing number of clusters.	1
5.2	Solving examples	1
5.3	Evaluate the performance of different machine learning algorithms.	1
5.4	Improving model performance - Bagging, Boosting, Random forests.	1

LESSON PLAN FOR LAB COMPONENT

No.	Topic	No. of Hours	Experiment
1	Study of Machine Learning libraries in python	2	Implement programs listed under CO1
2	Data Summarization and Visualization	2	
3	k-NN	2	Implement programs listed under CO2
4	Naive Bayes	2	
5	Decision Tree	2	Implement programs listed under CO3
6	Linear Regression	2	
7	Multiple Regression	2	
8	Feed forward Neural Network	2	Implement programs listed under CO4
9	SVM	2	
10	K means	2	Implement programs listed under CO5
11	Performance Evaluation and improvement -Random forest	2	

12	Compare different classification algorithms on real world dataset	2	

List of Experiments

CO1

1. Programs to handle data using NumPy, Pandas and matplotlib/ plotly/ bokeh/ seaborn for data visualization.
2. Calculate the mean, median, and mode of a given numeric dataset.
3. Plot a histogram and a boxplot for any dataset to visualize the data distribution.
4. Explore a real-world dataset and summarize its key characteristics using descriptive statistics and data visualization.

CO2

1. You are given a dataset that contains missing values in some of its features. Your task is to explore the dataset, identify the missing values, and discuss possible strategies to handle them when using the k-Nearest Neighbour (k-NN) algorithm for classification.(Use any publicly available dataset, plot the decision boundary for different k values and observe the impact on the model's performance.)
2. You are given a dataset with a mix of categorical and continuous numeric features. Your task is to implement the Naive Bayes algorithm for a binary classification problem, considering the presence of both types of features. Additionally, you will explore and apply different strategies to handle continuous numeric features in the Naive Bayes algorithm.(Explore different datasets to perform three variants of naive Bayes: Gaussian Naive Bayes, Multinomial Naive Bayes, and Bernoulli Naive Bayes.)

CO3

1. Program to implement decision trees using and standard dataset available in the public domain and find the accuracy of the algorithm.(Implement the pruning technique to avoid overfitting and re-evaluate the decision tree's performance after pruning. Compare the decision tree model's performance with other classification algorithms, such as k-Nearest Neighbors (k-NN) or Naive Bayes. Use either the ID3, C4.5, or CART (Gini impurity) algorithm)
2. Explore the concepts of simple linear regression, multiple linear regression, and correlations using the ordinary least squares estimation method to fit regression models.
3. Work with a dataset containing independent variables (features) and a dependent variable (target) to predict and analyze their relationships.(Implement feature scaling (e.g., standardization or normalization) for the independent variables and re-evaluate the performance of the multiple linear regression model. Implement regularization techniques (e.g., Lasso or Ridge regression) to handle potential overfitting in the multiple linear regression model. Compare the performance of regularized and non-regularized models.)

CO4

1. Programs on feed forward network to classify any standard dataset available in the public domain.
2. Programs on SVM to classify any standard dataset in the public domain.

CO5

1. Programs to implement k-means clustering technique using any standard dataset available in the public domain.

2. Programs to implement Random Forest technique using any standard dataset available in the public domain.
3. Compare the performance evaluation of different classification algorithms.

Sample project topics

1	Apply KNN, Naïve Bayes and Decision tree classifier on Breast cancer dataset and compare the performance using different metrics. Identify the optimum set of parameters for the algorithms using parameter tuning method and compare the performance.
2	Predict medical expenses of people based on insurance data set. Identify the correlations and techniques to boost the accuracy of the model.

LESSON PLAN FOR PROJECT COMPONENT

Total No. of Class Hours: 24 **12 Hours of self-study hours also should be utilized for the development of the complete project.**		
No.	**Topic**	**No. of Class Hours[24]**
1	Preliminary Design of the Project	4
2	Zeroth presentation (4th week)	2
3	Project work - First Phase	4
4	Interim Presentation (7th and 8th weeks)	4
5	Project work - Final Phase & Report writing (discussions in class during project hours)	6
6	Final Evaluation and Presentation (11th and 12th weeks)	4

CO Assessment Questions	
	CO1
1	Differentiate between supervised and unsupervised learning algorithms
2	Explain the typical methods to visualize data
3	Illustrate using a standard data set, how cleaning and selection of right features are done.
	CO2
4	Explain how to apply k-NN classifier in a data science problem.
5	Use Naive Bayes algorithm to determine whether a red domestic SUV car is a stolen car or not using the following data:

<table>
<tr><td></td><td>
<table>
<tr><th>Example No.</th><th>Color</th><th>Type</th><th>Origin</th><th>Stolen?</th></tr>
<tr><td>1</td><td>Red</td><td>Sports</td><td>Domestic</td><td>Yes</td></tr>
<tr><td>2</td><td>Red</td><td>Sports</td><td>Domestic</td><td>No</td></tr>
<tr><td>3</td><td>Red</td><td>Sports</td><td>Domestic</td><td>Yes</td></tr>
<tr><td>4</td><td>Yellow</td><td>Sports</td><td>Domestic</td><td>No</td></tr>
<tr><td>5</td><td>Yellow</td><td>Sports</td><td>Imported</td><td>Yes</td></tr>
<tr><td>6</td><td>Yellow</td><td>SUV</td><td>Imported</td><td>No</td></tr>
<tr><td>7</td><td>Yellow</td><td>SUV</td><td>Imported</td><td>Yes</td></tr>
<tr><td>8</td><td>Yellow</td><td>SUV</td><td>Domestic</td><td>No</td></tr>
<tr><td>9</td><td>Red</td><td>SUV</td><td>Imported</td><td>No</td></tr>
<tr><td>10</td><td>Red</td><td>Sports</td><td>Imported</td><td>Yes</td></tr>
</table>
</td></tr>
<tr><td></td><td>CO3</td></tr>
<tr><td>6</td><td>Explain how to estimate a linear regression model.</td></tr>
<tr><td>7</td><td>Consider the following set of training examples
Find the entropy of this collection of training examples with respect to the target function “classification”?
Calculate the information gain of a2 relative to these training examples?
<table>
<tr><th>Instance</th><th>Classification</th><th>a1</th><th>a2</th></tr>
<tr><td>1</td><td>+</td><td>T</td><td>T</td></tr>
<tr><td>2</td><td>+</td><td>T</td><td>T</td></tr>
<tr><td>3</td><td>-</td><td>T</td><td>F</td></tr>
<tr><td>4</td><td>+</td><td>F</td><td>F</td></tr>
<tr><td>5</td><td>-</td><td>F</td><td>T</td></tr>
<tr><td>6</td><td>-</td><td>F</td><td>T</td></tr>
</table>
</td></tr>
<tr><td>8</td><td>Explain how to simplify a decision tree by pruning</td></tr>
<tr><td></td><td>CO4</td></tr>
<tr><td>9</td><td>Explain how artificial neural networks mimic human brain to model arbitrary functions and how these can be applied to real-world problems.</td></tr>
<tr><td>10</td><td>Explain how a support vector machine can be used for classification of linearly separable data.</td></tr>
<tr><td>11</td><td>Explain how the kernel trick is used to construct classifiers in nonlinearly separated data.</td></tr>
<tr><td></td><td>CO5</td></tr>
<tr><td>12</td><td>Find the three clusters after one epoch for the following eight examples using the k- means algorithm and Euclidean distance: A1 = (2,10), A2 = (2,5), A3 = (8,4), A4 = (5,8), A5 = (7,5), A6 = (6,4), A7 = (1,2), A8 = (4,9). Suppose that the initial seeds (centres of each cluster) are A1, A4 and A7.</td></tr>
<tr><td>13</td><td>Suppose 10000 patients get tested for flu; out of them, 9000 are actually healthy and 1000 are actually sick. For the sick people, a test was positive for 620 and negative for 380. For the healthy people, the same test was positive for 180 and negative for 8820. Construct a confusion matrix for the data and compute the precision and recall for the data.</td></tr>
</table>

23MCAT302	Advanced Software Engineering	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The course intended to teach Software Engineering in an Industry perspective, focusing on tools and techniques prevalent in Industry today, to make students Industry-ready.

Prerequisite:

Course Outcomes: After the completion of the course the student will be able to

CO1	Prepare Software Plan, Analyse and Design Software Engineering Models.
CO2	Apply Coding Practices, Version Control using 'git' to maintain Software Quality.
CO3	Implement unit tests using at least one of the specified frameworks (JUnit, unittest, or phpdbg).
CO4	Apply Agile principles and practices in real-world software development projects.
CO5	Comprehend the concepts of continuous integration, including the significance of automated builds and testing.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3						3			
CO2	3	3	3		3		3					
CO3	3				3		2					
CO4	3	3	3				3					
CO5	3	3										

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse		✓	✓	
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution

Total Marks	CIA (Marks)	ESE (Marks)	ESE Duration
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
	10 Questions, each	2 questions will be given from each module, out of which 1	

PATTERN 1	question carries 2 marks Marks: (2x10 =20 marks)	question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULEI : Introduction to Software Engineering (10hrs)

Introduction to Software Engineering: What is Software Engineering, Characteristics of Software. Life cycle of a software system: software design, development, testing, deployment, Maintenance. Project planning phase: project objectives, scope of the software system, empirical estimation models, COCOMO, staffing and personnel planning. Software Engineering models: Predictive software engineering models, model approaches, waterfall, incremental, V model ,prototyping models. Software requirements specification, Eliciting Software requirements, Requirement specifications, Requirements modelling, Requirements documentation. Use cases and User stories.

MODULEII : Programming Style Guides and Coding Standards (10hrs)

Programming Style Guides and Coding Standards; Literate programming and Software documentation; Documentation generators, Javadoc, phpDocumentor. Version control systems basic concepts; Concept of Distributed version control system and Git; Setting up Git; Core operations in Git version control system using command line interface (CLI): Clone a repository; View history; Modifying files; Branching; Push changes, Clone operation, add, commit, log, diff commands, conflict resolution. Pushing changes to the master; Using Git in IDEs and UI based tools. Software Quality: Understanding and ensuring requirements specification quality, design quality, quality in software development, conformance quality.

MODULEIII : Unit testing and Unit Testing frameworks (9hrs)

Unit testing and Unit Testing frameworks, The xUnit Architecture, Writing Unit Tests using at least one of Junit (for Java), unittest (for Python) or phpdbg (PHP). Writing tests with Assertions, defining and using Custom Assertions,single condition tests, testing for expected errors, Abstract test.

MODULEIV : Concepts of Agile Development methodology (11hrs)

Concepts of Agile Development methodology; Scrum Framework. Software testing principles, Program inspections, Program walkthroughs, Program reviews; Blackbox testing: Equivalence class testing, Boundary value testing, Decision table testing, Pairwise testing, State transition testing, Use-case testing; White box testing: control flow testing, Data flow testing.

MODULEV : Software Configuration Management (8hrs)

Software Configuration Management: Using version control, Managing dependencies, Managing software configuration, Managing build and deployment environments. Continuous Integration: Prerequisites for continuous integration, Essential practices. Continuous Delivery: Principles of Software delivery, Introduction and concepts. Build and deployment automation

Text books

1. Philip A. Laplante, What Every Engineer Should Know about Software Engineering, CRC Press
2. Murali Chemuturi, Mastering Software Quality Assurance: Best Practices, Tools and Technique for Software Developers, J Ross Publishing
3. Erich Gamma et. al., Design Patterns: Elements of Reusable Object-Oriented Software, Addison-Wesley
4. Alistair Cockburn and Robert Cecil Martin, Agile Software Development: The Cooperative Game (2nd edition), Addition Wesley

Reference books

1. Ben Straub, Scott Chacon, Pro Git, 2nd Edition, Apress.
2. Vaskaran Sarcar, Java Design Patterns: A Hands-On Experience with Real-World Examples, Apress.
3. Ken Schwaber , Agile Software Development with Scrum, Pearson.
4. Lisa Crispin, Agile Testing: A Practical Guide for Testers and Agile Teams, Adison Wesley.
5. Paul Hamill, Unit Test Frameworks, O'Reilly Media.
6. Glenford J. Myers, et. al., The Art of Software Testing, Wiley.
7. Lee Copeland, A Practitioner's Guide to Software Test Design, Artech House Publishers.
8. Jez Humble and David Farley, Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation, Pearson Education.

COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
MODULE 1		
1.1	Software Engineering, Characteristics of Software Engineering	1
1.2	Life cycle of a software system	1
1.3	Project planning	1
1.4	Software Engineering Models :Waterfall model	1
1.5	Incremental, V model	1
1.6	Prototyping models ,Spiral model	1
1.7	Eliciting Software requirements	1
1.8	Requirement specifications, Requirements modelling	1
1.9	Requirements documentation. Use cases and User stories.	1
1.10	Sample projects: Software Requirements Specification	1
MODULE II		
2.1	Programming style guides and coding standards	1
2.2	Documentation generators, Javadoc, phpDocumentor	1
2.3	Software version control systems, basic concepts	1
2.4	Git distributed version control system, introduction	1
2.5	Git distributed version control system, introduction	1
2.6	Common operations in Git	1
2.7	Common operations in Git	1
2.8	Using Git in IDEs and UI based tools	1
2.9	Using Git in IDEs and UI based tools	1
2.10	Software quality, achieving	
MODULE III		
3.1	Unit testing and Unit Testing frameworks	1
3.2	The xUnit Architecture	1
3.3	Unit Testing concepts and xUnit architecture	1
3.4	Writing Unit Tests using at least one of Junit (for Java)	1
3.5	Unit testing frameworks: Junit, unittest, phpdbg	1
3.6	Unit testing frameworks: Junit, unittest, phpdbg	1
3.7	Writing tests with Assertions, defining and using Custom Assertions	1
3.8	Writing unit test code	1
3.9	single condition tests, testing for expected errors, Abstract test.	1
MODULE IV		
4.1	Concepts of Agile Development methodology;	1
4.2	Scrum Framework	1
4.3	Scrum Framework	1
4.4	Software testing principles, Program inspections,	1
4.5	Program walkthroughs, Program reviews	1
4.6	Blackbox testing: Equivalence class testing	1
4.7	Boundary value testing, Decision table testing,	1

4.8	Pairwise testing, State transition testing	1
4.9	Use-case testing	1
4.10	White box testing: control flow testing	1
4.11	Data flow testing	1
MODULE V		
5.1	Managing software configuration	1
5.2	Managing build and deployment environments	1
5.3	Continuous Integration	1
5.4	Continuous Integration	1
5.5	Continuous Delivery, concepts and practices	1
5.6	Continuous Delivery, concepts and practices	1
5.7	Build and deployment automation	1
5.8	Build and deployment automation	1

CO Assessment Questions	
1	a. Prepare a detailed Software Requirements Specification (SRS) document for the e-commerce platform project. SRS should cover both functional and non-functional requirements, outline the system architecture, and address compliance and legal considerations, define the types of data managed and data storage methods.
2	a. Explain the role of documentation generators, such as Javadoc and phpDocument or, in automating the documentation process. b. Explain the core concepts of software version control system and common operations with Git distributed version control system.
3	a. Illustrate xUnit architecture, which is the basis for most unit testing frameworks, and outline its key components. Explain how the xUnit architecture provides a structured approach to designing and executing unit tests. b. Using Java/Python as the programming language, write a unit test for a sample class or function. Include relevant test cases, setup, and assertions. Explain the purpose of each test case and the expected outcomes.
4	a. Describe the Scrum Framework in detail, including its roles, artifacts, and ceremonies. Explain how the Scrum Framework promotes collaboration, transparency, and adaptability in software development. b. Explore the various black-box testing techniques, including equivalence class testing, boundary value testing, decision table testing, pairwise testing, state transition testing, and use-case testing. Provide an example scenario for each technique and explain how it is applied to uncover defects.
5	a. Explain the concept of managing build and deployment environments. Discuss the role of environment configuration and automation in ensuring consistent and reliable deployments. b. Outline the essential practices of CI, including automated testing, continuous building, and integration of code from multiple contributors.

23MCAP305	Mobile Application Development (Flutter)	L	T	P	J	S	C	Year of Introduction
		1		2		3	2	2023

Preamble: This course provides an introduction to mobile application development using the Flutter framework. Students will learn how to build cross-platform mobile applications for iOS and Android using a single codebase. The course covers topics such as Flutter architecture, widget-based UI development, state management, navigation and data storage. Through hands-on projects and assignments, students will gain practical experience in developing interactive and responsive mobile applications.

Prerequisite: Basic programming language

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the features and installation of Flutter
CO2	Solve basic programs using Dart constructs.
CO3	Develop simple mobile applications in Flutter using Dart Language.
CO4	Develop interactive Flutter App by using widgets, layout, gestures and animation
CO5	Develop mobile applications using database Connections

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3				3		2		3			
CO2	3				3		2		3			
CO3	3				3		2		3			
CO4	3				3		2		3			
CO5	3				3		2		3			

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember	✓	--	✓	✓
Understand	✓	--	✓	✓
Apply	✓	--	✓	✓
Analyse			✓	
Evaluate			✓	
Create			✓	

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓
Evaluate	✓	
Create	✓	

Mark Distribution of CIA							
Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Practical [P]		Total Marks
		Assignment	Test-1	Test-2	Class work	Lab Exam	
1-0-2-0	5	10	20	--	25	40	100

Total Marks distribution			
Total Marks	CIA (Marks)	ESE (Marks)	ESE Duration
100	100		

SYLLABUS

MODULE I : Introduction to Flutter (2hrs)

Features of Flutter, Advantages and Disadvantages of flutter, flutter architecture, Flutter Installation, Creating Simple Application in Android Studio.

MODULE II :Flutter Basics (2hrs)

Introduction to Dart Programming-Variables and Data types- Decision Making and Loops. Functions- Object Oriented Programming.

MODULE III :Developing Flutter UI(Widgets ,Layouts and Gestures) (3hrs)

Using Common Widgets: Safearea, Appbar, Column, Row, Container, Buttons, Text, Richtext, Form ,Images And Icon. Building Layouts: High Level View Of Layouts, Creating The Layout, Types of Layout Widgets. Applying Gestures: Setting Up Gesturedetector, Implementing The Draggable And Dragtarget Widgets

MODULE IV : Animation and Navigation on Flutter (3hrs)

Adding Animation To An App :Using Animated Container, Using Animated CrossFade, Using Animated Opacity. Creating An App's Navigation: Using the Navigator, Using the Named Navigator Route, Using the Bottom NavigationBar, Using the TabBar and TabBar View.

MODULE V : Creating Apps using Database (2 hrs)

Using Firebase with Flutter: Adding the Firebase Backend, Configuring the Firebase Project, Testing and Deploying of Flutter Application: Widget testing, Deploying Flutter Apps on Android / iOS.

Text books

1. Beginning Flutter a Hands-on Guide to App Development, Marco L. Napoli, Wiley, 2020.
2. Beginning App Development with Flutter: Create Cross-Platform Mobile Apps, By Rap Payne, 2019
3. Progressive Web Application Development by Example: Develop fast, reliable, and engaging user experiences for the web, Packt Publishing Limited ,2018
4. Building Progressive Web Apps,O'Reilly 2017

Reference books

1. Flutter in Action by Eric Windmill, MANING, 2019
2. Google Flutter Mobile Development Quick Start Guide.Packt,2019

Online References:

1. https://docs.flutter.dev/reference/tutorials
2. https://www.tutorialspoint.com/flutter/index.htm
3. https://www.w3schools.com/css/css_rwd_intro.asp

4. https://www.javatpoint.com/flutter		
COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
MODULE 1: Introduction to Flutter (2hrs)		
1.1	Features of Flutter, Advantages and Disadvantages of flutter, flutter architecture	1
1.2	Flutter Installation, Creating Simple Application in Android Studio	1
MODULE II: Introduction to Dart Programming (2hrs)		
2.1	Introduction to Dart Programming-Variables and Data types	1
2.2	Functions- Object Oriented Programming	1
MODULE III: Common Widgets, Layouts, Gestures (3hrs)		
3.1	Using Common Widgets: SafeArea, Appbar, Column, Row, Container, Buttons, Text , Richtext, Form ,Images and Icon.	1
3.2	BUILDING LAYOUTS : high level view of layouts, Creating the layout , Types of layout widgets	1
3.3	APPLYING GESTURES: Setting Up GestureDetector, Implementing the Draggable and Dragtarget Widgets	1
MODULE IV: Apply Animation and Navigation (3hrs)		
4.1	Adding Animation To An App :Using Animated Container, Using Animated CrossFade, Opacity	1
4.2	Creating An App's Navigation: Using the Navigator, Using the Named Navigator Route	1
4.3	Creating An App's Navigation: Using the Bottom NavigationBar, Using the TabBar and TabBarView.	1
MODULE V:Database Connection (2hrs)		
5.1	Using Firebase with Flutter: Adding the Firebase Backend, Configuring	1
5.2	Deploying of Flutter Application: Widget testing, Deploying Flutter Apps on Android / iOS.	1

LESSON PLAN FOR LAB COMPONENT

No.	Topic	No. of Hours	Experiment
1	Installation(CO1)	2	a) To install and configure Flutter Environment b) To design Flutter UI by including common widgets.

2	Dart Programming language (CO2)	5	a) Program to print your name in Dart. b) Program in Dart that finds simple interest. c) Write a password generator in Dart. Be creative with how you generate passwords - strong passwords have a mix of lowercase letters, uppercase letters, numbers, and symbols. The passwords should be random, generating a new password every time the user asks for a new password. Include your run-time code in a main method. d) Randomly generate a 4-digit number. Ask the user to guess a 4-digit number. For every digit the user guessed correctly in the correct place, they have a "cow". For every digit the user guessed correctly in the wrong place is a "bull." Every time the user makes a guess, tell them how many "cows" and "bulls" they have. Once the user guesses the correct number, the game is over. Keep track of the number of guesses the user makes throughout the game and tell the user at the end.
3	Layout, Widgets ,gestures ,animation, navigation(CO3 and CO4) (Apply all these on your selected application)	8	a) To create an interactive Form using form widget b) To design a layout of Flutter App using layout widgets c) To include icons, images, charts in Flutter app d) To apply navigation, routing and gestures in Flutter App
4	Database	9	a) To Connect Flutter UI with fireBase database

			b) To test and deploy production ready Flutter App on Android platform

CO Assessment Questions	
1	Briefly explain flutter architecture Design and explain flutter UI using basic widgets
2	Write a program (using functions!) that asks the user for a long string containing multiple words. Print back to the user the same string, except with the words in backwards order.
3	Explain widgets and layout with suitable example.
4	Explain various animations and navigation methods available in flutter
5	List the detailed steps to connect your application with firebase

23MCAT306	Cyber Security	L	T	P	J	S	C	Year of Introduction
		2				2	2	2023

Preamble: This course provides an in-sight study of the principles, methodologies, and practices in the field of cyber security. Students will explore the concepts, techniques, and tools used to protect information systems from threats, vulnerabilities, and attacks. Through this, students will develop the knowledge and skills necessary to secure and defend information systems against cyber threats.

Prerequisite: Networking fundamentals

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the fundamental principles and concepts of cyber security.
CO2	Understand various cyber security technologies
CO3	Gain knowledge on vulnerabilities and its safeguard measures.
CO4	Understand and apply the knowledge on various cyber security tools
CO5	Understand the need for building cyber security strategy

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1				1	2	1	1		
CO2	2	2	2	1			1	2	2	2	1	
CO3	2	1	1				1	2	1	1		
CO4	2	1	1			2	1	2	1	1		
CO5	2	1	1			2	1	2	1	1		

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember	✓	✓	✓	
Understand	✓	✓	✓	
Apply	✓	✓	✓	
Analyse			✓	
Evaluate			✓	
Create			✓	

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember	✓	✓
Understand	✓	✓
Apply	✓	✓
Analyse	✓	
Evaluate	✓	
Create		

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Practical [P]		Total Marks
		Assignment	Test-1	Test-2	Class work	Lab Exam	
2-0-0-0	5	35	30	30			100

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	100		

SYLLABUS

MODULE I : Introduction to Cyber Security (4hrs)

Cyber Security- Layers of security, Vulnerability, Assets and Threat, Challenges and Constraints - Computer Criminals - CIA Triad - Motive of attackers - Spectrum of attacks - Taxonomy of various attacks

MODULE II : Cyber Security Technologies (4hrs)

Mobile Security – Advanced Data Security: Cloud Security, IoT Security - Incident detection response - Penetration testing

MODULE III : Vulnerabilities and Safeguards (8hrs)

Software Vulnerabilities - Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, poor cyber security awareness - Cyber Security Safeguards – Overview, Access control, Audit, Authentication, Biometrics, Deception, Denial of Service Filters, Ethical Hacking, Firewall

MODULE IV : Cyber Security Tools (3hrs)

Zenmap – Hydra –Kismet – John the Ripper – Airgeddon – Deauther Board

MODULE V : Cyber Security Strategies (5hrs)

Need for building cyber strategy – Cyber-attack strategies (Red team) – Cyber defense strategies (blue team) – Introduction to Cyber security kill chain – Reconnaissance – Weaponization

Text books

1. Cybersecurity - Attack and Defense Strategies by Yuri Diogenes, Dr. Erdal Ozkaya, third edition
2. Charles J. Brooks, Christopher Grow, Philip A. Craig, Donald Short, Cybersecurity Essentials, Wiley Publisher, 2018
   Standards, 1st edition, 2019

Reference books

1. William Stallings, Effective Cybersecurity: A Guide to Using Best Practices and Standards, 1st edition, 2019
2. "Principles of Information Security" by Michael E. Whitman and Herbert J. Mattord
3. "Cybersecurity: The Essential Body of Knowledge" by Dan Shoemaker, Wm. Arthur Conklin, and Dwayne Williams

COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
MODULE 1		
1.1	Cyber Security- Layers of security, Vulnerability	1
1.2	Assets and Threat, Challenges and Constraints - Computer Criminals	1
1.3	CIA Triad - Motive of attackers - Spectrum of attacks	1
1.4	Taxonomy of various attacks	1
MODULE II		
2.1	Mobile Security	1
2.2	Advanced Data Security: Cloud Security,	1
2.3	IoT Security	1
2.4	Incident detection response - Penetration testing	1
MODULE III		
3.1	Software Vulnerabilities , Complex Network Architectures	1
3.2	Open Access to Organizational Data, Weak Authentication	1
3.3	poor cyber security awareness	1
3.4	Cyber Security Safeguards – Overview, Access control	1
3.5	Authentication, Audit	1
3.6	Biometrics, Deception	1
3.7	Denial of Service Filters, Ethical Hacking	1
3.8	Firewall	1
MODULE IV		
4.1	Zenmap ,Hydra	1
4.2	Kismet ,John the Ripper	1
4.3	Airgeddon , Deauther Board	1
MODULE V		
5.1	Need for building cyber strategy	1
5.2	Cyber-attack strategies (Red team)	1
5.3	Cyber defense strategies (blue team)	1
5.4	Introduction to Cyber security kill chain	1
5.5	Reconnaissance – Weaponization	1

CO Assessment Questions	
1	a) Discuss the concept of layers of security in cybersecurity and explain why it is important to implement multiple layers of defense. Provide examples of different security layers and their specific purposes. b) Explain the CIA triad (Confidentiality, Integrity, Availability) in the context of cybersecurity. Discuss why each aspect is important for maintaining the security of information assets and provide examples of measures taken to ensure each element of the triad.
2	a) Discuss the key challenges and vulnerabilities in mobile security. Explain how factors such as device diversity, app vulnerabilities, and insecure network connections can pose risks to mobile devices and data. b) Discuss the security considerations and challenges associated with cloud computing. Explain the shared responsibility model and the measures organizations should take to secure their data and applications in the cloud.
3	a) Discuss the challenges and risks associated with complex network architectures. Explain how the complexity of a network can introduce vulnerabilities and make it harder to secure. Provide examples of strategies to mitigate these risks. b) Explain the concept of biometrics in authentication. Discuss the different biometric technologies and their applications in cyber security. Describe the advantages and limitations of biometric authentication.
4	a) Discuss the importance of vulnerability scanning and penetration testing in cyber security. Explain how tools like Zenmap, Hydra, and Kismet, John the Ripper, Airgeddon, and Deauther Board can be utilized in a comprehensive security assessment.
5	a) Explain the concept of cyber-attack strategies and the role of the Red team in cyber security. Discuss different tactics and techniques used by Red teams to simulate real-world cyber-attacks. Provide examples of common Red team methodologies and their objectives. b) Explain the reconnaissance phase of the Cyber security Kill Chain. Discuss the techniques used by attackers to gather information about target systems and networks. Explain the importance of reconnaissance in planning and executing successful cyber-attacks.

23MCAM307	Mini Project	L	T	P	J	S	C	Year of Introduction
				6	6	6	3	2023

Preamble: This project work aims to enable the students to apply the software engineering principles on a real software project, to make the students familiar with the stages of a deployment pipeline and to develop a software product using the latest software development methodology.

Prerequisite: Knowledge in software engineering principles and programming skills

Course Outcomes: After the completion of the course the student will be able to

CO 1	Identify a real-life project which is useful to society / industry.
CO 2	Interact with people to identify the project requirements.
CO 3	Apply suitable development methodology for the development of the product / project.
CO 4	Analyse and design a software product / project.
CO 5	Test the modules at various stages of project development.
CO 6	Build and integrate different software modules.
CO 7	Document and deploy the product / project.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3	3	
CO 3	3	3	3	3	3	3	3	3	3		3	
CO 4	3	3	3	3	3		3	3	3	3	3	
CO 5	3	3	3	3	3		3	3			3	
CO 6	3	3	3	3	3	3	3	3		3	3	3
CO 7	3	3	3	3	3	3	3	3	3	3	3	

Assessment Pattern for Project component

Bloom's Category	Continuous Assessment Tools		
	Evaluation 1	Evaluation 2	Report
Remember			
Understand	✓	✓	
Apply	✓	✓	
Analyse	✓	✓	
Evaluate		✓	
Create		✓	

Mark Distribution of CIA								
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**		**Practical [P]**	**Project [J]**			**Total Marks**
		Assignment	**Test-1**	**Continuous evaluation by Supervisor**	**Evaluation 1**	**Evaluation-2**	**Report**	
0-0-6-0	10	--	--	40	20	20	10	100

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	100	--	--

Guidelines

- Students shall identify Real-Life Projects which are relevant and useful to the society or industry
- The project shall be an individual project and must be done in-house or online/offline internship in reputed industry/institution, as per the decision of the department.
- Attendance as per MCA regulations is applicable for submitting the project for final evaluation
- Students shall submit project synopsis and get prior approval from the Project (Faculty) Supervisor before the project work begins.
- If there is a customer for the project then he/she will be the Product Owner (External Guide) and a faculty from the department will be the Internal Guide. If there is no such customer then the Internal Guide himself/herself shall act as the Product Owner.
- A faculty / technical staff shall act as the Scrum Master to continuously monitor the project development. Periodic meetings, of less than 15 minutes, at the convenience of the Scrum Master are to be highly encouraged. Ensure such meetings occur once in three days.
- Set a sprint as two weeks, ensure biweekly reviews. A review shall not exceed 30 minutes. A demo to the Product Owner (Project Guide) is mandatory in every review.
- The student shall maintain a Scrum Book (Rough Record) which has to be divided into 4 parts – (i) Product Backlog (ii) Database & UI Design (iii) Testing & Validation and (iv) Details of Versions. Make dated entries in the corresponding part at regular intervals. The corrections and comments from Product Owner and Scrum Master should be clearly indicated with the Date
- Test Driven Development methodology may be practiced for the project development. BugZilla, BackLog or any such tool may be used for Bug Tracking.
- Git shall be used for Version Control and Git commit history may be verified as part of project evaluation.
- LaTeX or an equivalent tool shall be used for preparing Presentations and

Project Report

- Interim evaluations of project's progress shall be conducted as part of Internal Assessment. Project Evaluation Board may consist of Project Supervisor, Product Owner, Scrum Master and one other Faculty Member from the department. Scrum reviews shall not be sacrificed for such presentations.
- At the end of the semester entire project development activities shall be evaluated internally by the Project Evaluation Board.

Schedule

Week 1

- Familiarisation with build tools (editor/IDE, compiler such as gcc with commonly used options/switches, debugger like dgb).
- Familiarisation with an IDE (Eclipse, NetBeans…), that supports build tools and common version control operations using Git.
- Familiarisation with Docker Selection of Topic, Formation of Development Team, Feasibility analysis

Week 2

- Topic Approval, Meeting of Development Team including Scrum Master with Product Owner.
- Informal, preliminary discussions of requirements.
- Creating user stories in the rough record.
- Commencement of the Project.

Week 3

- Identifying modules, Initial Design of Database & UI.
- Creating a Docker container for the environment.
- Creating an empty git repository by Scrum Master / one member of the Development team and setting permission to other members.
- Pushing the first version of the Project along with a Readme file containing contact details of team members.
- Creating pull requests for sample update of Readme by each member and merging the pull requests of one by another.

Week 4-5

- Setting up systems for development, testing and production.
- Design of the basic model of a simple deployment pipeline.
- Creating a suitable folder structure (Maven's folder structure is desirable).
- Creating Unit tests using an XUnit framework, Writing the build and code analysis script, Writing acceptance test scripts and test cases, Setting up a Continuous Integration System like Jenkins. Automating acceptance tests with Selenium, Karate or an equivalent tool, writing a simple deployment script that uses scp/rsync or Ansible for copying the Docker file and running Docker with ssh.
- First Scrum Review.
- (Here onwards, the Scrum reviews are conducted on every other week).

Week 7

- Project Presentation – Interim.

- Evaluation to be based on Git History.

Week 14

- Submission of Project Report, with Scrum Book
- Project Presentation – Final
- Evaluation to be based on Git History, Scrum Book, Project Report and Presentation

Text books

1. Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation (Addison-Wesley Signature Series (Fowler)) 1st Edition.
2. Alistair Cockburn, Agile Software Development: The Cooperative Game, Addison Wesley, 2nd Edition (2006).
3. Andrew Hunt, David Thomas, The Pragmatic Programmer: From Journeyman to Master, Pearson India, 1st Edition (2008).
4. Ken Schwaber, Mike Beedle, Agile Software Development with Scrum, Pearson (2008).
5. Lisa Crispin, Janet Gregory, Agile Testing: A Practical Guide for Testers and Agile Teams, Addison Wesley Professional, 1st Edition (2008).
6. Mike Cohn, User Stories Applied: For Agile Software Development, Addison Wesley, 1st Edition, (2004).
7. Pressman, R.S., Software Engineering: A Practitioner's Approach, McGraw Hill SE, 7th Edition, (2010).
8. Robert C. Martin, Agile Software Development, Principles, Patterns and Practices, Prentice Hall Imprint, Pearson Education, 2nd Edition (2002).
9. Rod Stephens, Beginning Software Engineering, Wrox Series, Wiley India Pvt Ltd (2015).
10. RyPress Ry's Git Tutorial (Free e-book).

Web Reference

1. Introduction to DevOps (https://www.edx.org/course/introduction-devops-microsoft- dev212x)

23MCAE331	Artificial Intelligence	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: Artificial intelligence is the intelligence exhibited by machines or software that emphasizes on creating intelligent machines that work and reacts like humans. This course introduces the techniques of artificial intelligence and analyzes various methods of solving problems in uninformed and heuristics search methods. This course is designed to span a wide variety of topics in computer science research, including machine learning, Game playing, Expert Systems & fuzzy operations.

Prerequisite: Mathematical foundations for computer science

Course Outcomes: After the completion of the course the student will be able to

CO1	Apply the steps needed to provide a formal specification for solving the problem.
CO2	Apply and analyze the different types of control and heuristic search methods to solve problems.
CO3	Apply various Game theory concepts & Knowledge structures to solve problem.
CO4	Formulate knowledge representation and examine resolution in predicate and propositional logic.
CO5	Apply feasible planning and learning techniques to solve non-trial problems.
CO6	Apply knowledge of expert system architecture and fuzzy logic concepts to solve practical problems.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	3	3							2			
CO3	3	3							2			
CO4	3	3										
CO5	3	3							2			
CO6	3	3	3		2	2	3		3		3	

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Artificial Intelligence (9hrs)

Introduction to AI, Foundations and History of AI, Applications of AI Intelligent Agents: Agents and Environments, the concept of Rationality, Nature of environments, structure of agents. AI-Problem formulation, Problem Definition - Problem characteristics. Production systems, Production system characteristics. Example AI Problems (8 Puzzle problem, Missionary Cannibals Problem, Crypt arithmetic Problems).

MODULE II : Search Strategies (10hrs)

Blind search strategies -Depth First Search, Breadth First Search, Best First Search, Iterative Deepening Search, Heuristic Search strategies- Admissible Heuristics and examples - Simple Hill Climbing and Steepest Ascending Hill Climbing, Simulated Annealing, A* algorithm.

MODULE III : Game playing (10hrs)

Two Player Zero Sum Games, Modelling Two Player Zero Sum Games as search problems, Min-Max Algorithm, Optimizing Min Max Algorithm using $\alpha - \beta$ cut off, Knowledge Representation Structures : Frames, Sematic Networks and Conceptual Dependencies.

MODULE IV: Knowledge representation using Logic, Planning, Learning (10hrs)

First Order Predicate Logic (FOPL), Well Formed Formula(WFF) in FOPL, Inference

rules for FOPL, The Clause Form and conversion of WFFs to Clause Form, Resolution- Refutation. Planning*:* - Overview, components of a planning system, Goal stack planning, Hierarchical planning, Learning*:*-Forms of learning, neural net learning & genetic learning.

MODULE V: Expert systems and Fuzzy logic (9hrs)

Expert systems:–Architecture of expert systems, Roles of expert systems, Languages and tools – Typical expert system examples. Fuzzy Logic: - Fuzzy Variables, Fuzzy Sets and Fuzzy Set Operations, Typical Examples using FuzzySets.

Text books

1. Kevin Night and Elaine Rich, "Artificial Intelligence (SIE)", McGrawHill-2008.
2. StuartRussel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education2007

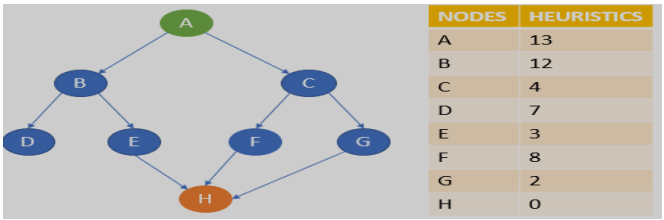
Reference books

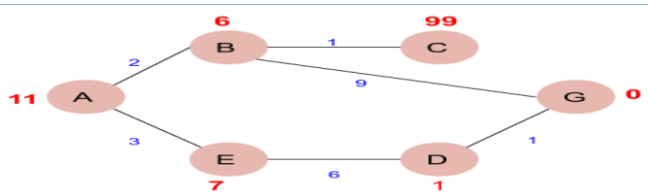
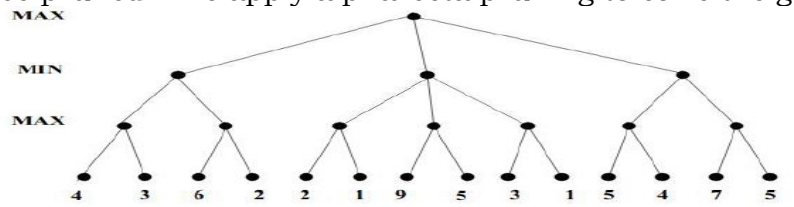
1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education,2007.

Suggested MOOC

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**9hrs**
1.1	Introduction to AI – history & application	1
1.2	Intelligent Agents: Agents and Environments	1
1.3	Nature of environments and Structure of agents	1
1.4	AI-Problem formulation	1
1.5	Production systems	1
1.6	Production system characteristics	1
1.7	8 Puzzle problem	1
1.8	Missionary Cannibals Problem	1
1.9	Crypt arithmetic Problems	1
	MODULE II	**9hrs**
2.1	Blind search strategies	1
2.2	Depth First Search	1
2.3	Breadth First Search	1
2.4	Best First Search	1
2.5	Iterative Deepening Search	1
2.6	Heuristic Search strategies- Admissible Heuristics	1
2.7	Simple Hill Climbing	1
2.8	Steepest Ascending Hill Climbing	1
2.9	Simulated Annealing	1
2.10	A* algorithm	1
	MODULE III	**9hrs**
3.1	Two Player Zero Sum Games	1
3.2	Modeling Two Player Zero Sum Games as search problems	1
3.3	Min-Max Algorithm	1
3.4	Optimizing Min Max Algorithm using α – β cut off	1

3.5	Knowledge Representation Structures	1
3.6	Frames	1
3.7	Sematic Networks	1
3.8	Conceptual Dependencies	1
3.9	Knowledge Representation Structures	1
3.10	Knowledge Representation Structures examples	1
MODULE IV		**10hrs**
4.1	First Order Predicate Logic (FOPL)	1
4.2	Well Formed Formula(WFF) in FOPL	1
4.3	Inference rules for FOPL	1
4.4	The Clause Form and conversion of WFFs to Clause Form	1
4.5	Resolution- Refutation	1
4.6	Planning :- Overview	1
4.7	Goal stack planning, Hierarchical planning	1
4.8	Learning :-Forms of learning	1
4.9	Neural net learning	1
4.10	Genetic learning	1
MODULE V		**8hrs**
5.1	Architecture of expert systems	1
5.2	Roles of expert systems	1
5.3	Languages and tools	1
5.4	Typical expert system examples	1
5.5	Fuzzy Logic:	1
5.6	Fuzzy Variables	1
5.7	Fuzzy Sets and Fuzzy Set Operations	1
5.8	Typical Examples using Fuzzy Sets Operations	1
5.9	Typical Examples using Fuzzy Sets Operations	1
CO Assessment Questions		
1	a) You are given two jugs, a 4-liter one and a 3-liter one. Neither have any measuring markers on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 litres of water into a 4-liter jug. State the production rules and solve the problem. b) Solve the following crypt-arithmetic problem as step by step procedure. CROSS + ROADS = DANGER	
2	a) Using the greedy best first search algorithm, find an optimal path from S to G in the search graph shown in figure. Show in a tabular form the various stages in the execution of the algorithm with details of the current node, children of the current node, the contents of the OPEN list and the contents of the CLOSED list.  NODES HEURISTICS A 13 B 12 C 4 D 7 E 3 F 8 G 2 H 0 b) Perform A* Algorithm for the given graph below	

	
3	a) Determine which of the branches in the game tree shown below will be pruned if we apply alpha-beta pruning to solve the game  b) Draw a semantic network representing the following knowledge: "Every vehicle is a physical object. Every car is a vehicle. Every car has four wheels. Electrical system is a part of car. Battery is a part of electrical system. Pollution system is a part of every vehicle. Vehicle is used in transportation. Swift is a car."
4	a) Represent the following statements in predicate logic: I. All Romans were either loyal to Caesar or hated him. II. Every gardener likes the sun III. People only try to assassinate rulers they are not loyal to b) Consider the following sentences,• John likes all kinds of food • Apples are food • Chicken is food • Anything anyone eats and isn't killed by is food • Bill eats peanuts and is still alive • Sue eats everything bill eats. i) Translate these sentences into formulas in predicate logic ii) Prove that john likes peanuts using backward chaining iii) Convert the formulas of a part into clause form iv) Prove that john likes peanuts using resolution.
5	a) Consider two discrete fuzzy sets, A= {0.1/0+0.8/1+1/2+0.6/3+0/4} B={0.2/0+0.5/1+1/2+0.4/3+0.1/4} find Complement, Union, Intersection, Difference and De-Morgan's principle. b) Illustrate and explain the working of machine learning behind AI Camera.

23MCAE333	Data Visualization Techniques	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The course focuses on data visualization providing a comprehensive study of the principles, techniques, and applications of visualizing data effectively, enabling students to analyze, interpret, and communicate data through interactive and impactful visualizations.

Prerequisite:

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the importance and history of data visualization.
CO2	Apply interactive visualization techniques and web-specific components.
CO3	Identify and utilize appropriate data visualization types
CO4	Analyze and pre-process data effectively for visualization.
CO5	Evaluate visualizations and address validity concerns.
CO6	Develop interactive visualizations using web-specific tools like D3.js.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	2	2		2		2					
CO3	3	2	2		2		2					
CO4	3	2	2		2		2					
CO5	3	2										
C06	3	3			3				2			

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate			✓	
Create			✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	100

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Data Visualization (9hrs)

Introduction: Introduction to Data Visualization – History of Visualization – Need for Visualization - Interactive Visualization – Web Specific Components – Common Types of Data Visualization – Data Visualization and Infographics .

MODULE II : **Data Abstraction (9hrs)**

Data Abstraction: Data Set types – Attribute Types – Semantics. Task Abstraction : Actions – Targets. Charts – Data Pre-processing - Choosing the optimal charts – Making charts effective – Context in Visualization - Analyzing Visual Patterns – Beautiful vs Useful Design - Cognitive Load Theory - Responsive Design principles.

MODULE III : Perception and Visualization (10hrs)

Perception and Visualization – Perceptual processing – Metrics - The Visualization Process – Visual Variables – Taxonomies. Visualization validation: Threats to Validity –Validation approaches.

MODULE IV : Visualization Techniques (10hrs)

Visualization Techniques: Spatial Data Visualization - Multivariate Data Visualization
Techniques: Point-Based – Line based – Region based – Hybrid Techniques – Visualization techniques for trees, graphs and networks – Text and Document Visualization.

MODULE V : Interaction concepts (9hrs)

Interaction concepts – Interaction techniques: screen space – object space – data space – attribute space – Interaction Control – Web specific visualization with the case study of D3.

Text books

1. "Data Visualization: A Handbook for Data Driven Design" by Aditi B. Malladi and Srividya K. Balaji, Notion Press,2021
2. "Visual Data Mining: Techniques and Tools for Data Visualization and Mining" by R. Krishna Kumar and S. Sathiya Keerthi, CRC Press,2018
3. "Fundamentals of Data Visualization" by Vivek S. Kale and Sourabh S. Shirhatti, Springer, 2019.
4. "Data Visualization: Principles and Techniques" by Subhashis Dasgupta, PHI Learning, 2017.
5. "Data Visualization: A Guide to Visual Storytelling for Analytics" by Pradeep Kumar and Sathyanarayanan Srinivasan, Wiley,2021.

Reference books

1. "Data Visualization Using Python: Transform the Way You Perceive Data" by Bijal Shah and Geeta Dave, BPB Publications, 2020
2. "Data Visualization: Creating Interactive and Impactful Visualizations in Python" by Sarang Gupta and Tanmay Datta, Apress, 2022
3. "Interactive Data Visualization: Learn How to Visualize Data in the Browser with Python and Bokeh" by Adnan Aziz and Mounish Panchakarla, Packt Publishing, 2020

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1 (10hrs)	
1.1	Introduction to Data Visualization	1
1.2	History of Visualization – Need for Visualization	1
1.3	Interactive Visualization	1
1.4	Interactive Visualization Tools	1
1.5	Web Specific Components	1
1.6	Features of Web Specific Components	1
1.7	Common Types of Data Visualization	1
1.8	Data Visualization	1
1.9	Components of Data Visualization (Bar Charts, Line Charts, Column Charts, etc.)	1
1.10	Infographics	1
	MODULE II (10hrs)	
2.1	Data Abstraction : Data Set types – Attribute Types – Semantics.	1
2.2	Task Abstraction : Actions – Targets	1
2.3	Charts – Data Pre-processing	1
2.4	Choosing the optimal charts	1
2.5	Making charts effective	1
2.6	Context in Visualization	1
2.7	Analyzing Visual Patterns	1
2.8	Beautiful vs Useful Design	1
2.9	Cognitive Load Theory	1
2.10	Responsive Design principles.	1
	MODULE III (9hrs)	
3.1	Perception and Visualization	1
3.2	Perceptual processing	1
3.3	Metrics	1
3.4	The Visualization Process	1
3.5	Visual Variables – Taxonomies	1
3.6	Data visualization taxonomy	1
3.7	Visualization validation	1
3.8	Threats to Validity	1
3.9	Validation approaches	1

MODULE IV (10hrs)		
4.1	Visualization Techniques: Spatial Data Visualization	1
4.2	Multivariate Data Visualization Techniques : Point-Based	1
4.3	Line based	1
4.4	Region based	1
4.5	Hybrid Techniques	1
4.7	Visualization techniques for trees, graphs	1
4.8	Visualization techniques for networks	1
4.9	Text Visualization.	1
4.10	Document Visualization.	1
MODULE V (8hrs)		
5.1	Interaction concepts	1
5.2	Interaction techniques	1
5.3	Screen space	1
5.4	Object space	1
5.5	Data space	1
5.6	Attribute space	1
5.7	Interaction Control	1
5.8	Web specific visualization with the case study of D3.	1

CO Assessment Questions	
Module 1	1. Discuss the importance of interactive visualization and its advantages over static visualizations. 2. Compare and contrast data visualization and infographics, highlighting their similarities and differences. 3. Provide examples of web-specific components used in data visualization.
Module 2	1. Discuss the various attribute types in data visualization and their implications for visualization design. 2. Define task abstraction in the context of data visualization and provide examples of actions and targets. 3. Describe the process of choosing optimal charts for different types of data and visualization goals. 4. Implement a Python program to choose the optimal chart type based on the given dataset and the analytical tasks to be performed.
Module 3	1. Discuss different metrics used to evaluate the effectiveness of visualizations. 2. Describe the visualization process and the role of visual variables in creating meaningful visual representations. 3. Differentiate between different taxonomies used in data visualization and provide examples of each. 4. Write a Python program to generate visualizations using different visual variables such as colour, shape, and size to encode data attributes.

Module 4	1. Discuss spatial data visualization techniques and their applications in representing geographic information. 2. Discuss the challenges and considerations in visualizing complex datasets. 3. Provide examples of effective visualization techniques for different types of data. 4. Implement a Python script to create a network visualization of a given graph using a suitable library.
Module 5	1. Discuss the role of interaction control in enabling user exploration and analysis of visualizations. 2. Discuss the principles of responsive design in the context of interactive data visualizations. 3. Provide examples of how interaction techniques can enhance user engagement and understanding of visualizations. 4. Develop a Python program that allows users to interactively filter and explore data by manipulating visual attributes or selecting data points.

23MCAE335	Distributed Computing	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This course is to understand the system models, algorithms and protocols that allow computers to communicate and coordinate their actions to solve a problem. This course helps the learner to understand the distributed computation model and various concepts like global state, termination detection, mutual exclusion, deadlock detection, shared memory, failure recovery, consensus, file system. It helps the learners to develop solutions to problems in distributed computing environment.

Prerequisite: Basic knowledge in data structures and operating systems

Course Outcomes: After the completion of the course the student will be able to

CO1	Summarize various aspects of distributed computation model and logical time.
CO2	Illustrate election algorithm, global snapshot algorithm and termination detection algorithm.
CO3	Compare token based, non-token based and quorum based mutual exclusion algorithms.
CO4	Recognize the significance of deadlock detection and shared memory in distributed systems.
CO5	Explain the concepts of failure recovery and consensus.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	2					2					
CO 2	3	3	2				2					
CO 3	3	2			3		2					
CO 4	3	3	2				2					
CO 5	3	3	2	2	3		2					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Distributed systems basics and Computation model: (10hrs)

Distributed System – Definition, Relation to computer system components, Motivation, Primitives for distributed communication, Design issues, Challenges and applications. A model of distributed computations – Distributed program, Model of distributed executions, Models of communication networks, Global state of a distributed system, Cuts of a distributed computation, Past and future cones of an event, Models of process communications.

MODULE II : Election algorithm, Global state and Termination detection: (10hrs)

Logical time – A framework for a system of logical clocks, Scalar time, Vector time. Leader election algorithm – Bully algorithm, Ring algorithm. Global state and snapshot recording algorithms – System model and definitions, Snapshot algorithm for FIFO channels – Chandy Lamport algorithm. Termination detection – System model of a distributed computation, Termination detection using distributed snapshots, Termination detection by weight throwing, Spanning-tree-based algorithm.

MODULE III : Mutual exclusion and Deadlock detection: (10hrs)

Distributed mutual exclusion algorithms – System model, Requirements of mutual exclusion algorithm. Lamport's algorithm, Ricart–Agrawala algorithm, Quorum-based mutual exclusion algorithms – Maekawa's algorithm. Token-based algorithm – Suzuki–Kasami's broadcast algorithm. Deadlock detection in distributed systems – System model, Deadlock handling strategies, Issues in deadlock detection, Models of deadlocks.

MODULE IV : Distributed shared memory and Failure recovery (10hrs)

Distributed shared memory – Abstraction and advantages. Shared memory mutual exclusion – Lamport's bakery algorithm. Check pointing and rollback recovery – System model, consistent and inconsistent states, different types of messages, Issues in failure recovery, checkpoint based recovery, log based roll back recovery.

MODULE V : Consensus and Distributed file system: (8hrs)

Search Engine – Search engine architecture, Crawling, Storage, Indexing, Ranking, HITS Algorithm, Page rank algorithm, Random walk, SALSA Algorithm, Bayesian Algorithm; Google - Google architecture, Data Structures, Crawling, Searching, Web Spam Pages.

Text books

1. Ajay D. Kshemkalyani and Mukesh Singhal, Distributed Computing: Principles, Algorithms, and Systems, Cambridge University Press, 2011.

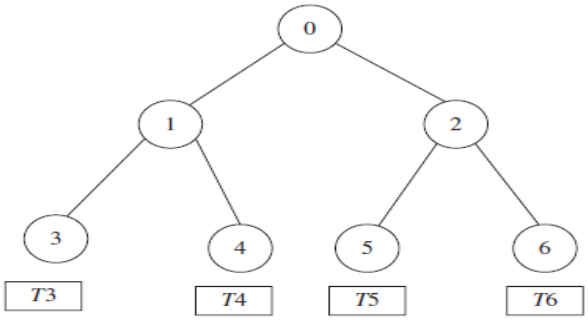
Reference books

1. George Coulouris, Jean Dollimore, Tim Kindberg and Gordon Blair. Distributed Systems: Concepts and Design, Addison Wesley, Fifth edition.
2. Kai Hwang, Geoffrey C Fox, Jack J Dongarra, Distributed and Cloud Computing – From Parallel Processing to the Internet of Things, Morgan Kaufmann Publishers, 2012.
3. Sukumar Ghosh, Distributed Systems: An Algorithmic Approach, CRC Press, Second edition, 2015.
4. Maarten Van Steen, Andrew S. Tanenbaum, Distributed Systems, Prentice Hall of India, Third edition, 2017.
5. Randy Chow and Theodore Johnson, Distributed Operating Systems and Algorithm Analysis, Pearson Education India, First edition, 2009.
6. Valmir C. Barbosa, An Introduction to Distributed Algorithms, MIT Press, 2003.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
MODULE 1		**10hrs**
1.1	Distributed System – Definition, Relation to computer system components	1
1.2	Primitives for distributed communication.	1
1.3	Design issues, challenges and applications.	1
1.4	Design issues, challenges and applications.	1
1.5	A model of distributed computations – Distributed program	1
1.6	Model of distributed executions	1
1.7	Models of communication networks.	1
1.8	Global state of a distributed system, Cuts of a distributed computation	1
1.9	Cuts of a distributed computation, Past and future cones of an event.	1
1.10	Models of process communications.	1
MODULE II		**10hrs**
2.1	Logical time – A framework for a system of logical clocks, Scalar time	1
2.2	Vector time.	1
2.3	Leader election algorithm – Bully Algorithm.	1
2.4	Ring Algorithm	1
2.5	Global state and snapshot recording algorithms – System model and definitions	1
2.6	Snapshot algorithm for FIFO channels – Chandy Lamport algorithm.	1
2.7	Termination detection – System model of a distributed	1

	computation	
2.8	Termination detection using distributed snapshots.	1
2.9	Termination detection by weight throwing.	1
2.10	Spanning tree-based algorithm.	1
MODULE III		**10hrs**
3.1	Distributed mutual exclusion algorithms – System model, Lamport's algorithm	1
3.2	Ricart–Agrawala algorithm	1
3.3	Quorum-based mutual exclusion algorithms – Maekawa's algorithm	1
3.4	Token-based algorithm – Suzuki–Kasami's broadcast algorithm.	1
3.5	Deadlock detection in distributed systems – System model	1
3.6	Deadlock handling strategies	1
3.7	Issues in deadlock detection	1
3.8	Models of deadlocks	1
3.9	Ricart–Agrawala algorithm	1
3.10	Quorum-based mutual exclusion algorithms – Maekawa's algorithm	1
MODULE IV		**10hrs**
4.1	Distributed shared memory – Abstraction and advantages.	1
4.2	Shared memory mutual exclusion – Lamport's bakery algorithm.	1
4.3	Checkpointing and rollback recovery – System model, consistent and inconsistent states	1
4.4	Checkpointing and rollback recovery – System model, consistent and inconsistent states	1
4.5	different types of messages, Issues in failure recovery	1
4.6	different types of messages, Issues in failure recovery	1
4.7	checkpoint based recovery	1
4.8	checkpoint based recovery	1
4.9	log based roll back recovery.	1
4.10	log based roll back recovery.	1
MODULE V		**8hrs**
5.1	Consensus and agreement algorithms – Assumptions, The Byzantine agreement and other problems	1
5.2	Agreement in (message-passing) synchronous systems with failures – Consensus algorithm for crash failures	1
5.3	Agreement in (message-passing) synchronous systems with failures – Consensus algorithm for crash failures	1
5.4	Distributed File System – File Service Architecture	1
5.5	Case Studies: Sun Network File System	1
5.6	Case Studies	1
5.7	Andrew File System	1
5.8	Google File System	1

CO Assessment Questions	
1	**Course Outcome1 (CO1):** 1. Define logical clock and explain the implementation of the logical clock. 2. Explain different forms of load balancing.
2	**Course Outcome 2 (CO2):** 1. Apply ring-based leader election algorithm with 10 processes in the worst-performing case. Count the number of messages needed. 2. Apply spanning tree-based termination detection algorithm in the following scenario. The nodes are processes 0 to 6. Leaf nodes 3, 4, 5, and 6 are each given tokens T3, T4, T5 and T6 respectively. Leaf nodes 3, 4, 5 and 6 terminate in the order, but before terminating node 5,it sends a message to node 1. 
3	**Course Outcome 3 (CO3):** 1. What are the requirements of mutual exclusion algorithms? 2. Illustrate Suzuki- Kasami's broadcast algorithm.
4	**Course Outcome 4 (CO4):** 1. Compare different models of deadlocks. 2. Illustrate the detailed abstraction of distributed shared memory and interaction with application processes.
5	**Course Outcome 5 (CO5):** 1. Explain how consensus problem differs from the Byzantine agreement problem. 2. Classify different log based roll back recovery techniques.

23MCAE337	Digital Image Processing	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This course introduces the techniques to understand the concept of enhancement, transforms, smoothing, restoration, compression, morphological image analysis, classification & segmentation in two-dimensional space. Simulate human vision into computer vision based on feature extraction to develop applications in different areas are introduced.

Prerequisite: Linear Algebra, Basic programming skills in any language.

Course Outcomes: After the completion of the course the student will be able to

CO1	Identify the fundamental concepts of digital image processing, image formation and representation of images.(Understand)
CO2	Demonstrate the image enhancement methods in the spatial domain.(Apply)
CO3	Exhibit image transforms and image smoothing & sharpening using various kinds of filters in frequency domain.(Apply)
CO4	Identify various approaches in image restoration and compression.(Understand)
CO5	Determine morphological basics and image segmentation methods.(Apply)

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3							3			
CO2	3	3	3		2		3		3			1
CO3	3	3	3		2		3		3			1
CO4	3	3							3			
CO5	3	3	3		2		3		3			1

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Digital Image Processing (9hrs)

Basic concepts, image processing and computer vision, Components of an image processing system. Image processing applications. Mathematical preliminaries: Basic Vector and Matrix operations, Elements of Visual Perception: Structure of the human eye and image formation, Brightness adaptation and discrimination. Types of Images: Binary, Gray scale and Color Images. Image Sampling and Quantization: Digital image as a 2D array, Spatial and Intensity resolution, 2D-sampling theorem. RGB and HSI color models.

MODULE II : Image enhancement (9hrs)

Concept of Image enhancement, Basic grey level transformation functions: Image negative, Log transformation, Power-law transformation, Piecewise linear transformations. Histogram of an Image, Histogram equalization with illustration. Fundamentals of Spatial Filtering: Mechanics of Spatial filtering, 2D correlation and convolution. Smoothing spatial filters: Linear and Nonlinear types. Sharpening spatial filters: Laplacian operator

MODULE III : Image Transform (9hrs)

Representation of an image in frequency domain, Unitary transformation of Image-transform pair equations in matrix form, Properties of unitary transforms. 1D-DFT, 2D-DFT of an image- Properties of 2D-DFT. DCT and its properties, Filtering an Image in the Frequency Domain– Steps of frequency domain filtering. Basic concept and illustration of frequency domain image smoothing and sharpening.

MODULE IV : Image Restoration & Image compression (9hrs)

Concept of Image restoration, A Model of the Image Degradation/Restoration Process, Image Noise Models, Point Spread Function, Restoration using Inverse filtering, Wiener filtering. Image compression: Need for compression, redundancy, classification of image compression schemes, A general image compression system, Huffman coding, JPEG standard.

MODULE V : Morphological image processing and Image segmentation (9hrs)

Morphological image processing basics: erosion and dilation, opening and closing, Hit or Miss transformation. Image segmentation: Fundamentals, Point detection, Line detection, Basic steps of edge detection, Hough transform, Edge detectors - Canny edge detector. Thresholding: Basics of intensity thresholding, Global thresholding and Otsu's method. Region-based segmentation: Region growing, Region Splitting and Merging.

Text books

1. Rafael C., Gonzalez & Woods R.E., "Digital Image Processing", Pearson Education.(Third Edition)
2. Jain A.K, "Fundamentals of Digital Image Processing", Prentice Hall, Eaglewood Cliffs, NJ.

Reference books

1. Schalkoff R. J., "Digital Image Processing and Computer Vision", John Wiley
2. Pratt W.K., "Digital Image Processing", John Wiley
3. Al Bovick , "Handbook of Image and Video Processing" , Academic Press, 2000

Suggested MOOC

1. https://archive.nptel.ac.in/courses/106/105/106105032/
2. https://archive.nptel.ac.in/courses/117/105/117105135/

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**9hrs**
1.1	Basic concepts	1
1.2	Image processing and computer vision	1
1.3	Components of an image processing system & image processing applications	1
1.4	Mathematical preliminaries	1
1.5	Elements of Visual Perception	1
1.6	Types of Images	1
1.7	Image Sampling and Quantization	1
1.8	Spatial and Intensity resolution	1
1.9	RGB and HSI color models	1
	MODULE II	**9hrs**
2.1	Concept of Image enhancement	1
2.2	Basic grey level transformation functions	1
2.3	Histogram	1
2.4	Fundamentals of Spatial Filtering	1
2.5	2D correlation and convolution	1
2.6	Smoothing spatial filters	1
2.7	Linear and Nonlinear types	1
2.8	Sharpening spatial filters	1
2.9	Laplacian operator	1

MODULE III		**9hrs**
3.1	Representation of an image in frequency domain	1
3.2	Unitary transformation of an Image-transform pair equations in matrix form	1
3.3	Properties of unitary transforms	1
3.4	1D-DFT	1
3.5	2D-DFT of an image	1
3.6	DCT and its properties	1
3.7	Filtering an Image in the Frequency Domain	1
3.8	Basic concept and illustration of frequency domain image smoothing	1
3.9	Sharpening.	1
MODULE IV		**9hrs**
4.1	Concept of Image restoration, A Model of the Image Degradation/Restoration Process	1
4.2	Image Noise Models	1
4.3	Wiener filtering	1
4.4	Restoration using Inverse filtering	1
4.5	Image compression: Need for compression	1
4.6	Redundancy	1
4.7	classification of image compression schemes	1
4.8	A general image compression system	1
4.9	Huffman coding & JPEG standard	1
MODULE V		**8hrs**
5.1	Morphological image processing basics: erosion and dilation	1
5.2	opening and closing	1
5.3	Hit or Miss transformation	1
5.4	Image segmentation	1
5.5	Basic steps of edge detection, Hough transform	1
5.6	Edge detectors - Canny edge detector	1
5.7	Thresholding	1
5.8	Global thresholding and Otsu's method	1
5.9	Region-based segmentation	

CO Assessment Questions	
1	Develop a automated programs using mathlab for processing basic operations like RGB to Gray, rotate the image, binary conversion by using the functions.
2	Using the mathlab functions, enhance images for analysis by using common pre-processing techniques such as contrast adjustment and noise filtering.
3	Design an attendance marking system through MATLAB by detecting a face. This facial recognition should perform fundamental tasks like smoothing and sharpening of image.
4	Develop a simple project of color image compression scheme based on discrete wavelet transformation (DWT).
5	Develop a simple project of Weed Detection in crops by computational vision.

23MCAE339	Big Data Analytics	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: Big Data Analytics has emerged as a critical field in today's data-driven era, as organizations strive to make data-informed decisions and gain a competitive edge. This course aims to provide students with a solid foundation in the principles, techniques, and tools of Big Data Analytics. Through the course, students will develop the skills necessary to tackle real-world challenges in analyzing large-scale data.

Prerequisite: Nosql

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the basic concepts of Big data.
CO2	Understand NoSQL big data management
CO3	Understand the basics of Hadoop and HDFS
CO4	Get and insight on map-reduce analytics using Hadoop
CO5	Use Hadoop related tools such as Pig and Hive for big data Analytics

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3					2					
CO2	3	3					2					
CO3	3	3					2					
CO4	3	3					2					
CO5	3	3					2					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate			✓	
Create			✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Big Data Platform (6hrs)

History of Data Management-Structuring Big data Elements of Big Data, Big data stack - Big data Analytics - Introducing Technologies for handling Big Data: Distributed and Parallel Computing for Big Data

MODULE II Big Data Storage (11hrs)

Big Data Storage Concepts- Clusters - File Systems and Distributed File Systems- NoSQL – Sharding – Replication –Sharding and Replication – CAP Theorem – ACID – BASE Big Data Processing Concepts- Parallel Data Processing – Distributed Data Processing – Hadoop – Processing in Batch Mode – Processing in Real time Mode.

MODULE III :Introduction to Hadoop (11hrs)

Working with Big Data: Data format – analyzing data with Hadoop – scaling out – Hadoop streaming – Hadoop pipes – design of Hadoop distributed file system (HDFS) – HDFS concepts – Java interface – data flow – Hadoop I/O – data integrity – compression– serialization – Avro – file-based data structures.

MODULE IV :Understanding Map reduce Framework (7hrs)

Understanding Map Reduce: Fundamentals- Map Reduce Framework- Exploring Features of Map Reduce- Working of Map Reduce- Exploring Map and Reduce Functions- Techniques to optimize Map Reduce- Uses of Map Reduce

MODULE V : Introduction to Apache Pig and Hive (12hrs)

Apache Pig: Introduction, Parallel processing using Pig, Pig Architecture, Grunt, Pig Data Model-scalar and complex types. Pig Latin- Input and output, Relational operators, User defined functions. Working with scripts.
Apache Hive Fundamentals: Introduction-Hive modules, Data types and file formats, Hive QL-Data Definition and Data Manipulation.
Programming assignments maybe given at the end of each module to get hands on experience.

Text books

1. Chandrakant Naikodi, “Managing Big Data”, Vikas Publishing, 2015.
2. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilley.
3. Eric Sammer, "Hadoop Operations", 1st Edition, O'Reilley.
4. DreamTech Editorial Services, “Big Data”, Dreamtech Press, 2015 Edition.
5. AlanGates, Programming Pig Dataflow Scripting with Hadoop, O’ReillyMedia, Inc, 2011.
6. Jason Rutherglen, Dean Wampler, Edward Caprialo, Programming Hive, O’ReillyMedia Inc, 2012.

Reference books

1. Vignesh Prajapati, Big data analytics with R and Hadoop, SPD 2013.
2. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.
3. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.
4. Chuck Lam, Hadoop in Action, Manning Publications,2010.
5. Donald Miner, Adam Shook, “Map Reduce Design Pattern”, O’Reilly, 2012
6. Michael Frampton, “Big Data Made Easy: A Working Guide to the Complete Hadoop Toolset”, Apress, 2014.
7. Michael Manoochehri, “Data Just Right”, Pearson education, 2015.
8. Thomas Erl ,”Big Data Fundamentals Concepts, Drivers and Techniques”, Pearson Education First Edition,2016.
9. Vijay Srinivas Agneeswaran, “Big Data Analytics beyond HADOOP”, Pearson Education(2015).

Web References

1. https://www.edureka.co/blog/big-data-tutorial

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	History of Data Management	1
1.2	Structuring Big data Elements of Big Data	1
1.3	Big data stack	1
1.4	Big data Analytics	1
1.5	Introducing Technologies for handling Big Data: Distributed and Parallel Computing for Big Data	1
1.6	Introducing Technologies for handling Big Data: Distributed and Parallel Computing for Big Data	1
	MODULE II	
2.1	Big Data Storage Concepts- Clusters	1
2.2	File Systems and Distributed File Systems-	1
2.3	NoSQL	1
2.4	Sharding, Replication, Sharding and Replication	1
2.5	Sharding, Replication, Sharding and Replication	1
2.6	CAP Theorem – ACID – BASE Big Data Processing Concepts	1
2.7	CAP Theorem – ACID – BASE Big Data Processing Concepts	1
2.8	Parallel Data Processing	1
2.9	Distributed Data Processing	1
2.10	Hadoop – Processing in Batch Mode	1
2.11	Processing in Real time Mode	1
	MODULE III	
3.1	Data format	1
3.2	Analyzing data with Hadoop	1
3.2	Scaling out	1
3.3	Hadoop streaming	1

3.4	Hadoop pipes	1
3.5	Design of Hadoop distributed file system (HDFS), HDFS concepts	1
3.6	Java interface	1
3.7	Data flow	1
3.8	Hadoop I/O – data integrity	1
3.9	Compression– serialization	1
3.10	Avro – file-based data structures	1
3.11	Avro – file-based data structures	1
MODULE IV		
4.1	Fundamentals- Map Reduce Framework	1
4.2	Exploring Features of Map Reduce	1
4.3	Working of Map Reduce	1
4.4	Exploring Map and Reduce Functions	1
4.5	Techniques to optimize Map Reduce	1
4.6	Techniques to optimize Map Reduce	1
4.7	Uses of Map Reduce	1
4.7	Uses of Map Reduce	1
MODULE V		
5.1	Introduction to Apache Pig	1
5.2	Parallel processing using Pig	1
5.3	Pig Architecture	1
5.4	Grunt	1
5.5	Pig Data Model-scalar and complex types	1
5.6	Pig Latin- Input and output	1
5.7	Relational operators, User defined functions	1
5.8	Working with scripts	1
5.9	Introduction-Hive modules, Data types and file formats	1
5.10	Data types and file formats	1
5.11	Hive QL-Data Definition and Data Manipulation.	1
5.12	Data Definition and Data Manipulation.	1

CO Assessment Questions	
1	a) Identify and explain the four key elements of big data: volume, variety, velocity, and veracity. b) Discuss the advantages and limitations of distributed and parallel computing for handling big data. Explain how these technologies help in processing and analyzing large datasets efficiently.
2	a) Explain the concept of data sharding in the context of big data storage. Discuss how sharding helps in distributing data across

	multiple nodes and improving scalability and performance. b) Explain the concepts of ACID and BASE in the context of big data processing. Discuss how these principles influence the design and implementation of distributed data processing systems.
3	a) Explain the concept of scaling out in Hadoop. Discuss the techniques and strategies used to scale a Hadoop cluster horizontally to handle increasing amounts of data and processing requirements. b) Discuss the Java interface for interacting with HDFS. Explain the classes and methods provided by the Hadoop Java API for reading, writing, and manipulating data stored in HDFS.
4	a) Explain the fundamentals of the MapReduce programming model. Discuss the key components and workflow involved in a MapReduce job. b) Discuss the challenges and considerations when designing and implementing MapReduce jobs.
5	a) Describe the architecture of Apache Pig, including its components and their roles in the data processing pipeline. Discuss the interaction between Pig Latin scripts and the Pig execution engine. b) Explore Hive QL (Query Language). Discuss the syntax and semantics of Hive QL for data definition (DDL) and data manipulation (DML) operations.

23MCAE341	Operations Research	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The course aims at building capabilities in the students for analyzing different situations in the industrial/ business scenario involving limited resources and finding the optimal solution within constraints. The objective of this course is to enable the student to understand and analyse managerial and engineering problems to equip him to use the resources such as capitals, materials, productions, controlling, directing, staffing, and machines more effectively.

Prerequisite: A basic course in Calculus, linear algebra and probability.

Course Outcomes-After the completion of the course the student will be able to

CO1	Solve different types of Linear Programming Problems. (Apply)
CO2	Apply the concept of linear programming problems in real life. (Apply)
CO3	Solve different decision-making problems using optimization techniques (Apply)
CO4	To appropriately formulate Network models for service and manufacturing systems, and apply operations research techniques and algorithms to solve these Network problems (Apply)
CO5	To appropriately formulate Queuing models for service and manufacturing systems, and apply operations research techniques to solve these Queuing problems. (Apply)

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2					1					
CO2	3	2					1					
CO3	3	2					1					
CO4	3	2					1					
CO5	3	2					1					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	✓
Evaluate			✓	✓
Create			✓	✓

Mark Distribution of CIA					
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**			**Total Marks**
		Assignment	**Test-1**	**Test-2**	
3-1-0-0	5	15	10	10	40

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3hrs

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

MODULE I: Linear Programming Problem(9Hrs)

Linear programming problem- Slack and surplus variable- Standard form- Solution of Linear programming problem- Basic solution- Basic feasible solution- Degenerate- and Nondegenerate solutions- Optimal solution- Solution by simplex method- Artificial variables, Big- M method.

MODULE II: Duality(9Hrs)

Duality in Linear Programming Problem- Statement of duality theorem- Statement of complementary slackness theorem. The primal- Duality solutions using simplex method, Revised simplex method.

MODULE III: Transportation and assignment problem(9Hrs)

Transportation problem- Solution of Transportation problem- Finding an initial basic feasible solution- North West Corner method- Matrix minima method- Vogel's Approximation method- Test for Optimality- Modi method- Unbalanced Transportation problem, Maximization in Transportation problem. Assignment problem- Optimal solution- Hungarian method of assignment- Maximization in assignment problem.

MODULE IV: Network Analysis(9Hrs)

Network analysis- Project scheduling- Construction of project networks- Critical path method (CPM)- Identification of critical path using CPM- Estimation of Floats- Total float, Independent float- Project Evaluation and Review Technique (PERT) - Computation of expected completion times by PERT.

MODULE V: Queuing Theory(9Hrs)

Queuing theory- Elements of Queuing System- Kendall's notation- Operating characteristics, Poisson process- Exponential distribution- Mean and variance- Birth and Death process. Queuing models based on Poisson process- Single server models with finite and infinite capacity- Multi server model with finite and infinite capacity.

Text books

1. Kantiswarup, P.K. Gupta and Man Mohan, Operation Research, Sultan Chand (2010).

Reference books

1. Hamdy A Taha, Operations Research- an introduction, Eighth Edition, Prentice Hall of India.
2. Ravindran, Philips and Solberg, Wiley, Operation Research, Second edition (2007).
3. Introduction to Operations Research - Course (nptel.ac.in), Prof.G.Sreenivasan, IIT Madras.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours [45 hours]
	MODULE 1	**9Hrs**
1.1	Linear programming problem- Slack and surplus variable- Standard form-.	1
1.2	Solution of Linear programming problem	1
1.3	Basic solution- Basic feasible solution- Degenerate- and Nondegenerate solutions	1
1.4	Basic solution- Basic feasible solution- Degenerate- and Nondegenerate solutions-continued	1
1.5	Optimal solution	1
1.6	Solution by simplex method	1
1.7	Solution by simplex method-continued	1
1.8	Artificial variables, Big- M method	1
1.9	Artificial variables, Big- M method-continued	1
	MODULE II	**9Hrs**
2.1	Duality in Linear Programming Problem	1
2.2	Duality in Linear Programming Problem-continued	1
2.3	Statement of duality theorem	1
2.4	Statement of complementary slackness theorem.	1
2.5	The primal- Duality solutions using simplex method	1
2.6	The primal- Duality solutions using simplex method-continued	1

2.7	Revised simplex method	1
2.8	Revised simplex method-continued	1
2.9	Revised simplex method-continued	1
MODULE III		**9Hrs**
3.1	Transportation problem	1
3.2	Solution of Transportation problem- Finding an initial basic feasible solution-	1
3.3	North West Corner method	1
3.4	Matrix minima method- Vogel's Approximation method	1
3.5	Test for Optimality- Modi method	1
3.6	Unbalanced Transportation problem	1
3.7	Maximization in Transportation problem.	1
3.8	Assignment problem- Optimal solution- Hungarian method of assignment	1
3.9	Maximization in assignment problem.	1
MODULE IV		**9Hrs**
4.1	Network analysis- Project scheduling- Construction of project networks	1
4.2	Network analysis- Project scheduling- Construction of project networks-continued	1
4.3	Critical path method (CPM)- Identification of critical path using CPM.	1
4.4	Critical path method (CPM)- Identification of critical path using CPM-continued	1
4.5	Estimation of Floats- Total float, Independent float	1
4.6	Estimation of Floats- Total float, Independent float-continued	1
4.7	Project Evaluation and Review Technique (PERT)	1
4.8	Computation of expected completion times by PERT	1
4.9	Computation of expected completion times by PERT-continued	1
MODULE V		**9Hrs**
5.1	Queuing theory- Elements of Queuing System- Kendall's notation	1
5.2	Operating characteristics, Poisson process	1
5.3	Exponential distribution- Mean and variance	1
5.4	Birth and Death process	1
5.5	Queuing models based on Poisson process- Single server models with finite capacity	1
5.6	Single server models with finite capacity-continued	1
5.7	Single server models with infinite capacity	1
5.8	Single server models with infinite capacity-continued	1
5.9	Multi server model with finite and infinite capacity	1

CO Assessment Questions	
1	1. In your role as a manufacturing company manager, you oversee the production of two distinct products, Product A and Product B. Your primary objective is to maximize the overall profit, taking into account the constraints imposed by limited resources. Each unit of Product A generates a profit of $20, while Product B brings in $30 per unit. However, you are constrained by a maximum of 200 labor hours and 400 machine hours available. Product A requires 2 labor hours and 4 machine hours per unit, while Product B consumes 3 labor hours and 2 machine hours per unit. By applying the Simplex Method, your aim is to determine the optimal production quantities for both products to achieve the highest possible total profit within these resource limitations. 2. You manage a furniture manufacturing company that produces three types of tables: Table A, Table B, and Table C. The profit per unit for Table A is $50, for Table B is $60, and for Table C is $70. However, you have constraints due to limited woodworking hours (300 hours available) and limited materials (1,000 units available). Table A requires 2 hours of woodworking and 5 units of materials, Table B requires 3 hours of woodworking and 4 units of materials, and Table C requires 4 hours of woodworking and 6 units of materials per unit. Using the Big M Method, determine the optimal production quantities to maximize profit while staying within these constraints. 3. **Team Work:** You are managing a team of software developers and designers working on a software project. Your goal is to optimize the allocation of team members to various project tasks to maximize productivity and minimize costs while adhering to certain constraints. Each team member has different skills, hourly rates, and availability, and each task requires a specific combination of skills (you would need to collect relevant data on team members' skills, costs, availability, task requirements, and any other relevant parameters). Using an optimization method inspired by the Simplex Method, determine the optimal assignment of team members to tasks to achieve the highest efficiency and cost-effectiveness while ensuring that all tasks are completed within the project's timeframe.

2	1. The management of a production facility aims to optimize the production of two types of items, Product X and Product Y, to maximize profit. Product X yields a profit of $15 per unit, while Product Y yields $20 per unit. However, there are constraints: a labor-hour constraint of 200 hours and a machine-hour constraint of 300 hours. Product X requires 3 labor hours and 2 machine hours per unit, while Product Y requires 2 labor hours and 4 machine hours per unit. Using the Dual Simplex Method, determine the optimal production quantities for Products X and Y that maximize profit while respecting these constraints and the additional constraint that at least 20 units of Product Y must be produced. 2. In a project management scenario, a project manager is overseeing two distinct projects, Project X and Project Y. Project X has a benefit of $8,000, and Project Y has a benefit of $12,000. However, the manager has constraints related to resource availability, with a maximum of 400 resource hours per week. Project X requires 50 resource hours, and Project Y requires 60 resource hours per week. Using the Dual Simplex Method, determine the optimal allocation of resources to projects to maximize the weekly benefit while considering resource constraint 3. **Team Work**: You are a project manager leading a cross-functional team to optimize resource allocation for a complex project. The project requires various skill sets from team members, and you have to distribute tasks efficiently while considering individual expertise, work hours, and cost constraints (you would need to collect relevant data). Using an optimization approach inspired by linear programming (e.g., a revised simplex-like technique), develop a method to find the optimal task assignments that maximize productivity, minimize costs, and ensure team members are assigned to tasks that match their expertise, all while adhering to time and budget constraints.
3	1. In a logistics scenario, a manager is tasked with optimizing the delivery of goods from three warehouses (W1, W2, and W3) to four retail stores (S1, S2, S3, and S4). The transportation costs per unit (in dollars) between each warehouse and store are provided in the given table. The supply at each warehouse and the demand at each store are specified but not quantified. Using the transportation method, determine the optimal shipment quantities from each warehouse to each store that minimize the total transportation costs while ensuring that supply and demand constraints are met. Transportation Costs (in dollars per unit) S1 S2 S3 S4

	W1 5 7 9 8 W2 6 8 10 9 W3 7 9 11 6 2. In a project management scenario, a manager has four tasks (T1, T2, T3, and T4) to be completed and a team of four experts (E1, E2, E3, and E4) available for assignment. The time (or cost) each expert takes to complete each task is given in the following table: Assignment Costs (in hours or dollars) T1 T2 T3 T4 E1 5 7 6 9 E2 4 6 8 7 E3 6 5 9 8 E4 8 6 5 7 Using the assignment method, determine the optimal assignment of experts to tasks that minimizes the total time (or cost) required to complete all tasks while ensuring that each task is assigned to exactly one expert and each expert is assigned to exactly one task. Please fill in the assignment costs accordingly. 3. **Team Work**: You are managing a distribution team with three members (Team Member 1, Team Member 2, and Team Member 3) responsible for delivering goods from three warehouses (W1, W2, and W3) to four retail stores (S1, S2, S3, and S4). The transportation costs per unit between each warehouse and store are yet to be determined. Each team member has a unique skill set, with varying skill levels that are currently unspecified. Using linear programming and the transportation method, devise a model to determine the optimal assignment of team members to delivery routes (from each warehouse to each store) that minimizes the total transportation costs while considering their skill levels. You can now collect specific data for transportation costs and skill levels as needed.
4	1. In the context of project management, a complex construction project consists of various activities, each with an estimated duration and dependencies, as shown in the table below: Activity Duration (days) Predecessors A 3 None B 5 A C 4 A D 2 B E 5 B, C F 3 C G 6 D, E H 4 F, G

Here, "Duration" represents the estimated time required for each activity and "Predecessors" indicates which activities must be completed before a given activity can commence. Activity A has no dependencies.

a) Calculate the earliest start and finish times for each activity.
b) Determine the latest start and finish times for each activity to identify the critical path.
c) Find the critical path and its duration.

2. In the management of a construction project, several critical activities are identified. The project consists of the following activities, their estimated durations, and dependencies:

Activity	(O)	(M)	(P)	Dependencies
A	4	6	8	None
B	3	5	9	A
C	5	7	10	A
D	2	4	6	B
E	4	6	8	C
F	6	9	12	D, E

Using the PERT technique, calculate:

a) The expected duration (TE) for each activity.
b) The variance (Var) for each activity.
c) The critical path and its expected duration.

Solve the problem by applying PERT principles, considering the optimistic (O), most likely (M), and pessimistic (P) times for each activity.

3. **Team Work**: As the project manager for a complex construction project involving critical activities assigned to architecture, engineering, and construction teams, each task has an estimated base duration, but collaboration is essential among these teams for project success. Activities, ranging from architecture to construction, have varying durations. Collaboration times have been established between teams, with Architecture-Engineering taking 2 days, Engineering-Construction needing 3 days, and Construction-Architecture requiring 2 days. The task is to calculate the total duration for each activity, factoring in both its base duration and collaboration time. Then, determine the earliest start and finish times for every activity and find the critical path that drives the project's total duration. Moreover, devise effective strategies for fostering teamwork, collaboration, and coordination between teams to ensure project efficiency.

Activity	Duration (days)	Team Responsible
A	7	Architecture
B	6	Architecture
C	8	Engineering

	D 5 Engineering E 6 Construction F 7 Construction G 4 Architecture H 8 Engineering I 6 Construction J 5 Engineering This table summarizes the critical project activities, their base durations in days, and the responsible teams for each activity.
5	1. In a call center handling technical support calls, the average rate of customer calls is 30 calls per hour. The customer service representatives have an average service rate of 40 calls per hour, and they can handle an unlimited number of calls. a) Calculate the utilization factor (ρ) for the customer service representatives. b) Determine the average number of customers in the system (L). c) Find the average time a customer spends in the system (W). d) Calculate the proportion of time that the customer service representatives are busy (Pbusy). Solve this problem to evaluate the call center's performance with a single server and infinite capacity. 2. In a computer repair shop, customers bring in their devices for repair. The shop can handle an average of 15 devices per hour, and it has a capacity to work on a maximum of 20 devices simultaneously. The average arrival rate of customers is 10 devices per hour. a) Calculate the utilization factor (ρ) for the repair shop. b) Determine the average number of devices in the system (L). c) Find the average time a device spends in the system (W). d) Calculate the proportion of time that the repair shop is busy (Pbusy). 3. **Team Work**: In a software development team, tasks are submitted for coding. The team has three developers working collaboratively. The average arrival rate of tasks is 25 per hour, and each developer can handle an average of 10 tasks per hour. The team's maximum capacity is 30 pending tasks. If the number of tasks in the system exceeds the team's capacity, excess tasks are rejected with a penalty. a) Calculate the average number of tasks waiting in the queue. b) Determine the probability that an arriving task is rejected due to overload. c) Find the average waiting time for a task in the queue. d) Determine the proportion of time that at least one developer is actively working.

23MCAE343	Artificial intelligence in medicine	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The course aims to provide the students an adequate knowledge about the many domains in the field of medicine and fundamentals of medical imaging systems. The students will realize the role of computer engineers in developing various diagnostic tools that can aid the clinician in medical image analysis using the AI algorithms.

Prerequisite: Linear Algebra, Basic programming skills in any language.

Course Outcomes: After the completion of the course the student will be able to

CO1	Identify the fundamental concepts of medical imaging modalities and format of images.(Understand)
CO2	Demonstrate the image enhancement methods in the spatial domain.(Apply)
CO3	Exhibit image segmentation methods in spatial and Neural Networks.(Apply)
CO4	Identify various approaches in Medical image detection and recognition using Deep learning.(Apply)
CO5	Determine Medical image registration methods.(Apply)

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3							3			
CO2	3	3	3		2		3		3			
CO3	3	3	3		2		3		3			
CO4	3	3	3		2		3		3			
CO5	3	3	3		2		3		3			

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to medical imaging technology (9hrs)

Introduction to medical imaging technology, systems and modalities - X-rays based imaging systems, Gamma-rays based imaging systems, Ultrasound based imaging systems, MRI imaging. History, Importance, Applications, Trends, Challenges. Medical Image Storage, Archiving and Communication Systems and Formats, Picture archiving and communication system, (PACS); Formats: DICOM, Radiology Information Systems (RIS) and Hospital Information Systems (HIS).

MODULE II : Image enhancement (9hrs)

Image processing - components, Basic algorithms, Transforms, Thresholding, Contrast enhancement, SNR characteristics, filtering, Histogram modeling, Medical Image Visualization, Fundamentals of visualization, Surface and volume rendering/visualization, animation, interaction. Enhancement techniques – Pixel operations, Local operators, image averaging, Image subtraction, Adaptive image filtering Medical image enhancement with hybrid filters.
Case Study - Diagnosis on Diabetic retinopathy.

MODULE III : Medical Image Segmentation (9hrs)

Medical Image Segmentation – Threshold based segmentation, Region based segmentation, Watershed algorithm,Edge based segmentation, Clustering techniques. **Segmentation using Neural Networks** – Training and classification. Model based techniques, Automated segmentation techniques.

MODULE IV : DL (9hrs)

DL for automated feature extraction, Medical image detection and recognition techniques, CNN models for medical image classification, Introduction to Geometric Deep Learning in Medical Imaging, DL models for medical image segmentation.

MODULE V : Medical Image Registration **(9hrs)**

Medical Image Registration - Introduction, Intensity-based methods, Joint histograms, Information theory measures, cost functions, using DL techniques. Analysis of – Preprocessing techniques, Feature extraction techniques and tools, Selecting best features, Classification, Segmentation, Registration techniques.
Case Study - Diagnosis on Brain/Breast/Lung cancer.

Text books

1. Rafael C., Gonzalez & Woods R.E., "Digital Image Processing", Pearson Education.(Third Edition).
2. Bankman, "Handbook of Medical Image Processing and Analysis", Academic Press , Second Edition, 2008.
3. W. Birkfellner, "Applied Medical Image Processing: A Basic Course", CRC Press, Second Edition, 2014.

Reference books

1. LEI XING, MARYELLEN L. GIGER, JAMES K. MIN Artificial Intelligence in Medicine: Technical Basis and Clinical Applications, Elsevier Academic Press
2. Manda Raz, Tam C. Nguyen, Erwin Loh, Artificial Intelligence in Medicine: Applications, Limitations and Future Directions, Springer
3. Zhou, S. Kevin, Hayit Greenspan, Dinggang Shen, "Deep learning for medical image analysis", Academic Press, 2017.
4. Cao W, Yan Z, He Z, He Z, "A comprehensive survey on geometric deep learning", IEEE Access. 2020 Feb 19, 8:35929-49.

Suggested MOOC

1. https://archive.nptel.ac.in/courses/106/105/106105032/
2. https://archive.nptel.ac.in/courses/117/105/117105135/

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**9hrs**
1.1	Introduction to medical imaging technology, systems and modalities	1
1.2	X-rays based imaging systems	1
1.3	Gamma-rays based imaging systems	1
1.4	Ultrasound based imaging systems	1
1.5	MRI imaging. History, Importance, Applications, Trends, Challenges.	1
1.6	Medical Image Storage	1
1.7	Picture archiving and communication system, (PACS)	1
1.8	Formats: DICOM	1
1.9	Radiology Information Systems (RIS) and Hospital Information Systems (HIS).	1
	MODULE II	**9hrs**
2.1	Image processing - components, Basic algorithms	1
2.2	Transforms	1
2.3	Thresholding	1
2.4	Contrast enhancement	1
2.5	Histogram modeling	1
2.6	Medical Image Visualization	1
2.7	Animation	1
2.8	Enhancement techniques	1
2.9	Adaptive image filtering Medical image enhancement with hybrid filters.	1

MODULE III		9 hrs
3.1	Threshold based segmentation	1
3.2	Region based segmentation	1
3.3	Watershed algorithm	1
3.4	Edge based segmentation	1
3.5	Clustering techniques	1
3.6	Segmentation using Neural Networks	1
3.7	Training and classification	1
3.8	Model based techniques	1
3.9	Automated segmentation techniques.	1
MODULE IV		**9 hrs**
4.1	DL for automated feature extraction	1
4.2	Medical image detection	1
4.3	Recognition techniques	1
4.4	CNN models for medical image classification	1
4.5	CNN models for medical image classification -example	1
4.6	Introduction to Geometric Deep Learning in Medical Imaging	1
4.7	Introduction to Geometric Deep Learning in Medical Imaging-Example	1
4.8	DL models for medical image segmentation	1
4.9	DL models for medical image segmentation -Example	1
MODULE V		**9hrs**
5.1	Medical Image Registration - Introduction	1
5.2	Intensity-based methods	1
5.3	Joint histograms	1
5.4	Information theory measures	1
5.5	Cost functions, using DL techniques	1
5.6	Analysis of Preprocessing techniques	1
5.7	Feature extraction techniques and tools	1
5.8	Selecting best features	1
5.9	Classification, Segmentation, Registration techniques.	1

CO Assessment Questions	
1	Differentiate various medical imaging modalities and their contribution to AIM.
2	Case Study - Diagnosis on Diabetic retinopathy
3	Demonstrate a simple Medical image detection using DL
4	Develop a simple CNN models for medical image classification.
5	Develop a simple Case Study - Diagnosis on Brain/Breast/Lung cancer.

23MCAE345	Artificial Intelligence in cyber Security	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: To enable the students to understand the scope of artificial intelligence in solving cyber security issues, analyse the trends of applications of artificial intelligence in cyber security and execute algorithms as critical technologies in information security and improving security postures.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Apply the basic underlying architectures used for intrusion detection
CO2	Use artificial intelligence techniques in solving cyber security issues.
CO3	Devise intelligent automation aid for timely and effective detection, eradication and remediation of successful breaches.
CO4	Prepare for real-world applications in the fields of cyber security, machine learning, and fraud detection.
CO5	Prepare for careers in cyber security, network security, and threat detection.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2					2					
CO2	2	2					2					
CO3	2	2					2					
CO4	3	3	3				2					
CO5	2	3	3				2					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution

Total Marks	CIA (Marks)	ESE (Marks)	ESE Duration

100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Time series analysis (9hrs)

Time series analysis, Stochastic time series model, ANN time series model, Support Vector time series models, Time series components and decomposition, Use cases, Time series analysis in cyber security. Time series trends and seasonal spikes, Predicting DDoS attacks, Ensemble models, Voting ensemble method to detect cyber-attacks.

MODULE II : Types of abnormalities in URLs (10hrs)

Types of abnormalities in URLs, Features and extraction, Malicious URL detection using ML(Logistic Regression, SVM, DT), Multiclass classification, Knocking Down CAPTCHAs, Data Science to Catch Email Fraud and Spam, Anomaly detection using K-means, Using windows logs and active directory data.

MODULE III :Decision tree and Context-based malicious event detection: (10hrs)

Decision tree and Context-based malicious event detection, Impersonation – Types, Detection using data science techniques, Naive Bayes classifier for multinomial models. Statistical and machine learning approaches to detection of attacks on computers - Techniques to estimate attack severities, Networkbased attacks, Host-based attacks, Using Statistical pattern recognition, Network data visualization techniques.

MODULE IV : Levenshtein distance (8hrs)

Levenshtein distance, TensorFlow for intrusion detection, ML to detect financial fraud, Handling imbalanced datasets, Detecting credit card fraud, Managing under sampled data for logistic regression, Adam gradient optimizer for deep learning, Feature extraction and cosine similarity to quantify bad passwords.

MODULE V : Anomaly Detection (10hrs)

Anomaly Detection - Feature Engineering, Network and Web application, Intrusion Detection-Types and Case studies, Using data and algorithms. Malware Analysis – Feature extraction and Classification. Network Traffic Analysis – ML in Network security, Building predictive model. Adversarial Attack, Defense, and Applications with Deep Learning Frameworks, CNN for Malicious Network Traffic classification, Intrusion Detection in SDN-Based Networks.

Text books

1. Soma Halder, Sinan Ozdemir, “Hands-on Machine Learning for Cyber security”, Packt Publishing.
2. Chio, Clarence and David Freeman, “Machine learning and security:

Protecting systems with data and algorithms", O'Reilly Media, Inc., 2018.		
Reference books 1. Alazab, Mamoun, and MingJian Tang, "Deep learning applications for cyber security", Springer, 2019. 2. Roberto Di Pietro, Luigi V. Mancini, "Intrusion Detection System", Springer, 2008.		
COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
MODULE 1		**9hrs**
1.1	Time series analysis	1
1.2	Stochastic time series model	1
1.3	ANN time series model	1
1.4	Support Vector time series models	1
1.5	Time series components and decomposition, Use cases	1
1.6	Time series analysis in cybersecurity.	1
1.7	Time series trends and seasonal spikes	1
1.8	Predicting DDoS attacks	1
1.9	Ensemble models, Voting ensemble method to detect cyber-attacks	1
MODULE II		**10hrs**
2.1	Types of abnormalities in URLs	1
2.2	Features and extraction	1
2.3	Malicious URL detection using ML(Logistic Regression)	1
2.4	Malicious URL detection using ML(SVM)	1
2.5	Malicious URL detection using ML(DT)	1
2.6	Multiclass classification	1
2.7	Knocking Down CAPTCHAs	1
2.8	Data Science to Catch Email Fraud and Spam	1
2.9	Anomaly detection using K-means	1
2.10	Using windows logs and active directory data.	1
MODULE III		**10hrs**
3.1	Decision tree and Context-based malicious event detection	1
3.2	Impersonation – Types	1
3.3	Detection using data science techniques	1
3.4	Naive Bayes classifier for multinomial models.	1
3.5	Statistical and machine learning approaches to detection of attacks on computers	1
3.6	Techniques to estimate attack severities	1
3.7	Network based attacks	1
3.8	Host-based attacks	1
3.9	Using Statistical pattern recognition	1
3.10	Network data visualization techniques	1
MODULE IV		**8hrs**
4.1	Levenshtein distance	1
4.2	TensorFlow for intrusion detection	1

4.3	ML to detect financial fraud	1
4.4	Handling imbalanced datasets	1
4.5	Detecting credit card fraud	1
4.6	Managing under sampled data for logistic regression	1
4.7	Adam gradient optimizer for deep learning	1
4.8	Feature extraction and cosine similarity to quantify bad passwords.	1
MODULE V		**10hrs**
5.1	Anomaly Detection - Feature Engineering	1
5.2	Network and Web application,	1
5.3	Intrusion Detection-Types and Case studies, Using data and algorithms.	1
5.4	Malware Analysis – Feature extraction and Classification.	1
5.5	Network Traffic Analysis – ML in Network security	1
5.6	Building predictive model.	1
5.7	Adversarial Attack, Defense,	1
5.8	Applications with Deep Learning Frameworks	1
5.9	CNN for Malicious Network Traffic classification	1
5.10	Intrusion Detection in SDN-Based Networks.	1

CO Assessment Questions	
1	a) Apply stochastic time series models in understanding unpredictable cyber threats? b) Use time series analysis and AI assist in predicting and mitigating DDoS attacks?
2	a) Perform the K-means algorithm iteratively for a dataset with the following data points: (3, 4), (5, 4), (4, 5), (6, 6), (7, 6). Start with K=2 and initial centroids at (3, 4) and (7, 6). Show the steps of assignment and update for one iteration, including calculating the new centroids. b) Can you provide examples of specific use cases where Windows logs and Active Directory data were crucial in identifying security threats?
3	a) Compare and contrast statistical approaches with machine learning approaches for detecting attacks on computers. What are the strengths and limitations of each? b) Explore the application of reinforcement learning techniques, such as deep reinforcement learning and game theory, for adaptive and autonomous response to cyber-attacks in real-time.
4	a) You have two strings, "algorithm" and "logarithm." Calculate the Levenshtein distance and provide an optimal alignment (i.e., the specific edits required to transform one string into the other) along with the associated costs for each operation. b) You have two high-dimensional vectors: A = [3, 1, 0, 2, 4, 0, 0, 0, 1] B = [0, 0, 1, 3, 1, 1, 2, 0, 0] Calculate the cosine similarity between these vectors. Show the intermediate calculations of the dot product and magnitude in a high-dimensional space.

5	a) 'Feature extraction a crucial step in the process of malware analysis'. Analyse the statement given. b) Consider a university campus with a Software-Defined Networking (SDN) infrastructure. Develop an intrusion detection system that can identify and mitigate various attacks, such as ARP spoofing and Distributed Denial of Service (DDoS) attacks, within the SDN environment. Describe how your system adapts to changing network conditions and provides effective security.

23MCAE347	Natural Language Processing	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: To enable the students to understand the need for morphological processing and their representation, know about the various techniques used for speech synthesis and recognition, appreciate the syntax analysis and parsing that is essential for natural language processing, learn about the various representations of semantics and discourse and have knowledge about the applications of natural language processing.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Identify the different linguistic components of natural language.
CO2	Design a morphological analyzer for a given natural language.
CO3	Tag a given text with basic Language features.
CO4	Decide on the appropriate parsing techniques necessary for a given language and application.
CO5	Design innovative applications involving natural language.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	3	2	2								
CO3	3											
CO4	3	2										
CO5	3	3	3	3								

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate			✓	
Create			✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution

Total Marks	CIA (Marks)	ESE (Marks)	ESE Duration
100	40	60	3Hrs

End Semester Examination [ESE]: Pattern			
PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction(8Hrs)

Basics of Text Processing - Tokenization - N-grams – Perplexity - Smoothing - Morphology - Finite-State Transducers - Porter Stemmer Algorithm - Detection and Correction of Spelling Errors - Part-of-Speech Tagging.

MODULE II : Speech Processing(5Hrs)

Speech and Phonetics - Computational Phonology and Pronunciation Modelling - Finite-State Phonology - Speech Synthesis – Automatic Speech Recognition - MFCC vectors - Diphones - Triphones - Hidden Markov Model for Speech recognition - Acoustic Likelihood Computation - Computational Optimality Theory - Syllabification.

MODULE III : Syntax Analysis(8Hrs)

Context-Free Grammars - Dependency Grammars - Syntactic Parsing – Ambiguity – Probabilistic Context-Free Grammars - Statistical Parsing - Dynamic Programming Parsing Methods – Probabilistic Lexicalized CFGs – Collins Parser – Shallow parsers – Dependency parsing.

MODULE IV : Semantic and Pragmatic Interpretation(6Hrs)

Computational Semantics - Word Senses - WordNet - Word Relations - Computational Lexical Semantics – Word Sense Disambiguation - Supervised and Unsupervised Word Sense Disambiguation - Computational Discourse - Discourse Segmentation - Reference Resolution - Pronominal Anaphora Resolution - Co-reference Resolution.

MODULE V : NLP using Python & Trends in NLP(8Hrs)

Familiarise NLP libraries like NLTK, spaCy, StanfordNLP, IndicNLP etc - Applications and Recent trends in NLP: Information Extraction – Named Entity Recognition - Sentiment Analysis – Topic Modelling - Template-Filling - Question Answering and Summarization - Natural Language Generation - Machine translation - Dialog and Conversational Agents.

Text books

1. Daniel Jurafsky and James Martin, "Speech and Language Processing", Pearson Prentice Hall, 2nd Edition, 2014.
2. Christopher D. Manning and Hinrich Schutze, " Foundations of Natural Language Processing", 6th Edition, The MIT Press Cambridge, Massachusetts London, England, 2003.
3. Nitin Indurkhya, Fred J. Damerau, "Handbook of Natural Language Processing",
   Chapman & Hall/CRC, Machine Learning & Pattern Recognition Series, Second Edition, 2010.
4. Alexander Clark, Chris Fox, Shalom Lappin, "The Handbook of Computational
   Linguistics and Natural Language Processing", Wiley-Blackwell, 2012.

Reference books

1. Stevan Bird, "Natural Language Processing with Python", Shroff, 2009.
2. James Allen, Natural Language Understanding, 2nd Edition, 2003, Pearson Education.
3. James Allen, "Natural Language Understanding", Addison Wesley, Second Edition, 2007.
4. Christopher D. Manning and Hinrich Schütze, "Foundations of Statistical Natural Language Processing", MIT Press, 1999.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	Introduction: Function words, Content words, Type Token Ratio (TTR), Zipf's Law, Heap's Law.	1
1.2	Basics of Text Processing - Tokenization, Segmentation, Lemmatization, Stemming, N-grams, Perplexity, Smoothing.	1
1.3	Morphology: Inflectional morphology& Derivational morphology. Finite state transducer for morphological parsing,	1
1.4	Porter Stemmer Algorithm.	1
1.5	Detection and Correction of Spelling Errors.	1
1.6	Part-of-Speech Tagging – English Word Classes Tag sets. Rule Based Tagging	1
1.7	HMM Transformation Based Tagging. Evaluation and Error Analysis.	1
1.8	Maximum Entropy Models.	1
	MODULE II	
2.1	Speech and Phonetics : Phonological Categories – Acoustic Phonetics and Signals- Computational Phonology and	1

	Pronunciation Modelling	
2.2	Finite-State Phonology. Speech Synthesis – Phonetic and Acoustic Analysis.	1
2.3	Automatic Speech Recognition - Architecture MFCC vectors	1
2.4	Diphone Waveform synthesis – Evaluation - Triphones - Hidden Markov Model for Speech recognition.	1
2.5	Acoustic Likelihood Computation - Evaluation - Computational Optimality Theory - Syllabification	1
	MODULE III	
3.1	Syntax Analysis- Phrase structure grammars and dependency grammars.	1
3.2	Parsing with Context free Grammar - Ambiguity in parsing - Probabilistic Context-Free Grammars	1
3.3	Statistical Parsing Dynamic Programming Parsing Methods – CKY Parsing.	1
3.4	Dynamic Programming Parsing Methods – Earley Parsing	1
3.5	Dynamic Programming Parsing Methods – Chart Parsing	
3.6	Probabilistic Lexicalized CFGs – Probabilistic CKY Parsing of PCFGs.	1
3.7	Collins Parser & Shallow parsers.	1
3.8	Conditional Random Fields (CRF) Dependency parsing	1
	MODULE IV	
4.1	Computational Semantics: Word Senses - Relations Between Senses – WordNet - Metaphor - Hyponymy and Other Word Relations.	1
4.2	Word Sense Disambiguation - Supervised Word Sense Disambiguation.	1
4.3	Dictionary and Thesaurus Methods - Unsupervised Sense Disambiguation.	1
4.4	Discourse Segmentation – Supervised & Unsupervised Discourse Segmentation	1
4.5	Text Coherence - Reference Resolution Phenomena Hobbs and Centering Algorithm	1
4.6	Pronominal Anaphora Resolution – Coreference Resolution.	1
	MODULE V	
5.1	NLP using Python - Make use of any of the NLP libraries like NLTK, spaCy, StanfordNLP , IndicNLP.	1

5.2	Applications: Information Extraction – Named Entity Recognition .	1
5.3	Sentiment Analysis – Template Filling.	1
5.4	Topic Modelling(LDA)	1
5.5	Machine translation - Sequence to sequence model for MT and its problems.	1
5.6	Incorporating the attention mechanism for decoding a sequence - Neural Machine Translation	1
5.7	Question Answering and Summarization.	1
5.8	Natural Language Generation - Dialog and Conversational Agents.	1

CO Assessment Questions

1

a) Find one tagging error in each of the following sentences that are tagged with the Penn Treebank tagset:
- I/PRP need/VBP a/DT flight/NN from/IN Atlanta/NN
- Does/VBZ this/DT flight/NN serve/VB dinner/NNS

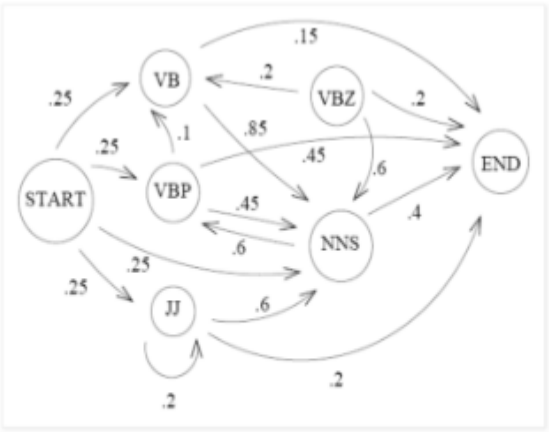
1. Atlanta/NNS, dinner/NNP
2. Atlanta/NN, dinner/NN
3. from/JJ, dinner/NN
4. flight/NNS,Atlanta/FW

b) Given a corpus C, the Maximum Likelihood Estimation (MLE) for the bigram "computational linguistics" is 0.25 and the count of occurrence of the word "computational" is 1200. If the vocabulary size is 4400, what is the likelihood of "computational linguistics" after applying add-2 smoothing?

2

a) Consider the HMM given below to solve the sequence labeling problem of POS tagging.

	free	*workers*
JJ	0.00158	0
NNS	0	0.000185
VB	0.00115	0
VBP	0.00081	0
VBZ	0	0.00005



The above table contains emission probability and the figure contains transition probability. With that HMM, calculate the probability that the sequence of words "free workers" will be assigned the following

	parts of speech; VB NNS. b) Explain the relevance of DFT and Mel Filter bank in Speech processing.
3	a) Consider the following PCFG fragment: S → NN VP (0.50) S → VP NN (0.50) NP → NN PB (0.40) P B → PP NN (0.30) V P → VB NN (0.30) V P → VB NP (0.20) V P → NN VB (0.25) V P → NN PB (0.15) P P → with (0.10) P P → without (0.10) V B → play (0.30) V B → enjoy (0.20) V B → watch (0.25) NN → childern (0.15) NN → cricket (0.15) NN → friends (0.20) NN → football (0.10) NN → music (0.12) Using CKY algorithm, find the probability score for the most probable tree for the sentence S1 = “children play cricket with friends”. b) Which of the following is/are true? 1. Phrase structures explicitly represent structural categories 2. Dependency structure explicitly represent functional categories 3. Minimum spanning tree is one of the dependency parsing method 4. In dependency structure, dependencies usually form a tree.
4	a) Match the followings 1. Hyperlex i. Supervised 2. Naive Bayes ii. Unsupervised 3. Lesk Algorithm iii. Knowledge-based b) Two concepts along with their glosses are given below. Find the similarity score between concepts “currency” and “money” with the Lesk’s algorithm. (Note: Do not consider the stop words.) currency : the metal or paper medium of exchange that is presently used money : the most common exchange medium; functions as legal tender
5	a) Explain the relevance of Named Entity Recognition in Information Extraction. b) Suppose you are using Gibbs sampling to estimate the distributions, θ and β for topic models. The underlying corpus has 3 documents and 5 words, {machine, learning, language, nature, vision} and the number of topics is 2. At certain point, the structure of the documents looks like

		the following Doc1: nature(1) language(1) vision(1) language(1) nature(1) nature(1) language(1) vision(1) Doc2: nature(1) language(1) language(2) machine(2) vision(1) learning(2) language(1) nature(1) Doc3: machine(2) language(2) learning(2) language(2) machine(2) machine(2) learning(2) language(2) (number) –number inside the brackets denote the topic no. 1 and 2 denote whether the word is currently assigned to topics t1 and t2 respectively. $\eta = 0.3$ and $\alpha = 0.3$. Using the above structure the estimated value of $\beta(2)_{nature}$ at this point .

23MCAE349	Accountancy and Financial Management	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The Accountancy and Financial Management course is designed to provide students with a deep understanding of financial principles and practices, equipping them with the skills necessary for accounting, financial analysis, and decision-making in various organizational contexts.

Prerequisite: Nil.

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand Financial Accounting Principles and Practices
CO2	Apply Cost Accounting Techniques for Decision Making
CO3	Analyze and Interpret Financial Data
CO4	Implement Financial Management Strategies
CO5	Demonstrate Ethical and Professional Behaviour in Financial Management

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3							2				
CO2		3										
CO3			3									3
CO4											3	
CO5					3	2						
CO6	3							3				

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Financial Accounting (8hrs)

Introduction to Accounting, Accounting Principles and Concepts, Recording of Transactions, Preparation of Financial Statements (Income Statement, Balance Sheet, Cash Flow Statement), Adjustments and Closing Entries, Depreciation and its Accounting, Partnership Accounts.

MODULE II : Cost Accounting (9hrs)

Cost Concepts and Classifications, Cost Behaviour and Cost Volume Profit Analysis, Job and Process Costing, Activity-Based Costing, Budgeting and Budgetary Control, Standard Costing and Variance Analysis, Marginal Costing and Break-Even Analysis.

MODULE III : Management Accounting (9hrs)

Nature and Scope of Management Accounting, Decision-Making using Relevant Cost and Differential Analysis, Pricing Decisions and Transfer Pricing, Capital Budgeting and Investment Decisions, Performance Measurement and Balanced Scorecard, Responsibility Accounting, Ethical Issues in Management Accounting.

MODULE IV : Financial Management (8hrs)

Time Value of Money, Capital Structure and Cost of Capital, Dividend Policy, Working Capital Management, Cash Management, Risk and Return, Capital Budgeting Techniques (NPV, IRR, Payback Period), Financial Derivatives and Risk Management

MODULE V : Business Finance (8hrs)

Sources of Finance (Equity, Debt, Hybrid), IPOs and Stock Exchanges, Bonds and Debentures, Leasing and Hire Purchase, Mergers and Acquisitions, Financial Statement Analysis, International Financial Management.

Text books

1. Financial Accounting by Walter T. Harrison Jr., Charles T. Horngren, and C. William Thomas
2. Cost Accounting: A Managerial Emphasis by Charles T. Horngren, Srikant M. Datar, and Madhav V. Rajan:

Reference books

1. Management Accounting: Information for Decision-Making and Strategy Execution" by Anthony A. Atkinson, Robert S. Kaplan, Ella Mae Matsumura, and S. Mark Young
2. Financial Management: Theory & Practice" by Eugene F. Brigham and Michael C. Ehrhardt:

COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
MODULE 1		**8hrs**
1.1	Introduction to Accounting	1
1.2	Accounting Principles and Concepts	1
1.3	Recording of Transactions	1
1.4	Preparation of Financial Statements (Income Statement, Balance Sheet, Cash Flow Statement)	1
1.5	Preparation of Financial Statements (Income Statement, Balance Sheet, Cash Flow Statement)	1
1.6	Adjustments and Closing Entries	1
1.7	Depreciation and its Accounting	1
1.8	Partnership Accounts	1
MODULE II		**9hrs**
2.1	Cost Concepts and Classifications	1
2.2	Cost Behavior and Cost Volume Profit Analysis	1
2.3	Job and Process Costing	1
2.4	Activity-Based Costing	1
2.5	Budgeting and Budgetary Control	1
2.6	Budgeting and Budgetary Control	1
2.7	Budgeting and Budgetary Control	1
2.8	Standard Costing and Variance Analysis	1
2.9	Marginal Costing and Break-Even Analysis	1
MODULE III		**9hrs**
3.1	Nature and Scope of Management Accounting	
3.2	Decision-Making using Relevant Cost and Differential Analysis	
3.3	Pricing Decisions and Transfer Pricing	
3.4	Pricing Decisions and Transfer Pricing	
3.5	Capital Budgeting and Investment Decisions	
3.6	Capital Budgeting and Investment Decisions	
3.7	Performance Measurement and Balanced Scorecard	
3.8	Responsibility Accounting	
3.9	Ethical Issues in Management Accounting	
MODULE IV		**8hrs**
4.1	Time Value of Money	1
4.2	Capital Structure and Cost of Capital	1
4.3	Dividend Policy	1
4.4	Working Capital Management	1

4.5	Cash Management	1
4.6	Risk and Return	1
4.7	Capital Budgeting Techniques (NPV, IRR, Payback Period)	1
4.8	Financial Derivatives and Risk Management	1
MODULE V		**8hrs**
5.1	Sources of Finance (Equity, Debt, Hybrid)	1
5.2	IPOs and Stock Exchanges	1
5.3	Bonds and Debentures	1
5.4	Leasing and Hire Purchase	1
5.5	Mergers and Acquisitions	1
5.6	Financial Statement Analysis	1
5.7	International Financial Management	1
5.8	International Financial Management	1

CO Assessment Questions	
1	Explain the accrual basis of accounting and how it differs from the cash basis. Provide examples of transactions for each.
2	Calculate the break-even point for a company based on provided cost and revenue data. Interpret the results and explain their significance for managerial decision-making.
3	Given a set of financial statements (balance sheet, income statement, and cash flow statement), calculate and analyze key financial ratios such as liquidity, profitability, and solvency ratios. Interpret the ratios and provide insights into the company's financial health
4	Evaluate two investment projects using different capital budgeting techniques (such as NPV, IRR, and payback period). Justify your choice of method and recommend which project the company should invest in.
5	Analyze a case study involving ethical dilemmas in financial reporting. Identify the ethical issues, discuss the potential consequences of different actions, and recommend a course of action based on ethical principles.

23MCAE351	Optimization Techniques	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The objective of the course is to introduce the basic concepts of optimization and various algorithms used for solving optimization problems. It provides a background that enables students to design and implement metaheuristics to solve complex optimization problems.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the basic ideas and techniques for solving one dimensional and multidimensional optimization problems.
CO2	Explain unconstrained optimization techniques for solving and optimizing problems in real world situations.
CO3	Explain the concept of Game theory and identify the best strategy in competitive situations.
CO4	Solve complex optimization problems using swarm intelligence-based models.
CO5	Explain the design and implementation of evolutionary algorithms on optimization problems

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2				3					
CO2	3	3	2				3					
CO3	3	3	2				3					
CO4	3	3	3		3		3					
CO5	3	3	3				3					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Basic ideas of one dimensional and multidimensional optimization problems: (9hrs)

Basic ideas of one dimensional and multidimensional optimization problems - Unconstrained and constrained problems - Lagrange's multipliers - Kuhn-Tucker's conditions - Quadratic programming - Wolf's method - Beale's method

MODULE II : Unconstrained Non-linear Programming: (11hrs)

Unconstrained Non-linear Programming: One dimensional minimization methods, Classification, Fibonacci method and Quadratic interpolation method Unconstrained Optimization Techniques: Uni-variant method, Powells method and steepest descent method.

MODULE III : Games Theory: (10hrs)

Games Theory- Competitive games, rectangular game, saddle point, minimax (maximin) method of optimal strategies, value of the game. Solution of games with saddle points, dominance principle. Rectangular games without saddle point – mixed strategy for 2 x 2 games.

MODULE IV : Models of Life and Intelligence (8hrs)

Models of Life and Intelligence - Fundamentals of bio-inspired models and bioinspired computing. Evolutionary models and techniques, Swarm models and its self-organisation- Ant Colony Optimization – Ant Colony Optimization for Travelling Salesman Problem – Particle Swarm Optimization – Artificial Bee Colony Algorithm

MODULE V : Genetic Algorithms: (11hrs)

Concept of "Genetics" and "Evolution" and its application to probabilistic search techniques - Basic GA framework and different GA architectures - GA operators: Encoding, Crossover, Selection, Mutation, etc. - Solving single-objective optimization problems using GAs. Concept of multi-objective optimization problems (MOOPs) and issues of solving them - Multi-Objective Evolutionary Algorithm(MOEA) - Non-Pareto approaches to solve MOOPs - Pareto-based approaches to solve MOOPs -Some applications with MOEAs.

Text books

1. Singiresu S. Rao, Engineering Optimization: Theory and Practice by John Wiley and Sons, 4th edition, 2009.
2. H. S. Kasene and K. D. Kumar, Introductory Operations Research, Springer (India), Pvt. Ltd., 2004.
3. Melanie Mitchell: An Introduction to Genetic Algorithms, MIT Press, 1st edition, 1998
4. S. N. Sivanandam and S. N. Deepa: Principles of Soft Computing, Wiley, 3rd edition, 2018.
5. Evolutionary Algorithm for Solving Multi-objective, Optimization Problems (2nd Edition), Collelo, Lament, Veldhnizer (Springer).

Reference books

1. Handy A. Taha, Operations Research -an Introduction, PHI, 9th Edn., 2011
2. Melanie Mitchell: An Introduction to Genetic Algorithms, MIT Press, 1st edition, 1998.
3. Fox, R.L., Optimization methods for Engineering Design" , Addition Welsey, 1971.
4. R. Hariprakash and B. Durga Prasad, Operations Research , Scitech. 1st edn., 2010.
5. B. S. Goel and S. K. Mittal, Operations Research, PragathiPrakashan, 25th Edn., 2009.
6. Randy L. Haupt and Sue Ellen Haupt: Practical Genetic Algorithms, Wiley, 2nd edition, 2004.
7. K. V. Mittal and C. Mohan, 'Optimization Methods in Operations Research and System Analysis', 3rd Edn., New Age International Publishers.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**7hrs**
1.1	One dimensional and multidimensional optimization problems - Introduction	1
1.2	One dimensional and multidimensional optimization problems - Introduction	1
1.3	Lagrange's multipliers	1
1.4	Kuhn-Tucker's conditions	1
1.5	Quadratic programming	1
1.6	Wolf's method	1
1.7	Beale's method.	1
	MODULE II	**8hrs**
2.1	Unconstrained Non-linear Programming-One dimensional minimization methods	1
2.2	Unconstrained Non-linear Programming-One dimensional minimization methods	1
2.3	Classification	1
2.4	Fibonacci method and Quadratic interpolation method	1
2.5	Unconstrained Optimization Techniques	1
2.6	Unconstrained Optimization Techniques	1
2.7	Uni-variant method	1
2.8	Powells method & steepest descent method	1

MODULE III		6hrs
3.1	Games Theory- Competitive games	1
3.2	Rectangular game	1
3.3	Saddle point, optimal strategies	1
3.4	Solution of games with saddle points	1
3.5	Dominance principle	1
3.6	Rectangular games without saddle point	1
MODULE IV		**7hrs**
4.1	Fundamentals of bio-inspired models and bio-inspired computing.	1
4.2	Evolutionary models and techniques	1
4.3	Swarm models and its self organisation	1
4.4	Swarm models and its self organisation	1
4.5	Ant Colony Optimization	1
4.6	Ant Colony Optimization	1
4.7	Particle Swarm intelligence	1
MODULE V		**9hrs**
5.1	Basic GA framework and different GA architectures	1
5.2	GA operators: Encoding, Crossover, Selection, Mutation, etc.	1
5.3	Solving single-objective optimization problems using GAs	1
5.4	Solving single-objective optimization problems using GAs	1
5.5	Concept of multi-objective optimization problems (MOOPs) and issues	1
5.6	Concept of multi-objective optimization problems (MOOPs) and issues	1
5.7	Multi-Objective Evolutionary Algorithm(MOEA) - Non-Pareto approaches to solve MOOPs	1
5.8	Multi-Objective Evolutionary Algorithm(MOEA) - Non-Pareto approaches to solve MOOPs	1
5.9	Pareto-based approaches to solve MOOPs -Some applications with MOEAs.	1

CO Assessment Questions	
1	Explain the concept of constraints in an optimization problem. Provide an example.
2	Describe a real-world application where genetic algorithms could be used to find an optimal solution.
3	Compare and contrast gradient descent and genetic algorithms in terms of their optimization strategies
4	What is the role of heuristics in optimization techniques?
5	Briefly explain how the simplex method works in solving linear programming problems.

23MCAE353	Wireless Sensor Networks	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This course provides a comprehensive exploration of the principles, design, and applications of Wireless Sensor Networks (WSN). WSN plays a pivotal role in diverse sectors such as environmental monitoring, healthcare, industrial automation, and smart cities. This course helps to explore the fundamental concepts, delve into cutting-edge technologies, and engage in hands-on activities to reinforce your understanding.

Prerequisite: Computer networks.

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the unique characteristics that make wireless sensor networks suitable for various applications.
CO2	Analyze the interdependencies among different components of a sensor node.
CO3	Explain the role of routing protocols in facilitating communication among sensor nodes.
CO4	Explain how transport control protocols handle congestion in wireless sensor networks.
CO5	Explain the importance of accurate and timely management of information in network management.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3										
CO2	3	3							3			
CO3	3	3							3			
CO4	3	3							3			
CO5	2	3										

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE 1: Introduction and Overview of Wireless Sensor Networks (8Hrs)

Introduction: Background of Sensor Network Technology, Applications of Sensor Networks. Basic Overview of the Technology: Basic Sensor Network Architectural Elements, Brief Historical Survey of Sensor Networks, Challenges and Hurdles,
Applications of Wireless Sensor Networks: Range of Applications, WSN Applications,
Home Control, Building Automation, Industrial Automation, Medical Applications. Examples of Category 1 WSN Applications: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring, Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring,
Nanoscopic Sensor Applications.

MODULE II : Basic Wireless Sensor Technology (8Hrs)

Basic Wireless Sensor Technology: Introduction, Sensor Node Technology, Hardware and Software, Sensor Taxonomy, WN Operating Environment, WN Trends
Wireless Transmission Technology and Systems: Radio Technology Primer, Propagation and Propagation Impairments,
Modulation, Available Wireless Technologies, Campus Applications, MAN/WAN Applications.

MODULE III : Medium Access Control Protocols and Routing Techniques for Wireless Sensor Networks (10Hrs)

Medium Access Control Protocols for Wireless Sensor Networks: Fundamentals of MAC Protocols, Performance Requirements,
Protocols for WSNs: Schedule-Based Protocols, Random Access-Based Protocols
Routing Protocols for Wireless Sensor Networks: Introduction, Data Dissemination and Gathering,
Routing Challenges and Design Issues in Wireless: Network Scale and Time-Varying Characteristics, Resource Constraints, Sensor Applications Data Models
Routing Strategies in Wireless Sensor Networks, WSN Routing Techniques, Flooding and Its Variants, Sensor Protocols for Information via Negotiation, Low-Energy Adaptive Clustering Hierarchy, Power-Efficient Gathering in Sensor Information
Systems, Directed Diffusion, Geographical Routing

MODULE IV : Transport Control Protocols for Wireless Sensor Networks (10Hrs)

Transport Control Protocols for Wireless Sensor Networks: Traditional Transport Control Protocols, TCP (RFC 793), UDP (RFC 768), Mobile IP, Feasibility of Using TCP or UDP for WSNs.
Transport Protocol Design Issues: Examples of Existing Transport Control Protocols, CODA (Congestion Detection and Avoidance), ESRT (Event-to-Sink Reliable Transport), RMST (Reliable Multisegment Transport), PSFQ (Pump Slowly, Fetch Quickly), GARUDA, ATP (Ad Hoc Transport Protocol), Problems with Transport Control Protocols,
Performance of Transport Control Protocols: Congestion, Packet Loss Recovery.

MODULE V Network Management Requirements (8Hrs)

Network Management Requirements,
Traditional Network Management Models: Simple Network Management Protocol,
Telecom Operation Map, Network Management Design Issues, Example of Management Architecture: MANNA,
Other Issues Related to Network Management, Naming, Localization.

Text books

1. "Wireless Sensor Networks, Technology, Protocols, and Applications", Kazem Sohraby, Daniel Minoli, Taieb Znati.

Reference books

1. "Wireless Sensor Networks: Principles and Practice" by S. Sitharama Iyengar
2. "Wireless Communications and Networking" by William Stallings.
3. "Wireless Sensor Networks" by Ian F. Akyildiz, Mehmet Can Vuran, and Joseph J. P. Veccia.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**8hrs**
1.1	Introduction: Background of Sensor Network Technology	1
1.2	Applications of Sensor Networks	1
1.3	Basic Overview of the Technology, Basic Sensor Network Architectural Elements	1
1.4	Brief Historical Survey of Sensor Networks, Challenges and Hurdles	1
1.5	Applications of Wireless Sensor Networks: Range of Applications, WSN Applications,	1
1.6	Home Control, Building Automation, Industrial Automation, Medical Applications.	1
1.7	Examples of Category 1 WSN Applications: Sensor and Robots, Reconfigurable Sensor Networks, Highway Monitoring,	1
1.8	Military Applications, Civil and Environmental Engineering Applications, Wildfire Instrumentation, Habitat Monitoring, Nanoscopic Sensor Applications.	1
	MODULE II	**8hrs**
2.1	Basic Wireless Sensor Technology: Introduction	1
2.2	Sensor Node Technology, Hardware and Software	1
2.3	Sensor Taxonomy, WN Operating Environment, WN Trends	1

2.4	Wireless Transmission Technology and Systems: Radio Technology Primer	1
2.5	Propagation and Propagation Impairments	1
2.6	Modulation, Available Wireless Technologies,	1
2.7	Campus Applications	1
2.8	MAN/WAN Applications	1
	MODULE III	**10hrs**
3.1	Medium Access Control Protocols for Wireless Sensor Networks: Fundamentals of MAC Protocols, Performance Requirements,	1
3.2	Protocols for WSNs: Schedule-Based Protocols, Random Access-Based Protocols	1
3.3	Routing Protocols for Wireless Sensor Networks: Introduction, Data Dissemination and Gathering,	1
3.4	Routing Challenges and Design Issues in Wireless: Network Scale and Time-Varying Characteristics,	1
3.5	Resource Constraints, Sensor Applications Data Models	1
3.6	Routing Strategies in Wireless Sensor Networks, WSN Routing Techniques,	1
3.7	Flooding and Its Variants, Sensor Protocols for Information via Negotiation,	1
3.8	Low-Energy Adaptive Clustering Hierarchy,	1
3.9	Power-Efficient Gathering in Sensor Information Systems	1
3.10	Directed Diffusion, Geographical Routing	1
	MODULE IV	**10hrs**
4.1	Transport Control Protocols for Wireless Sensor Networks: Traditional Transport Control Protocols, TCP (RFC 793), UDP (RFC 768),	1
4.2	Mobile IP, Feasibility of Using TCP or UDP for WSNs.	1
4.3	Transport Protocol Design Issues: Examples of Existing Transport Control Protocols,	1
4.4	CODA (Congestion Detection and Avoidance),	1
4.5	ESRT (Event-to-Sink Reliable Transport),	1
4.6	RMST (Reliable Multisegment Transport),	1
4.7	PSFQ (Pump Slowly, Fetch Quickly), GARUDA, ATP (Ad Hoc Transport Protocol),	1
4.8	PSFQ (Pump Slowly, Fetch Quickly), GARUDA, ATP (Ad Hoc Transport Protocol)	1
4.9	Problems with Transport Control Protocols	1
4.10	Performance of Transport Control Protocols: Congestion, Packet Loss Recovery	1
	MODULE V	**8hrs**
5.1	Network Management Requirements,	1
5.2	Traditional Network Management Models: Simple Network Management Protocol,	1

5.3	Traditional Network Management Models: Simple Network Management Protocol,	1
5.4	Telecom Operation Map, Network Management Design Issues,	1
5.5	Telecom Operation Map, Network Management Design Issues,	1
5.6	Example of Management Architecture: MANNA,	1
5.7	Other Issues Related to Network Management, Naming, Localization,	1
5.8	Other Issues Related to Network Management, Naming, Localization,	1

CO Assessment Questions	
1	1. Explain the significance of sensor networks in modern technological landscapes. 2. List three broad categories of applications for wireless sensor networks. 3. Explain how the characteristics of wireless sensor networks make them suitable for a range of applications. 4. Explain the role of wireless sensor networks in building automation and industrial automation.
2	1. Explain the role of wireless sensor technology in modern communication systems. 2. Define sensor taxonomy and give an example from each category. 3. Propose measures to optimize a wireless sensor network for a specific operating environment. 4. Propose a wireless technology solution for improving communication on a university campus.
3	1. Explain the basic principles of MAC protocols and their role in wireless sensor networks. 2. Explain the fundamental operation of schedule-based MAC protocols in WSNs. 3. Explain the concept of flooding and its variants in WSNs.
4	1. Discuss the feasibility of using TCP or UDP in Wireless Sensor Networks (WSNs) and Mobile IP. 2. List two examples of existing transport control protocols other than TCP and UDP. 3. Explain the congestion detection and avoidance mechanisms employed by CODA.
5	1. Explain why network management is essential for the efficient operation of communication networks. 2. Explain the role of SNMP in managing network elements. 3. Explain the purpose of MANNA in managing communication networks.

23MCAE355	Advanced Computer Graphics	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This subject intends to provide an overview of the foundations of Computer Graphics rendering. Special emphasis is laid on modern concepts like Ray Tracing that have already become industry standards for graphics rendering with modern GPUs. Other fundamentals such as colorimetry and radiometry are also introduced in the subject. Although the course is expected to be treated theoretically for evaluation purposes, practical sessions and talks by external experts from the graphics processing industry may be desirable.

Prerequisite: Fundamentals of computer hardware, Linear Algebra.

Course Outcomes: After the completion of the course the student will be able to

CO1	Apply foundational knowledge in computer graphics to work with Graphics APIs.
CO2	Explain various shape drawing algorithms and transformations.
CO3	Explain viewing concepts and follow the workflow in computer graphics pipeline.
CO4	Explain different shading, texture mapping and data structures used in computer graphics.
CO5	Apply concepts in Raytracing to better understand and design computer graphics models.
CO6	Apply concepts in colorimetry and radiometry to work with images.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3											
CO2	3	2	2		3							
CO3	3											
CO4	3											
CO5	3											
CO6	3											

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA					
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**			**Total Marks**
		Assignment	**Test-1**	**Test-2**	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to computer graphics: (9hrs)

Applications, Preliminary discussion on Graphics Pipeline, Numerical Issues, Efficiency and Coding Graphics Programs.
Raster Images: Raster Devices, Images, Pixels, RGB Color and Alpha Composition.
Fundamentals of Signal Processing for Images and Sampling Theory (Theoretical understanding only).
Mathematical Foundations of Computer Graphics: Review of Trigonometry and Geometry, Theoretical foundations of Linear Algebra – Vectors and Matrices, Eigen Values and Eigen Vectors, Matrix Diagonalization(Theoretical understanding only).

MODULE II : Fundamentals of shape drawing: (11hrs)

Line drawing - DDA and Bresenham Algorithms, Circle drawing: Mid Point and Bresenham. Transformations (2D, 3D):, Translation and Affine Transformations, Inverse of Transformation Matrices, Coordinate transformations.
Viewing: Viewing Transformations, Projective Transformation, Perspective Projection, Field of View Graphics Pipeline: Rasterization, Operations, Antialiasing, Culling primitives for efficiency.

MODULE III : Surface shading: (10hrs)

Surface shading: Diffuse Shading, Phong Shading, Artistic Shading. Texture Mapping: 2D and 3D Mapping, Texture Mapping for Rasterized Triangles, Bump

Textures, Displacement Mapping, Shadow Maps.
Data Structures for Graphics: Triangle Meshes, Scene Graphs, Spatial Data Structures, BSP Tree for visibility, Tiling Multidimensional Arrays. Graphics APIs: Intuitive understanding of role of Graphics APIs such as OpenGL, Direct3D(DirectX), Vulkan etc.

MODULE IV : Ray Tracing (8hrs)

Basic Ray Tracing Algorithms, Perspective, Computing Viewing Rays, Ray-Object Intersection, Shading, Shadows, Ideal Specular Reflection, Ray Tracing Program, Transparency and Refraction, Instancing, Constructive Solid Geometry, Distribution Ray Tracing. Using Graphics Hardware: Introduction, Geometry for Hardware, Processing Geometry using Pixels

MODULE V : Illumination Modeling: (11hrs)

Light: Radiometry, Transport Equation, Photometry; Colors: Colorimetry, Color Spaces, Chromatic Adaption, Color Appearance; Tonal Reproduction: Classification, Dynamic Range, Image Formation, Frequency based Operators, Gradient Domain Operators, Gradient Domain Operators, Spatial Operators, Division, Sigmoids, Night Tonemapping. Global Illumination: Particle tracing for Lambertian scenes, Path Tracing, Accurate Direct Lighting. Reflection Models: Real World Materials, Implementing Reflection Models, Specular Reflection models, Smooth layered Model, Rough Layered Model.

Text books

1. Peter Shirley, Steve Marschner: “Fundamentals of Computer Graphics”, 4th Edtn. AK Peters, 2015. – All Modules.
2. Donald Hearn and M. Pauline Baker, “Computer Graphics”, 2nd Edtn. PHI, 1996. – Module 2(Fundamentals of Shape Drawing).

Reference books

1. Matt Pharr and Greg Humphreys, “Physically Based Rendering: From Theory to Implementation”, 2nd Edtn, Morgan Kaufmann,2010.
2. Gilbert Strang, “Introduction to Linear Algebra”, 4th Edtn, Wellesley-Cambridge Press, 2009.
3. William Stallings, “Data and Computer Communications”, 10th Edtn, Pearson, 2013.
4. Vulkan Documentation, https://www.khronos.org/vulkan/.
5. OpenGL Documentation, https://www.khronos.org/opengl/
6. Nvidia Developer, “Nvidia Ray Tracing Documentation”, Nvidia Documentation, https://raytracing-docs.nvidia.com/.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**9hrs**
1.1	Introduction to computer graphics: Major Areas and Major Applications, Preliminary discussion on Graphics Pipeline.	1
1.2	Numerical Issues, Efficiency and Coding Graphics Programs.	1
1.3	Raster Images: Raster Devices, Images, Pixels.	1
1.4	Raster Images: Raster Devices, Images, Pixels.	1
1.5	RGB Color and Alpha Composition.	1
1.6	Fundamentals of Signal Processing for Images and Sampling Theory (Theoretical understanding only).	1

1.7	Mathematical Foundations of Computer Graphics: Review of Trigonometry and Geometry.	1
1.8	Theoretical foundations of Linear Algebra – Vectors and Matrices, Eigen Values and Eigen Vectors, Matrix.	1
1.9	Diagonalization(Theoretical understanding only).	1
MODULE II		**11hrs**
2.1	Fundamentals of shape drawing:- Line drawing - DDA and Bresenham Algorithms.	1
2.2	Circle drawing: Mid-Point and Bresenham.	1
2.3	Transformations (2D, 3D):, Translation and Affine Transformations.	1
2.4	Inverse of Transformation Matrices, Coordinate transformations.	1
2.5	Viewing: Viewing Transformations.	1
2.6	Projective Transformation	1
2.7	Perspective Projection, Field of View	1
2.8	Graphics Pipeline: Rasterization.	1
2.9	Operations.	1
2.10	Antialiasing.	1
2.11	Culling primitives for efficiency.	1
MODULE III		**10hrs**
3.1	Surface shading: Diffuse Shading.	1
3.2	Phong Shading.	1
3.3	Artistic Shading.	1
3.4	Texture Mapping: 2D and 3D Mapping.	1
3.5	Texture Mapping for Rasterized Triangles.	1
3.6	Bump Textures, Displacement Mapping, Shadow Maps.	1
3.7	Data Structures for Graphics: Triangle Meshes.	1
3.8	Scene Graphs, Spatial Data Structures	1
3.9	BSP Tree for visibility.	1
3.10	Tiling Multidimensional Arrays.	1
MODULE IV		**8hrs**
4.1	Ray Tracing: Basic Ray Tracing Algorithms, Perspective, Computing Viewing Rays, Ray-Object Intersection, Shading,	1
4.2	Shadows, Ideal Specular Reflection, Ray Tracing Program.	1
4.3	Transparency and Refraction, Instancing, Constructive Solid Geometry, Distribution Ray Tracing.	1
4.4	Using Graphics Hardware: Introduction.	1
4.5	Geometry for Hardware.	1
4.6	Processing Geometry using Pixels.	1
4.7	Graphics APIs: Intuitive understanding of role of Graphics APIs such as OpenGL, Direct3D(DirectX), Vulkan etc. – No programming required	1
4.8	Graphics APIs: Intuitive understanding of role of Graphics APIs such as OpenGL, Direct3D(DirectX), Vulkan etc. – No programming required	1

MODULE V		11hrs
5.1	Light: Radiometry, Transport Equation, Photometry; Global Illumination: Particle tracing for Lambertian scenes, Path Tracing, Accurate Direct Lighting	1
5.2	Global Illumination: Particle tracing for Lambertian scenes, Path Tracing, Accurate Direct Lighting	1
5.3	Global Illumination: Particle tracing for Lambertian scenes, Path Tracing, Accurate Direct Lighting	1
5.4	Reflection Models: Real World Materials, Implementing Reflection Models,	1
5.5	Specular Reflection models, Smooth layered Model, Rough Layered Model.	1
5.6	Colors: Colorimetry, Color Spaces.	1
5.7	Chromatic Adaption.	1
5.8	Color Appearance.	1
5.9	Tonal Reproduction: Classification, Dynamic Range, Image Formation.	1
5.10	Frequency based Operators, Gradient Domain Operators, Gradient Domain Operators, Spatial Operators.	1
5.11	Division, Sigmoids, Night Tonemapping.	1

CO Assessment Questions	
1	Explain the workflow in the computer graphics pipeline.
2	How does alpha composition affect image appearance?
3	Explain Eigen vectors and Eigen values?
4	Explain some of the pitfalls of Bresenham line drawing algorithm.
5	Explain Affine transformation and its purpose.
6	Compare the mid-point and Bresenham circle drawing algorithms.
7	Explain how anti-aliasing affects the image quality.
8	Explain projective transformation.
9	Explain Field of View.
10	Explain some of the benefits of using Triangle meshes.
11	How is Phong shading different from Artistic Shading?
12	How is texture mapping for rasterized image performed.
13	Explain what makes Ray Tracing a highly system intensive rendering process.
14	How can transparency be achieved using ray tracing.
15	Explain the techniques used in Ray Tracing for shadows.
16	Explain Tonal Reproduction.
17	Write a short note on particle tracing for Lambertian scenes.
18	How can rough and smooth surfaces be modeled?

23MCAE357	INTERNET OF THINGS	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This course intends to provide insight into new innovations that will build novel type of interactions among things and humans, and enables the realization of smart cities, infrastructures, and services for enhancing the quality of life and utilization of resources. An overview of IOT and its related concepts, different IOT architectures and their components, emerging paradigms such as Fog computing, Platforms and solutions supporting development and deployment of IOT applications, message passing mechanisms such as RPC, REST, and CoAP, data and knowledge management, data confidentiality, data integrity, and operation control issues faced by IOT are included in the course.

Prerequisite: Basic concepts of Information Technology and Internet

Course Outcomes: After the completion of the course the student will be able to

CO1	Describe the main concepts and features of the IOT paradigm.
CO2	Identify and describe the components of Arduino Uno and other popular models.
CO3	Develop programs to read sensor data and control actuators using Python.
CO4	Discuss the communication flow between end-devices, gateways, network servers, and application servers.
CO5	Discuss key enablers and solutions to enable practical IoT systems.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3						2					
CO2	3	1					2					
CO3	3	1					2					
CO4	3	1					2					
CO5	3	1	1				2					

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓

Apply	✓	✓
Analyse	✓	✓
Evaluate	✓	
Create	✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to IoT (9hrs)

Introduction to Embedded Systems and IoT? Key concepts and technologies of IoT, OSI Model TCP/IP, MQTT protocol, Sensors. Overview of wireless protocols: NFC, Zigbee, Wifi, bluetooth, Lorawan.
Mobile communication protocols 2G to 5G. Applications of IoT in various sectors. Benefits and challenges of IoT. Future trends of IoT.

MODULE II : Getting Started with Arduino (8hrs)

Introduction to Arduino Uno and other popular models, Arduino hardware components and functionalities, Setting up Arduino development environment.
Basics of Arduino programming language, Controlling LEDs, buttons, and other basic components, Interfacing sensors and actuators with Arduino, Introduction to arduino cloud.

MODULE III : Introduction to Raspberry Pi echo system (10hrs)

Raspberry pi Overview, Different Models, Setting up your Raspberry Pi with Raspbian OS. Exploring the Raspberry Pi GPIO pins and connecting components, Programming Raspberry Pi with Python, Connecting to the internet and cloud platforms with Raspberry Pi, Interfacing sensors and actuators with Raspberry Pi. Introduction to raspberry pi pico.

MODULE IV : LoRaWAN for Long-Range Communication (10hrs)

Introduction to LoRaWAN technology, Benefits of LoRaWAN for IoT applications Understanding the principles of wireless communication, LoRaWAN network architecture and components.
The LoRaWAN protocol: End-device, Gateway, Network Server and Application Server.
Setting up a LoRaWAN gateway and end devices The LoRaWAN Network type : public, private, hybrid and community networks. HTTP and MQTT protocols to connect your application.
Programming LoRaWAN devices for sending and receiving data: How to set up your own IoT Dashboard.

MODULE V : Creating a simple IoT project (9hrs)

Building a simple weather station using Arduino and sensors.
Implementing home automation with Raspberry Pi and smart devices.
Creating a LoRaWAN-based monitoring system for remote environments.

Text books

1. The Internet of Things Samuel Green Guard : MIT press 2021
2. Programming Arduino: Getting Started with Sketches, Simon Monk: McGraw Hill.
3. Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux, Derek Molloy, Wiley.
4. https://lora-developers.semtech.com/documentation/tech-papers-and-guides/lora-and-lorawan/

Reference books

1. https://online.stanford.edu/courses/xee100-introduction-internet-things
2. https://www.netacad.com/courses/iot/introduction-iot
3. https://youtu.be/csJWcz15MYY?si=4Mor6K5UQkK8ah8q
4. https://azure.microsoft.com/en-in/solutions/iot/iot-technology-protocols
5. https://youtu.be/zJ-LqeX_fLU?si=zrMJAKNeJVDj75gO
6. https://www.youtube.com/watch?v=UFCmTZUoZ1M
7. https://www.youtube.com/playlist?list=PLBcrWxTa5CS08SANSQzwVD7YtyyasZByE
8. https://www.udemy.com/course/raspberry-pi-for-beginners-step-by-step/
9. https://www.univ-smb.fr/lorawan/en/free-book/
10. https://www.udemy.com/course/lora-lorawan-internet-of-things/

MOOC (Reference)

1. https://www.coursera.org/specializations/internet-of-things
2. https://web.mit.edu/professional/digital-programs/courses/IoT/phone/index.html

COURSE CONTENTS AND LECTURE SCHEDULE		
No.		No. of Hours
MODULE 1 (9hrs)		
1.1	Introduction to Embedded Systems and IoT?	1
1.2	Key concepts and technologies of IoT, OSI Model TCP/IP, MQTT protocol, Sensors.	1
1.3	Key concepts and technologies of IoT, OSI Model TCP/IP, MQTT protocol, Sensors.	1
1.4	Overview of wireless protocols: NFC, Zigbee	1
1.5	Overview of wireless protocols: Wifi, bluetooth, Lorawan.	1
1.6	Mobile communication protocols 2G to 5G.	1
1.7	Applications of IoT in various sectors.	1
1.8	Benefits and challenges of IoT.	1
1.9	Future trends of IoT.	1
MODULE II (8hrs)		
2.1	Introduction to Arduino Uno and other popular models	1
2.2	Arduino hardware components and functionalities	1
2.3	Setting up Arduino development environment.	1
2.4	Basics of Arduino programming language,	1
2.5	Controlling LEDs, buttons, and other basic components	1
2.6	Interfacing sensors and actuators with Arduino	1
2.7	Interfacing sensors and actuators with Arduino	1
2.8	Introduction to arduino cloud	1
MODULE III (10hrs)		
3.1	Raspberry pi Overview	1
3.2	Different Models, Setting up your Raspberry Pi with Raspbian OS.	1
3.3	Exploring the Raspberry Pi GPIO pins and connecting components	1
3.4	Programming Raspberry Pi with Python	1
3.5	Programming Raspberry Pi with Python	1
3.6	Connecting to the internet and cloud platforms with Raspberry Pi	1
3.7	Connecting to the internet and cloud platforms with Raspberry Pi	1
3.8	Interfacing sensors and actuators with Raspberry Pi.	1
3.9	Interfacing sensors and actuators with Raspberry Pi.	1
3.10	Introduction to raspberry pi pico	1
MODULE IV (10hrs)		

4.1	Introduction to LoRaWAN technology	1
4.2	Benefits of LoRaWAN for IoT applications	1
4.3	Understanding the principles of wireless communication,	1
4.4	LoRaWAN network architecture and components.	1
4.5	The LoRaWAN protocol: End-device, Gateway, Network Server and Application Server.	1
4.6	The LoRaWAN protocol: End-device, Gateway, Network Server and Application Server.	1
4.7	Setting up a LoRaWAN gateway and end devices	1
4.8	The LoRaWAN Network type: public, private, hybrid and community networks. HTTP and MQTT protocols to connect your application.	1
4.9	The LoRaWAN Network type: public, private, hybrid and community networks. HTTP and MQTT protocols to connect your application.	1
4.10	Programming LoRaWAN devices for sending and receiving data: How to set up your own IoT Dashboard	1
MODULE V (9hrs)		
5.1	Building a simple weather station using Arduino and sensors.	1
5.2	Building a simple weather station using Arduino and sensors.	1
5.3	Building a simple weather station using Arduino and sensors.	1
5.4	Implementing home automation with Raspberry Pi and smart devices.	1
5.5	Implementing home automation with Raspberry Pi and smart devices.	1
5.6	Implementing home automation with Raspberry Pi and smart devices.	1
5.7	Creating a LoRaWAN-based monitoring system for remote environments.	1
5.8	Creating a LoRaWAN-based monitoring system for remote environments.	1
5.9	Creating a LoRaWAN-based monitoring system for remote environments.	1

CO Assessment Questions	
1	1. Explain the fundamental concepts of the Internet of Things (IoT) paradigm. 2. Differentiate between traditional systems and embedded systems. 3. List and describe the main features that characterize the IoT paradigm. 4. Discuss the challenges and potential drawbacks associated with IoT deployments.
2	1. List and explain the primary hardware components of Arduino boards. 2. Identify and describe the key components of an Arduino Uno board and mention any differences or additional features found in other popular Arduino models?

	3. Explain how to write Arduino code to control LEDs (light-emitting diodes).
3	1. Compare and contrast different Raspberry Pi models, highlighting their specifications and use cases. 2. Explain how to connect a Raspberry Pi to cloud platforms for data storage or remote monitoring. 3. Demonstrate how to interface various sensors and actuators with a Raspberry Pi. 4. Discuss the features and applications of Raspberry Pi Pico in comparison to traditional Raspberry Pi boards.
4	1. List and elaborate on the benefits of using LoRaWAN technology in various IoT applications. 2. Describe the architecture of a LoRaWAN network, highlighting the roles of end-devices, gateways, network servers, and application servers. 3. Explain the communication flow between end-devices, gateways, network servers, and application servers.
5	1. Suggest additional features or sensors that could be added to enhance the capabilities of the weather station. 2. Outline the steps involved in programming the Arduino for the weather station project. 3. Outline the development of a remote monitoring dashboard to visualize the data collected from the remote environment.

23MCAE359	Computer Vision	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The aim of the course is to introduce the standard computer vision problems and the solution methodologies. The course focuses on development of algorithms and techniques to analyze and interpret the visible world around us and the applications ranging from Biometrics, Medical diagnosis, document processing, mining of visual content, to surveillance, advanced rendering etc. Also intends to explore and contribute to research and further developments in the field of computer vision.

Prerequisite: : Knowledge in Digital Image Processing

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the basic concepts of computer vision and develop an appreciation towards various computational tools used for object/image recognition.
CO2	Understand and implement the various segmentation, pattern analysis, objection detection/recognition methods.
CO3	Understand the geometric relationships between 2D images and the 3D world
CO4	Understand and implement the algorithms for 3D reconstruction from various cues.
CO5	Build a complete system to solve a computer vision problem.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2					2					
CO2	3	3	2				2					
CO3	3	2			3		2					
CO4	3	3	2				2					
CO5	3	3	2	2	3		2					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse				
Evaluate				
Create				

Mark Distribution of CIA					
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**			**Total Marks**
		Assignment	**Test-1**	**Test-2**	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction: (6hrs)

Image Processing: Image pre-processing, Image representations (continuous and discrete), Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing, Computer Vision and Computer Graphics: Components of a vision system: Cameras- Camera Model, Camera Projections and Camera Calibration- Radiometry- Light in space- Light in surface - Sources, shadows and shading.

MODULE II : Image Formation Models: (7hrs)

Image Formation Models : Monocular imaging system , Camera Projection Models – Orthographic, Affine, Perspective, Projective models, Transformation: Orthogonal, Euclidean, Affine, Projective etc.; Fourier Transform, Binocular imaging systems, Multiple images-The Geometry of multiple views, Structure determination, shape from shading, Stereopsis, Photometric Stereo, Depth from Defocus , Construction of 3D model from images.

MODULE III : Feature Extraction and Motion Estimation: (7hrs)

Edge Detection - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Histogram Orientation, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT, Background Subtraction and Modeling, Optical Flow, Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation, Structure from motion.

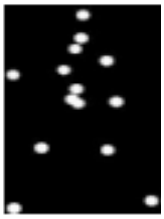
MODULE IV : Shape Representation and Segmentation (9hrs)
Contour based representation, Region based representation, Deformable curves and surfaces , Snakes and active contours, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation, Level set representations, Fourier, and wavelet descriptors, Medial representations, Multi-resolution analysis, Object recognition, Shape from X : Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation, Shape from Texture, color, motion and edges.
MODULE V : Applications: (6hrs)
Image Understanding and Computer Vision Applications: Pattern recognition methods, Face detection, Face recognition, 3D shape models of faces Application: Surveillance – foreground-background separation –human gait analysis Application: In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.
Text books 1. D. Forsyth and J. Ponce, Computer Vision - A modern approach, Prentice Hall 2. Richard Szeliski, Computer Vision: Algorithms and Applications (CVAA), Springer, 2010 3. Shapiro L. G. and Stockman G., “Computer Vision”, Prentice Hall, 2001.
Reference books 1. E. R. Davies, , *Computer & Machine Vision*, Academic Press, 2012 2. Dana H. Ballard, Christopher M. Brown, *Computer Vision*, Prentice Hall 1st Edition (May 1, 1982) , ISBN-978-0131653160 3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, 2ndEdition, Cambridge University Press, March 2004

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**6hrs**
1.1	Introduction to Image Processing, Image pre-processing.	1
1.2	Image representations (continuous and discrete), Convolution and Filtering.	1
1.3	Image Enhancement, Restoration, Histogram Processing.	1
1.4	Computer Vision and Computer Graphics: What is Computer Vision - Low-level, Mid-level, High-level.	1
1.5	Components of a vision system- Cameras- Model, Projections and Calibration.	1
1.6	Radiometry- Light in space- Light in surface - Sources, shadows and shading.	1
	MODULE II	**7hrs**
2.1	Image Formation Models: Monocular imaging system & Binocular imaging systems.	1
2.2	Camera Projection Models – Orthographic, Affine, Perspective, Projective models.	1
2.3	Transformation: Orthogonal, Euclidean, Affine, Projective etc.	1
2.4	Fourier Transform.	1
2.5	The Geometry of multiple views, Structure determination, Shape from shading.	1
2.6	Stereopsis, Photometric Stereo.	1
2.7	Depth from Defocus, Construction of 3D model from images.	1

MODULE III		7hrs
3.1	Edge Detection - Canny, LOG.	1
3.2	Edge Detection - DOG.Line detectors (Hough Transform)	
3.3	Corner Detection - Harris and Hessian Affine.Histogram Orientation, SIFT, SURF, HOG, GLOH.	
3.4	Scale-Space Analysis- Image Pyramids	1
3.5	Gaussian derivative filters, Gabor Filters	1
3.6	DWT.Background Subtraction and Modeling, Optical Flow	1
3.7	Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation, Structure from motion.	1
MODULE IV		**9hrs**
4.1	Contour based representation, Region based representation.	1
4.2	Deformable curves and surfaces , Snakes and active contours.	1
4.3	Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs	1
4.4	Texture Segmentation, Level set representations.	1
4.5	Fourier and wavelet descriptors.	1
4.6	Medial representations, Multi-resolution analysis.	1
4.7	Object recognition - Shape from X : Light at Surfaces;	1
4.8	Phong Model, Reflectance Map, Albedo estimation.	1
4.9	Shape from Texture, color, motion and edges.	
MODULE V		**10hrs**
5.1	Pattern recognition methods: - Neural network structures for pattern recognition.	1
5.2	Pattern classification using Genetic Algorithms.	1
5.3	Face detection, Face recognition, 3D shape models of faces.	1
5.4	Gesture Recognition.	1
5.5	Surveillance – foreground-background separation. Human gait analysis	1
5.6	In-vehicle vision system: locating roadway – road markings – identifying road signs – locating pedestrians.	1
5.7	Pattern recognition methods: - Neural network structures for pattern recognition.	1
5.8	Pattern classification using Genetic Algorithms.	1
5.9	CNN for Malicious Network Traffic classification	1
5.10	Intrusion Detection in SDN-Based Networks.	1

CO Assessment Questions	
1	a) Explain the different components of a vision system. b) What are shadows? Differentiate umbra from penumbra.
2	a) Explain the different methods for solving the binocular fusion problem. b) What is SVD? State the Tomasi's and Kanade's factorization algorithm for affine shape from motion.
3	a) Derive the optical flow constraint equation. b) Explain how Gabor wavelets can estimate the gradient vector field $\nabla f(x, y)$ in edge detection, extracting both edge strength and edge direction.

	Also describe how they can be used in a demodulation network to localise facial features. Identify one application of Gabor wavelets in pattern matching
4	a) What is meant by a pose? How can you hypothesize a correspondence between a collection of image features and a collection of object features, using pose consistency? b) Propose an algorithm for shape classification that could correctly classify all of the objects shown here as cashew nuts, despite their variations in size (or hence distance), pose angles, colors, and intrinsic shapes.  How can shape grammars, active contours, boundary descriptors, zeroes of curvature, and codon constraints enable a classifier to achieve those invariances?
5	a) What can we learn from the perceptual experiments of the Swedish psychologist Johansson, involving sparse dot patterns such as shown below.  How might his findings be useful in computer vision for data fusion, integration of motion cues in object recognition, and general aspects of scene understanding? b) In self-driving cars, the following acronyms are names for automated vision systems. Define them and briefly describe how they work. (i) LIDAR (ii) SLAM

23MCAE361	Deep Learning	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: Deep learning is a subfield of machine learning that focuses on training artificial neural networks to perform tasks with a level of complexity and sophistication previously considered challenging for traditional machine learning approaches. Deep learning has led to significant breakthroughs in various domains, including computer vision, natural language processing, and reinforcement learning.

Students will learn core concepts and principles of deep learning and artificial neural networks.

Prerequisite: Basic concepts of linear algebra, probability and optimization.

Course Outcomes: After the completion of the course the student will be able to

CO1	Apply the Perceptron model to solve binary classification problems.
CO2	Design neural networks using TensorFlow
CO3	Solve real world problems with CNN.
CO4	Solve real world problems with RNN.
CO5	Understand the difference between discriminative and generative models and how GANs use both to generate data.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3			3		3					
CO2	3	3	3		3		3					
CO3	3	3	3		3		3					
CO4	3	3	3									
CO5	3	3										

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Mark
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Review of Neural Networks (12hrs)

Model of a biological neuron, McCulloch Pitts Neuron, Activation Functions, Perceptron, Perceptron Learning Algorithm, Multilayer Perceptron, Back propagation, Learning XOR, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks.

MODULE II : Training Neural Networks (8hrs)

Training Neural Networks: Initialization, dropout, batch normalization and dropout, overfitting, underfitting, training and validation curves.
Introduction to TensorFlow: graphs, nodes, Tensor data structures - rank, shape, type, Building neural networks with TensorFlow, Introduction to Keras/Pytorch.

MODULE III : Convolutional Neural Networks (10hrs)

Convolutional Neural Networks: Convolution operation, Convolutional layers in neural network, pooling, fully connected layers.
Case study: Architecture of Lenet, Alexnet and VGG 16

MODULE IV : Recurrent Neural Networks (9hrs)

Recurrent Neural Networks: Back propagation, vanishing gradients, exploding gradients, truncated backpropagation through time, Gated Recurrent Units (GRUs), Long Short-Term Memory (LSTM) cells, solving the vanishing gradient problem with LSTMs.

MODULE V Generative Adversarial Networks (9hrs)

Autoencoders, variational autoencoders.
Generative Adversarial Networks (GAN): Discriminative and generative models, GAN discriminator, GAN generator, upsampling, GAN Training, GAN challenges, loss functions, cross entropy, minimax loss, Wasserstein loss.
LLMs, uses and examples.

Text books

1. Generative Deep Learning: David Foster, OReily, (2019)
2. Deep Learning, Ian Goodfellow, Yoshua Bengio and Aaron Courville, MIT press (2016)
3. Hands on Machine Learning with Scikit Learn and TensorFlow, Aurélien Géron (2019)
4. Deep Learning Illustrated, Jon Krohn, Grant Beyleveld, Aglae Bassens, Pearson, 1st Edn., (2020)

5. Online book Dive Deep into Machine Learning at https://d2l.ai/

References

1. http://neuralnetworksanddeeplearning.com
2. Hands on Machine Learning with Scikit Learn and TensorFlow, Aurélien Géron
3. Probabilistic Machine Learning: An Introduction, Kevin Murphy
4. Convolutional neural networks for visual computing ,Ragav Venkatesan and Baoxin Li CRC press
5. GANs in Action: Deep Learning with Generative Adversarial Network Jakub Langgr, Vladimir Bok
6. Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play David Foster
7. https://developers.google.com/machine-learning/gan

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	**12hrs**
1.1	Review of Neural Networks: Model of a biological neuron	1
1.2	McCulloch Pitts Neuron, Activation functions	1
1.3	Perceptron	1
1.4	Perceptron Learning Algorithm	1
1.5	Multilayer Perceptron	1
1.6	Multilayer Perceptron	1
1.7	Back propagation	1
1.8	Back propagation	1
1.9	Learning XOR,	1
1.10	Sigmoid Neurons	
1.11	Gradient Descent,	1
1.12	Feed forward Neural Networks	1
	MODULE II	**8hrs**
2.1	Training Neural Networks	1
2.2	Initialization, Dropout	1
2.3	Batch normalization and drop out	1
2.4	Over fitting, under fitting, training and validation curves,	1
2.5	Data visualization, feature and weight visualization, tSNE	1
2.6	Introduction to TensorFlow, graphs, nodes, Tensor Data Structures - rank, shape, type	1
2.7	Building neural networks with tensor flow	1
2.8	Introduction to Keras	1
	MODULE III	**10hrs**
3.1	Convolutional neural networks	1
3.2	Convolution operation	1
3.3	Back propagation in multilayer neural networks	1
3.4	Convolutional layers in neural network, pooling	1
3.5	Fully connected layers	1

3.6	Case study: Architecture of Lenet, Alexnet and VGG 16	1
3.7	Case study: Architecture of Lenet, Alexnet and VGG 16	1
3.8	Case study: Architecture of Lenet, Alexnet and VGG 16	1
3.9	Case study: Architecture of Lenet, Alexnet and VGG 16	1
3.10	Case study: Architecture of Lenet, Alexnet and VGG 16	1
MODULE IV		**9hrs**
4.1	Recurrent neural networks	1
4.2	Back propagation: vanishing gradients, exploding gradients	1
4.3	Truncated Backpropagation Through Time	1
4.4	LSTM	1
4.5	Gated Recurrent Units (GRUs)	1
4.6	Long Short-Term Memory (LSTM) Cells	1
4.7	Long Short-Term Memory (LSTM) Cells	1
4.8	Solving the vanishing gradient problem with LSTMs	1
4.9	Solving the vanishing gradient problem with LSTMs	1
MODULE V		**9hrs**
5.1	Autoencoders, Variational autoencoders	1
5.2	Generative Adversarial Networks (GAN)	1
5.3	Discriminative and generative models	1
5.4	GAN Discriminator	1
5.5	GAN Generator, upsampling,	1
5.6	GAN Training	1
5.7	GAN challenges	1
5.8	Loss functions, cross entropy	1
5.9	minimax loss, Wasserstein loss	1

CO Assessment Questions	
1	1. Evaluate the importance of the back propagation algorithm in the context of training neural networks. 2. Build a neural network using perceptron to realize AND and OR gate. 3. Design an MLP to realize XOR gate.
2	1. Given a dataset, how would you implement a feed-forward neural network using TensorFlow? 2. Outline the fundamental steps required to train a neural network using TensorFlow. 3. Demonstrate how to use TensorFlow to implement a training loop for a simple neural network. 4. Design an MLP for the MNIST dataset using TensorFlow.
3	1. Examine the advantages of using CNNs over traditional machine learning techniques for real-world image recognition tasks. 2. Investigate the role of pooling layers in CNNs and their impact on solving real-world problems.

	3. Design CNN architecture tailored for CIFAR dataset. 4. Propose a strategy to integrate real-time data feeds, like video streams, into a CNN for real-time analysis.
4	1. Compare the advantages of RNNs over traditional machine learning techniques for tasks like speech recognition or language modeling. 2. Examine the challenges and limitations of using basic RNNs in real-world problems. 3. Propose an RNN-based solution for a real-world application, such as sentiment analysis over a movie script or predicting stock market trends. 4. Design a hybrid neural network architecture combining RNNs with other types of networks for a multi-modal real-world challenge.
5	1. Given a dataset, demonstrate how you would construct an autoencoder to perform dimensionality reduction. 2. Propose an approach that combines the principles of VAEs with other generative models, like GANs, for enhanced data generation. 3. Assess the effectiveness of a VAE in comparison to an autoencoder for a specific task, such as anomaly detection. 4. Given a dataset of images, describe a potential use case for a GAN. 5. Design a basic GAN architecture tailored for a specific application, such as generating art or enhancing low-resolution images. 6. Evaluate the ethical implications of using GANs to generate realistic data, such as faces or voices.

23MCAE363	BIOINFORMATICS	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This course helps to understand the concepts of computational biology and bioinformatics. The students will learn Database tools and their uses, various algorithms for biological sequence analysis, Genomics and Gene Recognition, Protein structure and to use various visualization techniques, data mining & machine learning in bioinformatics.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the fundamentals of Computational Biology and Bioinformatics.
CO2	Classify various biological databases.
CO3	Use suitable algorithm for Biological Sequence Analysis and make use of database search tools.
CO4	Discuss Gene structure and expression of Prokaryotic and Eukaryotes.
CO5	Apply data mining & machine learning methods to analyse and visualize biological data.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1				1					
CO2	3	3	1				2					
CO3	3	3	2				2					
CO4	3	2	1				1					
CO5	3	3	2		2		2					

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓

Evaluate	✓	
Create	✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Marks distribution

Total Marks	CIA (Marks)	ESE (Marks)	ESE Duration
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Computational Biology and Bioinformatics (7hrs)

Computational Biology: Cell - Central Dogma of Molecular Biology - Structure of DNA, RNA and Protein - Coding and Non-coding RNAs - mRNA, tRNA, miRNA and siRNA.
Bioinformatics: Nature & Scope of Bioinformatics, Gnome projects, Importance of bioinformatics, Pattern recognition and prediction.

MODULE II : Biological Databases (8hrs)

Biological Databases, Primary Sequence Databases, Composite protein sequence databases, Secondary Databases, Composite protein pattern databases, Structure classification databases.

MODULE III : Data Searches and pairwise Alignment (10hrs)

Dot Plots, Concept of Simple Alignment, Scoring matrices: Introduction to PAM & Blosum, Needleman and Wunsch Algorithm, Global and Local Alignments, Smith Waterman Algorithm, Multiple Sequence Alignment. Familiarize Database search tools: BLAST & FastA

MODULE IV : Genomics and Gene recognition (10hrs)

Introduction to Gene expression in prokaryotes, Prokaryotic Gene structure, GC content in prokaryotic genomes, Gene Density. Eukaryotic Genomes: Gene structure, GC content in eukaryotic genomes, Gene Expression – Introduction to Microarrays.

MODULE V :Data Visualization, Data mining and Machine learning (10hrs)

Data Visualization - Introduction, Sequence Visualization, Structure Visualization, User Interface, Animation Versus Simulation, General-Purpose Technologies.
Data Mining using biological data, Methods, Infrastructure, Pattern recognition and discovery, Genetic Algorithms, Neural networks using biological data, Statistical methods using biological data, Introduction to Hidden Markov Models and Text mining

Text books

1. Dan. E. Krane and M. L. Raymer, "Fundamental Concepts of Bioinformatics", Pearson Education, 2003.
2. Bryan Bergeron, M.D, "Bioinformatics Computing", Pearson Education, 2015.
3. Attwood T. K. and D. J. Parry-Smith," Introduction to Bioinformatics", Pearson Education, 2003.
4. Neli C Jones and Pavel A Pevzner, "An Introduction to Bioinformatics Algorithms", MIT Press, 2004.

Reference books

1. Jean-Michel Claverie and Cedric Notredame, "Bioinformatics For Dummies" , 2nd Edition,Wiley Publishing.
2. David W Mount, "Bioinformatics- Sequence and Genome Analysis " , 2/e, Cold Spring Harbor.
3. Laboratory Press, New York.
4. "Bioinformatics for Dummies" J. Claverie & C. Notredame ,Wiley India.

Web Reference

1. https://nptel.ac.in/courses/102/106/102106065/

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	Cell - Central Dogma of Molecular Biology, Structure of DNA	1
1.2	RNA and Protein: Coding and Non-coding RNAs -mRNA	1
1.3	tRNA, miRNA and siRNA	1
1.4	Nature & Scope of Bioinformatics, Gnome projects	1
1.5	Importance of bioinformatics, Pattern recognition and prediction	1
1.6	Folding problem	1
1.7	Sequence analysis, homology and analogy	1
	MODULE II	
2.1	Primary Sequence databases: Nucleic acid and Protein sequence: PIR, MIPS, SWIS-PROT	1
2.2	Protein sequence: TrEMBL, NRL-3D	1
2.3	Composite protein sequence Databases: NRDB, OWL,	1

	MIPSX and SWISS-PROT+TrEMBL	
2.4	Secondary Databases, Need for Secondary databases	1
2.5	Prosite	1
2.6	Prints	1
2.7	Blocks, Profile, Pfam, Identify	1
2.8	Composite Protein Pattern Database and Structure Classification Databases	1
MODULE III		
3.1	Dot Plots	1
3.2	Concept of Simple Alignment, GAPS	1
3.3	Scoring matrices	1
3.4	Introduction to PAM	1
3.5	Introduction to Blosum	1
3.6	Needleman and Wunsch Algorithm	1
3.7	Global and Local Alignments: Semiglobal alignment	1
3.8	Smith Waterman Algorithm	1
3.9	Alignment scores and statistical significance of database search , Multiple Sequence Alignment.	1
3.10	Familiarize Database search tools: BLAST & FastA	1
MODULE IV		
4.1	Introduction to Gene expression in Prokaryotes	1
4.2	Prokaryotic Gene structure	1
4.3	GC content in prokaryotic genomes	1
4.4	Prokaryotic Genomes -Gene Density	1
4.5	Eukaryotic Genomes	1
4.6	Gene structure , ORF in Prokaryotic	1
4.7	GC content in Eukaryotic Genomes	1
4.8	Gene Expression - cDNAs & ESTs,	1
4.9	Serial Analysis of Gene Expression	1
4.10	Introduction to Microarrays.	1
MODULE V		
5.1	Data Visualization Introduction	1
5.2	Sequence Visualization- Sequence Map	1
5.3	Structure Visualization- Rendering tools	1
5.4	User Interface - User Interface Components, Alternative Metaphors, Display Architecture	1
5.5	Animation Versus Simulation, General-Purpose Technologies.	1
5.6	Data Mining, Methods, Infrastructure	1
5.7	Pattern recognition and discovery	1
5.8	Genetic Algorithms	1
5.9	Neural networks, Statistical methods	1
5.10	Hidden Markov Models and Text mining	1

CO Assessment Questions	
1	1. Explain the concept of DNA. 2. Explain the concept of RNA. 3. Illustrate the concept of translation and transcription. 4. Discuss Gnome project and its impact on bioinformatics.
2	1. Explain the features of biological databases? 2. Discuss primary sequence databases and secondary sequence databases. 3. Classify the two important classification schemes of structure classification databases. 4. Retrieve the sequence from primary / secondary databases. 5. Use of BLAST for comparing sequences.
3	1. Explain the importance of scoring matrices in sequence alignment. 2. Explain the different algorithms used for sequence alignment . 3. Illustrate Local and global alignment Algorithm for the sequence CGTGAATTCAT (sequence#1 or A) GACTTAC (sequence #2 or B) 4. Compute the best alignment of these two sequences: ACTGATTCA ACGCATCA Using -2 as a gap penalty, -3 as a mismatch penalty, and 2 as the score for a match
4	1. Explain the Prokaryotic gene structure 2. Explain the Eukaryotic gene structure 3. Demonstrate the usage of Open Reading Frame with an example a. 5′-ATCTAAAATGGGTGCC-3′ 4. Explain the working principle of microarray
5	1. Differentiate between the different protein molecular structure visualizations. 2. Use Web-based Map Viewer program, RasMol, PyMol data visualization techniques in bioinformatics . 3. Use PubMed to search for a particular pattern to specify the importance of mining the biomedical literature for data on functions to complement the sequence and structure data mined from nucleotide and protein databases. 4. Compare any three machine learning technologies and their applicability to data mining methods.

23MCAE365	Social Network Analysis	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: This course intends to provide insight into social network analysis. The objective of this course is to enable students analyse and visualize network data. This course will create an understanding about the semantic web, structure of various social networks and the structure of search engines.

Prerequisite: Basic concepts of graph theory and networks

Course Outcomes: After the completion of the course the student will be able to

CO1	Explain the basic concepts of semantic web and social network analysis.
CO2	Describe the ontology-based knowledge representation techniques in social network.
CO3	Discuss aggregation of social network information and representation of social individuals and social relationships.
CO4	Describe the structure of the Web and Facebook as a graph and the algorithms for searching and community discovery.
CO5	Explain the general architecture of a search engine and specifically the Google search engine architecture.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2					1					
CO2	2	2					1					
CO3	2	2					2					
CO4	2	3		2	2	2	2			2		
CO5	2	3		2	2		2					

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓
Evaluate	✓	
Create	✓	

Mark Distribution of CIA					
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**			**Total Marks**
		Assignment	**Test-1**	**Test-2**	
3-1-0-0	5	15	10	10	40

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to the Semantic Web and Social Networks (9hrs)

The Semantic Web, Limitations of the current Web, The semantic solution, Development of the Semantic Web, The emergence of the social web, Social Network Analysis, Development of Social Network Analysis, The global structure of networks, The macro-structure of social networks, Personal networks.

MODULE II : Electronic sources for network analysis (8hrs)

Electronic discussion networks, Blogs and online communities, Web-based networks.

Knowledge Representation on the Semantic Web: Ontologies and their role in the Semantic Web, Ontology languages for the Semantic Web, The Resource Description Framework (RDF) and RDF Schema, The Web Ontology Language (OWL), Comparison of Ontology languages with the Unified Modelling Language (UML), Comparison to the Entity/Relationship (E/R) model and the Relational model, Comparison to the Extensible Markup Language (XML) and XML Schema.

MODULE III : Modelling and aggregating social network data (8hrs)

Network data representation, Ontological representation of social individuals, Ontological representation of social relationships, Aggregating and reasoning with

social network data, Representing identity, On the notion of equality, Determining equality, Reasoning with instance equality, Evaluating smushing.

MODULE IV : Graph Structure of the Web (10hrs)

Breadth First Search (BFS) Algorithm, Strongly Connected Components (SCC) Algorithm, Weakly Connected Components (WCC) Algorithm, In-degree and out-degree distributions, Connected Components, Zipf's Law, Rank Exponent R, Out-Degree Exponent O, Hop Plot Exponent H, Eigen Exponent E.
Graph Structure of Facebook: Hyper ANF Algorithm, Iterative Fringe Upper Bound (iFUB) Algorithm, Spid, Degree Distribution, Path Length, Component Size, Clustering Coefficient and Degeneracy, Friends-of-Friends, Degree Assortativity, Login Correlation, Effects of Age, Gender and Country of Origin.

MODULE V : Link Analysis (10hrs)

Search Engine – Search engine architecture, Crawling, Storage, Indexing, Ranking, HITS Algorithm, Page rank algorithm, Random walk, SALSA Algorithm, Bayesian Algorithm; Google - Google architecture, Data Structures, Crawling, Searching, Web Spam Pages.

Text books

1. Social Networks and the Semantic Web, Peter Mika, Springer, 2007. (For Modules 1, 2 & 3)
2. Practical Social Network Analysis with Python, Krishna Raj P. M., Ankith Mohan, K.
3. G. Srinivasa, Springer, 2018. (For Modules 4 & 5)

Reference books

1. Social Network Analysis, John Scott, SAGE Publications, 4th Edition (2017)
2. Social Network Analysis - Interdisciplinary Approaches and Case Studies, Xiaoming Fu, Jar-Der Luo and Margarete Boos, CRC Press (2017)
3. Handbook of Social Network Analysis, John Scott and Peter J. Carrington, SAGE Publications (2011)
4. Social Network Analysis - Methods and Applications, Stanley Wasserman and Katherine Faust, Cambridge University Press (2012)

MOOC (Reference)

1. https://onlinecourses.nptel.ac.in/noc20_cs78/preview
2. https://www.coursera.org/learn/social-network-analysis
3. https://www.coursera.org/learn/python-social-network-analysis

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	The Semantic Web, Limitations of the current Web	1
1.2	The semantic solution	1
1.3	Development of the Semantic Web	1
1.4	The emergence of the Social Web	1
1.5	Social Network Analysis	1
1.6	Development of Social Network Analysis	1
1.7	The global structure of networks	1

1.8	The macro-structure of social networks	1
1.9	Personal networks	1
MODULE II		
2.1	Electronic sources for network analysis, Electronic discussion networks	1
2.2	Blogs and online communities	1
2.3	Web-based networks	1
2.4	Knowledge Representation on the Semantic Web	1
2.5	Ontologies and their role in the Semantic Web	1
2.6	Ontology languages for the Semantic Web, The Resource Description Framework (RDF) and RDF Schema	1
2.7	The Web Ontology Language (OWL), Comparison of Ontology languages with the Unified Modelling Language (UML)	1
2.8	Comparison to the Entity/Relationship (E/R) model and the Relational model, Comparison to the Extensible Markup Language (XML) and XML Schema	1
MODULE III		
3.1	Modelling and aggregating social network data, Network data representation	1
3.2	Ontological representation of social individuals	1
3.3	Ontological representation of social relationships	1
3.4	Aggregating and reasoning with social network data	1
3.5	Representing identity	1
3.6	Notion of equality, Determining equality	1
3.7	Reasoning with instance equality	1
3.8	Evaluating smushing	1
MODULE IV		
4.1	Graph Structure of the Web	1
4.2	Breadth First Search (BFS) Algorithm	1
4.3	Strongly Connected Components (SCC) Algorithm, Weakly Connected Components (WCC) Algorithm	1
4.4	In-degree and out- degree distributions, Connected Components	1
4.5	Zipf's Law	1
4.6	Rank Exponent R, Out-Degree Exponent O, Hop Plot Exponent H, Eigen Exponent E	1
4.7	Graph Structure of Facebook: HyperANF Algorithm	1
4.8	Iterative Fringe Upper Bound (iFUB) Algorithm, Spid, Degree Distribution, Path Length	1
4.9	Component Size, Clustering Coefficient and Degeneracy, Friends-of-Friends	1
4.10	Degree Assortativity, Login Correlation, Effects of Age, Gender and Country of Origin	1
MODULE V		

5.1	Link Analysis: Search Engine – Search engine architecture	1
5.2	Crawling, Storage, Indexing	1
5.3	Ranking, HITS Algorithm	1
5.4	Page rank algorithm	1
5.5	Random walk	1
5.6	SALSA Algorithm	1
5.7	Bayesian Algorithm	1
5.8	Google - Google architecture	1
5.9	Data Structures, Crawling, Searching	1
5.10	Web Spam Pages	1

CO Assessment Questions	
1	1. Explain the development of semantic Web and the emergence of Social Web. 2. Describe the global structure social networks. 3. Discuss in detail about the macro-structure of social networks. 4. "Most network analysis methods work on an abstract, graph-based representation of real-world networks". Justify this statement.
2	1. Describe the characteristics of Resource Description Framework (RDF). 2. Compare the features of Web Ontology Language (WOL) and Unified Modeling Language (UML). 3. Compare the features of Web Ontology Language (WOL) and Entity Relationship (ER) Model.
3	1. Describe the ontological representation of social individuals. 2. Explain the generic architecture of Semantic Web applications. 3. Discuss how semantic web applications can be built with social network features?
4	1. Describe Zipf's Law. 2. Write the limitations of HyperANF Algorithm and explain how it can be sorted out using the Iterative Fringe Upper Bound (iFUB) Algorithm. 3. What is meant by Degree Assortativity? What is the use of this measure? 4. "A user who logs in more generally has more friends on Facebook", describe how can we conclude this statement.
5	1. Draw the architecture of a general search engine and explain how it works. 2. Explain how the HITS Algorithm works to assign ranks to web pages. 3. Compare the HITS Algorithm and the Page Rank Algorithm

23MCAE367	Embedded Systems	L	T	P	J	S	C	Year of Introduction
		3	1	0		3	4	2023

Preamble: This course introduces students to the basic concepts behind Embedded Systems. It helps the students to understand the various techniques involved in embedded system design and development.

Prerequisite: Basic knowledge of the subjects Operating Systems and System Software

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the basic concepts of Embedded Systems and its Applications.
CO2	Demonstrate the role of individual components involved in a typical embedded system.
CO3	Learn about the co-design approach for embedded hardware and firmware development.
CO4	Understand the concepts involved in Embedded System Design and development Process.
CO5	Learn about techniques used in the Integration and Testing of Embedded Hardware and Firmware.
CO6	Understand the basic concepts of RTOS based Embedded System Design

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	3	3										
CO3	3	3			3							
CO4			3	2								
CO5		3										
CO6		3										

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓

Evaluate	✓	
Create	✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Embedded Systems (9hrs)

Introduction to Embedded Systems: Embedded system, Embedded system Vs General Computing System, Processor Embedded into a System.
Embedded Hardware units and devices in a system, Embedded Software in a System, Introduction to embedded system design, classification of Embedded systems, Skills Required for an embedded system Designer, Examples of the Embedded Systems. Major Application Areas of Embedded Systems, Purpose of Embedded Systems

MODULE II : Embedded System Design and development Process (10hrs)

Embedded System Design and development Process: Embedded System- On-Chip (SoC) and Use of VLSI Circuit Design Technology, Build Process for embedded systems. Design Process in Embedded System, Design Challenges in Embedded System Design. Hardware-Software Co-Design in an Embedded System, Formalism of System Design.

MODULE III : Hardware Software Co-Design and Program Modelling (9hrs)

Hardware Software Co-Design and Program Modelling: – Fundamental Issues in Hardware Software Co-Design. Computational Models in Embedded Design - Data Flow Graph Model, Control Data Flow Graph, State Machine Model, Sequential Program Model, Concurrent / communicating Process Model, Object oriented model, UML.
MODULE IV : Design and Development of Embedded Product (10hrs)
Embedded Hardware Design and Development: - Analog Electronic Components, Digital Electronic Components, VLSI and Integrated Circuit Design, Embedded Firmware Design and Development: - Embedded Firmware Design Approaches, Embedded Firmware Development Languages
MODULE V : Integration and Testing of Embedded Hardware and Firmware (10hrs)
Integration and Testing of Embedded Hardware and Firmware: - Integration of Hardware and Firmware, Testing Embedded Systems. RTOS based Embedded System Design: - Basic operating system services, Introduction to Real Time Operating System(RTOS), RTOS Task-Scheduling models, How to Choose an RTOS
Text books 1. Raj Kamal, Embedded Systems: Architecture, Programming and Design, Third Edition, McGraw Hill Education (India), 2014. 2. Shibu K.V., Introduction to Embedded Systems, McGraw Hill Education (India), 2009.
Reference books 1. J Staunstrup and Wayne Wolf, Hardware / Software Co-Design: Principles and Practice, Prentice Hall. 2. Jean J. Labrose, Micro C/OS II: The Real Time Kernel, 2e, CRC Press, 2002. 3. Steave Heath, Embedded System Design, Second Edition, Elsevier. 4. Wayne Wolf , Computers as Components-Principles of Embedded Computer System Design, Morgan Kaufmann publishers, Third edition, 2012. **MOOC (Reference)** 1. https://nptel.ac.in/courses/108/102/108102045/. 2. https://www.coursera.org/learn/embedded-software-hardware. 3. https://www.edx.org/course/embedded-systems-shape-the-world-multi-threaded-in.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	Introduction to Embedded Systems: Embedded system	1
1.2	Embedded system Vs General Computing System	1
1.3	Processor Embedded into a System	1
1.4	Embedded Hardware units and devices in a system	1
1.5	Embedded Software in a System, Introduction to embedded system design,	1
1.6	Classification of Embedded systems	1
1.7	Skills Required for an embedded system Designer	1
1.8	Examples of the Embedded Systems	1

1.9	Major Application Areas of Embedded Systems, Purpose of Embedded Systems.	1
MODULE II		
2.1	Embedded System Design and development Process: Embedded System	1
2.2	On-Chip (SoC) and Use of VLSI Circuit Design Technology	1
2.3	Build Process for embedded systems	1
2.4	Build Process for embedded systems	1
2.5	Design Process in Embedded System	1
2.6	Design Process in Embedded System	1
2.7	Design Challenges in Embedded System Design	1
2.8	Hardware-Software Co-Design in an Embedded System	1
2.9	Hardware-Software Co-Design in an Embedded System	1
2.10	Formalism of System Design.	1
MODULE III		
3.1	Hardware Software Co-Design and Program Modelling: – Fundamental Issues in Hardware Software Co-Design.	1
3.2	Hardware Software Co-Design and Program Modelling: – Fundamental Issues in Hardware Software Co-Design.	1
3.3	Computational Models in Embedded Design - Data Flow Graph Model	1
3.4	Control Data Flow Graph	1
3.5	State Machine Model	1
3.6	Sequential Program Model	1
3.7	Concurrent / communicating Process Model	1
3.8	Concurrent / communicating Process Model	1
3.9	Object oriented model, UML	1
MODULE IV		
4.1	Embedded Hardware Design and Development: - Analog Electronic Components	1
4.2	Embedded Hardware Design and Development: - Analog Electronic Components	1
4.3	Digital Electronic Components	1
4.4	Digital Electronic Components	1
4.5	VLSI and Integrated Circuit Design	1
4.6	Embedded Firmware Design and Development	1
4.7	Embedded Firmware Design and Development	1
4.8	Embedded Firmware Design Approaches	1
4.9	Embedded Firmware Development Languages	1
4.10	Embedded Firmware Development Languages	1
MODULE V		
5.1	Integration and Testing of Embedded Hardware and Firmware	1
5.2	Integration and Testing of Embedded Hardware and Firmware	1
5.3	Integration and Testing of Embedded Hardware and Firmware	1
5.4	Integration of Hardware and Firmware	1
5.5	Integration of Hardware and Firmware	1

5.6	Testing Embedded Systems	1
5.7	RTOS based Embedded System Design: - Basic operating system services	1
5.8	Introduction to Real Time Operating System(RTOS)	1
5.9	RTOS Task-Scheduling models	1
5.10	How to Choose an RTOS.	1

CO Assessment Questions	
1	1. Define Embedded System. 2. Illustrate the major Applications of Embedded System. 3. List out the classifications of Embedded System.
2	1. Illustrate the components of an embedded System with the help of relevant diagram. 2. Explain about the processor Embedded into a System.
3	1. Describe the Fundamental Issues in Hardware Software Co-Design. 2. Explain UML with the help of an example.
4	1. Describe any three Digital Electronic Components used in the embedded Hardware development. 2. Explain about Embedded Firmware Design Approaches.
5	1. Explain any one technique used for the Integration of Hardware and Firmware. 2. List out the techniques used for the Testing of Embedded Systems
6	1. Define RTOS. 2. Describe How you will Choose an RTOS.

23MCAE369	Pattern Recognition	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The syllabus serves as a guide to explore the fundamentals of classification algorithms in Pattern Recognition and evaluate the performance of models using appropriate metrics. Pattern Recognition is an essential area of study with a wide range of applications, from image and speech recognition to medical diagnostics, finance, and beyond. This course is designed to provide students with a comprehensive understanding of the principles, algorithms, and techniques that underlie the identification and extraction of patterns in various domains.

Prerequisite: Basic knowledge in Linear Algebra, Probability Theory, Statistics and Programming in Python

Course Outcomes: After the completion of the course the student will be able to

CO1	Analyze and preprocess data to extract meaningful features, remove noise and outliers, and transform the data into a suitable format for pattern recognition algorithms
CO2	Effectively address classification and density estimation challenges in pattern recognition and related domains
CO3	Comprehend and proficiently apply Linear Discriminant Function-based classifiers to make informed decisions and solve classification problems in various practical contexts
CO4	Make a comprehensive understanding of Unsupervised Methods and to evaluate and apply these methods effectively in data analysis and pattern recognition tasks.
CO5	Apply pattern recognition techniques to real-world problems in fields such as image processing, computer vision, speech recognition, and natural language processing

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2				3					
CO2	3	3										
CO3	3	3	2		3		3					
CO4	3	3	3				3					
CO5	3	3	3	2	3		3	2		2	2	

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Assessment Pattern for Lab component		
Bloom's Category	**Continuous Assessment Tools**	
	Class work	**Test1**
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓
Evaluate	✓	
Create	✓	
Mark Distribution of CIA		

Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**			**Total Marks**
		Assignment	**Test-1**	**Test-2**	
3-1-0-0	5	15	10	10	40

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	**PART A**	**PART B**	**ESE Marks**
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Pattern Recognition (7hrs)

Introduction to Pattern Recognition; Feature engineering; Supervised and Unsupervised learning; Classification vs Clustering; Regression, Graphical methods: Introduction to Linear models for regression; Polynomial regression and Bayesian regression; Bayesian belief network and Hidden Markov Models.

MODULE II : Bayesian Decision Theory (7hrs)

Bayesian Decision Theory; Minimum error rate classification Classifiers; Discriminant functions; Decision surfaces; The normal density and Discriminant-

functions for the Normal density; Parametric density estimation Technique:- Maximum-Likelihood (ML) estimation; Non Parametric density estimation:-Parzen-window method, K-Nearest Neighbour method.

MODULE III : Linear discriminant based classifiers and tree classifiers (7hrs)

Linear discriminant based classifiers and tree classifiers: Linear discriminant function based classifiers-Perceptron-Minimum Mean Squared Error (MME) method, Support Vector machine, Decision Trees.

MODULE IV : Unsupervised Methods (10hrs)

Unsupervised Methods: Component Analysis and Dimension Reduction: - Principal Component Analysis, Fisher Linear Discriminant analysis; Clustering:- Partitioning methods: K-means, Hierarchical methods: AGNES and DIANA, Density-based methods: DBSCAN; Model based methods: Gaussian Mixture Model (GMM); Evaluation metrics of clustering methods.

MODULE V : Applications (10hrs)

Applications: Face recognition - preprocessing, face detection algorithms, selection of representative patterns, classification algorithms, results and discussion.

Text books

1. Pattern Classification, R.O.Duda, P.E.Hart and D.G.Stork, John Wiley, 2001.
2. Pattern Recognition and Machine Learning by Christopher M. Bishop.
3. Introduction to Machine Learning with Python by Andreas C. Müller and Sarah Guido.
4. Deep Learning by Ian Goodfellow, YoshuaBengio, and Aaron Courville.

Reference books

1. Machine Learning: An Algorithmic Perspective by S. Marsland.
2. Pattern Classification, 2nd Edn., by R. O. Duda, P. E. Hart and D. G. Stork.
3. An Introduction to Pattern Recognition by Michael Alder.
4. Pattern Recognition and Classification: An Introduction by Geoff Dougherty.
5. Understanding Machine Learning: From Theory to Algorithms by Shai Ben-David and ShaiShalev-Shwartz.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	Introduction to Pattern Recognition, Feature engineering	1
1.2	Supervised and Unsupervised learning	1
1.3	Classification vs Clustering	1
1.4	Introduction to Linear models for regression	1
1.5	Polynomial regression and Bayesian regression	1
1.6	Introduction to Graphical Models	1
1.7	Bayesian belief network and Hidden Markov Models	1
	MODULE II	
2.1	Bayesian Decision Theory	1
2.2	Minimum error rate classifiers	1
2.3	Discriminant functions; Decision surfaces;	1
2.4	The normal density and Discriminant-functions for the Normal density	1

2.5	Parametric density estimation Technique: Maximum-Likelihood (ML) estimation;	1
2.6	Non Parametric density estimation	1
2.7	Parzen-window method, K-Nearest Neighbour method	1
MODULE III		
3.1	Linear discriminant function based classifiers	1
3.2	Perceptron	1
3.3	Minimum Mean Squared Error (MME) method	1
3.4	Support Vector machines (SVM)	1
3.5	Decision Trees- CART	1
3.6	C4.5	1
3.7	ID3	1
MODULE IV		
4.1	Component Analysis and Dimension Reduction : Principal Component Analysis	1
4.2	Fisher Linear Discriminant analysis	1
4.3	Clustering: Partitioning methods: K-means	1
4.4	Hierarchical methods: AGNES	1
4.5	DIANA	1
4.6	Density-based methods: DBSCAN	1
4.7	Model based methods: Gaussian Mixture Model (GMM)	1
MODULE V		
5.1	Applications: Face recognition	1
5.2	Preprocessing	1
5.3	Face detection algorithms	1
5.4	Selection of representative patterns	1
5.5	Classification algorithms	1
5.6	Results and discussion	1

CO Assessment Questions	
1	a) Describe the design principles of pattern recognition system with an example b) Explain Hidden Markov model and its role in the classifier design.
2	a) Discuss the general principal of Maximum likelihood estimation. Show that MLE of the mean of a Gaussian population is equal to the sample mean and MLE of the variance of a Gaussian population is equal to the sample variance. b) Explain the principles of K-nearest neighbour Classifier. How will you find the optimal value of K?
3	a) Explain two class and multi class case of linear discriminant functions. Also explain linear decision bounding for 4 class problem with the help of suitable diagram. b) Develop a perceptron for the AND function with binary inputs and bipolar targets, initialize all weights and bias to zero. Find out the

	final weights and bias and plot the decision surface.
4	a) Differentiate between agglomerative and divisive clustering techniques. b) Apply K-means clustering algorithm on given data for K=3. Use C1(2), C2(16), C3(38) as initial cluster centres. Data : 2,4,6,3,31,12,15,16,38,35,14,21,23,25,30..
5	a) Explain the principles and functioning of face detection algorithms in the context of computer vision and facial recognition b) Explain the methods and strategies used to select the representative patterns, and how they contribute to the overall accuracy and efficiency of a face recognition system

23MCAE371	Business Management	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: The primary aim of this course is to understand basic principles of management and accounting. In our day to day life managers will have to manage so many resources in the present day complex business environment. By effective and efficient management the goals of the organisation can be attained. This course is intended to give an idea regarding managing the resources for the effective performance of the organisation and decision making in everyday life. Basic idea regarding book keeping and accounting is also required for managers for taking decisions.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand management as a process..
CO2	Critically analyse and evaluate management theories and practices.
CO3	Perform planning and organising for an organisation.
CO4	Do staffing and related human resource development function.
CO5	Take proper decisions to get competitive advantage.
CO6	Understand basic concepts in book keeping and accounting.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3							2				
CO2	3	3										
CO3	3		3									3
CO4	3										3	
CO5	3				3	2						
CO6	3							3				

Assessment Pattern for Theory component

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test 2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate				
Create				

Assessment Pattern for Lab component

Bloom's Category	Continuous Assessment Tools	
	Class work	Test1
Remember		
Understand	✓	✓
Apply	✓	✓
Analyse	✓	✓

Evaluate	✓	
Create	✓	

Mark Distribution of CIA

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Total Marks
		Assignment	Test-1	Test-2	
3-1-0-0	5	15	10	10	40

Total Marks distribution

Total Marks	CIA (Marks)	ESE (Marks)	ESE Duration
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Management (10hrs)

Introduction to Management: Basic Managerial Concepts, Levels of management, Managerial Skills, Managerial role. Management functions- Planning, Organising, Staffing, leading and Controlling.

Early Contributions in Management: Management thought - Classical approach, scientific management, contributions of Taylor, Gilbreths, Fayol's 14 principles of management.

Human relation approach - contribution of Elton Mayo Systems approach - organization as an open system and Contingency approach.

MODULE II : Planning (8hrs)

Planning: Nature and importance of planning, types of plans - Steps in planning, Levels of planning - The Planning Process - MBO definition and process, SWOT Analysis, importance.

Organising: Nature of organizing,-span of control in management, factors affecting span of control- Authority and responsibility.

Organisation structure - Formal and informal, Types of organization structure line, line and staff, functional, divisional, project, matrix, virtual form of organisations.

MODULE III : Staffing and related HRD Functions (7hrs)
Staffing and related HRD Functions: meaning, nature, staffing process, Job analysis and manpower planning, job description and job specification, Recruitment & selection, selection process, Tests and interviews. Training and development - concept and methods ,Performance appraisal- concept and methods.
MODULE IV : Managerial Decision Making and controlling (12hrs)
Decision making –types of decisioins, decision making process, Decision Making Tools, Importance of controlling, Techniques of controlling- Break Even Analysis, Budgetary Control - Benchmarking –importance and limitations of benchmarking, Six Sigma importance, limitations and process of six sigma, Total Quality Management- Introduction to marketing management-Marketing mix- product life cycle.
MODULE V : Keeping and Accountancy (10hrs)
Book- Keeping and Accountancy -Elements of Double Entry -Book- Keeping - rules for journalizing -Ledger accounts –Cash book- – Trial Balance- Method of Balancing accounts- the journal proper (simple problems). Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems) - Introduction to Accounting packages (Description only).
Text books 1. L M Prasad, “Principles of Management”, Sultan Chand & Sons, 8th Edition (2010) Peter F Drucker, “The Practice of Management”, Butterworth-Heinemann publication, 2nd Edition (2007) . 2. Double Entry book Keeping – Batliboi. 3. Harold Koontz and Heinz Weihrich, “Essentials of Management”, McGraw Hill Education, 10th Edition (2015). 4. A Systematic approach to Accounting: Dr K.G. Chandrasekharan Nair.
Web Reference 1. Management Functions http://nptel.ac.in/courses/122108038/ 2. Leadership http://nptel.ac.in/courses/110105033/33

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	Introduction to Management: Basic Managerial concepts	1
1.2	Introduction to Management: Basic Managerial concepts	1
1.3	Levels of management	1
1.4	Managerial Skills	1
1.5	Management roles	1
1.6	Management functions	1
1.7	Management functions	1
1.8	Early Contributions in Management: Management thought - Classical approach	1
1.9	scientific management, contributions of Taylor, Gilbreths, Fayol’s 14 principles of management	1
1.10	Human relation approach - contribution of Elton Mayo Systems	1
	MODULE II	
2.1	Planning: Nature and importance of planning, types of plans - Steps in planning	1

2.2	Levels of planning - The Planning Process	1
2.3	MBO definition and process	1
2.4	SWOT Analysis, importance	1
2.5	Organising : Nature of organizing,-span of control in management	1
2.6	factors affecting span of control- authority and responsibility	1
2.7	Organisation structure - Formal and informal, Types of organization structure line, line and staff	1
2.8	functional, divisional, project, matrix, virtual form of organisations	1
MODULE III		
3.1	Staffing and related HRD Functions: meaning, nature, staffing process.	1
3.2	Staffing and related HRD Functions: meaning, nature, staffing process.	1
3.3	Job analysis and manpower planning	1
3.4	job description and job specification	1
3.5	Recruitment & selection, selection process, Tests and Interviews.	1
3.6	Recruitment & selection, selection process, Tests and Interviews.	1
3.7	Training and development - concept and methods	1
3.8	Performance appraisal - concept and methods	1
3.9	Performance appraisal - concept and methods	1
MODULE IV		
4.1	Managerial Decision Making and controlling : Decision making –types of decisions	1
4.2	decision making process, Decision Making Tools	1
4.3	Importance of controlling, Techniques of controlling	1
4.4	Break Even Analysis, Budgetary Control	1
4.5	Benchmarking	1
4.6	importance and limitations of benchmarking	1
4.7	Six Sigma importance	1
4.8	limitations and process of six sigma	1
4.9	Total Quality Management	1
4.10	Total Quality Management	1
4.11	Introduction to marketing management	1
4.12	Marketing mix- product life cycle	1
MODULE V		
5.1	Book- Keeping and Accountancy	1
5.2	Elements of Double Entry -Book-Keeping	1
5.3	Rules for journalizing	1
5.4	Ledger accounts	1
5.5	Cash book	1
5.6	Trial Balance- Method of Balancing accounts- (simple	1

	problems)	
5.7	Trial Balance- Method of Balancing accounts- (simple problems)	1
5.8	Final accounts: Preparation of trading and profit and loss Account- Balance sheet (with simple problems)	1
5.9	Introduction to Accounting packages.	1
5.10	Introduction to Accounting packages.	

CO Assessment Questions	
1	Describe various functions of management.
2	Explain different theories of management thought.
3	Illustrate different steps in planning
4	Describe different types of training methods for employees in an organisation.
5	Explain the decision process in an organisation with case example.
6	Explain the procedure of preparation of balance sheet with a simple example.

23MCAE373	Cryptography And Cyber Security	L	T	P	J	S	C	Year of Introduction
		3	1			3	4	2023

Preamble: Cryptography and cyber security are essential disciplines that focus on protecting sensitive information and securing communication channels from unauthorized access, ensuring confidentiality, integrity, authenticity, and resilience against cyber threats. The course explores the fundamental concepts of cryptography and covers various cryptographic algorithms, protocols, and systems used to protect data integrity, confidentiality, authentication, and non-repudiation. Through a combination of theoretical discussions, case studies, students will develop the knowledge and skills necessary to design, implement, and evaluate secure systems and effectively mitigate cyber threats.

Prerequisite: Computer Networks

Course Outcomes: After the completion of the course the student will be able to

CO1	Understand the fundamental concepts of cryptography and its role in ensuring secure communication and data protection.
CO2	Provide basic mathematical concepts used in Cryptography.
CO3	Provide basic understanding of various cryptographic algorithms.
CO4	Provide basic understanding of Hashing techniques, Digital Signature schemes and key management techniques.
CO5	Provide an understanding of network security implementation at application layer, transport layer, and network layer and the protocols used.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1				1					
CO2	2	2	2	1			1					
CO3	2	1	1				1					
CO4	2	1	1			2	1					
CO5	2	1	1			2	1					

Assessment Pattern

Bloom's Category	Continuous Assessment Tools			End Semester Examination
	Test1	Test2	Other tools	
Remember	✓	✓	✓	✓
Understand	✓	✓	✓	✓
Apply	✓	✓	✓	✓
Analyse			✓	
Evaluate			✓	
Create			✓	

Mark Distribution of CIA					
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**			**Total Marks**
		Assignment	**Test-1**	**Test-2**	
3-1-0-0	5	15	10	10	40

Total Mark distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	40	60	3 hours

End Semester Examination [ESE]: Pattern

PATTERN	PART A	PART B	ESE Marks
PATTERN 1	10 Questions, each question carries 2 marks Marks: (2x10 =20 marks)	2 questions will be given from each module, out of which 1 question should be answered. Each question can have a maximum of 2 sub divisions. Each question carries 8 marks. Marks: (5x8 = 40 marks) Time: 3 hours	60
	Total Marks: 20	Total Marks: [5x8 = 40 marks]	

SYLLABUS

MODULE I : Introduction to Cryptography (6hrs)

Introduction to Cryptography: Services, Mechanisms and attacks, Phishing, ransomware, DoS attack, OSI security architecture-Network security model-Classical Encryption techniques (Symmetric cipher model, substitution techniques, transposition techniques, steganography).

MODULE II : Mathematical Background (9hrs)

Mathematical Background: Elementary number theory: Prime numbers, Fermat's and Euler's theorems, Testing for primality, Modular Arithmetic: Congruences, Chinese remainder theorem.

Finite fields: Review of groups, rings and fields; Finite fields of the form GF(p), Polynomial Arithmetic, Finite fields of the form GF(2").Discrete logarithms Euclidean Algorithms.

MODULE III :Symmetric and Asymmetric key Encryption (10hrs)

Conventional Symmetric Key Encryption: Block ciphers and Stream Ciphers, Modes of operation (ECB, CBC, CFB, OFB), multiple encryption, Data Encryption Standard-Block cipher principles-block cipher modes of operation-Advanced Encryption Standard (AES)-Triple DES.

Public key cryptography: Principles of public key cryptosystems-The RSA algorithm-Key management – Diffie Hellman Key exchange-Elliptic curve arithmetic-Elliptic curve cryptography.

MODULE IV :Understanding of Hashing techniques (11hrs)

Hash Functions and MAC: Properties of hash functions, birthday attack, Message Authentication Code Algorithms, MAC protocols, HMAC, CBC-MAC.
Digital Signatures: Classification of signature schemes, RSA signature, Digital Signature Standard, one time signature schemes, attacks on Digital Signatures, Blind Signatures.

MODULE V : Introduction to Cyber Security (12hrs)

Security Services for Email-attacks possible through E-mail – establishing keys privacy authentication of the source-Message Integrity-Non-repudiation-Pretty Good Privacy-S/MIME.
IPSecurity: Overview of IPSec–IPv4and IPv6-Authentication Header Encapsulation Security Payload (ESP)-Internet Key Exchange.
Web Security: SSL/TLS Basic Protocol, Secure Electronic Transaction (SET).

Text books

1. William Stallings, "Cryptography and Network Security – Principles and Practice", Seventh Edition, Pearson Education, 2017.
2. Nina Godbole, Sunit Belapure, Cyber Security: Understanding Cyber-crimes, Computer Forensics and Legal Perspectives, First Edition, Wiley India, 2011.

Reference books

1. Behrouz A. Ferouzan, Debdeep Mukhopadhyay, "Cryptography and Network Security", 3rd Edition, Tata Mc Graw Hill, 2015.
2. Charles Pfleeger, Shari Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Prentice Hall, New Delhi, 2015.
3. Charlie Kaufman, Radia Perlman and Mike Speciner, Network Security", Prentice Hall of India
4. Manuel Mogollon, Cryptography and Security Services – Mechanisms and Applications, Cybertech Publishing.
5. William R. Cheswick, Steven M. Bellovin, Aviel D. Rubin, Firewalls and Internet Security AddisonWesley.

COURSE CONTENTS AND LECTURE SCHEDULE

No.		No. of Hours
	MODULE 1	
1.1	Introduction to Cryptography: Services, Mechanisms and attacks	1
1.2	Phishing, ransomware, DoS attack	1
1.3	OSI security architecture-Network security model	1
1.4	Classical Encryption techniques :Symmetric cipher model	1
1.5	substitution techniques, transposition techniques	1
1.6	Steganography	1
	MODULE II	
2.1	Mathematical Background: Elementary number theory: Prime numbers	1
2.2	Fermat's and Euler's theorems	1
2.3	Testing for primality	1
2.4	Modular Arithmetic: Congruences, Chinese remainder	1

	theorem.	
2.5	Fields: Review of groups, rings and fields	1
2.6	Finite fields of the form GF(p)	1
2.7	Polynomial Arithmetic	1
2.8	Finite fields of the form GF(2").	1
2.9	Discrete logarithms Euclidean Algorithms	1
	MODULE III	
3.1	Conventional Symmetric Key Encryption: Block ciphers and Stream Ciphers	1
3.2	Modes of operation (ECB, CBC, CFB, OFB)	1
3.2	Modes of operation (ECB, CBC, CFB, OFB)	1
3.3	multiple encryption	1
3.4	Data Encryption Standard-Block cipher principles-block cipher modes of operation	1
3.5	Data Encryption Standard-Block cipher principles-block cipher modes of operation	1
3.6	Advanced Encryption Standard (AES	1
3.7	Triple DES.	1
3.8	Public key cryptography: Principles of public key cryptosystems-The RSA algorithm	1
3.9	Key management – Diffie Hellman Key exchange	1
3.10	Elliptic curve arithmetic-Elliptic curve cryptography	1
	MODULE IV	
4.1	Hash Functions and MAC: Properties of hash functions	1
4.2	Birthday attack	1
4.3	Message Authentication Code Algorithms	1
4.4	MAC protocols	1
4.5	HMAC	1
4.6	CBC-MAC	1
4.7	Digital Signatures: Classification of signature schemes, RSA signature	1
4.8	Digital Signature Standard	1
4.9	One time signature schemes	1
4.10	Attacks on Digital Signatures	1
4.11	Blind Signatures	1
	MODULE V	
5.1	Security Services for Email	1
5.2	Attacks possible through E-mail	1

5.3	Establishing keys privacy authentication of the source	1
5.4	Message Integrity-Non-repudiation	1
5.5	Pretty Good Privacy	1
5.6	S/MIME.	1
5.7	IPSecurity: Overview of IPSec – IPv4 and IPv6	1
5.8	Authentication Header	1
5.9	Encapsulation Security Payload (ESP)	1
5.10	Internet Key Exchange.	1
5.11	Web Security: SSL/TLS Basic Protocol	1
5.12	Secure Electronic Transaction (SET	1

CO Assessment Questions	
1	1. Identify three independent dimensions used for characterise cryptographic systems 2. Explain various network security services. 3. Encrypt the plaintext message 'honesty is the best' by using a 6 – character key 'CENTRE' with the Vigenere cipher.
2	1. State Fermat's Theorem. Find out the result of 3 12 mod 11 using second version of Fermat's Theorem. 2. Find the multiplicative Inverse of 7 in Z 180 using the Extended Euclidian Algorithm.
3	1. Discuss the four types of transformations used by AES. 2. Explain Diffie-hellman key exchange algorithm with suitable example.
4	1. Illustrate Digital Signature Algorithm (DSA) in detail. 2. With a neat diagram explain HMAC Algorithm.
5	1. Explain the Authentication Header(AH) and Encapsulation Security Payload(ESP) with suitable diagram. 2. Explain PGP protocol with its application.

Semester IV

23MCAN302	Main Project (Research Project/Internship)	L	T	P	J	S	C	Year of Introduction
				27		14	14	2023

Preamble: This project work aims to enable the students to apply the software engineering principles on a real software project, to make the students familiar with the stages of a deployment pipeline and to develop a software product using the latest software development methodology.

Prerequisite: Knowledge in software engineering principles and programming skills

Course Outcomes: After the completion of the course the student will be able to

CO1	Identify a real-life project which is useful to society / industry.
CO2	Interact with people to identify the project requirements.
CO3	Apply suitable development methodology for the development of the product / project.
CO4	Analyse and design a software product / project.
CO5	Test the modules at various stages of project development.
CO6	Build and integrate different software modules.
CO7	Document and deploy the product / project.

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3					3			3	3	3
CO2	3	3					3			3	3	3
CO3	3	3	3	3	3		3			3	3	3
CO4	3	3	3	3	3		3			3	3	3
CO5	3	3	3	3	3	3	3	3		3	3	3
CO6	3	3	3	3	3	3	3	3		3	3	3
CO7	3	3	3	3	3	3	3	3	3	3	3	3

Assessment Pattern

Bloom's Category	Continuous Assessment Tools		
	Evaluation 1	Evaluation 2	Report
Remember			
Understand	✓	✓	
Apply	✓	✓	
Analyse	✓	✓	
Evaluate		✓	
Create		✓	

Mark Distribution of CIA						
Course Structure [L-T-P-J]	**Attendance**	**Theory [L- T]**		**Practical [P]**	**Project [J]**	**Total Marks**
		Assignment	**Test-1**	**Continuous evaluation by Supervisor, Guide(s) and Scrum Master**	**Project Assessment Board-Evalaution-2**	
0-0-27-0	-	-	-	30	40	70

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
100	70	30	-

Guidelines

- Students shall identify Real-Life Projects which are relevant and useful to the society or industry
- The project shall be an individual project and must be done in-house. Attendance as per MCA regulations is applicable for submitting the project for final evaluation.
- However, in exceptional cases students shall be permitted to do projects/internship offered by industry/institution with prior permission from the department.
- In such cases, the student is required to produce a letter from the organisation before starting the project and a committee constituted by the head of the department shall make the decision on permission. Industries and training institutes that offer project work for a fee shall not be permitted.
- Students shall submit project synopsis and get prior approval from the Project (Faculty) Supervisor before the project work begins.
- If there is a customer for the project then he/she will be the Product Owner (External Guide) and a faculty from the department will be the Internal Guide. If there is no such customer then the Internal Guide himself/herself shall act as the Product Owner.
- A faculty / technical staff shall act as the Scrum Master to continuously monitor the project development. Periodic meetings, of less than 15 minutes, at the convenience of the Scrum Master are to be highly encouraged. Ensure such meetings occur once in three days.
- The student shall maintain a Scrum Book (Rough Record) which has to be divided into 4 parts – (i) Product Backlog (ii) Database & UI Design (iii) Testing & Validation and (iv) Details of Versions. Make dated entries in the corresponding part at regular intervals. The corrections and comments from Product Owner and Scrum Master should be clearly indicated with the Date.
- Test Driven Development methodology may be practiced for the project development. BugZilla, BackLog or any such tool may be used for Bug Tracking.
- Git shall be used for Version Control and Git commit history may be

verified as part of project evaluation.

- LaTeX or an equivalent tool shall be used for preparing Presentations and Project Report.
- Students shall be encouraged to publish their work in journals and due credit shall be given to such students.
- For the externally done projects, periodic confidential progress report and attendance statement shall be collected from the External Guide and be reviewed by the Project Supervisor.
- Set a sprint as two weeks, ensure biweekly reviews. A review shall not exceed 30 minutes. A demo to the Product Owner (Project Guide) is mandatory in every review.
- Interim evaluations of the project's progress shall be conducted by a Project Assessment Board as part of internal assessment. Two such evaluations are desirable. Scrum reviews shall not be sacrificed for such presentations.
- The Project Assessment Board shall be constituted by the Head of the Department with the following five members.

  Chairman:
  1. Head of the Department

  Members
  2. Project supervisor/s of the student
  3. One faculty member from the Department
  4. One faculty member from a sister Department
  5. An external expert, either from an academic/research institute or Industry (For the externally done projects, the external guide shall be invited as external expert).

- At the end of the semester, two evaluations shall be there on the entire project development activities. An internal evaluation by the Project Assessment Board and an external evaluation by an External Examiner.
- An External Examiner either from an academic institute or industry shall be appointed by the institution for the External Evaluation.

Schedule

Week 1 to 6

- Selection of Topic, Submission of project synopsis and getting approval.
- Meeting of Development Team including Scrum Master with Product Owner (Project Guide).
- Commencement of the Project.
- First Sprint release and Scrum Review by the Product Owner (Project Guide).
- Second Sprint release and Scrum Review by the Project Guide.
- First interim evaluation by the Project Assessment Board.

Week 7 to 11

- Third Sprint release and Scrum Review by the Project Guide.
- Fourth Sprint release and Scrum Review by the Project Guide.
- Second interim evaluation by the Project Assessment Board.

Week 12 to 14

- Fifth Sprint release and Scrum Review by the Project Guide.
- Submission of project report, with Scrum Book.

- Final project presentation.
- Evaluation by the Project Assessment Board.
- Final evaluation by the External Examiner.

23MCAS304	Seminar and Technical Writing	L	T	P	J	S	C	Year of Introduction
				2		2	1	2023

Preamble: This course intends to enable the students to gain knowledge in any of the technically relevant current topics on Computer Science or Information Technology, and to acquire confidence in presenting the topic and preparing a report.

Prerequisite: Nil

Course Outcomes: After the completion of the course the student will be able to

CO1	Annotate the ideas presented in technical papers
CO2	Comprehend a concept by referring different technical documents
CO3	Prepare technical documents
CO4	Present a topic before an audience
CO5	Interact with the audience

CO - PO MAPPING

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO 1	3	3	3	3			3		3	2		2
CO 2	3	3	3	3			3		3	2		2
CO 3	3	3	2	2		3	3		3	2		2
CO 4	3	2				3			3		2	
CO 5	3	2				3			3		2	

Assessment Criteria

Scope and relevance of topic	20%
Quality of presentation slides	10%
Presentation skills	30%
Knowledge in the topic	20%
Report	20%
Scope and relevance of topic	20%

Course Structure [L-T-P-J]	Attendance	Theory [L- T]			Practical [P]		Total Marks
		Assignment	Test-1	Test-2	Evaluation by Faculty Guide	Evaluation by the Faculty Committee	
0-0-2-0	-	-	-	-	20	30	50

Total Marks distribution			
Total Marks	**CIA (Marks)**	**ESE (Marks)**	**ESE Duration**
50	50	-	-

Guidelines:

- Students shall conduct detailed study on a technically relevant current topic in Computer Science / Information Technology under the supervision of a Faculty Guide and present it as a seminar at the end of the study.
- The study may be conducted on
    - Articles published in reputed journals/conference proceedings
    - Recent development in Computer Science / Information Technology
    - Recent research and development activity in a research lab
    - Latest software tool or framework
- Students shall submit an abstract on identified topic and get prior approval from the Faculty Guide before the study begins.
- The student shall submit a seminar report, based on the study and their findings. The report shall not be a reproduction of original paper or manual.
- The study and its findings shall be presented in the class taking duration of 15-20 minutes.
- LaTeX or an equivalent tool shall be used for preparing Presentations and Seminar Report.
- Students shall been courage to publish their study in journals and due credit shall be given to such students.
- A committee of three senior faculty members shall constituted by the head of the department and the seminar presentation shall be evaluated by that committee.