

Mahatma Education Society's

**Pillai HOC College of Arts, Science &
Commerce (Autonomous)**

Affiliated to University of Mumbai



SYLLABUS

**Master of Science (M. Sc.)
in Information Technology Part II**

A.Y. 2026-27

As per the National Education Policy
Choice Based Credit & Grading System



Mahatma Education Society's

College Code: 870

PILLAI HOC COLLEGE OF ARTS, SCIENCE & COMMERCE

Pillai HOCL Educational Campus, HOC Colony, Rasayani, Via. Panvel, Dist. Raigad. Pin 410207

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(NAAC Accredited 'A+' Grade , CGPA - 3.26 in Cycle 2 & ISO 9001:2015 Certified)

Affiliated to the University of Mumbai, Approved by Government of Maharashtra




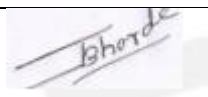
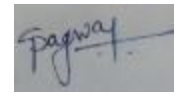
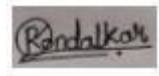
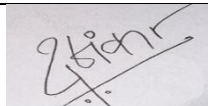



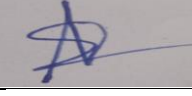
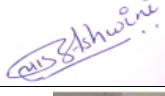


(AUTONOMOUS COLLEGE)

Ref.No: PHCASC/BOS Meeting/Attendance/2026-27

Date: 01.04.2026

Board of Studies Mathematics, Statistics and Computer Application

Sr. No	Name	Signature
1	Dr. Swapna Kadam Vice Chancellor Nominee	
2	Dr. Annie Rajan, Subject Experts	
3	Dr. Homraj Patelpaik Subject Experts	
4	Mr. Swapnil H. Patil Industry Expert	
5	Mr. Akash Ghadge Meritorious Alumnus	
6	Dr. Rinkoo Shantnu Principal	
7	Ms. Priyanka Sorte Chairperson (Programme Co-ordinator BSc. CS)	
8	Ms. Priya Prakash Member (Mathematics, Statistics)	
9	Ms. Harshita Singh Member (Mathematics, Statistics)	
10	Ms. Mrunal Wanjale Member (Mathematics, Statistics)	
11	Ms. Arpita Kante Member (Programme Co-ordinator BSc. DS)	
12	Ms. Anita Mhatre Member (Programme Co-ordinator MSc. DS)	
13	Ms. Sangeeta Menon Member (Programme Co-ordinator BSc.AIML)	

14	Ms. Aarti Wani Member	
15	Ms. Rutuja Madane Member	
16	Ms. Kranti Vartak Member	
17	Ms. Jyoti Borade Member	
18	Ms. Sonali Dagwar Member	
19	Ms. Rutuja Kondalkar Member	
20	Mr. Yash Karkhanis Member	
21	Ms. Aishwarya Mokal Member	
22	Ms. Vinaya Bhoir Member (Programme Co-ordinator BSc. Cyber Security)	
23	Ms. Namrata Kedari Member	
24	Ms. Ashwini Patil Member	
25	Ms. Ashwini Lad Member (Programme Co-ordinator MSc.IT)	
26	Ms. Priyanka Sonawane Member (Programme Co-ordinator BSc.IT)	
27	Mr. Shinoj Mathew Member	

A. INTRODUCTION TO MASTER OF SCIENCE IN INFORMATION TECHNOLOGY (M.SC.IT)

Master of Science (Information Technology) is a Programme designed to meet the needs of the market for expertise in Information Technology (IT). The Programme is intended to address the increasing demand in the work-place for IT professionals with a broad and sound knowledge of both technical and managerial skills. A master degree is granted to individuals who have undergone study demonstrating a mastery or high-order overview of a specific area.

The programme aims to equip postgraduate students with an integrated set of skills to advance their careers in Information Technology, providing both theoretical and practical knowledge necessary to understand and design complex computer applications. It prepares students to embrace future developments in the field and ensures strong professional relevance. The programme enables learners to acquire the latest skills and build future capabilities using world-class technology, developing a solid foundation in computer systems and IT, along with proficiency in advanced programming languages for creating sophisticated software across diverse applications. Additionally, students gain the expertise to work with high-end internet technologies and the managerial ability to analyze, design, develop, and maintain software solutions.

Master of Science in Information Technology (M. Sc.IT)

Programme Outcomes

Sr. No.	PO Title	POs in brief
PO1	Fundamental Knowledge Acquisition	Graduates will demonstrate a comprehensive and foundational knowledge of their chosen discipline along with an awareness of interdisciplinary connections.
PO2	Critical Thinking and Analytical Reasoning	Graduates will be able to analyse complex problems, synthesize data from multiple sources (qualitative and quantitative), and employ logical reasoning to formulate well-supported conclusions and arguments.
PO3	Effective Communication	Graduates will exhibit proficiency in both written and oral communication, articulating ideas clearly, persuasively, and ethically to diverse audiences
PO4	Problem Solving	Graduates will possess the ability to identify, formulate, and design solutions for real-world problems in their professional or social contexts, applying relevant theoretical knowledge and practical skills.
PO5	Information and Digital Literacy	Graduates will demonstrate the capability to locate, evaluate, and effectively use information from various sources, and utilize modern tools and Information and Communication Technology (ICT) for professional and academic tasks.
PO6	Research Skills and Scientific Temperament	Graduates will develop a sense of inquiry and research methodology, including the ability to design experiments (where applicable), collect and analyse data, and interpret results while maintaining scientific rigor and intellectual honesty.
PO7	Ethical Reasoning and Professional Integrity	Graduates will recognize ethical dilemmas, commit to professional and academic ethics, and demonstrate an understanding of moral and social responsibilities in their personal and professional conduct.
PO8	Employability and Professional Skills	Graduates will acquire the necessary job-ready skills, managerial competencies, and professional values to secure gainful employment or pursue advanced education in their respective fields.

PO9	Environmental and Sustainability Consciousness	Graduates will understand the importance of environmental conservation and sustainable development, displaying responsibility toward ecological challenges and advocating for healthy environmental practices.
PO10	Life-Long Learning	Graduates will develop the capacity for independent and self-directed learning to continuously upgrade their knowledge and skills, enabling them to adapt to rapid technological and societal changes.
PO11	Civic and Social Responsibility	Graduates will act as responsible citizens with an informed awareness of constitutional values, engaging proactively in community development and addressing social needs.
PO12	Empathy and Social Intelligence	Graduates will be able to cultivate and demonstrate affective, interpersonal, social and emotional intelligence.

Programme Specific Outcomes (PSO)

Sr. No	PSO Title	Programme Specific Outcomes
PSO1	Designing Ethical and Sustainable Computer Systems	Apply knowledge of mathematics, science, and computing to design, analyze, and evaluate complex computer-based systems while considering economic, environmental, social, ethical, and sustainability constraints.
PSO2	Research-Driven IT Solutions in Context	Review literature and conduct research to design experiments, analyze data, and draw valid conclusions; apply modern techniques, skills, and tools to implement effective IT solutions; and use contextual knowledge to assess professional, legal, health, social, and cultural issues in practice.
PSO3	Ethical and Societal Impacts of Computing	Analyze the local and global impact of computing on individuals, organizations, and society; apply ethical principles in professional practice; and function effectively as a team member or leader in multidisciplinary environments.
PSO4	Professional Communication and Continuous Development	Communicate effectively with diverse audiences through written, oral, and graphical modes; apply engineering and management principles to manage projects as a team member or leader; and engage in independent, lifelong learning for ongoing professional development.

Evaluation Pattern

Marking Code	Marking Scheme
A	50 Marks Semester End Exam, 50 Continuous Assessment (20 Marks Internal Exam, 10 Marks Research Paper, 10 Marks Assignments, 10 Marks Presentation)
B	40 Marks Semester End Exam, 60 Marks Project
C	100 Marks Practical Examination.
D	50 Marks Practical Examination.

Credit Structure of the Program (III & IV)

Semester - III							
Course Code	Course Type	Course Title	Theory/ Practical	Marks	Credits	Lectures /Week	Evaluation Pattern
HPSIT201	Major	Advanced Artificial Intelligence	Theory	100	4	4	A
HPSIT202	Major	Advanced Machine Learning	Theory	100	4	4	A
HPSIT203	Major	Storage As A Service	Theory	100	2	2	A
HPSIT204	Major	Natural Language Processing	Theory	100	4	4	A
HPSIT205	RP	Research Project-I	Project	100	4	4	-
HPSIT206 P	Major Practical	Practical (HPSIT201)	Practical	50	2	2	D
HPSIT207 P	Major Practical	Practical (HPSIT202)	Practical	50	2	2	D

Semester - IV							
Course Code	Course Type	Course Title	Theory/ Practical	Marks	Credits	Lectures /Week	Evaluation Pattern
HPSIT251	Major	Blockchain	Theory	100	4	4	A
HPSIT252	Major	Deep Learning	Theory	100	4	4	A
HPSIT253	RP	Research Project-II	Project	200	6	6	-
HPSIT254P	Major Practical	Practical (HPSIT251)	Practical	50	2	2	D
HPSIT255P	Major Practical	Practical (HPSIT252)	Practical	50	2	2	D
HPSIT256P	Major Practical	Robotic Process Automation Practical	Practical	100	4	4	C

Semester III

BOS	Mathematics, Statistics and Computer Application				
Course	Advanced Artificial Intelligence				
Course Code	HPSIT201	Level	6.5		
		Type	Theory	Practical	Total
Semester	III	Credits	04	02	06
Type	Major	No of Teaching hours	60	30	90
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	150	50	50	50	

Learning Objectives	
1.	To explore the applied branches of artificial intelligence
2.	To enable the learner to understand applications of artificial intelligence
3.	To enable the student to solve the problem aligned with derived branches of artificial intelligence.

Course Outcomes	
CO1	Understand the fundamental principles and concepts of Artificial Intelligence.
CO2	Implement intelligent agents for different applications.
CO3	Understand advanced AI concepts and techniques
CO4	Demonstrate proficiency in deep learning and neural networks
CO5	Understand the concepts and applications of generative AI
CO6	Implement generative adversarial networks and variational autoencoders
CO7	Develop skills in using neural networks for image recognition and text generation
CO8	Create and train GAN models for image synthesis

Modules at Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Advanced Artificial Intelligence	15	CO1, CO2, CO3, CO4
2	Machine Learning	15	CO5, CO6, CO7, CO8
		30	

Syllabus

Module No.	Content	No. of Lectures
1	Unit 1: Foundations of Artificial Intelligence <ul style="list-style-type: none"> · Introduction to Artificial Intelligence · Intelligent Agents · Problem-solving using search algorithms · Knowledge Representation 	15
2	Unit 2: Advanced Artificial Intelligence <ul style="list-style-type: none"> · Introduction to advanced AI concepts · Deep learning and neural networks · Natural language processing and understanding · Reinforcement learning · AI applications in various domains such as healthcare, finance, and robotics 	15
3	Unit 3: Machine Learning <ul style="list-style-type: none"> · Machine Learning Paradigms: Machine Learning systems, supervised and un-supervised learning, inductive learning, deductive learning, clustering, support vector machines, case-based reasoning and learning. · Artificial Neural Networks: Artificial Neural Networks, Single-Layer feedforward networks, multi-layer feed-forward networks, radial basis function networks, design issues of artificial neural networks and recurrent networks 	15
4	Generative AI <ul style="list-style-type: none"> · Introduction to generative AI and its applications · Generative adversarial networks (GANs) · Variational autoencoders · Text generation and image synthesis using generative AI · Ethical considerations in generative AI 	15
Case Study Scenario		
M1	Case Study: AI-Based Symptom Checker A clinic built a small AI Symptom Checker to help patients describe their health problems. The system uses an intelligent agent that takes symptoms as input and uses simple search algorithms and knowledge representation to suggest possible issues. Later, basic neural networks and NLP were added so the system could understand patient text better. This small tool shows how both foundational and advanced AI concepts help support healthcare decisions.	

M2	<p>Case Study: Smart Product Recommender</p> <p>An online shop created a machine learning system to recommend products to customers. It used supervised learning to learn from past purchases and clustering to group similar buyers. A simple neural network improved the predictions. Later, Generative AI was added using a small GAN to create sample product images and a text generator to write short descriptions. This showed how ML and generative AI can enhance online shopping.</p>	
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Text and References:

1. Deep Learning, Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Pres , 2020
2. Artificial Intelligence: A Modern Approach, Stuart Russell and Peter Norvig, Prentice Hall, 2020R
3. Reinforcement Learning: An Introduction, Richard S. Sutton and Andrew G. Barto, MIT Press, 2023
4. Python Machine Learning, Sebastian Raschka and Vahid Mirjalili, Packt Publication, 2021
5. Artificial Intelligence, Saroj Kaushik, Cengage, Cengage Publication, 2019

Semester End Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	15 M
Q2	Attempt any 3 out of 5 (Module II)	15 M
Q3	Attempt any 3 out of 5 (Module I & II)	15 M
Q4	Case Study (Attempt Any 1 from 2)	05 M

Syllabus

List of Practicals		No. Of Lectures	CO Mapping
1	Implementing advanced deep learning algorithms such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs) using Python libraries like TensorFlow or PyTorch.	4	CO1
2	Building a natural language processing (NLP) model for sentiment analysis or text classification.	4	CO1
3	Creating a chatbot using advanced techniques like transformer models.	4	CO1, CO2
4	Developing a recommendation system using collaborative filtering or deep learning approaches.	4	CO1, CO2

5	Implementing a computer vision project, such as object detection or image segmentation.	4	CO1, CO2, CO3
6	Training a generative adversarial network (GAN) for generating realistic images.	4	CO1, CO2, CO3
7	Applying reinforcement learning algorithms to solve complex decision-making problems.	4	CO1, CO2, CO3
8	Utilizing transfer learning to improve model performance on limited datasets	4	CO1, CO2, CO3, CO4
9	Building a deep learning model for time series forecasting or anomaly detection.	4	CO1, CO2, CO3, CO4
10	Implementing a machine learning pipeline for automated feature engineering and model selection.	4	CO1, CO2, CO3, CO4
11	Using advanced optimization techniques like evolutionary algorithms or Bayesian optimization for hyperparameter tuning.	4	CO5
12	Deploying a machine learning model in a production environment using containerization and cloud services.	4	CO6
13	Use Python libraries such as GPT-2 or textgenrnn to train generative models on a corpus of text data and generate new text based on the patterns it has learned.	4	CO6,7
14	Experiment with neural networks like GANs (Generative Adversarial Networks) using Python libraries like TensorFlow or PyTorch to generate new images based on a dataset of images.	4	CO8

Semester End Practical Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks:50
Q1	Program	30
Q2	Journal	10
Q3	Viva & Attendance	10

BOS	Mathematics, Statistics and Computer Application				
Course	Machine Learning				
Course Code	HPSIT202	Level	6.5		
		Type	Theory	Practical	Total
Semester	III	Credits	04	02	06
Type	Major	No of Teaching hours	60	60	120
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	150	50	50	50	

Learning Objectives	
1	To demonstrate proficiency in using Python libraries like Sci-kit-learn, NumPy, Pandas, PyTorch, Keras and Matplotlib for machine learning tasks.
2	To apply techniques to clean and handle missing data, outliers, and different data types (numerical, categorical)
3	To Select, scale, and normalize features to enhance model performance.
4	To evaluate and assess the performance of machine learning models like classification and regression.
5	To translate problem statements into machine learning solutions

Course Outcomes	
CO1	Define and demonstrate an understanding of Machine Learning and its related terms conceptually and mathematically
CO2	Identify and differentiate the advantages and limitations of Machine Learning algorithms and their use cases.
CO3	Implement classifier algorithms for supervised learning tasks.
CO4	Apply feature engineering techniques to improve a dataset for machine learning.
CO5	Evaluate the performance of different machine learning models on a given dataset.
CO6	Diagnose reasons for poor performance in a machine learning model.
CO7	Analyze the ethical implications of a machine learning system.
CO8	Critique the suitability of a machine learning solution for a real-world problem, considering factors beyond just model performance.
CO9	Assess the potential biases and fairness concerns in a machine learning model.
CO10	Develop a custom machine learning algorithm for a specific real-world problem.
CO11	Propose a comprehensive machine learning solution to address a complex real-world challenge.

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Introduction to Machine Learning	30	CO1 ,CO2 , CO3, CO4
2	Models in Machine Learning and Applications	30	CO5,CO6,CO7,C08 CO9,CO10,CO11
		60	

Syllabus

Module No.	Content	No. of Lectures
1	<p>Unit I</p> <p>Introduction What Is Machine Learning? Basic Concepts in Machine Learning - Classification versus Regression, Supervised versus Unsupervised Learning Simple versus Complex Models, Parametric versus Nonparametric Models Overfitting versus Underfitting, Bias–Variance Trade-Off</p> <p>General Principles in Machine Learning Occam’s Razor, No-Free-Lunch Theorem, Law of the Smooth World, Curse of Dimensionality.</p> <p>Advanced Topics in Machine Learning Reinforcement Learning, Meta-Learning, Causal Inference,and Other Advanced topics</p> <p>Mathematical Foundation Probability and Statistics Random Variables and Distributions, Expectation: Mean, Variance, and Moments, Joint, Marginal, and Conditional Distributions, Common Probability Distributions, Transformation of Random Variables</p> <p>Information Theory Information and Entropy, Mutual Information, KL Divergence</p> <p>Mathematical Optimization General Formulation, Optimality Conditions, Numerical Optimization Methods</p> <p>Unit II</p> <p>Classification Algorithms Introduction, Decision-based methods: Nonlinear Instance-based methods, Decision Tree algorithm, Use Cases (Reference 2)</p> <p>Feature Extraction Feature Extraction: Concepts,Linear Dimension Reduction, Nonlinear Dimension Reduction (I): Manifold Learning, Nonlinear Dimension Reduction (II): Neural Networks</p>	30

2	<p>Unit III</p> <p>Discriminative Models Statistical Learning Theory, Linear Models, Learning Discriminative Models in General, Neural Networks, Ensemble Learning</p> <p>Generative Models Overview of Generative Models, Formulation of Generative Models, Bayesian Decision Theory, Statistical Data Modeling, Density Estimation, Maximum- Likelihood Estimation, Maximum-Likelihood Classifier, Generative Models (in a Nutshell) Generative versus Discriminative Models</p> <p>Unimodal Models Gaussian Models, Multinomial Models, Markov Chain Models, Generalized Linear Models</p> <p>Mixture Models Formulation of Mixture Models, Expectation-Maximization Method, Expectation-Maximization Method, Gaussian Mixture Models, Hidden Markov Models</p> <p>Entangled Models Formulation of Entangled Models, Linear Gaussian Models, Non-Gaussian Models, Deep Generative Models</p> <p>Bayesian Learning Formulation of Bayesian Learning, Conjugate Priors, Approximate Inference, Gaussian Processes</p> <p>Graphical Models Concepts of Graphical Models, Bayesian Networks, Markov Random Fields</p> <p>Unit IV Domain-Based Machine Learning Applications, Ethical Aspects of Machine Learning (Reference 2)</p>	30
Case Study Scenario		
M1	<p>A national bank in India notices a sudden increase in online credit-card fraud, especially small “testing transactions.” The bank provides a dataset containing: transaction amount, merchant category, time of transaction geographical location cardholder spending history device/browser fingerprint</p>	

M2	<p>university wants to identify students likely to fail in the final semester.</p> <p>The dataset contains:</p> <ul style="list-style-type: none"> attendance %, internal marks, assignment submission history, LMS login frequency, doubt-session participation, demographic fields, final exam result (pass/fail or continuous score). <p>he university wants:</p> <ul style="list-style-type: none"> A classification model to predict who is at risk of failing. A regression model to estimate the expected final marks. A dashboard to help faculty intervene early.
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Text and References:

- a. Machine Learning Fundamentals: A Concise Introduction, Hui Jiang, Cambridge University Press, first, 2021
- b. Machine Learning Concepts, Techniques and Applications

Semester End Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	15 M
Q2	Attempt any 3 out of 5 (Module II)	15 M
Q3	Attempt any 3 out of 5 (Module I & II)	15 M
Q4	Case Study (Attempt Any 1 from 2)	05 M

Practical Syllabus

List of Practicals		No. Of Lectures	CO Mapping
1.	Data Pre-processing and Exploration	3	CO1, CO2
a.	Load a CSV dataset. Handle missing values, inconsistent formatting, and outliers.	3	CO1, CO2
b.	Load a dataset, calculate descriptive summary statistics, create visualizations using different graphs, and identify potential features and	3	CO1, CO2

	target variables Note: Explore Univariate and Bivariate graphs (Matplotlib) and Seaborn for visualization.		
c.	Create or Explore datasets to use all pre-processing routines like label encoding, scaling, and binarization.	3	O3, CO4.CO5
2.	Testing Hypothesis	3	O3, CO4.CO5
a.	Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a CSV file and generate the final specific hypothesis. (Create your dataset)	3	O3, CO4.CO5
3	Linear Models	3	CO6, CO7
a.	Simple Linear Regression Fit a linear regression model on a dataset. Interpret coefficients, make predictions, and evaluate performance using metrics like R-squared and MSE	3	CO6, CO7
b.	Multiple Linear Regression Extend linear regression to multiple features. Handle feature selection and potential multicollinearity.	3	CO8
10	Regularized Linear Models (Ridge, Lasso, ElasticNet)	3	CO8
	Implement regression variants like LASSO and Ridge on any generated dataset.		
	Discriminative Models		
	Logistic Regression Perform binary classification using logistic regression. Calculate accuracy, precision, recall, and understand the ROC curve.		
	Implement and demonstrate k-nearest Neighbor algorithm. Read the training data from a .CSV file and build the model to classify a test sample. Print both correct and wrong predictions.		
	Build a decision tree classifier or regressor. Control hyperparameters like tree depth to avoid overfitting. Visualize the tree.		
	Implement a Support Vector Machine for any relevant dataset.		

Semester End Practical Evaluation (50 Marks)*Time: 2 Hrs*

Question No	Questions	Total Marks: 50
Q1	Program	30
Q2	Journal	10
Q3	Viva & Attendance	10

BOS	Mathematics, Statistics and Computer Application				
Course	Storage as a Service				
Course Code	HPSIT203	Level	6.5		
		Type	Theory	Practical	Total
Semester	III	Credits	02	-	02
Type	Major	No of Teaching hours	30	-	30
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	100	50	50	00	

Learning Objectives	
1	Gain a deep understanding of storage network architecture
2	Analyze and design storage networks to meet diverse requirements.
3	Acquire comprehensive knowledge of storage technologies.
4	Evaluate and select appropriate storage devices and subsystems based on performance, reliability, and scalability criteria.
5	Develop Proficiency in File System management and learn data Management. Strategies
6	Understand the storage networking fundamentals, technologies, protocols, and their best practices.

Course Outcomes	
CO1	Covers the evolution of data access methods and introduces concepts like network storage architectures, storage networking functions, and storage I/O requirements.
CO2	Discusses different types of storage devices (disk drives, tape drives) and subsystem architectures, along with storage interconnect technologies like SCSI.
CO3	Explores the concept of storage virtualization, its technologies, and implications for performance and reliability, as well as the fundamentals of network backup.
CO4	Covers the relationship between file systems and operating systems, network file system basics, and protocols like NFS and CIFS.
CO5	Discusses clustered and distributed file systems, network storage for databases,

	and data management techniques including historical file versions and compliance storage.
CO6	Provides a historical context for storage networking, reviews block and file storage protocols, optical technologies, virtualization implementations, and network operating principles.

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Basics of storage networking—DAS vs SAN/NAS, storage devices, I/O path, SCSI, virtualization, and network backup.	15	CO1 ,CO2 & CO3
2	File systems and advanced storage networking—NFS/CIFS, clustered/distributed file systems, data management, protocols, and modern SCSI networking.	15	CO4, CO5 & CO6
		30	

Syllabus

Module No.	Content	No. of Lectures
1	<p>Unit 1:</p> <p>i. Data Access in the Internet Era: Availability Requirements for Network Storage, Traditional Client/Server Computing with Direct Attached Storage, Network Storage Architectures That Overcome DAS. Limitations Establishing a Context for Understanding Storage Networks, The Three Primary Functions of Storage Networking, Connecting, Storing, Filing, File Systems, and Operating Systems, SAN and NAS as Storing and Filing Applications. Getting Down with Storage I/O: Requirements for Storage I/O, The I/O Path.</p> <p>ii. Storage Devices: Disk Drives, Tape Drives. Storage Subsystems: Subsystem Architecture, Common Functions of Storage Subsystems JBOD Tape Subsystems and Disk Subsystems for Backup. SCSI Storage Fundamentals and SAN Adapters: The Architecture and Logic of SCSI. SCSI Command Basics HBAs and Network Storage Interfaces Device. Interconnect Technologies for Storage Networks: Fundamental Concepts in Storage Interconnects, Legacy DAS Interconnects, Serial Storage Interconnects</p> <p>iii. Storage Virtualization: The Power in Volume Management , Software and SAN</p>	15

	<p>Virtualization Systems , The Concept of Storage Virtualization , A Review of Technologies Used in Storage Virtualization , Virtualization Products: Volume Managers and SAN Virtualization Systems , Performance of SAN Virtualization ,Scaling Storage with Virtualization , Address Space Manipulation Techniques , Storage Pooling , Extending Management Functions in Volume Management and SAN , Virtualization Systems , Reliability and Risk Considerations. Network Backup: The Foundation of Storage Management Fundamentals of Backup and Recovery, Backup Operations, Backup Applications in Storage Networks, Disk-Based Backup</p>	
<p>2</p>	<p>Unit 2:</p> <p>b. File System Fundamentals: The Strange and Wonderful Relationship Between File Systems and, Operating Systems, File System Structures, File System Constructs and Functions. Network File Systems and Network Attached Storage: Fundamentals of Network File Systems, The Complete I/O Process for File I/O in a Network, NFS and CIFS Protocols for Network File Systems, Applications for Network File Storage Extended Features of Network File Systems Network Attached Storage (NAS)</p> <p>c. New Directions in Network Filing: Clustered File Systems, Distributed File Systems, and Network Storage for Databases Cluster File Systems, Super- Scaling Network File Systems with SAN-Based Distributed File, Systems Network Storage for Databases.</p> <p>Data Management: Managing Data in Time Historical Versions of Files, Storing Data in Compliance with Government Regulations Capacity Management, Tiered Storage, Information Life Cycle Management.</p> <p>c. Overview of Storage Networking: Brief History of Storage Drivers for Change, What Is a Storage Network? Block Storage Protocol Review: ATA, SCSI, and SBCCS, Mainframe Storage Networking: ESCON and FICON, File Server Protocol Review: CIFS, NFS, and DAFS, Backup Protocols: NDMP and EXTENDED COPY, Optical Technologies: SONET/SDH, DWDM/CWDM, and RPR/802.17, Virtualization Implementations: Host, Storage Subsystem, and Network. OSI Reference Model Versus Other Network Models: OSI Reference Model, SCSI Bus Interface and the ANSI T10 SCSI-3 Architecture Model, Ethernet and the IEEE 802 Reference Model, TCP/IP Suite and the ARPANET Model, Fibre Channel Architecture and ANSI T11 Model . Overview of Network Operating Principles: Conceptual Underpinnings, SCSI Parallel Interface, Ethernet, TCP/IP Suite, Fibre Channel. Overview of Modern SCSI Networking Protocols: iSCSI, FCP, FCIP, iFCP</p>	<p>15</p>
<p>Case Study Scenario</p>		

M1	A financial company, FinTrust Corp, struggles with slow data access because all its servers use Direct Attached Storage (DAS). Customer transaction logs, reports, and analytics files are stored separately on each server, causing low availability and I/O delays. To solve this, the company upgrades to a network storage solution using SAN and NAS . NAS handles shared files and department documents. SAN supports high-speed databases and transaction systems. They use RAID disk arrays, JBOD units, and tape drives for long-term backup. Storage virtualization is implemented to pool all storage devices into one logical system, allowing easy scaling and centralized management. A network-based backup system performs daily disk backups and weekly tape backups, improving recovery time. The new architecture increases data availability, boosts I/O performance, and reduces downtime across all financial operations.
M2	A data analytics company, DataWave, faces slow file access because its old file servers cannot handle growing workloads. To fix this, the company shifts to a NAS-based network file system using NFS and CIFS for fast sharing of reports and logs. For high-speed database operations, DataWave adds a SAN-based distributed file system. They implement tiered storage, store historical versions for compliance, and use capacity management to track growth. Modern storage protocols like iSCSI and FCP improve performance, while NDMP-based backup ensures quick recovery. The upgraded system delivers faster file access, better scalability, and reliable storage management.

Text and References:

1. Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems Author: Marc Farley Publisher: Cisco Press Year: 2004
2. Storage Networking Protocol Fundamentals Author: James Long Publisher: Cisco Press Year: 2006
3. Storage Virtualization: Technologies for Simplifying Data Storage and Management Author: Tom Clark Publisher: Addison Wesley Professional Year:2005
4. Information Storage and Management: Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments (2nd Edition) Authors: Somasundaram Gnanasundaram, Alok Shrivastava Publisher: John Wiley & Sons, Inc. Year: 2012.

Semester End Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	15 M
Q2	Attempt any 3 out of 5 (Module II)	15 M
Q3	Attempt any 3 out of 5 (Module I & II)	15 M
Q4	Case Study (Attempt Any 1 from 2)	05 M

BOS	Mathematics, Statistics and Computer Application				
Course	Natural Language Processing				
Course Code	HPSIT204	Level	6.5		
		Type	Theory	Practical	Total
Semester	III	Credits	04	-	04
Type	Major	No of Teaching hours	60	-	60
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	100	50	50	00	

Learning Objectives	
1	The prime objective of this course is to introduce the students to the field of Language Computing and its applications ranging from classical era to modern context.
2	To provide understanding of various NLP tasks and NLP abstractions such as Morphological analysis, POS tagging, concept of syntactic parsing, semantic analysis etc.
3	To provide knowledge of different approaches/algorithms for carrying out NLP tasks
4	To highlight the concepts of Language grammar and grammar representation in Computational Linguistics.

Course Outcomes	
CO1	Students will get ideas about know-hows, issues and challenges in Natural Language Processing and NLP applications and their relevance in the classical and modern context.
CO2	Students will get an understanding of Computational techniques and approaches for solving NLP problems and develop modules for NLP tasks and tools such as Morph Analyzer, POS tagger, Chunker, Parser, WSD tool etc.
CO3	Students will also be introduced to various grammar formalisms, which they can apply in different fields of study
CO4	Students can take up project work or work in R&D firms working in NLP and its allied areas.
CO5	Student will be able to understand applications in different sectors

Modules at Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Introduction to NLP , NLP Task, Morphological Analysis and Regular Expressions and Part-of-Speech (POS) Tagging and Evaluation	30	CO1 ,CO2 & CO3
2	NL Parsing Basics and Grammar Formalisms , Probabilistic Parsing and Dependency Parsing, Lexical Semantics and Word Senses, Coreference Resolution and Semantic Representations	30	CO4 & CO5
		60	

Syllabus

Module No.	Content	No. of Lectures
1	<p>Unit I</p> <p>a) Introduction to NLP: Brief history, NLP applications, Challenges/Open Problems, NLP Abstraction levels, Introduction to NL computing techniques and steps (segmentation, tagging, parsing, etc.)</p> <p>b) NLP Tasks: Segmentation, Chunking, Tagging, Named Entity Recognition (NER), Parsing, Word Sense Disambiguation, NL Generation, Text Processing Challenges</p> <p>Unit II</p> <p>a) Morphological Analysis and Regular Expressions: Introduction to Morphology, Types of morphological parsing: rule-based vs. paradigm-based, Regular Expressions and Automata Finite State Automata (FSA) and Finite State Transducers (FST), Introduction to the Porter stemming algorithm.</p> <p>b) Part-of-Speech (POS) Tagging and Evaluation: Word Classes and Introduction to POS Tagging, Survey of POS tagsets in English and Indian languages, Introduction to rule-based approaches like ENG TOWL, Stochastic Approaches: Overview of probabilistic models, N-gram models, and Hidden Markov Models (HMM) for POS tagging,</p>	15

	Transformation-Based Learning (TBL) Morphology, Evaluation Metrics and Error Analysis: Precision, Recall, F-measure, error-analysis	
2	<p>Unit III</p> <p>a) NL Parsing Basics and Grammar Formalisms: Introduction to NL Parsing (top-down and bottom-up parsing approaches), Introduction to constituency and dependency schools of grammar, Overview of grammar notations: CFG, LFG, PCFG, LTAG, Overview of English CFG, Introduction to Paninian Karaka Theory for Indian language parsing, Overview of CFG parsing using Earley's and CYK algorithms, Introduction to Paninian Karaka Theory for Indian language parsing, Overview of CFG parsing using Earley's and CYK algorithms.</p> <p>b) Probabilistic Parsing and Dependency Parsing: Introduction to probabilistic parsing techniques, Overview of probabilistic CFG (PCFG) and its applications, dependency parsing and its importance, Overview of Covington algorithm, MALT parser, and MST parser for dependency parsing.</p> <p>Unit IV</p> <p>a) Lexical Semantics and Word Senses: Introduction to semantic analysis theories and methodologies, lexical semantics, word senses, and relationships, Introduction to WordNet for English and IndoWordnet, Overview of WSD techniques like Lesk Algorithm and Walker's algorithm, Importance of WSD in resolving ambiguity in NLP.</p> <p>b) Coreference Resolution and Semantic Representations: coreference resolution, including Anaphora and Cataphora, Importance of resolving coreference in NLP applications, Semantic Representations and Word Similarity and understanding lexical semantics.</p>	15
Case Study Scenario		
M1	<p>A telecom company receives thousands of customer complaints daily through email and chat. To automate issue-based routing, the company develops an NLP pipeline. The system performs text segmentation, tokenization, POS tagging, and named entity recognition (NER) to detect key information like dates, locations, and bill amounts.</p> <p>Regular expressions and morphological analysis (stemming using Porter Algorithm) help standardize words such as “disconnecting”, “disconnected”, “disconnection” into a single root. A probabilistic POS tagger (HMM-based) and chunking are used to identify product names and service issues.</p> <p>Evaluation metrics like precision, recall, and F-measure are applied to check tagging accuracy.</p> <p>This system improves classification accuracy and reduces human workload in routing complaints.</p>	

M2	<p>A university builds an academic-help chatbot to answer student questions like “When is the exam?” or “Who is the course coordinator?”</p> <p>To properly understand user queries, the NLP system uses CFG-based parsing (using Earley’s algorithm) to detect sentence structure and extract intent.</p> <p>For Indian language queries (Hindi/Marathi), Paninian Karaka Theory is used to identify syntactic roles such as agent, object, and instrument.</p> <p>To resolve word ambiguity (e.g., “course” meaning <i>subject</i> or <i>direction</i>), the system uses a Word Sense Disambiguation (WSD) method like Lesk Algorithm, leveraging WordNet and IndoWordNet.</p> <p>Dependency parsing using MALT/MST parsers helps determine relationships like subject–verb and object–verb, improving answer accuracy.</p> <p>Coreference resolution ensures correct interpretation of pronouns in conversations, e.g., “Who is the HOD? Where is <i>he</i> available?”</p> <p>This enhances the chatbot’s understanding, especially for multi-turn dialogue.</p>
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Text and References:

- a. Handbook of Natural Language Processing, Indurkha, N., & Damerau, 2010
- b. Speech and Language Processing, Martin, J. H., & Jurafsky, D, 2013.
- c. Foundations of Statistical Natural Language Processing, MIT Press ,1997.
- d. Natural Language Processing With Python, O’Reilly, 2016.

Semester End Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	15 M
Q2	Attempt any 3 out of 5 (Module II)	15 M
Q3	Attempt any 3 out of 5 (Module I & II)	15 M
Q4	Case Study (Attempt Any 1 from 2)	05 M

Semester IV

BOS	Mathematics, Statistics and Computer Application				
Course	Blockchain				
Course Code	HPSIT251	Level	6.5		
		Type	Theory	Practical	Total
Semester	IV	Credits	02	01	2
Type	Major	No of Teaching hours	60	60	120
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	150	50	50	50	

Learning Objectives	
1	Understand the structure of a Blockchain
2	Learn the fundamentals of Ethereum and Bitcoin
3	Gain a comprehensive understanding of smart contract and Dapp.
4	Learn the concepts of permissioned and public blockchains and NFT.

Course Outcomes	
After successful completion of this course, students would be able to: -	
CO1	Provide conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved.
CO2	Demonstrate blockchain applications.
CO3	Gain the ability to write and deploy basic smart contracts on the Ethereum blockchain using Solidity programming language and tools like Truffle and Remix.
CO4	Able to analyze cryptoeconomic design and learn NFT and permissioned blockchains...

Modules At Glance

Module No.	Content	No. of Lectures	Mapping with CO
1	Blockchain Introduction Bitcoin and Ethereum	30	CO1 & CO2
2	Smart Contract & Dapp and Permissioned Blockchain ,Cryptoeconomics & NFT	30	CO3, CO4
		60	

Syllabus

Module No.	Content	No. of Lectures
1	<p>UNIT 1: Blockchain Introduction</p> <ol style="list-style-type: none"> 1. Blockchain – Introduction, History, Centralised versus Decentralised systems 2. Layers of blockchain, Importance of blockchain, Blockchain uses and use cases. 3. Working of Blockchain – Blockchain foundation, Cryptography 4. Game Theory, Computer Science Engineering, Properties of blockchain solutions 5. blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms 6. Scaling blockchain. 	15
	<p>UNIT 2: <u>Bitcoin and Ethereum</u></p> <ol style="list-style-type: none"> 1. A Working of Bitcoin: Money, Bitcoin, Bitcoin blockchain, bitcoin network, 2. bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets, Interacting with the Bitcoin Blockchain 3. Ethereum- Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, 4. Ethereum Blockchain, Ethereum Accounts, Advantages of Accounts, Account State, 5. Merkle Patricia Tree, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, 6. Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine. 7. Mining Ether: Difficulty, Factors Required for Block Validation 8. How Proof of Work Helps Regulate Block Time 9. Faster Blocks, How Ethereum Uses Stale Blocks, Forking 	15
2	<p>UNIT 1: <u>Smart Contract & Dapp</u></p> <ol style="list-style-type: none"> 1. Basic of Solidity Programming:- writing loops in solidity 2. statement and expressions in solidity 3. Value types, Global special variables, Units and Functions 4. Behind Dapp Deployment-Seven Ways to Think About Smart Contracts, Smart Contract Deployment- EVM as Back End: Introduction to Truffle, Use of Remix and test networks for deployment, Dapp deployment. 5. Blockchain Application Development -Decentralized Applications, , Interacting Programmatically with Ethereum— Sending Transactions, Creating a Smart Contract, Executing Smart Contract Functions 	15

	UNIT 2: <u>Permissioned Blockchain ,Cryptoeconomics & NFT</u> 1. Permissioned Blockchain- , Public vs. Private Blockchains, 2. Decentralized Application Architecture, Hyperledger concept, Exploring Hyperledger fabric project, Iroha project 3. Cryptoeconomics- Why Is Cryptoeconomics useful?, Understanding Hashing vs. encryption, 4. Speed of blocks, Ether Issuance scheme, Common Attack Scenarios 5. NFT- What are NFTs? NFT Marketplaces, Creating and Minting NFTs, Legal Aspects of NFTs, The Future of NFTS	15
Case Study Scenario		
M1	A pharmaceutical company transitions from a centralized database to a private Ethereum-based blockchain to prevent vaccine counterfeiting. They deploy a Smart Contract to automatically verify if a vial's temperature logs, signed by Ethereum Accounts of distributors, adhere to the cold-chain rules. The consensus mechanism ensures that all records, which become immutable via cryptography, are immediately shared, increasing trust and regulatory compliance.	
M2	A city land registry chooses a Hyperledger Fabric Permissioned Blockchain to replace its paper records, ensuring that only authorized nodes can validate transactions. They deploy a Solidity Smart Contract to automatically transfer ownership of property NFTs upon payment, eliminating bureaucratic delays. The front-end DApp allows users to sign these transfers using their wallets, securing the process with cryptography. This system uses Cryptoeconomics to incentivize honest validation among government and notary participants, protecting against Common Attack Scenarios.	

References Books

- Introducing Ethereum and Solidity, Chris Dannen, Apress, 2017
- Beginning Blockchain: A Beginner's Guide to Building Blockchain Solutions, Bikramaditya Singhal , Gautam Dhameja ,Priyansu Sekhar Panda, Apress,2018
- Blockchain for dummies, Tiana Laurence, Wiley,2017

Semester End Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 4 (Module I)	15M
Q2	Attempt any 3 out of 4 (Module II)	15M
Q3	Attempt any 3 out of 4 (Module I & II)	15M
Q4	Case Study (Attempt Any 1 from 2)	05M

Practical Syllabus

List of Practicals		No. Of Lectures	CO Mapping
1	<p>a. Develop a secure messaging application where users can exchange messages securely using RSA encryption. Implement a mechanism for generating RSA key pairs and encrypting/decrypting messages.</p> <p>b. Allow users to create multiple transactions and display them in an organised format.</p> <p>c. Create a Python class named Transaction with attributes for sender, receiver, and amount. Implement a method within the class to transfer money from the sender's account to the receiver's account..</p> <p>d. Implement a function to add new blocks to the miner and dump the blockchain.</p>	15	CO1
2	<p>a. Write a python program to demonstrate mining.</p> <p>b. Demonstrate the use of the Bitcoin Core API to interact with a Bitcoin Core node.</p> <p>c. Demonstrating the process of running a blockchain node on your local machine.</p> <p>d. Demonstrate mining using geth on your private network.</p>	15	CO2
3	<p>a. Write a Solidity program that demonstrates various types of functions including regular functions, view functions, pure functions, and the fallback function.</p> <p>b. Write a Solidity program that demonstrates function overloading, mathematical functions, and cryptographic functions.</p> <p>c. Write a Solidity program that demonstrates various features including contracts, inheritance, constructors, abstract contracts, interfaces.</p> <p>d. Write a Solidity program that demonstrates use of libraries, assembly, events, and error handling.</p> <p>e. Build a decentralized application (DApp) using Angular for the front end and Truffle along with Ganache CLI for the back end.</p>	15	CO3
4	<p>a. Install and demonstrate use of hyperledger-Irhoa</p> <p>b. Demonstration on interacting with NFT</p>	15	CO4

Semester End Practical Evaluation (50 Marks)
Paper Pattern

Time: 2 Hrs

Question No	Questions	Total Marks: 50
Q1	Program	<i>30</i>
	Journal	<i>10</i>
	Viva & Attendance	<i>10</i>

BOS	Mathematics, Statistics and Computer Application				
Course	Deep Learning				
Course Code	HPSIT252	Level	6.5		
		Type	Theory	Practical	Total
Semester	IV	Credits	02	01	2
Type	Major	No of Teaching hours	60	60	120
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	150	50	50	50	

Learning Objectives	
1	To present the mathematical, statistical and computational challenges of building Neural networks
2	To study the concepts of deep learning
3	To enable the students to know deep learning techniques to support real-time Applications

Course Outcomes	
CO1	Describe basics of mathematical foundation that will help the learner to understand the Concepts of Deep Learning.
CO2	Understand and describe model of deep learning
CO3	Understand various deep supervised learning architectures for text & image data.
CO4	Gain knowledge about various deep learning models and architectures.
CO5	Familiarize various deep learning techniques to design efficient algorithms for real- world applications.

Modules At Glance

Module No.	Content	No. of Hours	Mapping with CO
1	Applied Math and Machine Learning Basics, Numerical Computation, Deep Networks	30	CO1, CO2, CO3
2	Convolution Applications, Deep Learning Research, Generative Models, Diffusion Models , Applications	30	CO4, CO5

		60	
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Syllabus

Module No.	Content	No. of Lectures
1	<p>UNIT 1</p> <p>Applied Math and Machine Learning Basics: Linear Algebra: Scalars, Vectors, Matrices and Tensors, Multiplying Matrices and Vectors , Identity and Inverse Matrices, Linear Dependence and Span , norms, special matrices and vectors, Eigen decompositions.</p> <p>Numerical Computation: Overflow and under flow, poor conditioning, Gradient Based Optimization, Constraint optimization.</p>	15
	<p>UNIT 2:</p> <p>Deep Networks: Deep feed forward network, regularization for deep learning, Optimization for Training deep models.</p>	15
2	<p>UNIT 3:</p> <p>Convolution Applications: Convolutional Networks, Sequence Modelling, Applications</p> <p>Deep Learning Research: Linear Factor Models, Auto encoders, representation learning</p>	15
	<p>UNIT4:</p> <p>Generative Models: Approximate Inference, Deep Generative Models</p> <p>Diffusion Models (Reference 3)</p> <p>Applications: Transformers, Advance GANs (Reference 3)</p>	15
Case Study Scenario		
M1	<p>A logistics company wants to minimize fuel consumption for its delivery trucks across five major cities.</p> <ul style="list-style-type: none"> ● Distances between cities are represented as a distance matrix. ● Each truck's fuel usage per kilometer is represented as a vector. ● The company wants to compute the total expected fuel consumption by multiplying the distance matrix with the fuel vector. ● To find the most critical routes contributing to delays, they perform eigenvalue decomposition of the traffic congestion matrix. ● The norm of the route vectors helps identify unusually long or inefficient routes 	
M2	<p>An MRI machine collects raw image signals in a 3D tensor form. To reconstruct the final image:</p> <ul style="list-style-type: none"> ● A system of linear equations must be solved using the inverse of a transformation matrix. ● The reconstruction fails when some vectors in the measurement matrix are linearly dependent, causing the matrix to become non-invertible. ● Orthogonal matrices (special matrices) are used to stabilize reconstruction. 	

References Books

- A. Deep Learning Ian Goodfellow, Yoshua Bengio, Aaron, An MIT Press book, 1st, 2016
- B. Fundamentals of Deep Learning, Nikhil Buduma, O'Reilly, 1st, 2017
- C. Generative Deep Learning, David Foster, O'Reilly, 2nd, 2023
- D. Deep Learning: Methods and Applications, Deng & Yu, Now Publishers, 2023

Semester End Evaluation (50 Marks)

Time: 2 Hrs

Paper Pattern

Question No	Questions	Total Marks: 50
Q1	Attempt any 3 out of 5 (Module I)	15 M
Q2	Attempt any 3 out of 5 (Module II)	15 M
Q3	Attempt any 3 out of 5 (Module I & II)	15 M
Q4	Case Study (Attempt Any 1 from 2)	05 M

Practical Syllabus

List of Practicals		No. Of. Hours	CO Mapping
1	<p>Introduction to TensorFlow</p> <p>a. Create tensors with different shapes and data types.</p> <ul style="list-style-type: none"> ● Perform basic operations like addition, subtraction, multiplication, and division on tensors. ● Reshape, slice, and index tensors to extract specific elements or sections. ● Performing matrix multiplication and finding eigenvectors and eigenvalues using TensorFlow <p>b. Program to solve the XOR problem.</p>	6	CO1
2	<p>Linear Regression</p> <ul style="list-style-type: none"> ● Implement a simple linear regression model using TensorFlow's low- level API (or tf. keras). ● Train the model on a toy dataset (e.g., housing prices vs. square footage). ● Visualize the loss function and the learned linear relationship. ● Make predictions on new data points. 	6	OC2,OC3, OC4
3	<p>Convolutional Neural Networks (Classification)</p> <p>a. Implementing deep neural network for performing binary classification task</p> <p>b. Using a deep feed-forward network with two hidden layers for performing multiclass classification and predicting the class.</p>	6	OC2,OC3, OC4
4	Write a program to implement deep learning Techniques for image segmentation.	6	OC2,OC3, OC4
5	Write a program to predict a caption for a sample image using LSTM.	6	OC2,OC3, OC4
6	Applying the Autoencoder algorithms for encoding real-world data	6	OC2,OC3, OC4
7	Write a program for character recognition using RNN and compare it with CNN.	6	OC2,OC3, OC4
8	Write a program to develop Autoencoders using MNIST Handwritten Digits	6	OC2,OC3, OC4
9	Demonstrate recurrent neural network that learns to perform sequence analysis for stock price.(google stock price)	6	OC2,OC3, OC4
10	Applying Generative Adversarial Networks for image generation and unsupervised tasks.	6	OC2,OC3, OC4

Practical Evaluation (50 Marks)

Time: 2 Hrs

Question No	Questions	Total Marks: 50
Q1	Program	30
Q2	Journal	10
Q3	Viva & Attendance	10

BOS	Mathematics, Statistics and Computer Application				
Course	Robotic Process Automation				
Course Code	HPSIT256P	Level	6.5		
		Type	Theory	Practical	Total
Semester	IV	Credits	-	04	4
Type	Major	No of Teaching hours	-	120	120
Evaluation/ Assessment	Total Marks	Semester End	Continuous	Practical	
	100	-	-	100	

Learning Objectives	
1	UiPath Fundamentals: Learn UiPath RPA basics, including Studio and Orchestrator.
2	Workflow Design: Develop automation workflows efficiently with UiPath Studio.
3	Data Manipulation: Extract, transform, and integrate data using UiPath.
4	Error Management: Handle exceptions and ensure reliable automation
5	Orchestrator Management: Configure and monitor Orchestrator for robot management.
6	Advanced Features: Explore advanced UiPath capabilities like OCR and web automation. Understand the structure of a Blockchain

Course Outcomes	
CO1	Recall and describe fundamental RPA and UiPath concepts, including key features of Studio and Orchestrator.
CO2	Explain RPA principles and how UiPath facilitates process automation through its mechanisms.
CO3	Interpret roles of components and tools in the UiPath ecosystem, understanding their functions.
CO4	Summarize UiPath's data manipulation and integration capabilities for efficient automation.
CO5	Utilize UiPath Studio to create workflows for simple business processes, incorporating data extraction and manipulation techniques

Sr. No.	Practical Description	No.of Lectures	CO Mapping
	Module 1:		
1.	RPA Basics: Sequences and Flowcharts: a. Create a simple sequence-based project. b. Create a flowchart-based project. c. Automate UiPath Number Calculation (Subtraction, Multiplication, Division of numbers). d. Create an automation UiPath project using different types of variables (number, datetime, Boolean, generic, array, data table)	10	CO1, CO2
2.	Decision making and looping: a. Consider an array of names. We have to find out how many of them start with the letter "a". Create an automation where the number of names starting with "a" is counted and the result is displayed. b. Demonstrate switch statement with an example. c. Create an automation To Print numbers from 1 to 10 with break after the writeline activity inside for each activity d. Create an automation using Do..While Activity to print numbers from 5 to 1 e. Create an automation using Delay Activity between two writeline activities to separate their execution by 5 seconds f. Create an automation to demonstrate use of decision statements (if)	10	CO1, CO2
3.	Types of Recording: a. Basic Recording using Toolbar b. Basic Recording using Notepad c. Desktop Recording using Tool bar d. Desktop Recording by creating a workflow e. Web Recording e.g. Find the rating of the movie from imdb web site f. Web Recording manually	10	CO3, CO4
	Module 2:		
4.	Excel Automation: a. Automate the process to extract data from an excel file into a data table and vice versa b. Create an automation to Write data to specific cell of an excel sheet. c. Create an automation to Read data to specific cell of an excel sheet. d. Create an automation to append data to specific	10	CO3, CO4

	<p>cell of an excel sheet.</p> <p>e. Create an automation to sort a table of an excel sheet.</p> <p>f. Create an automation to filter a table of an excel sheet</p> <p>g. Choose a repetitive manual task from your workplace or daily life. Design and implement an RPA bot to automate this task using your preferred RPA tool</p>		
5.	<p>Different controls in UiPath:</p> <p>a. Implement the attach window activity.</p> <p>b. Automate using Anchor Base.</p> <p>c. Automate using Element Exists.</p> <p>d. Automate using Find Children control.</p> <p>e. Use Get Ancestor control</p> <p>f. Use Find Relative control</p>	12	CO3, CO4
6.	<p>Keyboard and Mouse Events:</p> <p>a. Demonstrate the following activities in UiPath:</p> <p>i. Mouse (click, double click and hover)</p> <p>ii. Type into</p> <p>iii. Type Secure text</p> <p>b. Demonstrate the following events in UiPath:</p> <p>. Element triggering event</p> <p>i. Image triggering event</p> <p>ii. System Triggering Event</p> <p>c. Automate the process of launching an assistant bot on a keyboard event.</p>	12	CO3, CO2
	Module 3:		
7.	<p>Screen Scraping and Web Scraping methods:</p> <p>a. Automate the following screen scraping methods using UiPath:</p> <p>a. Full Text</p> <p>b. Native</p> <p>c. OCR</p> <p>b. Demonstrate Data Scraping and display values in Message box.</p> <p>c. Demonstrate Screen Scraping for a pdf, web page and image file.</p>	12	CO3, CO4
8.	<p>PDF Automation and Exception Handling:</p> <p>a. Read PDF With OCR</p> <p>b. Merge PDF's into one</p> <p>c. Get PDF Total Page count Using Regex</p> <p>d. Extract data from a PDF or Excel file and</p>	12	CO3, CO4

	<p>populate it into a database or spreadsheet.</p> <p>e. Extract data from a PDF or Excel file and populate it into a database or spreadsheet. Implement data manipulation techniques like filtering, sorting, or data Validation.</p> <p>f. Demonstrate Exception Handling using UiPath</p>		
9.	<p>Email Automation:</p> <p>a. Configure Email using UiPath</p> <p>b. Read Emails</p> <p>c. Send Email with Attachment</p> <p>d. Save Email Attachments</p> <p>e. Reply to Email</p>	12	CO5, CO4
	Module 4:		
10.	<p>Orchestrator management and mini project:</p> <p>a. Deploy bots to Orchestrator</p> <p>b. Run jobs from Orchestrator</p> <p>c. Queue Introduction: Add items to Queue.. Get Queue item from Orchestrator</p> <p>d. Build UiPath Chatbot using Google dialogflow</p>	12	CO5, CO4
11.	<p>RPA Applications:</p> <p>a. Automate the extraction of data from invoices, validate information, and update accounting systems.</p> <p>b. Automate data entry tasks from various sources such as emails, forms, or documents, and validate data against predefined rules.</p> <p>c. Automate the process of expense reporting by extracting data from receipts, categorizing expenses, and generating reports.</p> <p>d. Automate inventory tracking and management processes, including stock updates, reordering, and inventory audits.</p> <p>e. Automate sales order processing tasks such as order entry, validation, and fulfilment.</p>	12	ALL CO'S
12.	<p>Prepare the Robotics process automation project on any one of the following domains: RPA in Logistics, Intelligent Process Automation, IT Process Automation Explained, RPA in Banking, RPA in Education, RPA in Telecommunications, RPA in Healthcare, RPA in Insurance, RPA in Accounting, RPA Challenges, RPA in Real Estate, RPA in BPO, RPA Security</p>	12	ALL CO'S

Semester End Practical Evaluation

Time: 2 Hrs

Question No	Questions	Total Marks: 50
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Q1	Program	30
Q2	Journal	10
Q3	Viva & Attendance	10

