AC: 02.06.2025 ITEM NO: 2.5

Deccan Education Society's

Kirti M. Doongursee College of Arts, Science and Commerce (AUTONOMOUS)

Affiliated to

UNIVERSITY OF MUMBAI

Syllabus for
Program: Masters of Science
Course: M.Sc. Part II
Subject: Information Technology

Choice Based Credit System (CBCS)
with effect from
Academic Year 2025-2026

PROGRAM OUTCOMES

PO	Description
A student completing Master's Degree in **Science** Program will be able to	
PO1	Ability to apply the knowledge of Information Technology with recent trends aligned with research and industry.
PO2	Ability to apply IT in the field of Computational Research, Soft Computing, Big Data Analytics, Data Science, Image Processing, Artificial Intelligence, Networking and Cloud Computing.
PO3	Ability to provide socially acceptable technical solutions in the domains of Information Security, Machine Learning, Internet of Things and Embedded System, Infrastructure Services as specializations.
PO4	Ability to apply the knowledge of Intellectual Property Rights, Cyber Laws and Cyber Forensics and various standards in interest of National Security and Integrity along with IT Industry.
PO5	Ability to write effective project reports, research publications and content development and to work in a multidisciplinary environment in the context of changing technologies.

Deccan Education Society's

Kirti M. Doongursee College (Autonomous)

Proposed Curriculum as per NEP-2020

Year of implementation- 2025-2026

Name of the Department-Information Technology

Semester	Course Code	Course Title	Vertical	Credit
III	25ITMJ911	Advanced Artificial Intelligence	Major	4
	25ITMJP91	Advance Artificial Intelligence Practical	Major	2
	25ITMJ912	Machine Learning	Major	4
	25ITMJP92	Machine Learning Practical	Major	2
	25ITMJ913	Storage as Services	Major	2
	25ITEL921 25ITEL922 25ITEL923	a. Natural Language Processing b. Security Operations Center c. Server Virtualization	Elective	2
	25ITELP91 25ITELP92 25ITELP93	a. Natural Language Processing Practical b. Security Operations Center Practical c. Server Virtualization Practical	Elective	2
	25ITRP93	Research PROJECT	RP	4
IV	25ITMJT11	Blockchain	Major	4
	25ITMJPT1	Blockchain – Practical	Major	2
	25ITMJT12	Deep Learning	Major	4
	25ITMJPT2	Deep Learning – Practical	Major	2
	25ITELT21 25ITELT22 25ITELT23	a.Data CenterTechnologies b. Cyber Forensics c.Robotic Process Automation	Elective	2
	25ITELPT1 25ITELPT2 25ITELPT3	a.Data CenterTechnologies Practical b. Cyber Forensics Practical c.Robotic Process Automation Practical	Elective	2
	25ITOJTT3	RESEARCH PROJECT	RP	6

SEMESTER- III

Course Code	SEM – III MAJOR	Credits	Lectures/ Week
25ITMJ911	Paper I- Advanced Artificial Intelligence	4	4

Course Outcomes:

After completion of course the learner will be able to:

CO1**:** Recall the key concepts, terminology, and common applications of expert systems.

CO2: Describe the applications of Machine Learning.

CO3**:** Use the applications of genetic algorithms in different problems related to artificial intelligence.

CO4**:** Compare various knowledge representation techniques by examining their structures, effectiveness, and their impact.

Unit	Details	Lectures
I	**Review of AI:** History, foundation and Applications **Expert System and Applications:** Phases in Building Expert System, Expert System Architecture, Expert System versus Traditional Systems, Rule based Expert Systems, Blackboard Systems, Truth MaintenanceSystem,Application of Expert Systems, Shells and Tools	15
II	**Probability Theory:** joint probability, conditional probability, Bayes's theorem, probabilities in rules and facts of rule based system, cumulative probabilities, rule based system and Bayesian method **Fuzzy Sets and Fuzzy Logic:** Fuzzy Sets, Fuzzy set operations, Types of Membership Functions, Multivalued Logic, Fuzzy Logic, Linguistic variables and Hedges, Fuzzy propositions, inference rules for fuzzy propositions, fuzzy systems, possibility theory and other enhancement to Logic	15
III	**Artificial Neural Networks:**Artificial Neural Networks, Single-Layer feedforward networks, multi-layer feed-forward networks, radial basis function networks. **Evolutionary Computation:** Soft computing, genetic algorithms, genetic programming concepts, evolutionary programming, swarm intelligence, ant colony paradigm, particle swarm optimization and applications of evolutionary algorithms.	15

IV	**Intelligent Agents:** Agents vs software programs, classification of agents, working of an agent, single agent and multiagent systems, performance evaluation, architecture, agent communication language, applications **Advanced Knowledge Representation Techniques**:Conceptual dependency theory, script structures, CYC theory, script structure, CYC theory, case grammars, semantic web. **Natural Language Processing**:Sentence Analysis phases, grammars and parsers, types of parsers, semantic analysis, universal networking language, dictionary	**15**

References:

- Artificial IntelligenceSaroj Kaushik Cengage 1st Edition 2019
- Artificial Intelligence: AModern Approach A. Russel, Peter Norvig 1st Edition
- Artificial Intelligence Elaine Rich,Kevin Knight, Shivashankr B. Nair Tata Mc-Grawhill 3rd Edition

Course Code	SEM – III MAJOR	Credits	Lectures/ Week
25ITMJP91	**Paper I- Artificial Intelligence Practical**	**2**	**4**

Course Objectives:

After completion of the course, a student should be able to:

CO1:Recall the key algorithms used in AI

CO2:Describe the differences between supervised and unsupervised learning.

CO3:Use a machine learning algorithm to classify a dataset.

CO4:Categorize the potential challenges of implementing AI in different sectors.

1	Implementing advanced deep learning algorithms such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs) using Python libraries like TensorFlow or PyTorch.
2	Building a natural language processing (NLP) model for sentiment analysis or text classification.
3	Creating a chatbot using advanced techniques like transformer models.
4	Developing a recommendation system using collaborative filtering or deep learning approaches.
5	Implementing a computer vision project, such as object detection or image segmentation
6	Training a generative adversarial network (GAN) for generating realistic images
7	Applying reinforcement learning algorithms to solve complex decision-making problems.
8	Utilizing transfer learning to improve model performance on limited datasets.
9	Building a deep learning model for time series forecasting or anomaly detection
10	Implementing a machine learning pipeline for automated feature engineering and model selection.

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	**SEM – III MAJOR**	**Credits**	**Lectures/ Week**
25ITMJ912	**Paper II-Machine Learning**	**4**	**4**

Course Outcomes:

After completion of the course, a student should be able to:

CO1: Recall knowledge about classification and regression techniques where a learner will be able to explore his skill to generate database knowledge using the prescribed techniques.

CO2: Describe the key issues in Machine Learning and its associated applications in intelligent business and scientific computing.

CO3: USe machine learning methods for extracting knowledge from datasets by implementing algorithms, evaluating models, and interpreting results in real-world scenarios.

CO4: Analyze adequate perspectives of big data analytics in various applications like recommender systems, social media applications etc.

Unit	Details	Lectures
I	**Introduction:** Machine learning, Examples of Machine Learning Problems, Structure of Learning, learning versus Designing, Training versus Testing, Characteristics of Machine learning tasks, Predictive and descriptive tasks, Machine learning Models: Geometric Models, Logical Models, Probabilistic Models. Features: Feature types, Feature Construction and Transformation, Feature Selection.	15
II	**Classification and Regression: Classification:** Binary Classification- Assessing Classification performance, Class probability Estimation Assessing class probability Estimates, Multiclass Classification. **Regression**: Assessing performance of Regression- Error measures, Overfitting-Catalysts for Overfitting, Case study of Polynomial Regression. **Theory of Generalization:** Effective number of hypothesis, Bounding the Growth function, VC Dimensions, Regularization theory.	15
III	**Linear Models:** Least Squares method, Multivariate Linear Regression, Regularized Regression, Using Least Square regression for Classification. Perceptron, Support Vector Machines, Soft Margin SVM, Obtaining probabilities from Linear classifiers, Kernel methods for non-Linearity.	15
IV	**Logic Based and Algebraic Model: Distance Based Models:** Neighbours and Examples, Nearest Neighbours Classification, Distance based clustering-K means Algorithm, Hierarchical clustering, **Rule Based Models:** Rule learning for subgroup discovery, Association rule mining. **Tree Based Models:** Decision Trees, Ranking and Probability estimation Trees, Regression trees, Clustering Trees.	15

References:

- Machine Learning: The Art and Science of Algorithms that Make Sense of Data Peter Flach Cambri University Press 2012
- IntroductionTo StatisticalMachine Learningwith Applications in R Hastie, Tibshirani, Friedman Springer 2nd Edition 2012
- Introduction to Machine Learning Ethem Alpaydin PHI 2nd Edition 2013

Course Code	SEM – III -MAJOR	Credits	Lectures/ Week
25ITMJP92	Paper II-Machine Learning Practical	2	4

Course Objectives:

After completion of the course, a student should be able to:

CO1:Recall the use of a dataset (like from Kaggle) to apply a machine learning algorithm to solve a classification or regression problem..

CO2: Describe feature scaling, encoding, or selection techniques.

CO3: Demonstrate the performance of different machine learning models (like comparing accuracy, precision, recall, or F1-score) on the same dataset to determine which is most effective.

CO4: Analyze the model's learning curves to understand overfitting or underfitting, and use this to adjust model complexity or training data size..

1	Data Pre-processing and Exploration a.Load a CSV dataset. Handle missing values, inconsistent formatting, and outliers. b.Load a dataset, calculate descriptive summary statistics, create visualizations using different graphs, and identify potential features and 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.
2	Testing Hypothesis 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	Linear Models 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 b.Multiple Linear Regression Extend linear regression to multiple features. Handle feature selection and potential multicollinearity. c.Regularized Linear Models (Ridge, Lasso, ElasticNet) Implement regression variants like LASSO and Ridge on any generated dataset.
4	Discriminative Models a.Logistic Regression Perform binary classification using logistic regression. Calculate accuracy, precision, recall, and understand the ROC curve. b.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. c.Build a decision tree classifier or regressor. Control hyperparameters like tree depth to avoid overfitting. Visualize the tree. d.Implement a Support Vector Machine for any relevant dataset.

	e.Train a random forest ensemble. Experiment with the number of trees and feature sampling. Compare performance to a single decision tree. f.Implement a gradient boosting machine (e.g., XGBoost). Tune hyperparameters and explore feature importance.
5	Generative Models a.Implement and demonstrate the working of a Naive Bayesian classifier using a sample data set. Build the model to classify a test sample. b.Implement Hidden Markov Models using hmmlearn
6	Probabilistic Models a.Implement Bayesian Linear Regression to explore prior and posterior distribution. b.Implement Gaussian Mixture Models for density estimation and unsupervised clustering
7	Model Evaluation and Hyperparameter Tuning a.Implement cross-validation techniques (k-fold, stratified, etc.) for robust model evaluation b.Systematically explore combinations of hyperparameters to optimize model performance.(use grid and randomized search)
8	Bayesian Learning a.Implement Bayesian Learning using inferences
9	Deep Generative Models a.Set up a generator network to produce samples and a discriminator network to distinguish between real and generated data. (Use a simple small dataset)
10	Develop an API to deploy your model and perform predictions

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	**SEM – III MAJOR**	**Credits**	**Lectures/ Week**
25ITMJ913	**Paper III–Storage as a Service**	**2**	**2**

Course Objectives:

After completion of the course, a student should be able to:

CO1:Recall the storage technologies: SAN, NAS, IP storage etc.

CO2:Describe the need for Storage Area Network and Data protection to satisfy the information explosion requirements.

CO3**:** Employ the concepts of Storage Area Network (SAN) architecture, protocols, and infrastructure in real-world scenarios by configuring, managing, and optimizing SAN systems

CO4: Compare the applications of Storage Area Networks (SAN) in addressing storage management needs in heterogeneous environments by evaluating their effectiveness, comparing different approaches, and identifying key challenges and solutions.

Unit	Details	Lectures
I	**Data storage and 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. **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 **Storage Virtualization:** The Power in Volume Management , Software and SAN 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	15

II	**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) **New Directions in Network Filing:** Clustered File Systems, Distributed File Systems, and Network Storage for Databases Cluster File Systems, SuperScaling Network File Systems with SAN-Based Distributed File, Systems Network Storage for Databases. 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. **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	**15**

References:

- Storage Networking Fundamentals: AnIntroduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems, Marc Farley Cisco Press 2004
- Storage Networking Protocol Fundamentals James Long Cisco Press 2006
- Storage Virtualization: Technologies for Simplifying Data Storage and Management Tom Clark Addison Wesley Professional 2005

Course Code	SEM III- Elective	Credits	Lectures /Week
25ITEL921	Natural Language Processing	2	2

Course Outcomes:

After completion of the course, a student should be able to:

CO1: Recall the core concepts of Language Computing.

CO2: Explain the purpose and function of various NLP tasks, including Morphological analysis, POS tagging, syntactic parsing, and semantic analysis.

CO3:Implement the algorithms for morphological analysis or part-of-speech tagging.

CO4:Compare various approaches to grammar representation (e.g., rule-based vs. statistical) used in computational linguistics,

Unit	Topic	Lectures
I	**Introduction to NLP:** Brief history, NLP applications, Challenges/Open Problems, NLP Abstraction levels, Introduction to NL computing techniques and steps (segmentation, tagging, parsing, Chunking) Named Entity Recognition (NER), Parsing, Word Sense Disambiguation. **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.	15
II	**Part-of-Speech (POS) Tagging and Evaluation**: Word Classes and Introduction to POS Tagging, Introduction to semantic analysis theories and methodologies, lexical semantics, word senses, and relationships, Introduction to WordNet. **Stochastic Approaches**: Overview of probabilistic models, N-gram models, and Hidden Markov Models (HMM) for POS tagging, Transformation-Based Learning (TBL) Morphology, Evaluation Metrics and Error Analysis: Precision, Recall, F-measure,	15

	error-analysis	

References:

- Handbook of Natural Language Processing Indurkhya, N.& Damerau,F. J.CRC Press Taylor and Francis Group 2nd Edition 2010
- Speech and Language Processing Martin, J. H., & Jurafsky, D. Pearson Education India 2nd Edition 2013
- Foundations of Statistical Natural Language Processing Manning,Christopher and Heinrich, Schutze MIT Press 1st Edition 199

Course Code	SEM III- Elective	Credits	Lectures/ Week
25ITELP91	**Natural Language Processing Practical**	**2**	**4**

Course Outcomes:

After completion of the course, a student should be able to:

CO1: List the key elements involved in syntactic parsing.

CO2: Explain the underlying principle of a trigram model and its application in language modeling.

CO3: Implement a program to perform sentence segmentation and word tokenization on a given text.

Note: - The following set of Practical can be performed using any Python Libraries for NLP such as NLTK, spaCy, genism:Link:-https://www.python.org/downloads/

1	Write a program to implement sentence segmentation and word tokenization.
2	Write a program to Implement stemming.
3	Write a program to Implement lemmatization.
4	Write a program to Implement a tri-gram model.
5	Write a program to Implement PoS tagging using HMM.

6	Write a program to Implement PoS tagging using Neural Model.
7	Write a program to Implement syntactic parsing of a given text.
8	Write a program to Implement dependency parsing of a given text.
9	Write a program to Implement Named Entity Recognition.
10	Write a program to Implement Text Summarization for the given sample text.

Course Code	**SEM III- Elective**	**Credits**	**Lectures/ Week**
25ITEL922	**Security Operations Center**	**2**	**2**

Course Outcomes:

After completion of the course, a student should be able to:

CO1: Define the core functions and responsibilities of a Security Operations Center
CO2: Explain the incident response lifecycle and differentiate between various security incident detection techniques
CO3: Employ prioritization based on incident response and severity level.
CO4: Differentiate between Network-based and Host-based Intrusion Detection Systems.

Unit	**Topic**	**Lectures**
I	SOC functions and responsibilities: Overview, Understanding the SOC analyst role, Introduction to the incident response lifecycle, Security Incident Detection and Classification, Techniques for detecting security incidents, Incident classification and severity levels, Establishing incident response priorities, Incident response planning and frameworks NIST, ISO 27035 Incident response roles and responsibilities	**15**

II	Network Security Monitoring and Analysis, Network Monitoring Tools, Common Network Attacks, Reconnaissance Attacks like Port Scanning, Network Mapping. Intrusion Detection and Prevention Systems: Network-based (NIDS) and Host-based (HIDS). PCAP Analysis for Incident Response, Host-Based Security Analysis Security Information and Event Management (SIEM): introduction, syslog, SIEM Platforms, Splunk, ELK Stack (Elasticsearch, Logstash, Kibana), Graylog.	**15**

References:

- Fundamentals of Cyber Security, Mayank Bhushan and Rajkumar Singh Rathore, BPB publication, 2018
- Beginner's Guide to Ethical Hacking and Cyber Security, Abhinav Ojha, Notion press, 2020

Course Code	**SEM III- Elective**	**Credits**	**Lectures/ Week**
25ITELP92	**Security Operations Center Practical**	**2**	**4**

Course Outcomes:

After completion of the course, a student should be able to:

CO1: Recall the basic principles of data encryption, decryption, and hashing using various tools such as OpenSSL and hacker tools.
CO2: Explain the concept of network traffic analysis and its role in identifying attacks, exploits and malicious activity.
CO3: Use Wireshark to examine and investigate various network traffic such as Telnet, SSH, HTTP, HTTPS, and DNS.
CO4: Investigate network attacks and exploits to identify vulnerabilities in Windows systems, MySQL databases, and other network services.

1	a. Encrypting and Decrypting Data Using a Hacker Tool b. Encrypting and Decrypting Data Using OpenSSL c. Hashing a Text File with OpenSSL and Verifying Hashes
2	a. Examining Telnet and SSH in Wireshark b. Investigating an Attack on a Windows Host

	c. Investigating a Malware Exploit
3	a. Demonstrate the use of Snort and Firewall Rules b. Demonstrate Extract an Executable from a PCAP c. Demonstrate a practical for Exploring DNS Traffic
4	a. Using Wireshark to Examine HTTP and HTTPS Traffic b. Exploring Processes, Threads, Handles, and Windows Registry
5	Perform a practical to Attack on a mySQL Database by using PCAP file.
6	Create your own syslog Server
7	Configure your Linux system to send syslog messages to a syslog server and Read them
8	Install and Run Splunk on Linux
9	Install and Configure ELK on Linux
10	Install and Configure GrayLog on Linux

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	**SEM III- Elective**	**Credits**	**Lectures /Week**
25ITEL923	**Server Virtualization on VMWare**	**2**	**2**
Course Outcomes: After completion of the course, a student should be able to: CO1: Identify the core components of VMware vSphere 6.7 suite. CO2: Explain the reasons for choosing vSphere as a virtualization platform. CO3: Employ a VMware vSphere deployment by considering server platforms and storage architectures. CO4: Compare the local storage with shared storage options and architectures.			

Unit	Topic	Lectures
I	**Introducing VMware vSphere 6.7:** Exploring VMware vSphere 6.7, Examining the Products in the vSphere Suite, Examining the Features in VMware vSphere, Licensing VMware vSphere, Why Choose vSphere? Planning and Installing VMware ESXi: VMware ESXi Architecture, Understanding the ESXi Hypervisor, Examining the ESXi Components, Planning a VMware vSphere Deployment, Choosing a Server Platform, Determining a Storage Architecture, Integrating with the Network Infrastructure, Deploying VMware ESXi, Installing VMware ESXi Interactively, Performing an Unattended Installation of VMware ESXi, Deploying VMware ESXi with vSphere Auto Deploy, Performing Post-installation Configuration, Reconfiguring the Management Network, Using the vSphere Host Client, Configuring Time Synchronization, Configuring Name Resolution, Installing and Configuring vCenter Server: Introducing vCenter Server, Centralizing User Authentication Using vCenter Single Sign-On, Understanding the Platform Services Controller, Using the vSphere. **Creating and Configuring a vSphere Network:** Putting Together a vSphere Network, Working with vSphere Standard Switches, Comparing Virtual Switches and Physical Switches, Understanding Ports and Port Groups, Understanding Uplinks, Configuring the Management Network, Configuring VMkernel Networking,	**15**
II	**Creating and Configuring Storage Devices:** Reviewing the Importance of Storage Design, Examining Shared Storage Fundamentals, Comparing Local Storage with Shared Storage, Defining Common Storage Array Architectures, Explaining RAID, Understanding vSAN, Understanding Midrange and External Enterprise Storage Array Design, Choosing a Storage Protocol, Making Basic Storage Choices, Implementing vSphere Storage Fundamentals Creating and Managing Virtual Machines: Understanding Virtual Machines, Examining Virtual Machines from the Inside, Examining Virtual Machines from the Outside, Creating a Virtual Machine, Choosing Values for Your New Virtual Machine, Sizing Virtual Machines, Naming Virtual Machines, Sizing Virtual Machine Hard Disks. **Managing Resource Allocation**: Reviewing Virtual Machine, Resource Allocation, Working with Virtual Machine Memory, Understanding ESXi Advanced Memory Technologies, Controlling Memory Allocation, Managing	**15**

	Virtual Machine CPU Utilization	

References:

- Mastering VMware vSphere 67, Nick Marshall, Mike Brown, G Blair Fritz, Ryan Johnson Sybex,Wiley,2019
- Mastering VMware vSphere 67, Martin Gavanda,Andrea Mauro,Paolo Valsecchi,Karel Novak Packt,2019

Course Code	**SEM III- Elective**	**Credits**	**Lectures /Week**
25ITELP93	**Server Virtualization on VMWare Practical**	**2**	**4**

Course Outcomes:

After completion of the course, a student should be able to:

CO1: Identify the primary components of the VMware ESXi architecture.

CO2: Describe the role of the ESXi hypervisor and its interaction with hardware resources.

CO3: Implement a basic VMware vSphere deployment considering server, storage, and network requirements.

CO4: Compare the different storage architectures for vSphere environments.

1	Deploying and Configuring Virtual Machines 1. Access Your Student Desktop 2. Create a Virtual Machine 3. Install VMware Tools 4. Copy Files to the Desktop
2	Working with vCenter Server Appliance 1. Access your vCenter Server Appliance and Configure Licenses 2. Configure Single Sign-On and Create a Data Center Object 3. Add Your ESXi Hosts to the vCenter Server Inventory 4. Configure the ESXi Hosts as NTP Clients 5. Create a Host and Cluster Folder. 6. Create Virtual Machine and Template Folders. 7. Navigate vSphere Client
3	Users, Groups, and Permissions 1. Join the vCenter Server Appliance to vclass.local Domain 2. Add vclass.local as an Identity Source . 3. View Active Directory Users. 4. Assign Object Permissions to an Active Directory User

	5. Assign Root-Level Global Permission 6. Log In with Windows Session Authentication 7. Use an Active Directory User to Manage a Virtual Machine
4	Using Standard Switches 1. View the Standard Switch Configuration 2. Create a Standard Switch with a Virtual Machine Port Group . 3. Attach Your Virtual Machines to the New Virtual Machine Port Group
5	Accessing iSCSI Storage 1. Validate an Existing ESXi Host iSCSI Configuration 2. Add a VMkernel Port Group to a Standard Switch 3. Configure the iSCSI Software Adapter 4. Connect the iSCSI Software Adapters to Storage
6	Managing VMFS Datastores 1. Create VMFS Datastores for the ESXi Host 2. Expand a VMFS Datastore to Consume Unused Space on a LUN. 3. Remove a VMFS Datastore. 4. Extend a VMFS Datastore 5. Create a Second Shared VMFS Datastore Using iSCSI
7	Accessing NFS Storage 1. Configure Access to NFS Datastores 2. View NFS Storage Information
8	Using Templates and Clones 1. Create a Virtual Machine Template 2. Create Customization Specifications 3. Deploy a Virtual Machine from a Template
9	Modifying Virtual Machines 1. Clone a Powered-On Virtual Machine 2. Increase the Size of a VMDK File 3. Adjust Memory Allocation on a Virtual Machine. 4. Rename a Virtual Machine in the vCenter Server Appliance Inventory 5. Add and Remove a Raw LUN on a Virtual Machine
10	Managing Resource Pools . 1. Create CPU Contention . 2. Create Resource Pools . 3. Verify Resource Pool Functionality
11	Monitoring Virtual Machine Performance . 1. Create the CPU Workload . . 2. Use Performance Charts to Monitor CPU 3. Undo Changes Made to the Virtual Machines

Course Code	SEM III	Credits	Lectures /Week
25ITRP93	Research PROJECT	4	120

Introduction

The NEP 2020 has emphasized on the inclusion of research and development in Higher
Education Institutions. As colleges are integral part of knowledge impartment and creation NEP 2020 has introduced the research component to quite substantial degree at
post graduate level. The multidisciplinary, transdisciplinary and translational research culture is expected to be introduced at postgraduate level. Such research project undertaken will obviously enhance the research productivity, collaboration at national and international level in various industries, government as well as community based organizations and agencies.

Course Outcomes:

CO1: Define well formulated specific objectives that help to develop the overall research methodology

CO2: Identifying the research methods and literature review

CO3: Apply pre-learnt concepts to design research problem with the help of literature survey and develop a thorough research proposal.

CO4: Analyze the research gap by comparative study.

Guidelines for Research Project

A student is expected to devote at least 2 to 3 months of effort to the Research Project Proposal.
A student should submit a Research Project Proposal report with the following details:

- Title: Title of the Research Project.
- Objective: A detailed objective of the proposal is needed.
- Introduction/Background
- Related works/Literature Survey: A detailed survey of the relevant works done by others in the domain. The student is expected to refer to at least 30 recent (last five years) research papers in addition to textbooks and web links in the relevant topic.
- Proposed Methodology: - Describe the overall research design, including whether it will be quantitative, qualitative, or mixed-methods. Explain the rationale behind the

chosen design and how it aligns with the research objectives. Explain the characteristics
of the participants, including demographics, sample size, selection criteria, and recruitment methods. Outline the methods used for data collection, such as surveys, interviews, observations, or document analysis.

- Significance / Scope of the work
- Conclusion
- References

Certified Spiral Bound Copy duly signed by Internal Guide and Head of the Department is required to submit at the time of External Viva Examination

Scheme of Examination for Research Project

Internal Examination A) Continuous Internal Evaluation:

<table>
<tr><td colspan="4">Method</td><td colspan="2">Marks</td></tr>
<tr><td colspan="4">Internal Viva 1</td><td colspan="2">25</td></tr>
<tr><td>Topic Weightage</td><td colspan="2">Introduction</td><td>Objectives</td><td>Literature Survey</td><td>Total</td></tr>
<tr><td>05</td><td colspan="2">05</td><td>05</td><td>10</td><td>25</td></tr>
<tr><td colspan="4">Internal Viva2</td><td colspan="2"></td></tr>
<tr><td>Proposed Methodology</td><td colspan="2">Significance / Scope and Conclusion</td><td>Documentation</td><td colspan="2">Total</td></tr>
<tr><td>10</td><td colspan="2">05</td><td>10</td><td colspan="2">25</td></tr>
</table>

External Examination A) External Evaluation:

Method				Marks			
External Viva				50			
Topic Weightage	Introduction	Objectives	Literature Review	Proposed Methodology	Documentation	Presentation/ Viva	Total
05	05	05	10	05	10	10	50

SEMESTER- IV

Course Code	MAJOR SEM – IV	Credits	Lectures/Week
25ITMJT11	Paper I- Blockchain	4	4

Course Outcomes:

After successful completion of this course, students would be able to

CO1 : Recall the fundamentals of Ethereum and Bitcoin.

CO2 : Describe the structure of a Blockchain

CO3 : Use the concepts of smart contracts and decentralized applications (DApps) by developing, deploying, and interacting with them on blockchain platforms.

CO4 : Compare permissioned and public blockchains, as well as the role of NFTs, by evaluating their advantages and limitations in various applications.

Unit	Topics	No of Lectures
I	**Blockchain Introduction** **a. Blockchain** – Introduction, History, Centralised versus Decentralised systems, Layers of blockchain, Importance of blockchain, Blockchain uses and use cases. **b. Working of Blockchain** – Blockchain foundation, Cryptography, Game Theory, Computer Science Engineering, Properties of blockchain solutions, blockchain transactions, distributed consensus mechanisms, Blockchain mechanisms, Scaling blockchain	15
II	**Bitcoin and Ethereum** **a**. **A Working of Bitcoin**: Money, Bitcoin, Bitcoin blockchain, bitcoin network, bitcoin scripts, Full Nodes and SVPs, Bitcoin wallets, Interacting with the Bitcoin Blockchain **b. Ethereum**- Ethereum as a Next-Gen Blockchain, Design Philosophy of Ethereum, Ethereum Blockchain, Ethereum Accounts, Advantages of Accounts, Account State, Merkle Patricia Tree, Ethereum Transaction and Message Structure, Ethereum State Transaction Function, Gas and Transaction Cost, Ethereum Smart Contracts, Contract Creation, Ethereum Virtual Machine. **c. Mining Ether**: Difficulty, Factors Required for Block Validation, How Proof of Work Helps Regulate Block Time, Faster Blocks, How Ethereum Uses Stale Blocks, Forking	15

III	Smart Contract & Dapp **a. Smart Contracts and Solidity:** Basic of Solidity Programming:- writing loops in solidity, statement and expressions in solidity, Value types, Global special variables, Units andFunctions **b. 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. **c. Blockchain Application Development** -Decentralized Applications, , Interacting Programmatically with Ethereum—Sending Transactions, Creating a Smart Contract, Executing Smart Contract Functions	**15**
IV	**Permissioned Blockchain ,Cryptoeconomics & NFT** **a. Permissioned Blockchain-**, Public vs. Private Blockchains,Decentralized Application Architecture, Hyperledger concept, Exploring Hyperledger fabric project, Iroha project **b. Cryptoeconomics**- Why Is Cryptoeconomics useful?, Understanding Hashing vs.encryption,Speed of blocks, Ether Issuance scheme,Common Attack Scenarios **c. NFT**- What are NFTs?NFT Marketplaces,Creating and Minting NFTs,Legal Aspects of NFTs, The Future of NFTS	**15**

References:

- Introducing Ethereum and Solidity Chris Dannen Apress 2017
- Beginning Blockchain: ABeginner's Guide toBuilding BlockchainSolutionsBikramadity Singhal , GautamDhameja ,Priyansu SekharPanda Apress 2018
- Blockchain for dummies Tiana Laurence Wiley 2017

Course Code	MAJOR SEM – IV	Credits	Lecturs/ week
25ITMJPT1	Blockchain- Practical	2	4

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recognize the differences between public and permissioned blockchains, and understand the concept of decentralized networks.

CO2:Describe the core components of blockchain such as smart contracts, consensus mechanisms (Proof of Work, Proof of Stake), and decentralized applications (DApps).

CO3: Implement and mint NFTs using blockchain platforms, and interact with them on decentralized marketplaces.

CO4:Differentiate the legal, ethical, and regulatory implications of using blockchain technology in different industries.

1	a.Develop a secure messaging application where users can exchange messages securely using RSA encryption. Implement a mechanism for generating RSA key pairs encrypting/decrypting messages. b.Allow users to create multiple transactions and display them in an organised format.
2	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.
3	Implement a function to add new blocks to the miner and dump the blockchain.
4	a.Write a python program to demonstrate mining.
5	Demonstrate the use of the Bitcoin Core API to interact with a Bitcoin Core node.
6	Demonstrating the process of running a blockchain node on your local machine.
7	Demonstrate mining using geth on your private network.
8	a.Write a Solidity program that demonstrates various types of functions including regula functions, view functions, pure functions, and the fallback function. b.Write a Solidity program that demonstrates function overloading, mathematical functions, and cryptographic functions c.Write a Solidity program that demonstrates various features including contracts, inheritance, constructors, abstract contracts, interfaces
9	a.Write a Solidity program that demonstrates use of libraries, assembly,events, and error handling

	b.Build a decentralized application (DApp) using Angular for the frontend and Truffle along with Ganache CLI for the back end.
10	a.Install and demonstrate use of hyperledger-Iroha b.Demonstration on interacting with NFT

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	MAJOR SEM – IV	Credits	Lectures/ Week
25ITMJT12	**Paper II-Deep Learning**	**4**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall common activation functions, such as ReLU, sigmoid, and tanh, and their role in introducing non-linearity to the model.

CO2**:** Explain the concept of overfitting in deep learning and the role of techniques like dropout and regularization to combat it.

CO3:Use deep learning frameworks (like TensorFlow or PyTorch) to build and train a simple neural network for a classification task, such as digit recognition using the MNIST dataset.

CO4:Compare the training and validation curves of a deep learning model to diagnose overfitting or underfitting.

Unit	Topics	No of Lectures
I	**a) 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. **b) Numerical Computation**: Overflow and underflow, poor conditioning, Gradient Based Optimization, Constraint optimization.	**15**
II	**a) Deep Networks:** Deep feed forward network, regularization for deep learning, Optimization for Training deep models.	**15**
III	**a) Convolution Applications**: Convolutional Networks, Sequence Modelling, Applications **b) Deep Learning Research**: Linear Factor Models, Auto encoders,representation learning	**15**
IV	**a) Generative Models:** Approximate Inference, Deep Generative Models **b) Diffusion Models (Reference 3)** **c) Applications**: Transformers, Advance GANs (Reference 3)	**15**

References:

- Deep Learning IanGoodfellow,Yoshua Bengio,Aaron An MIT Pressbook-1st Edition 2016
- Fundamentals of DeepLearningNikhil Buduma O'Reilly- 1st Edition 2017

- Generative Deep Learning David Foster O'Reilly- 2nd Edition - 2023

Course Code	MAJOR SEM – IV	Credits	Lectures/Week
25ITMJPT2	Paper II Deep Learning– Practical	2	4

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall the basic concepts and functionalities of TensorFlow, including how to create and manipulate tensors with different shapes and data types.

CO2: Describe the working mechanisms of convolutional neural networks (CNNs) and how they are used for classification tasks.

CO3: Use TensorFlow's low-level API (or tf.keras) to implement basic operations on tensors and perform matrix multiplication.

CO4: Examine the accuracy and performance of the linear regression model, identifying the relationship between input features and target variables.

1.	**Introduction to TensorFlow** a. ● Create tensors with different shapes and data types. ● 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 b. Program to solve the XOR problem
2.	**Linear Regression** ● Implement a simple linear regression model using TensorFlow's lowlevel 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
3.	**Convolutional Neural Networks (Classification)** a.Implementing deep neural network for performing binary classification task b.Using a deep feed-forward network with two hidden layers for performing multiclass classification and predicting the class
4.	Write a program to implement deep learning Techniques for image segmentation
5.	Write a program to predict a caption for a sample image using LSTM.

6.	Applying the Autoencoder algorithms for encoding real-world data
7.	Write a program for character recognition using RNN and compare it with CNN.
8.	Write a program to develop Autoencoders using MNIST Handwritten Digits
9.	Demonstrate recurrent neural network that learns to perform sequence analysis for stock price.(google stock price)
10.	Applying Generative Adversarial Networks for image generation and unsupervised tasks.

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	**SEM IV- ELECTIVE**	**Credits**	**Lectures /Week**
25ITELT21	**Data Center Technologies**	**2**	**2**

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall essential definitions related to data centers and their operational areas.

CO2: Describe the different operational areas and the overall architecture of a data center.

CO3: Demonstrate a basic data center architecture and identify its key components.

CO4: Compare different virtualization technologies based on their scalability and features.

Unit	**Topics**	**No of Lectures**
	Data Center Essential Definitions, Data Center Evolution, Operational Areas and Data Center Architecture. The Origins of Data Center Virtualization, Virtual Memory, Mainframe Virtualization. Hot Standby Router Protocol, Defining Virtualization Data Center Virtualization. Timeline Classifying Virtualization Technologies, A Virtualization Taxonomy, Virtualization Scalability Technology Areas, Classification Examples Data Center Network Evolution: Data Center Network	

I	Layers, Design Factors for Data Center Networks, Physical Network Layout Considerations, the ANSI/TIA-942 Standard Network Virtualization Benefits. Application Networking Services: The Use of Load Balancers, Load-Balancing Concepts, Layer 4 Switching Versus Layer 7 Switching, Connection Management, Address Translation and Load Balancing, Server NAT Dual NAT Port Redirection Transparent Mode, Other Load-Balancing Applications, Firewall Load Balancing, Reverse Proxy Load Balancing, Offloading Servers SSL, Offload TCP, Offload HTTP, Compression Load Balancer Proliferation in the Data Center Load Balancer	**15**
II	Extending Device Virtualization, Why to Use VDCs? VDCs in Detail Creating and Configuring VDCs, VDC Names and CLI Prompts Virtualization, Nesting, Allocating Resources to VDCs Using Resource Templates, Managing VDCs VDC Operations. The Virtual Data Center and Cloud Computing: The Virtual Data Center Automation and Standardization, Networking in the Clouds Software-Defined Networks, Software-Defined Networking (SDN) Fundamentals, Mininet Environment for SDN, Cloud Resource Management ,Cloud Service Providers and Organization Management, Desktop Virtualization and Remote Access.	**15**
References: • Data Center Virtualization Fundamentals, Gustavo Alessandro, Andrade Santana, Cisco Press, 2014		

Course Code	**SEM IV- ELECTIVE**	**Credits**	**Lectures/ Week**
25ITELPT1	**Data Center Technologies Practical**	**2**	**4**
Course Outcomes: After successful completion of this course, students would be able to CO1:Explain Cloud Security and Compliance CO2: Understand the concept of Cloud architecture and its model. CO3: Apply the virtualization concept with its types. CO4: Evaluate different virtualization and cloud computing solutions to determine their suitability for a specific data center setup.			

1	Sketch out and analyze the architecture of Openstack/ Eucalyptus/ OpenNebula/ KVM and identify different entities to understand the structure of it.
2	Create a Cloud Organization in AWS/Google Cloud/or any equivalent Open Source cloud softwares like Openstack/ Eucalyptus/ OpenNebula with Rolebased access control.
3	Install Virtualbox/VMware/ Equivalent open source cloud Workstation with different platforms of Linux or Windows OS on top of windows 8 and above
4	Install Python in the virtual machine created using VirtualBox/VMware and execute Simple Programs.
5	Create type 2 virtualization in VMWARE or any equivalent Open Source Tool. a. Starting and Stopping a virtual machine. b. Allocate memory and storage space as per requirement. c. Take snapshots of virtual machines d. Clone a virtual machine to create identical copies. e. Transfer the files from one virtual machine to another virtual machine
6	Create desktop Virtualization using Chrome Remote Desktop.
7	Setup your own virtual SDN lab using any of below given platform i) Virtualbox/Mininet Environment for SDN - http://mininet.org
8	A study and comparison on various cloud databases like Amazon RDS ,Google Cloud SQL,Microsoft Azure SQL Database, IBM Db2 on Cloud, Firebase Realtime Database (NoSQL), MongoDB Atlas (NoSQL),Oracle Cloud Autonomous Database
9	A study and comparison on various cloud storage like Amazon S3,Google Cloud Storage, Microsoft Azure Blob Storage, IBM Cloud Object Storage for its performance and scalability.
10	Simulate resource management using cloudsim open source framework.

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	SEM IV- ELECTIVE	Credits	Lectures/ Week
25ITELT22	Cyber Forensics	2	2

Course Outcomes:

After successful completion of this course, students would be able to

CO1: List the steps involved in a typical computer forensics investigation process.

CO2: Describe the various stages of a computer forensics investigation process and their objectives.

CO3: Execute appropriate data acquisition techniques to create forensic duplicates of storage media

CO4: Investigate for a given scenario and determine the appropriate steps in the computer forensics investigation process.

Unit	Topics	No of Lectures
I	Computer Forensics: The present Scenario, The Investigation Process, Computers – Searching and Seizing, Electronic Evidence, Procedures to be followed by the first responder. Hard Disks and File Systems Analysis, File System Metadata Analysis, Forensic Analysis Tools for File Systems, Introduction to tools like The Sleuth Kit (TSK), Autopsy, Data Acquisition and Duplication Techniques, Operating System Forensics, Hidden Data and Alternate Data Streams	15
II	Recovery of deleted files and partitions, Using Access Data FTK and Encase for forensics Investigation, Forensic analysis of Steganography and Image files, Cracking Application passwords. Network Traffic Analysis, Log Analysis in Network Forensics, Wireless Network Forensics, Web Server Logs, Domain and IP Address Analysis, Email Tracking and Email Crime investigation, Mobile Forensics.	15

References:

- EC-Council CHFIv10 Study Guide,EC-Council,2018
- The official CHFI Exam 312-49 study Guide, Dave Kleiman SYNGRESS,2007
- Digital Forensics and Incident Response,Gerard Johansen Packt Publishing, 2020
- Practical Cyber Forensics, Niranjan Reddy, Apress 2019

Course Code	SEM IV- ELECTIVE	Credits	Lectures/Week
25ITELPT2	Cyber Forensics Practical	2	4

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall types of digital evidence, such as data from hard drives, emails, network logs, and mobile devices.

CO2: Explain the concept of chain of custody in cyber forensics and why it's essential for preserving the integrity of evidence.

CO3: Apply forensic techniques to analyze network traffic and logs to identify security breaches or malicious activity (e.g., data exfiltration or malware communications)..

CO4: Analyze forensic evidence from disk images and file systems, such as Windows and Linux file systems, to uncover hidden or deleted data.

1	**Computer Forensics Investigation Process** a. Recovering Data using the EaseUS Data Recovery Wizard. b. Performing Hash, Checksum, or HMAC Calculations using the HashCalc. c. Creating a Disk Image File of a Hard Disk Partition using the Rdrive Image Tool**.**
2	**Understanding Hard Disks and File Systems** a. Analyzing File System Types Using the Sleuth Kit (TSK). b. Analyzing Raw image using Autopsy. c. Analyze file system of Linux image file. d. Analyze file system of Windows image file
3	**Data Acquisition and Duplication** a. Creating a dd image file b. Investigating NTFS Drive Using DiskExplorer for NTFS. c. Viewing Content of Forensic Image Using Access Data FTK Imager Tool
4.	**Defeating Anti-forensics Techniques** a. Cracking Application Password b. Detecting Steganography c. Perform a practical of identifying the packer used to pack a file by using ExeInfo PE and then unpacking the file using UPX.
5.	**Performing OS Forensics** a. Performa a Practical collect volatile information from a host computer running on a Windows OS by using tools PsTools, ogonSessions, and NetworkOpenedFiles. b. Performa a Practical for Discovering and Extracting Hidden Forensic Material on Computers Using OSForensics. c. Performing a Computer Forensic Investigation Using the Helix Tool d. examine Windows event logs using Event Log Explorer.

6.	**Network Forensics** a. Investigating Network Traffic Using Wireshark b. Investigating Network Attacks using Kiwi Log Viewer
7.	**Investigating Web Attacks** a. Analyzing Domain and IP Address Queries Using SmartWhois Tool
8.	**Database Forensics** a. Analyzing SQLite Databases using DB Browser for SQLite
9.	**Malware Forensics** a. Perform Static Analysis of the Suspicious File b. performing dynamic analysis of a malicious file to find the processes It starts, network operations, file changes and other activities
10.	**Investigating Email Crimes** a. Recovering Deleted Emails Using the Recover My Email utility. b. Tracing an Email Using the eMailTrackerPro Tool **Mobile Forensics** a. Analyzing the Forensic Image and Carving the Deleted Files Using Autopsy.

Note: Students are required to complete a minimum of 80% of all the practicals

Course Code	SEM IV- ELECTIVE	Credits	Lectures/ Week
25ITELT23	Robotic Process Automation	2	2

Course Outcomes:

After successful completion of this course, students would be able to
CO1: Recall the scope and common techniques used in automation.
CO2: Explain the benefits and applicability of Robotic Process Automation.
CO3: Implement control flow logic, including loops and decision-making, in UiPath workflows.
CO4: Compare the use cases for Sequence and Flowchart workflows in different automation scenarios.

Unit	Topics	No of Lectures
I	**Robotic Process Automation:** Scope and techniques of automation, About UiPath Record and Play, UiPath stack, Downloading and installing UiPath Studio, Learning UiPath Studio, Task recorder, Step-by-step examples using the recorder. **Sequence, Flowchart, and Control Flow:** Sequencing the workflow, Activities, Control flow, various types of loops, and decision making, Step-by-step example using Sequence and Flowchart, Step-by-step example using Sequence and Control flow. **Data Manipulation:** Variables and scope, Collections, Arguments – Purpose and use, Data table usage with examples, Clipboard management, File operation with step-by-step example, CSV/Excel to data table and vice versa (with a step-by-step example)	15
II	**Taking Control of the Controls:** Finding and attaching windows, Finding the control, Techniques for waiting for a control, Act on controls – mouse and keyboard activities, Working with UiExplorer, Handling events, Revisit recorder, Screen Scraping, When to use OCR, Types of OCR available, How to use OCR, Avoiding typical failure points. **Handling User Events and Assistant Bots:** What are assistant bots? ,Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger, Monitoring image and element triggers, An example of monitoring email, Example of monitoring a copying event and blocking it, Launching an assistant bot on a keyboard event.	15

References:

- Learning Robotic Process Automation, Alok Mani Tripathi, Packt ,2018

• Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation, Srikanth Merianda, Createspace Independent Publishing, 1st Edition 2018 • The Simple Implementation Guide to Robotic Process Automation (RPA): How to Best Implement RPA in an Organization, Kelly Wibbenmeyer, iUniverse, 1st Edition 2018			

Course Code	**SEM IV- ELECTIVE**	**Credits**	**Lectures/ Week**
25ITELPT3	**Robotic Process Automation Practical**	**2**	**4**

Course Outcomes:

After successful completion of this course, students would be able to

CO1: Recall the key concepts and terminology related to RPA, including sequences, flowcharts, decision making, and various UiPath controls.

CO2: Describe the basics of screen scraping, web scraping, and PDF automation techniques for data extraction.

CO3: Use decision-making structures and loops to automate tasks, such as counting specific items in arrays, performing mathematical calculations, and iterating through collections.

CO4: Investigate and resolve issues related to data inconsistencies, missing files, and invalid data during automation processes.

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)
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)
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
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 cell of an excel sheet. e. Create an automation to sort a table of an excel sheet. f. Create an automation to filter a table of an excel sheet 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
5	**Different controls in UiPath:** a. Implement the attach window activity. b. Automate using Anchor Base. c. Automate using Element Exists. d. Automate using Find Children control. e. Use Get Ancestor control f. Use Find Relative control
6	**Keyboard and Mouse Events:** a. Demonstrate the following activities in UiPath: i. Mouse (click, double click and hover) ii. Type into iii. Type Secure text b. Demonstrate the following events in UiPath: i. Element triggering event ii. Image triggering event iii. System Triggering Event c. Automate the process of launching an assistant bot on a keyboard event.

7	**Screen Scraping and Web Scraping methods:** a. Automate the following screen scraping methods using UiPath: a. Full Text b. Native c. OCR b. Demonstrate Data Scraping and display values in Message box. c. Demonstrate Screen Scraping for a pdf, web page and image file.
8	**PDF Automation and Exception Handling:** a. Read PDF With OCR b. Merge PDF's into one c. Get PDF Total Page count Using Regex d. Extract data from a PDF or Excel file and populate it into a database or spreadsheet. 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
9	**Email Automation:** a. Configure Email using UiPath b. Read Emails c. Send Email with Attachment d. Save Email Attachments e. Reply to Email
10	**Orchestrator management and mini project:** a. Deploy bots to Orchestrator b. Run jobs from Orchestrator c. Queue Introduction: i. Add items to Queue. ii. Get Queue item from Orchestrator d. Build UiPath Chatbot using Google dialogflow
11	**RPA Applications:** a. Automate the extraction of data from invoices, validate information, and update accounting systems. b. Automate data entry tasks from various sources such as emails, forms, or documents, and validate data against predefined rules. c. Automate the process of expense reporting by extracting data from receipts, categorizing expenses, and generating reports. d. Automate inventory tracking and management processes, including stock updates, reordering, and inventory audits. e. Automate sales order processing tasks such as order entry, validation, and fulfilment.

12	**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

Note: Students are required to complete a minimum of 80% of all the practicals.

Course Code	**SEM – IV – Research Project**	**Credits**	**Hours**
25ITOJTT3		**6**	**180**

Introduction

The research project proposal needs to be implemented by following the given timeline Under the NEP, students are expected to get industry ready by the time they pass out of their Masters' degree course. There is also an emphasis on research so that every student is expected to carry out independent research project as a part of their Post Graduate program. The emphasis is on research that is socially applicable, and carried out with scientific rigor. One benchmark of good quality research is publication of the project either in International or National level scientific journals or the presentation of students' research work at International, National or State level conferences. With this broad objective, the following has been proposed for student research projects at Masters level.

Course Outcomes:

CO1: Facilitate substantial data collection for the proposed research work

CO2: Carry out research following ethical aspects of research activities.

CO3:Develop the proposed system

CO4: Analyze the research findings/conclusions / results obtained

Note: A student is expected to devote at least 3 to 4 months of effort to the Research Project Implementation on the proposal submitted in Semester III. Students should submit a detailed research project implementation report at the time of viva. Students are not permitted to change the project they submitted as a proposal in Semester III.

Guidelines for Documentation of Research Project Implementation in Semester –IV
A student should submit a Research Project Implementation report with the following details:

- Title: Title of the Research Project.
- Objective: A detailed objective of the proposal is needed.
- Introduction/Background:
- Related works/Literature Survey: A detailed survey of the relevant works done by others in the domain. The student is expected to refer to at least 30 recent (last five years) research papers in addition to textbooks and web links in the relevant topic.
- Methodology: A proper and detailed procedure of how to solve the problem discussed. It shall contain the techniques, tools, software, and data to be used.
- Implementation details: A description of how the project has been implemented.
- Experimental setup and results: A detailed explanation of how experiments were conducted, what software was used, and the results obtained. Details like screenshots, tables, and graphs can come here.
- Analysis of the results: A description of what the results mean and how they have been arrived at. Different performing measures or statistical tools used etc may be part of this.
- Conclusion: A conclusion of the project performed in terms of its outcome
- Future enhancement: A small description of what enhancement can be done when more time and resources are available
- Program code: The program code may be given as an appendix.

Certified Spiral Bound Copy duly signed by Internal Guide and Head of the Department is required to submit at the time of External Viva Examination

Scheme of Examination for Research Project

Internal Examination A) Continuous Internal Evaluation:

Method		Marks		
Internal Viva 1		40		
Methodology	Implementation	Total		
20	20	40		
Internal Viva 2				
Experimental setup and results	Analysis of the results	Code	Document	Total
05	10	15	05	35

External Examination A) External Evaluation:

Method				Marks			
External Viva				75			
Introduction	Objectives	Methodology	Code/Mode	Results	Document	Viva	Total
05	05	10	20	20	05	10	75

Evaluation Scheme for Second Year (PG) under NEP (4 credits)

I. Internal Evaluation for Theory Courses – 40 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 20 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 20 marks

II. External Examination for Theory Courses – 60 Marks

Duration: 2 Hours

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15
Q.3	Unit III	15
Q.4	Unit IV	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be subdivided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.

- **Paper Pattern of Theory Paper:(for 4 credits)**

DES's Kirti M. Doongursee College (AUTONOMOUS), Dadar (W), Mumbai-28			
Regular / Additional / ATKT Examination			
Duration: 2 Hour			**Max Marks: 60**
Date: **Time:** **Code:** ***(For office use)***			
N. B.	i)	*All Questions are compulsory.*	
	ii)	*Mixing of sub-questions is not allowed*	
	iii)	*Draw neat labeled diagrams wherever necessary.*	
Q. No.			**Marks**
Q.1 A			**07**
OR			
Q.1 B			**07**
Q.1 C			**08**
OR			

Q.1 D		**08**
Q.1 E		**07**
	OR	
Q.1 F		**07**
Q.2 G		**08**
	OR	
Q.2 H		**08**
Q.3 I		**07**
	OR	
Q.3 J		**07**
Q.3 K		**08**
	OR	
Q. 3 L		**08**
Q.4 M		**07**
	OR	
Q.4 N		**07**
Q.4 O		**08**
	OR	
Q.4 P		**08**

III. Practical Examination

- Each core subject carries 50 Marks
- Duration: 3 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.

Evaluation Scheme for Second Year (PG) under NEP (2 credits)

I. Internal Evaluation for Theory Courses – 20 Marks

1) Continuous Internal Assessment(CIA) Assignment - Tutorial/ Case Study/ Project / Presentations/ Group Discussion / Ind. Visit. – 10 marks

2) Continuous Internal Assessment(CIA) ONLINE Unit Test – 10 marks

II. External Examination for Theory Courses – 30 Marks

Duration: 1 Hours

Theory question paper pattern:

Question	Based on	Marks
Q.1	Unit I	15
Q.2	Unit II	15

- All questions shall be compulsory with internal choice within the questions.
- Each Question may be subdivided into sub questions as a, b, c, d, etc. & the allocation of Marks depends on the weightage of the topic.
- **Paper Pattern of Theory Paper:(for 2 credits)**

DES's Kirti M. Doongursee College (AUTONOMOUS), Dadar (W), Mumbai-28			
Regular / Additional / ATKT Examination			
Duration: 1 Hour			**Max Marks: 30**
Date: **Time:** **Code:** ***(For office use)***			
N. B.	i)	*All Questions are compulsory.*	
	ii)	*Mixing of sub-questions is not allowed*	
	iii)	*Draw neat labeled diagrams wherever necessary.*	
Q. No.			**Marks**
Q.1 A			**07**
OR			
Q.1 B			**07**
Q.1 C			**08**

OR		
Q.1 D		**08**
Q.1 E		**07**
OR		
Q.1 F		**07**
Q.2 G		**08**
OR		
Q.2 H		**08**

III. Practical Examination

- Each core subject carries 50 Marks.
- Duration: 2 Hours for each practical course.
- Minimum 80% practical from each core subjects are required to be completed.
- Certified Journal is compulsory for appearing at the time of Practical Exam

NOTE: To pass the examination, attendance is compulsory in both Internal & External (Theory + Practical) Examinations.