

**Sheth NKT College of Commerce and Sheth JTT College of Arts, Thane  
(Autonomous)**

**Syllabus: Post Graduate Programme As per**

**NEP-2020**

**(w.e.f. 2024-25)**

**M.Sc. (Information Technology) Part II Sem III**

| Category           | Code    | Course                                       | Credit |
|--------------------|---------|----------------------------------------------|--------|
| Major Mandatory    | MSA301  | Advanced AI                                  | 4      |
|                    | MSAP302 | Advanced AI Practical                        | 2      |
|                    | MSM303  | Machine Learning                             | 4      |
|                    | MSMP304 | Machine Learning Practical                   | 2      |
|                    | MSS305  | Storage as a service                         | 2      |
| Elective (Any One) | MSN306  | Natural Language Processing                  | 4      |
|                    | MSSP307 | Security Operations Center (PR)              |        |
|                    | MSVP308 | Server Visualization on VMWare Platform (PR) |        |
|                    | MSRP309 | Research Project                             | 4      |
|                    |         | Total Credit                                 | 22     |

**Sheth T. J. Education Society's  
Sheth N.K.T.T College of Commerce and  
Sheth J.T.T College of Arts (Autonomous), Thane**

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | <b>Semester: III</b> |
| Course Category/Vertical: Major Mandatory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                      |
| Course Title: Advance Artificial Intelligence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                      |
| Course Code: MSA301                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  | Course Level:6.5     |
| Type: <b>Theory</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |                      |
| Course Credit: 4 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                      |
| Hours Allotted: 60 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                      |
| Marks Allotted: 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                      |
| <b>Course Objectives:</b><br>1: To understand the fundamental concepts of Artificial Intelligence including intelligent agents, search techniques, and knowledge representation.<br>2: To gain knowledge of advanced AI techniques such as deep learning, NLP, reinforcement learning, and their real-world applications.<br>3: To understand machine learning paradigms and various neural network models used for solving complex problems.<br>4: To learn the concepts of generative AI models and their applications along with ethical considerations.                                                                                                                                                                     |  |                      |
| <b>Course Outcomes:</b><br>CO1: Understand the basics of AI, the role of intelligent agents, and how AI solves problems using different search algorithms and knowledge representation methods.<br>CO2: Implement advanced AI techniques such as deep learning, natural language understanding, and reinforcement learning across different domains like healthcare and robotics.<br>CO3: Explore various machine learning paradigms and architectures of artificial neural networks; identify their advantages and limitations in specific applications.<br>CO4: Develop generative AI systems capable of creating synthetic text, images, and other content responsibly, with attention to ethical and social considerations. |  |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| <b>Unit No.</b> | <b>Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Hours</b> |
|-----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| I               | <b>Unit 1: Foundations of Artificial Intelligence</b><br>Introduction to Artificial Intelligence<br>Intelligent Agents<br>Problem-solving using search algorithms<br>Knowledge Representation                                                                                                                                                                                                                                                                                       | 15           |
| II              | <b>Unit 2: Advanced Artificial Intelligence</b><br>Introduction to advanced AI concepts<br>Deep learning and neural networks<br>Natural language processing and understanding<br>Reinforcement learning<br>AI applications in various domains such as healthcare, finance, and robotics                                                                                                                                                                                             | 15           |
| III             | <b>Unit 3: Machine Learning</b><br>Machine Learning Paradigms: Machine Learning systems, supervised and un-supervised learning, inductive learning, deductive learning, clustering, support vector machines, case based reasoning and learning.<br>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           |
| IV              | <b>Unit 4: Generative AI</b><br>Introduction to generative AI and its applications<br>Generative adversarial networks (GANs)<br>Variational autoencoders<br>Text generation and image synthesis using generative AI<br>Ethical considerations in generative AI                                                                                                                                                                                                                      | 15           |
|                 | <b>Total Hours</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>60</b>    |

**References:**

| Sr.No | Title                                         | Author                                                      | Publisher            | Edition | Year |
|-------|-----------------------------------------------|-------------------------------------------------------------|----------------------|---------|------|
| 1     | Deep Learning                                 | Ian Goodfellow,<br>Yoshua Bengio,<br>and Aaron<br>Courville | MIT Pres             | 2020    | 1    |
| 2     | Artificial Intelligence: A<br>Modern Approach | Stuart Russell and<br>Peter Norvig                          | Prentice Hall        | 2020    | 2    |
| 3     | Reinforcement<br>Learning: An<br>Introduction | Richard S. Sutton<br>and Andrew G.<br>Barto                 | MIT Press            | 2023    | 3    |
| 4     | Python Machine<br>Learning                    | Sebastian<br>Raschka and<br>Vahid Mirjalili                 | Packt<br>Publication | 2021    | 4    |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | <b>Semester: III</b> |
| Course Category/Vertical: Major Mandatory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                      |
| Course Title: Advance Artificial Intelligence                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |                      |
| Course Code: MSAP302                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  | Course Level:6.5     |
| Type: <b>Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |  |                      |
| Course Credit: 2 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                      |
| Hours Allotted: 60 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                      |
| Marks Allotted: 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                      |
| <b>Course Objectives:</b><br><b>To enable the students to:</b><br>After completion of course the learner will:<br>1: be able to understand the fundamentals concepts of expert system and its applications.<br>2: be able to use probability and concept of fuzzy sets for solving AI based problems.<br>3: be able to understand the applications of Machine Learning. The learner can also apply fuzzy system for solving problems.<br>4: learner will be able to apply to understand the applications of genetic algorithms in different problems related to artificial intelligence.<br>5: A learner can use knowledge representation techniques in natural language processing                                     |  |                      |
| <b>Course Outcomes:</b><br>Upon completion of this course, students will be able to:<br>1. Understand Deep Learning Fundamentals:<br>2. Understand NLP Fundamentals.<br>3. Implement Chatbot Architectures:<br>4. Implement Deep Learning approach<br>5. Understand Computer Vision<br>6. Understand Generative Adversarial Networks (GANs)<br>7. Understand reinforcement learning algorithms<br>8. Understand Transfer learning fundamentals<br>9. Implement anomaly detection technique<br>10. Understand Automated techniques<br>11. Implement evolutionary algorithms<br>12. Deploying a machine learning model<br>13. Deploying Python Libraries<br>14. Understand Generative Adversarial Networks implementation |  |                      |

## Syllabus: NEP 2020 w.e.f 2025-26

| Unit No. | Content                                                                                                                                                                            | Hours     |
|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| I        | Implementing advanced deep learning algorithms such as convolutional neural networks (CNNs) or recurrent neural networks (RNNs) using Python libraries like TensorFlow or PyTorch. |           |
| II       | Building a natural language processing (NLP) model for sentiment analysis or text classification.                                                                                  |           |
| III      | Creating a chatbot using advanced techniques like transformer models.                                                                                                              |           |
| IV       | Developing a recommendation system using collaborative filtering or deep learning approaches.                                                                                      |           |
| V        | Implementing a computer vision project, such as object detection or image segmentation.                                                                                            |           |
| VI       | Training a generative adversarial network (GAN) for generating realistic images.                                                                                                   |           |
| VII      | Applying reinforcement learning algorithms to solve complex decision-making problems.                                                                                              |           |
| VIII     | Utilizing transfer learning to improve model performance on limited datasets.                                                                                                      |           |
| IX       | Building a deep learning model for time series forecasting or anomaly detection.                                                                                                   |           |
| X        | Implementing a machine learning pipeline for automated feature engineering and model selection.                                                                                    |           |
| XI       | Using advanced optimization techniques like evolutionary algorithms or Bayesian optimization for hyperparameter tuning.                                                            |           |
| XII      | Deploying a machine learning model in a production environment using containerization and cloud services.                                                                          |           |
| XIII     | 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.                   |           |
| XIV      | 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. |           |
|          | <b>Total Hours</b>                                                                                                                                                                 | <b>60</b> |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Semester: III</b> |
| Course Category/Vertical: Major Mandatory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                      |
| Course Title: Machine Learning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                      |
| Course Code: MSM303                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Course Level:6.5     |
| Type: <b>Theory</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                      |
| Course Credit: 4 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |
| Hours Allotted: 60 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |
| Marks Allotted: 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |
| <b>Course Objectives:</b><br>1. To define and categorize machine learning problems.<br>2. To understand the principles of machine learning and the core algorithms used in machine learning.<br>3. To analyze and implement machine learning models for real-time applications.<br>4. To evaluate and improve the performance of machine learning models.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |
| <b>Course Outcomes:</b><br>After completion of the course, students will be able to:<br>CO1: Explain the fundamental concepts, principles, and mathematical foundations of machine learning, including supervised and unsupervised learning, probability, statistics, information theory, and optimization techniques.<br>CO2: Apply machine learning techniques such as classification, feature extraction, dimensionality reduction, and discriminative learning models to solve real-world data analysis problems.<br>CO3: Analyze and implement advanced machine learning models, including generative models, Bayesian learning, graphical models, mixture models, and deep generative models for predictive and probabilistic modeling.<br>CO4: Evaluate machine learning solutions for domain-specific applications by considering model performance, ethical issues, and emerging topics such as reinforcement learning, meta-learning, and causal inference. |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| Unit No. | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I        | <p><b>Unit I Introduction</b><br/> 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 General Principles in Machine Learning, Occam’s Razor, No-Free-Lunch Theorem, Law of the Smooth World, Curse of Dimensionality.</p> <p><b>Advanced Topics in Machine Learning</b><br/> Reinforcement Learning, Meta-Learning, Causal Inference, and Other Advanced topics</p> <p><b>Mathematical Foundation</b><br/> <b>Probability and Statistics</b><br/> Random Variables and Distributions, Expectation: Mean, Variance, and Moments, Joint, Marginal, and Conditional Distributions, Common Probability Distributions, Transformation of Random Variables</p> <p><b>Information Theory</b><br/> Information and Entropy, Mutual Information, KL Divergence</p> <p><b>Mathematical Optimization</b><br/> General Formulation, Optimality Conditions, Numerical Optimization Methods</p> | 15    |
| II       | <p><b>Classification Algorithms</b><br/> Introduction, Decision-based methods: Nonlinear Instance-based methods, Decision Tree algorithm, Use Cases (<b>Reference 2</b>)</p> <p><b>Feature Extraction</b><br/> Feature Extraction: Concepts, Linear Dimension Reduction, Nonlinear Dimension Reduction (I): Manifold Learning, Nonlinear Dimension Reduction (II): Neural Network</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 15    |
| III      | <p><b>Unit III</b><br/> <b>Discriminative Models</b><br/> Statistical Learning Theory, Linear Models, Learning Discriminative Models in General, Neural Networks, Ensemble Learning</p> <p><b>Generative Models</b><br/> 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><b>Unimodal Models</b><br/> Gaussian Models, Multinomial Models, Markov Chain Models, Generalized Linear Models</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 15    |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |           |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
|    | <b>Mixture Models</b><br>Formulation of Mixture Models, Expectation-Maximization Method, Expectation-Maximization Method, Gaussian Mixture Models, Hidden Markov Models<br><b>Entangled Models</b><br>Formulation of Entangled Models, Linear Gaussian Models, Non-Gaussian Models, Deep Generative Models<br><b>Bayesian Learning</b><br>Formulation of Bayesian Learning, Conjugate Priors, Approximate Inference, Gaussian Processes<br><b>Graphical Models</b><br>Concepts of Graphical Models, Bayesian Networks, Markov Random Fields |           |
| IV | <b>Unit IV</b><br>Domain-Based Machine Learning Applications, Ethical Aspects of Machine Learning                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15        |
|    | <b>Total Hours</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>60</b> |

#### References:

| Sr.No | Title                                                                       | Author                    | Publisher                        | Edition | Year |
|-------|-----------------------------------------------------------------------------|---------------------------|----------------------------------|---------|------|
| 1     | Machine Learning Fundamentals: A Concise Introduction                       | Hui Jiang                 | Cambridge University Press       | First   | 2021 |
| 2     | Machine Learning Concepts, Techniques and Applications                      | T V Geetha, SSendhilkumar | CRC Press Taylor & Francis Group | First   | 2023 |
| 3     | Mastering Classification Algorithms for Machine Learning                    | Partha Majumdar           | BPB                              | First   | 2023 |
| 4     | Machine Learning for Absolute Beginners                                     | Oliver Theobald           | Scatterplot Press                | Third   | 2021 |
| 5     | Machine Learning: The Art and Science of Algorithms that Make Sense of Data | Peter Flach               | Cambridge University Press       | First   | 2012 |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | <b>Semester: III</b> |
| Course Category/Vertical: Major Mandatory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                      |
| Course Title: Machine Learning Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                      |
| Course Code: MSMP304                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  | Course Level:6.5     |
| Type: <b>Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |                      |
| Course Credit: 2 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                      |
| Hours Allotted: 60 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                      |
| Marks Allotted: 50 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |                      |
| <b>Course Objectives:</b><br>To enable the students to:<br>1: Demonstrate proficiency in using Python libraries like Sci-kit-learn, NumPy, Pandas, PyTorch, Keras and Matplotlib for machine learning tasks.<br>2: Apply techniques to clean and handle missing data, outliers, and different data types (numerical, categorical)<br>3: Select, scale, and normalize features to enhance model performance.<br>4: Evaluate and assess the performance of machine learning models like classification and regression.<br>5: Translate problem statements into machine learning solutions.                                                                                                                                                                                                                                                                                                        |  |                      |
| <b>Course Outcomes:</b><br>After completion of the course, students will be able to:<br>CO1: Perform data preprocessing, exploratory data analysis, hypothesis testing, and feature engineering using Python libraries to prepare datasets for machine learning applications.<br>CO2: Develop and evaluate machine learning models using linear, discriminative, generative, probabilistic, and Bayesian learning techniques, and interpret their performance using appropriate evaluation metrics.<br>CO3: Apply advanced machine learning techniques, including Hidden Markov Models, Gaussian Mixture Models, deep generative models, cross-validation, and hyperparameter tuning to improve model accuracy and generalization.<br>CO4: Design, implement, and deploy machine learning solutions by developing predictive models and exposing them through APIs for real-world applications. |  |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| Unit No.   | Content                                                                                                                                                                                                                                                          | Hours |
|------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| <b>I</b>   | <b>Data Pre-processing and Exploration</b>                                                                                                                                                                                                                       |       |
| 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<br><b>Note:</b> 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.                                                                                                                                                    |       |
| <b>II</b>  | <b>Testing Hypothesis</b>                                                                                                                                                                                                                                        |       |
| 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)                 |       |
| <b>III</b> | <b>Linear Models</b>                                                                                                                                                                                                                                             |       |
| a.         | <b>Simple Linear Regression</b><br>Fit a linear regression model on a dataset. Interpret coefficients, make predictions, and evaluate performance using metrics like R-squared and MSE                                                                           |       |
| b.         | <b>Multiple Linear Regression</b><br>Extend linear regression to multiple features. Handle feature selection and potential multicollinearity.                                                                                                                    |       |
| c.         | <b>Regularized Linear Models</b> (Ridge, Lasso, ElasticNet)<br>Implement regression variants like LASSO and Ridge on any generated dataset.                                                                                                                      |       |
| <b>IV</b>  | <b>Discriminative Models</b>                                                                                                                                                                                                                                     |       |
| a.         | <b>Logistic Regression</b><br>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.                                            |           |
| <b>V</b>    | <b>Generative Models</b>                                                                                                                               |           |
| 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                                                                                                          |           |
| <b>VI</b>   | <b>Probabilistic Models</b>                                                                                                                            |           |
| a.          | Implement Bayesian Linear Regression to explore prior and posterior distribution.                                                                      |           |
| b.          | Implement Gaussian Mixture Models for density estimation and unsupervised clustering                                                                   |           |
| <b>VII</b>  | <b>Model Evaluation and Hyperparameter Tuning</b>                                                                                                      |           |
| 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)                                  |           |
| <b>VIII</b> | <b>Bayesian Learning</b>                                                                                                                               |           |
| a.          | Implement Bayesian Learning using inferences                                                                                                           |           |
| <b>IX</b>   | <b>Deep Generative Models</b>                                                                                                                          |           |
| 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) |           |
| <b>X</b>    | Develop an API to deploy your model and perform predictions                                                                                            |           |
|             | <b>Total Hours</b>                                                                                                                                     | <b>60</b> |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                  | <b>Semester: III</b> |
| Course Category/Vertical: Major Mandatory                                                                                                                                                                                                                                                                                                                                             |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                       |                      |
| Course Title: Storage as a Services                                                                                                                                                                                                                                                                                                                                                   |                      |
| Course Code: MSS305                                                                                                                                                                                                                                                                                                                                                                   | Course Level:6.5     |
| Type: <b>Theory</b>                                                                                                                                                                                                                                                                                                                                                                   |                      |
| Course Credit: 2 credits                                                                                                                                                                                                                                                                                                                                                              |                      |
| Hours Allotted: 30 Hours                                                                                                                                                                                                                                                                                                                                                              |                      |
| Marks Allotted: 50 Marks                                                                                                                                                                                                                                                                                                                                                              |                      |
| <b>Course Objectives:</b><br>1: To understand the fundamentals of storage networking, storage devices, interconnect technologies, and storage virtualization concepts in modern data environments.<br>2: To understand advanced file systems, network storage architectures, data management strategies, storage networking protocols, and modern storage communication technologies. |                      |
| <b>Course Outcomes:</b><br>CO-1: Students will be able to explain and analyze storage networking architectures, storage devices, interconnect technologies, and storage virtualization concepts.<br>CO-2: Students will be able to describe and evaluate file systems, network storage protocols, data management techniques, and modern storage networking technologies.             |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| Unit No. | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Hours |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I        | <p><b>Unit 1:</b></p> <p>a. <b>Data Access in the Internet Era:</b> 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>b. <b>Storage Devices:</b> Disk Drives, Tape Drives. <b>Storage Subsystems:</b> Subsystem Architecture, Common Functions of Storage Subsystems JBOD Tape Subsystems and Disk Subsystems for Backup. <b>SCSI Storage Fundamentals and SAN Adapters:</b> The Architecture and Logic of SCSI. SCSI Command Basics HBAs and Network Storage Interfaces Device. <b>Interconnect Technologies for Storage Networks:</b> Fundamental Concepts in Storage Interconnects, Legacy DAS Interconnects, Serial Storage Interconnects</p> <p>c. <b>Storage Virtualization:</b> 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. <b>Network Backup:</b> The Foundation of Storage Management Fundamentals of Backup and Recovery, Backup Operations, Backup Applications in Storage Networks, Disk-Based Backup</p> | 15    |
| II       | <p>a. <b>File System Fundamentals:</b> The Strange and Wonderful Relationship Between File Systems and, Operating Systems, File System Structures, File System Constructs and Functions. <b>Network File Systems and Network Attached Storage:</b> 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>b. <b>New Directions in Network Filing:</b> 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>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 15    |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |           |
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|  | <p><b>Data Management:</b> 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. <b>Overview of Storage Networking:</b> 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. <b>OSI Reference Model Versus Other Network Models:</b> 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 . <b>Overview of Network Operating Principles:</b> Conceptual Underpinnings, SCSI Parallel Interface, Ethernet, TCP/IP Suite, Fibre Channel. <b>Overview of Modern SCSI Networking Protocols:</b> iSCSI, FCP, FCIP, iFCP</p> |           |
|  | <b>Total Hours</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>30</b> |

#### References:

| Sr.No | Title                                                                                                                                    | Author                                            | Publisher                   | Edition | Year |
|-------|------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------|-----------------------------|---------|------|
| 1.    | Storage Networking Fundamentals: An Introduction to Storage Devices, Subsystems, Applications, Management, and Filing Systems            | Marc Farley                                       | Cisco Press                 |         | 2004 |
| 2     | Storage Networking Protocol Fundamentals                                                                                                 | James Long                                        | Cisco Press                 |         | 2006 |
| 3     | Storage Virtualization: Technologies for Simplifying Data Storage and Management                                                         | Tom Clark                                         | Addison Wesley Professional |         | 2005 |
|       | Information Storage and Management Storing, Managing, and Protecting Digital Information in Classic, Virtualized, and Cloud Environments | Somasundaram<br>Gnanasundaram<br>Alok Shrivastava | John Wiley & Sons, Inc.     | 2nd     | 2012 |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  | <b>Semester: III</b> |
| Course Category/Vertical: Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |  |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |                      |
| Course Title: Natural Language Processing                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                      |
| Course Code: MSN306                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  | Course Level:6.5     |
| Type: <b>Theory</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |                      |
| Course Credit: 4 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |                      |
| Hours Allotted: 60 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |  |                      |
| Marks Allotted: 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |                      |
| <b>Course Objectives:</b><br>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.<br>2: To provide understanding of various NLP tasks and NLP abstractions such as Morphological analysis, POS tagging, concept of syntactic parsing, semantic analysis etc.<br>3: To provide knowledge of different approaches/algorithms for carrying out NLP tasks.<br>4: To highlight the concepts of Language grammar and grammar representation in Computational Linguistics.                                                                                                                                                           |  |                      |
| <b>Course Outcomes:</b><br>CO1: Students will get idea about know-hows, issues and challenge in Natural Language Processing and NLP applications and their relevance in the classical and modern context.<br>CO2: Students will learn computational methods and grammar rules to build basic NLP tools like morphological analyzers, POS taggers, and parsers, and apply them in various language processing tasks.<br>CO3: Students can take up project work or work in R&D firms working in NLP and its allied areas.<br>CO4: Students will be able to analyze lexical semantics, perform word sense disambiguation, and apply coreference resolution techniques to improve semantic understanding in natural language processing applications. |  |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| Unit No. | Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Hours |
|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| I        | <b>a) Introduction to NLP:</b><br>Brief history, NLP applications, Challenges/Open Problems, NLP Abstraction levels, Introduction to NL computing techniques and steps (segmentation, tagging, parsing, etc.)<br><b>b) NLP Tasks:</b><br>Segmentation, Chunking, Tagging, Named Entity Recognition (NER), Parsing, Word Sense Disambiguation, NL Generation, Text Processing Challenges                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 15    |
| II       | <b>a) Morphological Analysis and Regular Expressions:</b><br>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.<br><b>b) Part-of-Speech (POS) Tagging and Evaluation:</b><br>Word Classes and Introduction to POS Tagging, Survey of POS tagsets in English and Indian languages, Introduction to rule-based approaches like ENGTOWL, 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, error-analysis                                                         | 15    |
| III      | <b>a) NL Parsing Basics and Grammar Formalisms:</b><br>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.<br><b>b) Probabilistic Parsing and Dependency Parsing:</b><br>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. | 15    |
| IV       | <b>a) Lexical Semantics and Word Senses:</b><br>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.<br><b>b) Coreference Resolution and Semantic Representations:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                   | 15    |

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|  | coreference resolution, including Anaphora and Cataphora, Importance of resolving coreference in NLP applications, Semantic Representations and Word Similarity and understanding lexical semantics. |           |
|  | <b>Total Hours</b>                                                                                                                                                                                   | <b>60</b> |

**References:**

| <b>Sr.No</b> | <b>Title</b>                                           | <b>Author</b>                              | <b>Publisher</b>                      | <b>Edition</b> | <b>Year</b> |
|--------------|--------------------------------------------------------|--------------------------------------------|---------------------------------------|----------------|-------------|
| 1.           | Handbook of Natural Language Processing                | Indurkha, N., & Damerau, F. J.             | CRC Press<br>Taylor and Francis Group | 2nd            | 2010        |
| 2.           | Speech and Language Processing                         | Martin, J. H., & Jurafsky, D.              | Pearson Education India               | 2nd            | 2013        |
| 3.           | Foundations of Statistical Natural Language Processing | Manning, Christopher and Heinrich, Schutze | MIT Press                             | 1st            | 1997        |
| 4.           | Natural Language Processing With Python                | Steven Bird, Edward Loper                  | O'Reilly Media                        | 2nd            | 2016        |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Semester: III</b> |
| Course Category/Vertical: Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |
| Course Title: Security Operations Center Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                      |
| Course Code: MSSP307                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Course Level:6.5     |
| Type: <b>Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |
| Course Credit: 4 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                      |
| Hours Allotted: 120 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |
| Marks Allotted: 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |
| <b>Course Objectives:</b><br>To enable the students to:<br>1: Learn encryption, decryption, and hashing techniques.<br>2: Analyze network traffic using Wireshark, focusing on Telnet, SSH, HTTP, and HTTPS protocols.<br>3: Investigate attacks on Windows hosts, and Utilize intrusion detection systems like Snort and implement firewall rules.<br>4: Extract executables from network traffic, explore DNS traffic, and perform attacks on MySQL databases.<br>5: Set up syslog servers, configure Linux systems for logging, and work with log management tools like Splunk, ELK, and GrayLog.                                                                                                                                                                                                                                                                                                                                                                                               |                      |
| <b>Course Outcomes:</b><br><b>After completion of the course, students able to</b><br><br><b>CO1:</b> Apply cryptographic techniques by performing encryption, decryption, hashing, and hash verification using tools such as OpenSSL and other security utilities.<br><b>CO2:</b> Analyze network traffic and security protocols using tools like Wireshark to investigate Telnet, SSH, HTTP, HTTPS, DNS, and PCAP files, including the extraction of executables and identification of network activities.<br><b>CO3:</b> Investigate host-based security incidents by analyzing Windows processes, threads, handles, the Windows Registry, malware behaviour, and system attacks to understand cyber threats and forensic evidence.<br><b>CO4:</b> Demonstrate practical skills in network and database security by configuring and analyzing Snort and firewall rules, as well as investigating attacks on MySQL databases using PCAP files to identify and mitigate security vulnerabilities. |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| <b>Prac No</b> | <b>Practical Description</b>                                                                                                                                         | <b>Hours</b> |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1              | a. Encrypting and Decrypting Data Using a Hacker Tool<br>b. Encrypting and Decrypting Data Using OpenSSL<br>c. Hashing a Text File with OpenSSL and Verifying Hashes |              |
| 2              | a. Examining Telnet and SSH in Wireshark<br>b. Investigating an Attack on a Windows Host<br>c. Investigating a Malware Exploit                                       |              |
| 3              | a. Demonstrate the use of Snort and Firewall Rules<br>b. Demonstrate Extract an Executable from a PCAP<br>c. Demonstrate a practical for Exploring DNS Traffic       |              |
| 4              | a. Using Wireshark to Examine HTTP and HTTPS Traffic<br>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                                                                                                                               |              |
|                | Total Hours                                                                                                                                                          | 120          |

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| <b>Programme Name: M.Sc (Information Technology)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Semester: III</b> |
| Course Category/Vertical: Elective                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                      |
| Name of the Dept: <b>Science and Technology</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |
| Course Title: Server Visualization on VMWare Platform Practical                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                      |
| Course Code: MSVP308                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Course Level:6.5     |
| Type: <b>Practical</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                      |
| Course Credit: 4 credits                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                      |
| Hours Allotted: 120 Hours                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |
| Marks Allotted: 100 Marks                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                      |
| <b>Course Objectives:</b><br>To enable the students to: <ul style="list-style-type: none"> <li>• To get the insight of Vmware products implementation</li> <li>• To understand the concepts behind the vCenter Appliance.</li> <li>• To understand the concepts behind the VMFS,vMotion,HA</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                      |
| <b>Course Outcomes:</b><br>After completion of the course, students will be able to: <p>CO1: Create, deploy, and manage virtual machines using vCenter Server Appliance, including configuring users, groups, permissions, templates, clones, and virtual machine settings.</p> <p>CO2: Configure and manage virtualization infrastructure by implementing virtual networking, switches, iSCSI storage, NFS storage, and VMFS datastores.</p> <p>CO3: Perform virtual machine administration by managing VM lifecycle operations, migration, snapshots, resource pools, and overall virtual machine status.</p> <p>CO4: Monitor and optimize virtualized environments by analyzing virtual machine performance and implementing High Availability (HA) clusters to ensure reliability and business continuity.</p> |                      |

**Syllabus: NEP 2020 w.e.f 2025-26**

| <b>Prac No</b> | <b>Practical Description</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Hours</b> |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 1              | <p>Deploying and Configuring Virtual Machines</p> <ol style="list-style-type: none"> <li>1. Access Your Student Desktop</li> <li>2. Create a Virtual Machine</li> <li>3. Install VMware Tools</li> <li>4. Copy Files to the Desktop</li> </ol>                                                                                                                                                                                                                                                    |              |
| 2              | <p>Working with vCenter Server Appliance</p> <ol style="list-style-type: none"> <li>1. Access your vCenter Server Appliance and Configure Licenses</li> <li>2. Configure Single Sign-On and Create a Data Center Object</li> <li>3. Add Your ESXi Hosts to the vCenter Server Inventory</li> <li>4. Configure the ESXi Hosts as NTP Clients</li> <li>5. Create a Host and Cluster Folder.</li> <li>6. Create Virtual Machine and Template Folders.</li> <li>7. Navigate vSphere Client</li> </ol> |              |
| 3              | <p>Users, Groups, and Permissions</p> <ol style="list-style-type: none"> <li>1. Join the vCenter Server Appliance to vclass.local Domain</li> <li>2. Add vclass.local as an Identity Source .</li> <li>3. View Active Directory Users.</li> <li>4. Assign Object Permissions to an Active Directory User</li> <li>5. Assign Root-Level Global Permission</li> <li>6. Log In with Windows Session Authentication</li> <li>7. Use an Active Directory User to Manage a Virtual Machine</li> </ol>   |              |
| 4              | <p>Using Standard Switches</p> <ol style="list-style-type: none"> <li>1. View the Standard Switch Configuration</li> <li>2. Create a Standard Switch with a Virtual Machine Port Group . .</li> </ol>                                                                                                                                                                                                                                                                                             |              |
|                | 3. Attach Your Virtual Machines to the New Virtual Machine Port Group                                                                                                                                                                                                                                                                                                                                                                                                                             |              |
| 5              | <p>Accessing iSCSI Storage</p> <ol style="list-style-type: none"> <li>1. Validate an Existing ESXi Host iSCSI Configuration</li> <li>2. Add a VMkernel Port Group to a Standard Switch</li> <li>3. Configure the iSCSI Software Adapter</li> <li>4. Connect the iSCSI Software Adapters to Storage</li> </ol>                                                                                                                                                                                     |              |
| 6              | <p>Managing VMFS Datastores</p> <ol style="list-style-type: none"> <li>1. Create VMFS Datastores for the ESXi Host</li> <li>2. Expand a VMFS Datastore to Consume Unused Space on a LUN.</li> <li>3. Remove a VMFS Datastore.</li> <li>4. Extend a VMFS Datastore</li> <li>5. Create a Second Shared VMFS Datastore Using iSCSI</li> </ol>                                                                                                                                                        |              |
| 7              | <p>Accessing NFS Storage</p> <ol style="list-style-type: none"> <li>1. Configure Access to NFS Datastores</li> <li>2. View NFS Storage Information</li> </ol>                                                                                                                                                                                                                                                                                                                                     |              |
| 8              | <p>Using Templates and Clones</p> <ol style="list-style-type: none"> <li>1. Create a Virtual Machine Template</li> <li>2. Create Customization Specifications</li> </ol>                                                                                                                                                                                                                                                                                                                          |              |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |     |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----|
|    | 3. Deploy a Virtual Machine from a Template                                                                                                                                                                                                                                                                                                                                                                                                            |     |
| 9  | Modifying Virtual Machines <ol style="list-style-type: none"> <li>1. Clone a Powered-On Virtual Machine</li> <li>2. Increase the Size of a VMDK File</li> <li>3. Adjust Memory Allocation on a Virtual Machine.</li> <li>4. Rename a Virtual Machine in the vCenter Server Appliance Inventory</li> <li>5. Add and Remove a Raw LUN on a Virtual Machine</li> </ol>                                                                                    |     |
| 10 | Migrating Virtual Machines .<br>Migrate Virtual Machine Files from Local Storage to Shared Storage <ol style="list-style-type: none"> <li>1. Create a Virtual Switch and a VMkernel Port Group for vSphere vMotion Migration .</li> <li>2. Prepare Virtual Machines to Demonstrate vSphere vMotion Migration</li> <li>3. Perform vSphere vMotion Migrations of Virtual Machines</li> <li>4. Perform Compute Resource and Storage Migrations</li> </ol> |     |
| 11 | Managing Virtual Machines. <ol style="list-style-type: none"> <li>1. Unregister a Virtual Machine from the vCenter Server Appliance Inventory</li> <li>2. Register a Virtual Machine in the vCenter Server Appliance Inventory .</li> <li>3. Unregister and Delete Virtual Machines from the Datastore .</li> </ol>                                                                                                                                    |     |
|    | <ol style="list-style-type: none"> <li>4. Take Snapshots of a Virtual Machine</li> <li>5. Add Files and Take Another Snapshot of a Virtual Machine .</li> <li>6. Revert the Virtual Machine to a Snapshot</li> <li>7. Delete an Individual Snapshot</li> <li>8. Delete All Snapshots.</li> </ol>                                                                                                                                                       |     |
| 12 | Managing Resource Pools . <ol style="list-style-type: none"> <li>1. Create CPU Contention .</li> <li>2. Create Resource Pools .</li> <li>3. III. Verify Resource Pool Functionality</li> </ol>                                                                                                                                                                                                                                                         |     |
| 13 | Monitoring Virtual Machine Performance . <ol style="list-style-type: none"> <li>1. Create the CPU Workload . .</li> <li>2. Use Performance Charts to Monitor CPU</li> <li>3. III. Undo Changes Made to the Virtual Machines</li> </ol>                                                                                                                                                                                                                 |     |
| 14 | Using vSphere HA. . . . <ol style="list-style-type: none"> <li>1. Create a Cluster Enabled for vSphere HA</li> <li>2. Add Your ESXi Hosts to the Cluster</li> <li>3. Test the vSphere HA Functionality</li> <li>4. View the vSphere HA Cluster Resource Usage.</li> <li>5. Manage vSphere HA Slot Size</li> <li>6. Configure a vSphere HA Cluster with Strict Admission Control</li> </ol>                                                             |     |
|    | Total Hours                                                                                                                                                                                                                                                                                                                                                                                                                                            | 120 |