# First Year Curriculum

## Admission Year 2026-27

# Masters of Technology
# Information Technology

**Faculty of Engineering & Technology**

**Parul University**

**Vadodara, Gujarat, India**

## 8. Detailed Syllabus

### Semester 1

**(1)**

a. **Course Name:** Advanced Data Structures and Algorithms
b. **Course Code:** 03020501PC01
c. **Prerequisite:** Fundamentals of Data Structures and algorithms.
d. **Rationale:** This subject demonstrates a deeper understanding of data organization. This course aims to teach students the principals involved in algorithm and their application in various areas. It will cover all types of approach which will be applied in real application.

e. **Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | The fundamental design, analysis, and implementation of basic data structures. |
| **CLOBJ 2** | Basic concepts in the specification and analysis of programs. |
| **CLOBJ 3** | Principles for good program design, especially the uses of data abstraction. |
| **CLOBJ 4** | Significance of algorithms in the computer field |
| **CLOBJ 5** | Various aspects of algorithm development |
| **CLOBJ 6** | Qualities of a good solution |

f. **Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain elementary data structures and asymptotic notation. |
| **CLO 2** | Explore advanced abstract data types. |
| **CLO 3** | Apply Various types of trees and graphs |
| **CLO 4** | Implement advanced algorithmic paradigms. |
| **CLO 5** | Develop applications using linear programming models. |

g. **Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| **1** | **Data Structures:** Elementary Data Structure: array, stacks, queues, linked lists, and applications, Abstract Data Type, Need for Randomizing Data Structures and Algorithms, Recursion, Time and space complexity analysis, Recall of asymptotic notation | **10%** | **5** |
| **2** | **Dictionaries and Skip Lists:** Dictionaries, Hash Function, Collision Resolution Techniques in Hashing: Open Addressing, Probing, Chaining, Double Hashing, Rehashing, Skip Lists, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists. | **20%** | **10** |
| **3** | **Trees and Graphs:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees, Graph representation and implementation, searching in a graph, BFS and DFS, Bipartite Graphs: Maximum Matching, Hungarian Algorithm, Application of graphs and trees. | **25%** | **10** |
| **4** | **Algorithmic paradigms:** Divide-and-conquer, Greedy Strategy, Dynamic programming, Backtracking, Branch-andBound, Binary search, Quicksort, Mergesort, shortest path algorithms, Minimum spanning trees algorithms, Network flow algorithms, Knapsack problem, Longest Common Subsequence Problem. | **25%** | **12** |
| **5** | **Linear Programming:** Assumptions of Linear Programming Models, Geometry of Linear Programs, Application of Linear Programming Incremental design (e.g., incremental sorting), Decremental design (e.g., GCD, factorial), Pruning (e.g., order statistics), NP-completeness: Examples, proof of NP-hardness and NP-completeness, Approximation algorithms, Randomized Algorithms. | **20%** | **8** |

**i. Text Book and Reference Book:**


1. Data Structures and Algorithm Analysis in C++ By Mark Allen Weiss | Pearson | 2nd Edition, Pub. Year 2004
2. Algorithm Design By M T Goodrich, Roberto Tamassia, | John Wiley | 2002

**(2)**

a. **Course Name:** Advanced Data Structures and Algorithms Laboratory
b. **Course Code:** 03020501PC02
c. **Prerequisite:** Fundamentals of Data Structures and algorithms.
d. **Rationale:** This subject demonstrates a deeper understanding of data organization. This course aims to teach students the principals involved in algorithm and their application in various areas. It will cover all types of approach which will be applied in real application.

e. **Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | The fundamental design, analysis, and implementation of basic data structures. |
| **CLOBJ 2** | Basic concepts in the specification and analysis of programs. |
| **CLOBJ 3** | Principles for good program design, especially the uses of data abstraction. |
| **CLOBJ 4** | Significance of algorithms in the computer field |
| **CLOBJ 5** | Various aspects of algorithm development |
| **CLOBJ 6** | Qualities of a good solution |

f. **Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain elementary data structures and asymptotic notation. |
| **CLO 2** | Explore advanced abstract data types. |
| **CLO 3** | Apply Various types of trees and graphs |
| **CLO 4** | Implement advanced algorithmic paradigms. |
| **CLO 5** | Develop applications using linear programming models. |

g. **Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. List of Experiment:**

| Sr. No. | List of Experiment |
|---|---|
| **1.** | List the factors that may influence the space complexity of a program. Write a recursive and non-recursive function to compute n! Compare the space requirements of no recursive function with those of recursive version. |
| **2.** | Write a program to implement Insert, Delete, Search, and Display operations in a singly linked list. |
| **3.** | Write a program to determine whether or not a character string has an unmatched parenthesis using a stack. |
| **4.** | Write a program to implement all the functions of a dictionary using Hashing. |
| **5.** | Write a program that uses functions to traverse a binary tree in Preorder, Inorder and Postorder. |
| **6.** | Write a program to implement Depth first search and Breadth First search using graph. |
| **7.** | Implement NQueen's problem using BackTracking. |
| **8.** | Implement the Rabin - Karp and Boyer Moore string matching algorithm. |
| **9.** | Write a program to implement a randomized algorithm. |
| **10** | Write a program to implement approximation algorithm. |

**(3)**

a. **Course Name:** Mathematical Foundations of Information Technology
b. **Course Code:** 03020501PC03
c. **Prerequisite:** Basic concepts of Statistics & Discrete Mathematics.
d. **Rationale:** To understand the mathematical fundamentals that are prerequisites for a variety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, and Machine learning. It develops the understanding of the mathematical and logical basis of many modern techniques in information technology like machine learning, programming language design, and concurrency.
e. **Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Develop a comprehensive understanding of definite and improper integrals, including the application of integration techniques to find areas and volumes in both Cartesian and Polar coordinates. |
| **CLOBJ 2** | Utilize differential equations to model and solve practical scenarios, demonstrating proficiency in various solution techniques. |
| **CLOBJ 3** | Analyse the convergence and divergence of sequences and series, employing tests such as the Alternating Series Test and Ratio Test |
| **CLOBJ 4** | Analyse matrix operations and determinants, exploring their properties and applications in solving systems of linear equations. |
| **CLOBJ 5** | Apply Fourier series for representing periodic functions, verifying Dirichlet's conditions. |
| **CLOBJ 6** | Solve optimization problems using multivariable calculus concepts, such as Lagrange's multiplier. |

f. **Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Understand the concept of probability for discrete and continuous variables. |
| **CLO 2** | Understand the concept of sampling theory. |
| **CLO 3** | Apply the concept of statistical inference to real life problems. |
| **CLO 4** | Gain conceptual and practical knowledge of graph theory. |
| **CLO 5** | Analyse and evaluate the problem of computer security, web traffic etc. |
| **CLO 6** | Apply various mathematical models in soft computing. |

g. **Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **4** | **-** | **-** | **4** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Probability Mass Density:** Probability mass density and cumulative distribution functions, Expected value, variance, conditional expectation, Applications of the Central Limit Theorem, Probabilistic inequalities. | 20% | 11 |
| 2 | **Random samples:** Sampling distributions of estimators, Methods of Moments and Maximum Likelihood. | 15% | 10 |
| 3 | **Statistical Analysis:** Statistical inference, Hypothesis testing: large sample tests, small sample tests, Chi-Square distribution, Introduction to multivariate statistical models: Multiple Correlation & Regression, The problem of overfitting model assessment. | 15% | 10 |
| 4 | **Graph Theory:** Graph Theory, Isomorphism, Planar graphs, Hamilton circuits and Euler cycles. Permutations and Combinations with and without repetition. | 20% | 12 |
| 5 | **Data Analysis:** Data Mining-Extracting patterns from large datasets, Network Protocols-Applying mathematical models for efficient data communication protocols, Analysis of Web Traffic-Utilizing mathematical models to interpret and optimize web traffic patterns, Computer Security-Implementing robust system and data security algorithms, Software Engineering-Management of computer resources and optimize the software development process, Computer Architecture-Design a systematic computer architecture, Operating Systems-Applying optimize resource management in OS, Distributed Systems-Leveraging Principles and challenges in distributed computing, Bioinformatics-Applying Computational analysis in biological data, Machine Learning-Apply Algorithms for automated learning. | 20% | 12 |
| 6 | **Model Application:** Applying mathematical models for soft computing problem-solving, data-driven analysis in bioinformatics, image processing and pattern recognition, Latest advancements in distribution functions. | 10% | 5 |

**i. Text Book and Reference Book:**


1. Foundation Mathematics for Computer Science, By John Vince | Springer
2. Probability and Statistics with Reliability, Queuing, and Computer Science Applications.By K. Trivedi | Wiley

3. Probability and Computing: Randomized Algorithms and Probabilistic Analysis. By M. Mitzenmacher and E. Upfal
4. Applied Combinatorics By Alan Tucke | Wiley

**(4)**

**a. Course Name:** Advanced Machine Learning

**b. Course Code:** 03020501PC05

**c. Prerequisite:** Data mining, DBMS

**d. Rationale:** This course helps the students to understand and apply different machine techniques.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To understand the basic theory underlying machine learning. |
| **CLOBJ 2** | To be able to formulate machine learning problems corresponding to different applications. |
| **CLOBJ 3** | To understand a range of machine learning algorithms along with their strengths and weaknesses. |
| **CLOBJ 4** | To be able to apply machine learning algorithms to solve problems of moderate complexity. |
| **CLOBJ 5** | To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Extract knowledge using machine learning techniques. |
| **CLO 2** | Adapt IOT for data collection. |
| **CLO 3** | Apply the techniques of clustering, classification, feature selection and visualization to real world data. |
| **CLO 4** | Analyse the dataset and perform Descriptive Statistics. |
| **CLO 5** | Apply deep learning technique on real world problems. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|
| 1 | **Introduction to Machine earning** | **20%** | **9** |

| | | | |
|---|---|---|---|
| | Different types of learning, Data pre-processing methods, Feature Selection and Generation, Concept of over fitting and under fitting, Bias and Variance. | | |
| 2 | **Supervised Learning**<br>Linear regression, Logistic regression, Multiple Linear regression, Classification- K Nearest-Neighbors, Decision Tree, Random forests, Naive Bayes, Support Vector Machines, Generalized Linear Models, Model selection and evaluation, k-fold cross-validation, Training-Validation-Testing split. | **20%** | **8** |
| 3 | **Unsupervised Learning**<br>Clustering- K-means, Agglomerative and Hierarchical clustering, Dimensionality Reduction, Principal Component Analysis and the Curse of Dimensionality. Modeling Sequence/Time-Series Data, Ensemble Methods- Boosting, Bagging, Adaboost. | **15%** | **8** |
| 4 | **Semi-supervised Learning and Generative Models**<br>Active Learning, Reinforcement Learning, Feature Representation Learning, Maximum likelihood estimator, Linear Discriminant Analysis, Bayesian learning, Latent variables and Expectation-maximization algorithm. | **15%** | **7** |
| 5 | **Recommender System and Optimization Techniques**<br>Content based recommendation, Collaborative filtering-based recommendation, Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization. | **15%** | **7** |
| 6 | **Foundations of Deep Learning**<br>Artificial Neural Networks, Biological motivation Perceptron, Multilayer Networks, Back Propagation, Stochastic Gradient Descent, Deep neural network, CNN, RNN, Recent trends in machine learning and deep learning techniques for IOT applications. | **15%** | **7** |

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

**i. Reference Books:**


1. Machine Learning with Python for Everyone, By Mark E. Fenner|Pearson
2. Deep Learning: Methods and Applications, By Li Deng and Dong Yu
3. Machine Learning, Anuradha Srinivasaraghavan, Vincy Joseph |Wiley
4. Data Mining concepts and Techniques, By Jiawei Han, Micheline Kamber | Elsevier

**(5)**

**a. Course Name:** Advanced Machine Learning Laboratory
**b. Course Code:** 03020501PC06
**c. Prerequisite:** Data mining, DBMS
**d. Rationale:** This course helps the students to understand and apply different machine techniques.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To understand the basic theory underlying machine learning. |
| **CLOBJ 2** | To be able to formulate machine learning problems corresponding to different applications. |
| **CLOBJ 3** | To understand a range of machine learning algorithms along with their strengths and weaknesses. |
| **CLOBJ 4** | To be able to apply machine learning algorithms to solve problems of moderate complexity. |
| **CLOBJ 5** | To apply the algorithms to a real-world problem, optimize the models learned and report on the expected accuracy that can be achieved by applying the models. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Extract knowledge using machine learning techniques. |
| **CLO 2** | Adapt IOT for data collection. |
| **CLO 3** | Apply the techniques of clustering, classification, feature selection and visualization to real world data. |
| **CLO 4** | Analyse the dataset and perform Descriptive Statistics. |
| **CLO 5** | Apply deep learning technique on real world problems. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. List of Experiments:**

| **Sr. No.** | **List of Experiment** |
|---|---|

| | |
|---|---|
| **1.** | Study of various Machine Learning Tools (Scikit, Weka). |
| **2.** | Write a program to implement Linear Regression. |
| **3.** | Write a program for classification in a data set. |
| **4.** | Write a program for clustering of similar objects into sets. |
| **5.** | Implement a simple application using IoT and Machine Learning Algorithm. |
| **6.** | Write a program to implement OR, AND gate using Perceptron with learning rule. |
| **7.** | Write a program to Implement Back-propagation algorithm in neural network. |
| **8.** | Write a program to Implement an optimization technique (Genetic Algorithm). |
| **9.** | Study of Deep Learning. |
| **10** | Write a program to Implement a deep Learning. |

**(6)**

a. **Course Name:** Research Methodology & IPR
b. **Course Code:** 03020201HM01
c. **Prerequisite:** Basic Analytical and analysis skill.
d. **Rationale:** The course introduces AI concepts and tools that can be applied to the design process, enabling students to create innovative, efficient, and user-centric designs in various creative domains.
e. **Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Understand the Foundations of Research Methodology |
| **CLOBJ 2** | Acquire practical skills in designing research studies, including formulating research questions and hypotheses. |
| **CLOBJ 3** | Distinguish between different types of intellectual property, such as patents, copyrights, trademarks, and trade secrets. |
| **CLOBJ 4** | Recognize and address ethical considerations in research, including the importance of informed consent and confidentiality. |

f. **Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Understand Mathematical Modeling – Explain the principles of mathematical modeling and its applications in research and problem-solving. |
| **CLO 2** | Develop Experimental and Simulation Skills – Gain proficiency in designing and executing experiments, as well as using simulation techniques for data-driven research. |
| **CLO 3** | Perform Data Analysis and Interpretation – Apply statistical and computational tools to analyze research data and derive meaningful insights. |
| **CLO 4** | Utilize Simulation Techniques – Implement various simulation methods to model real-world scenarios and validate research hypotheses. |
| **CLO 5** | Understand Intellectual Property Rights (IPR) – Explain the importance of IPR, including trademarks, copyrights, patents (and their types), trade secrets, and technology transfer in research and innovation. |

g. **Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **4** | **-** | **-** | **4** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|
| **1** | **Meaning of research problem:** | **20%** | **10** |

| | | | |
|---|---|---|---|
| | Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations. | | |
| **2** | **Effective literature studies approach:** Analysis Plagiarism, Research ethics, | **15%** | **5** |
| **3** | **Effective technical writing:** how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. | **25%** | **10** |
| **4** | **Nature of Intellectual Property:** Patents, Designs, Trademarks and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grant of patents, Patenting under PCT. | **20%** | **10** |
| **5** | **Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. | **20%** | **10** |

**i. Text Book and Reference Book:**


1. Intellectual Property Rights Under WTO" by T. Ramappa; S. Chand, 2008
2. "Research methodology: an introduction for science & engineering students" by Stuart Melville and Wayne Goddard; Juta & Co Ltd
3. "Research Methodology: An Introduction, Wayne Goddard" by Stuart Melville; Juta and Company Ltd, 2004
4. "Research Methodology: A Step-by-Step Guide for Beginners" by Ranjit Kumar; PEARSON; 3rd Edition.
5. "Resisting Intellectual Property" by Halbert; Taylor & Francis Ltd., 2007
6. "Industrial Design" by Mayall; McGraw Hill, 1992
7. "Product Design" by Niebel; McGraw Hill, 1974
8. "Introduction to Design" by Asimov; Prentice Hall, 1962
9. "Intellectual Property in New Technological Age" by Robert P. Merges, Peter S. Menell, and Mark A. Lemley; 2016

**(7)**

a. **Course Name:** English for Research Paper Writing
b. **Course Code:** 03020001MC01
c. **Prerequisite:** Basic Knowledge about sentence formation using different words in present, past tenses and future time. Also, basic knowledge on use of suitable nouns, adjectives, verbs, preposition, etc.
d. **Rationale:** To provide a better insight for the effective use of grammar knowledge especially in writing and to put their own thoughts in to writing.

e. **Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Understand that how to improve your writing skills and level of readability |
| **CLOBJ 2** | Learn about what to write in each section |
| **CLOBJ 3** | Understand the skills needed when writing a Title |
| **CLOBJ 4** | Ensure the good quality of paper at very first-time submission |

f. **Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Understand that how to improve your writing skills and level of readability |
| **CLO 2** | Learn about what to write in each section |
| **CLO 3** | Understand the skills needed when writing a Title |
| **CLO 4** | Ensure the good quality of paper at very first-time submission |

g. **Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **2** | **-** | **-** | **0** | **-** | **50** | **-** | **-** | **-** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

h. **Course Content:**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | 1Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. | **16%** | **5** |
| 2 | Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts, Introduction | **17%** | **5** |
| 3 | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. | **17%** | **5** |
| 4 | Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature. | **17%** | **5** |
| 5 | Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions | **17%** | **5** |
| 6 | Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission. | **16%** | **5** |

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

**i. Reference Books:**


1. Writing for Science By Goldbort R | Springer
2. How to Write and Publish a Scientific Paper By Day R | Cambridge University Press
3. Handbook of Writing for the Mathematical Sciences By Highman N | SIAM. Highman's book
4. English for Writing Research Papers By Adrian Wallwork | Springer New York Dordrecht Heidelberg London, | 2011

**(8)**

**a. Course Name:** Disaster Management

**b. Course Code:** 03021601MC01

**c. Prerequisite:** Basics knowledge of Environmental Science or Geography.

**d. Rationale:** This course enables students to understand, assess, and manage various types of disasters, their impacts, and mitigation strategies, thereby fostering resilience and sustainable development.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Ensuring the availability of local emergency equipment and transportation |
| **CLOBJ 2** | Achieving quick recovery from disaster. |
| **CLOBJ 3** | Long-term planning for particular disaster to reduce its risk. |
| **CLOBJ 4** | Shifting exposure from vulnerable area into safe place. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Differentiate types of disasters, identify their causes, and evaluate their impact on the environment and society. |
| **CLO 2** | Analyse disaster damage and apply effective management strategies. |
| **CLO 3** | Assess vulnerability and recommend appropriate risk mitigation measures. |
| **CLO 4** | Develop a hazard and vulnerability profile using relevant tools and techniques. |
| **CLO 5** | Classify structural and non-structural disaster mitigation strategies. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **2** | **-** | **-** | **0** | **-** | **50** | **-** | **-** | **-** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction to Disaster:** Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity Disaster and Development and disaster management Types ( Geological Disasters, Hydro-Meteorological Disasters, Biological Disasters, Technological Disasters and Man-made Disasters) , Global Disaster Trends, Causes, Consequences and Control of Disasters. | **20%** | **5** |
| 2 | **Disaster Management Cycle and Framework:** Disaster Management Cycle -Paradigm Shift in Disaster Management, Pre-Disaster -Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster -Evacuation Disaster Communication -Search and Rescue -Emergency Operation Centre -Incident Command System -Relief and Rehabilitation -Postdisaster -Damage and Needs Assessment, Restoration of Critical Infrastructure -Early Recovery Reconstruction and Redevelopment; IDNDR, Yokohama Strategy, Hyogo Framework of Action. | **30%** | **10** |
| 3 | **Disaster Management in India:** Disaster Profile, Lessons Learnt from Major Disasters, Disaster Management Act 2005 -Institutional and Financial Mechanism National Policy on Disaster Management, Roles and responsibilities of Government (States, Centre) and other stakeholders- Institutional Processes and Framework at State and Central Level- State Disaster Management Authority (SDMA). | **30%** | **10** |
| 4 | **Technology for Disaster Management & Mitigation:** Geo-informatics in Disaster Management (GIS, GPS), Disaster Communication System (Early Warning system), Land Use Planning and Development Regulations, Disaster Safe Designs and Constructions, Structural and Non-Structural Mitigation of Disasters S&T Institutions for Disaster Management in India. | **20%** | **5** |

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

**i. Reference Books:**

1. Introduction to Disaster Management By Modh Satish | Macmilan Publishers India
2. An overview on natural & man-made disasters and their reduction By R K Bhandani
3. Disaster Administration And Management Text And Case Studies By Goel S. L., | Deep &Deep Publication Pvt. Ltd., New Delhi.
4. Disaster Management By B.Narayan | Rawat Publication

**(9)**

**a. Course Name:** Information and Network Security

**b. Course Code:** 03020501PE01

**c. Prerequisite:** Students should be familiar with basic concepts of Software Flaws, Data Structures and Mathematics including Random numbers, Number theory, finite fields.

**d. Rationale:** This course provides an introduction to the fundamental principles of cryptography and its applications on the network security domain as well as software development domain. This subject covers various important topics concern to information security like symmetric and asymmetric cryptography, hashing, message and user authentication, digital signatures, key distribution and overview of the malware technologies. The subject also covers the applications of all of these in real life situations.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Identify the components associated with computer networks |
| **CLOBJ 2** | Distinguish and explain the concepts of: hacking and cracking; authorization, and attacks. |
| **CLOBJ 3** | Develop a networking plan for self or a client. |
| **CLOBJ 4** | Identify the function of a firewall, and how it keeps a computer secure and safe from viruses. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain the concepts of Information security and their use. |
| **CLO 2** | Describe the principles of symmetric and asymmetric cryptography. |
| **CLO 3** | Discuss message authentication and its requirement. |
| **CLO 4** | Explain the concepts of digital signature and digital certificates. |
| **CLO 5** | Implement various key management and remote authentication mechanisms. |
| **CLO 6** | Describe vulnerabilities in software flaws and concept of malware. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-

Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction:**<br>Computer Security Concept, The OSI Security Architecture, Security Attacks, Security Services, Security Mechanism,<br>A Model for Network Security. | **5%** | **2** |
| 2 | **Basic Concepts in Number Theory:**<br>Divisibility and The Division Algorithm, The Euclidean Algorithm, Modular Arithmetic, Groups, Rings, and Fields,<br>Finite Fields of the Form, Polynomial Arithmetic, Finite Fields of the Form GF(2"), Principles of Pseudorandom Number Generation, Pseudorandom Number Generators, Pseudorandom Number Generation Using a Block Cipher,<br>Prime Numbers, Fermat's and Euler's Theorems | **20%** | **9** |
| 3 | **Symmetric Ciphers:**<br>Symmetric Cipher Model, Substitution Techniques, Transposition Techniques, Stenography, Block Cipher Principles, Data Encryption Standard (DES), Deferential and Linear Cryptanalysis, Block Cipher Design Principles, Advanced Encryption Standard, Block Cipher Operation, RC4 | **20%** | **9** |
| 4 | **Asymmetric Ciphers:**<br>Principles of Public-Key Cryptosystems, The RSA Algorithm, Diffie Hellman Key Exchange, Elliptic Curve Cryptography, Pseudorandom Number Generation Based on an Asymmetric Cipher | **15%** | **7** |
| 5 | **Cryptographic Data Integrity Algorithms:**<br>Hash Function and its Application, Security Requirements for Cryptographic Hash Functions, Hash Functions Based<br>on Cipher Block Chaining, Secure Hash Algorithm (SHA), Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, HMAC, Introduction to Digital Signatures, ElGamal Digital Signature Scheme, Schnorr Digital Signature Scheme, Digital Signature Standard. | **20%** | **9** |
| 6 | **Key Management and Distribution:**<br>Symmetric Key Distribution Using Symmetric Encryption, Symmetric Key Distribution Using | **15%** | **7** |

| | | | |
|---|---|---|---|
| | Asymmetric Encryption, Distribution of Public Keys, X.509Certificates, Public-Key Infrastructure. | | |
| 7 | **Software Flaws and Malware:** Introduction, Software Flaws, Buffer overflow, Incomplete Mediation, Race Conditions, Malware, Brain, Morris Worm, Code red, SQL Slammer, Trojan Example, Malware Detection, The Future of Malware, Cyber Disease versus Biological diseases, Miscellaneous software-based Attacks, Salami Attacks, Linearization, Time bombs, Trusting Software | **5%** | **2** |

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

**i. Reference Books:**


1. Cryptography and Network Security (TextBook) By William Stallings | Pearson Education
2. Cryptography & Network Security By Behrouz A. Forouzan | Tata McGraw-Hill
3. Information Security Principles and Practice By Deven Shah, | Wiley-India
4. Information Security Principles and Practice By Mark Stamp | Wiley IndiaEdition
5. Information systems security By Nina Godbole | Wiley Publications,2008

**(10)**

**a. Course Name:** Information and Network Security Laboratory

**b. Course Code:** 03020501PE02

**c. Prerequisite:** Students should be familiar with basic concepts of Software Flaws, Data Structures and Mathematics including Random numbers, Number theory, finite fields.

**d. Rationale:** This course provides an introduction to the fundamental principles of cryptography and its applications on the network security domain as well as software development domain. This subject covers various important topics concern to information security like symmetric and asymmetric cryptography, hashing, message and user authentication, digital signatures, key distribution and overview of the malware technologies. The subject also covers the applications of all of these in real life situations.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Identify the components associated with computer networks |
| **CLOBJ 2** | Distinguish and explain the concepts of: hacking and cracking; authorization, and attacks. |
| **CLOBJ 3** | Develop a networking plan for self or a client. |
| **CLOBJ 4** | Identify the function of a firewall, and how it keeps a computer secure and safe from viruses. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain the concepts of Information security and their use. |
| **CLO 2** | Describe the principles of symmetric and asymmetric cryptography. |
| **CLO 3** | Discuss message authentication and its requirement. |
| **CLO 4** | Explain the concepts of digital signature and digital certificates. |
| **CLO 5** | Implement various key management and remote authentication mechanisms. |
| **CLO 6** | Describe vulnerabilities in software flaws and concept of malware. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**-

Continuous Evaluation, **ESE-** End Semester Examination

**h. List of Experiments:**

| Sr. No. | List of Experiment |
|---|---|
| **1.** | Implement Caesar cipher encryption-decryption |
| **2.** | Implement Monoalphabetic cipher encryption-decryption |
| **3.** | Implement Playfair cipher encryption-decryption |
| **4.** | Implement Polyalphabetic cipher encryption-decryption |
| **5.** | Implement Hill cipher encryption-decryption |
| **6.** | Implement Simple Transposition encryption-decryption |
| **7.** | Implement One time pad encryption-decryption |
| **8.** | Implement Diffi-Hellmen Key exchange Method |
| **9.** | Implement RSA encryption-decryption algorithm |
| **10.** | Demonstrate working of Digital Signature using Cryptool |
| **11.** | Demonstrate open port scanning and misuse of open ports using Netcat |

**(11)**

**a. Course Name:** Information Theory & Coding
**b. Course Code:** 03020501PE03
**c. Prerequisite:** Probability Theory, Computer Networks
**d. Rationale:** The objective of this course is to provide an insight to information coding techniques, error correction mechanism. Various compression techniques for text, video and image are covered for thorough knowledge of efficient information conveying systems.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To define and apply the basic concepts of information theory (entropy, channel capacity etc.) |
| **CLOBJ 2** | To learn the principles and applications of information theory in communication systems |
| **CLOBJ 3** | To study various data compression methods and describe the most common such methods |
| **CLOBJ 4** | To understand the theoretical framework upon which error-control codes are built |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain the principles and applications of information theory. |
| **CLO 2** | Evaluate the study how information is measured in terms of probability and entropy. |
| **CLO 3** | Describe coding schemes, including error correcting codes. |
| **CLO 4** | Implement the Fourier perspective; extensions to wavelets, complexity, compression, and efficient coding of audio-visual information |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction**<br>Information and entropy information measures, Shannon's concept of Information. Channel coding, channel mutual information capacity (BW) | 10% | 8 |
| 2 | **Theorems of coding**<br>Theorem for discrete memory less channel, information capacity theorem, Error detecting and error correcting codes. | 20% | 8 |
| 3 | **Types of codes**<br>Block codes, Hamming and Lee metrics, description of linear block codes, parity check Codes, cyclic code, Masking techniques. | 20% | 8 |
| 4 | **Compression technique**<br>Compression: loss less and lossy, Huffman codes, LZW algorithm, Binary Image compression schemes, run length encoding, CCITT group 3 1D Compression, CCITT group 3 2D compression, CCITT group 4 2D Compression | 20% | 8 |
| 5 | **Coding Method**<br>Convolutional codes, sequential decoding. Video image Compression: CITT H 261 Video coding algorithms, audio (speech) Compression. Cryptography and Cipher | 20% | 8 |
| 6 | **Case study**<br>Case study of CCITT group 3 1-DCompression, CCITT group 3 2D compression | 10% | 5 |

**i. Text Book and Reference Book:**


1. Elements of Information Theory" by Thomas M. Cover and Joy A. Thomas
2. Introduction to the Theory of Error-Correcting Codes" by Vera Pless
3. Information Theory, Inference, and Learning Algorithms" by David J.C. MacKay

**(12)**

**a. Course Name:** Information Theory & Coding Laboratory

**b. Course Code:** 03020501PE04

**c. Prerequisite:** Probability Theory, Computer Networks

**d. Rationale:** The objective of this course is to provide an insight to information coding techniques, error correction mechanism. Various compression techniques for text, video and image are covered for thorough knowledge of efficient information conveying systems.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To define and apply the basic concepts of information theory (entropy, channel capacity etc.) |
| **CLOBJ 2** | To learn the principles and applications of information theory in communication systems |
| **CLOBJ 3** | To study various data compression methods and describe the most common such methods |
| **CLOBJ 4** | To understand the theoretical framework upon which error-control codes are built |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain the principles and applications of information theory. |
| **CLO 2** | Evaluate the study how information is measured in terms of probability and entropy. |
| **CLO 3** | Describe coding schemes, including error correcting codes. |
| **CLO 4** | Implement the Fourier perspective; extensions to wavelets, complexity, compression, and efficient coding of audio-visual information |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | - | **20** | **-** | **30** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. List of Experiment:**

| Sr. NO. | Experiment List |
|---|---|
| 1 | Write a program to calculate different Entropies of Given Probability |
| 2 | Write a program to calculate Maximum Information & Channel Capacity of Given Probability |
| 3 | Write a program to implement Shannon Fano coding Algorithm |
| 4 | Write a program to implement Hamming Distance |
| 5 | Write a program to implement Huffman Coding Algorithm |
| 6 | Write a program to implement Huffman Coding Algorithm for Compression |
| 7 | Write a program to implement Cryptographic Algorithm (Ceaser Cipher) |
| 8 | Write a program to implement Run Length Encoding (RLE) Algorithm |
| 9 | Write a program to implement LZW Compression Algorithm |
| 10 | Case study of CCITT group 3 1-DCompression |

**(13)**

**a. Course Name:** Web Analytics and Development
**b. Course Code:** 03020501PE05
**c. Prerequisite:** Basics of Web Design.
**d. Rationale**: The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.
**e. Course Learning Objective**:

| | |
|---|---|
| **CLOBJ 1** | Learn how to use and deploy web/social/mobile analytics platforms such as Adobe Analytics, ComScore combined with an introduction to Mobile Analytics, Geo-Tracking and Geo-Location services. |
| **CLOBJ 2** | A grounded understanding of web intelligence and business analytics terminology related to the above. |
| **CLOBJ 3** | How to deploy web intelligence to improve the outcomes of your marketing or business plan. |
| **CLOBJ 4** | How Analysts impact the bottom line within various businesses and lines of business |
| **CLOBJ 5** | Growth potentials for Web Analysts and Big Data professionals |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain social networks, graph structures, and basic network measures for analysing web data. |
| **CLO 2** | Apply web analytics tools like clickstream analysis, A/B testing, and surveys for user behaviour. |
| **CLO 3** | Learn web search techniques including SEO, crawling, indexing, and ranking algorithms. |
| **CLO 4** | Explore link analysis, random graphs, and social affiliation to study network evolution. |
| **CLO 5** | Analyse network resilience, connection search, and the diffusion of innovation in social systems. |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. Course Content**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| **1** | **Introduction**<br>Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks,<br>Information Visualization | **20%** | **9** |
| **2** | **Web Analytics tools**<br>Click Stream Analysis, A/B testing, Online Surveys | **15%** | **8** |
| **3** | **Web Search and Retrieval**<br>Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models | **20%** | **9** |
| **4** | **Making Connection**<br>Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity | **25%** | **12** |
| **5** | **Connection**<br>Connection Search, Collapse, Robustness Social involvements and diffusion of Innovation | **20%** | **10** |

**i. Reference Books**


1. The Art of Computer Virus Research and Defence By Peter Szor
2. Crimeware, Understanding New Attacks and Defences By Markus Jakobsson and Zulfikar Ramzan | Symantec Press

**(14)**

**a. Course Name:** Web Analytics and Development laboratory
**b. Course Code:** 03020501PE06
**c. Prerequisite:** Understanding of HTML, CSS, and JavaScript.
**d. Rationale**: The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Learn how to use and deploy web/social/mobile analytics platforms such as Adobe Analytics, ComScore combined with an introduction to Mobile Analytics, Geo-Tracking and Geo-Location services. |
| **CLOBJ 2** | A grounded understanding of web intelligence and business analytics terminology related to the above. |
| **CLOBJ 3** | How to deploy web intelligence to improve the outcomes of your marketing or business plan. |
| **CLOBJ 4** | How Analysts impact the bottom line within various businesses and lines of business |
| **CLOBJ 5** | Growth potentials for Web Analysts and Big Data professionals |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain social networks, graph structures, and basic network measures for analysing web data. |
| **CLO 2** | Apply web analytics tools like clickstream analysis, A/B testing, and surveys for user behaviour. |
| **CLO 3** | Learn web search techniques including SEO, crawling, indexing, and ranking algorithms. |
| **CLO 4** | Explore link analysis, random graphs, and social affiliation to study network evolution. |
| **CLO 5** | Analyse network resilience, connection search, and the diffusion of innovation in social systems. |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **2** | **4** | **20** | **20** | **20** | **60** | **30** | **150** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. List of Experiment:**

| Sr. NO. | Experiment List |
|---|---|
| 1 | Demonstration of UCINET/NETDRAW software tool |
| 2 | Study of How Web Analytics collects Web Data and other types of data, also basic dashboards |
| 3 | Importing data into UCINET |
| 4 | Symmetrizing & dichotomizing, Running centrality measures |
| 5 | Implementation of Cohesion and Subgroups |
| 6 | Correlating matrices, Intermediate Metrics, Custom Metrics, Calculated Metrics |
| 7 | How Web Analytics Tracks Mobile Visitors, other Web Analytics Reports and Visualizations |
| 8 | Web Analytics Ecosystem and Deploying it in Industry - different measures |
| 9 | Web Analytics Case Studies |
| 10 | Study of different Social Media analytics tools |

**Semester – 2**

**(1)**

**a. Course Name**: Big Data Analytics
**b. Course Code:** 03020502PC01
**c. Prerequisite:** Data Structure, Computer Architecture and Organization
**d. Rationale**: Understand big data for business intelligence. Learn business case studies for big data analytics. Understand nosql big data management. Perform map-reduce analytics using Hadoop and related tool
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To make the students comfortable with tools and techniques required in handling large amounts of datasets. |
| **CLOBJ 2** | To provide an idea of using various deep learning methods in NLP, Neural Network etc. |
| **CLOBJ 3** | To gain the knowledge of several libraries and datasets publicly available will be used to illustrate the application of these algorithms. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Able to understand the mathematics behind functioning of artificial neural networks |
| **CLO 2** | Able to analyse the given dataset for designing a neural network-based solution |
| **CLO 3** | Able to carry out design and implementation of deep learning models for signal/image processing applications |
| **CLO 4** | Able to design and deploy simple TensorFlow-based deep learning solutions to classification problems |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. Course Content**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction**<br>What is big data, why big data, convergence of key trends, unstructured data, industry examples of big data, web analytics, big data and marketing, fraud and big data, risk and big data, credit risk management, big data and algorithmic trading, big data and healthcare, big data in medicine, advertising and big data, big data technologies, introduction to Hadoop, open source technologies, cloud and big data, mobile business intelligence, Crowd sourcing analytics, inter and trans firewall analytics. | **15%** | **7** |
| 2 | **Introduction to NoSQL**<br>Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schemaless databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce,<br>partitioning and combining, composing map-reduce calculations. | **15%** | **7** |
| 3 | **Hadoop**<br>Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop<br>distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structure | **15%** | **8** |
| 4 | **MapReduce**<br>MapReduce workflows, unit tests with MRUnit, test data and local tests, anatomy of MapReduce job run, classic Map-reduce, YARN, failures in classic Map-reduce and YARN, job scheduling, shuffle and sort, task execution, MapReduce types, input formats, output format | **25%** | **10** |
| 5 | **Data model**<br>Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, | **20%** | 8 |

| | | | |
|---|---|---|---|
| | Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration. | | |
| **6** | **Pig model**<br>Pig, Grunt, pig data model, Pig Latin, developing and testing Pig Latin scripts. Hive, data types and file formats, HiveQL data definition, HiveQL data manipulation, HiveQL queries | **10%** | 5 |

### i. Reference Books


1. Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses
2. By Michael Minelli, Michelle Chambers, and Ambiga Dhiraj | Wiley, Pub. Year 2013
3. NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence By P. J. Sadalage and M. Fowler | Addison-Wesley Professional, Pub. Year 2012
4. Hadoop: The Definitive Guide By Tom White
5. Hadoop Operations, Eric Sammer, O'Reilley. By 'Reilley
6. Programming Hive, E. Capriolo, D. Wampler, and J. Rutherglen, O'Reilley By E. Capriolo, D. Wampler, and J. Rutherglen
7. HBase: The Definitive Guide, Lars George, O'Reilley By O'Reilley
8. Handbook of Clinical Massage By Mario Paul Cassar | Elsevier
   Programming Pig By Alan Gates | O'Reilley,, Pub. Year 2011

**(2)**

a. **Course Name:** Big Data Analytics Laboratory
b. **Course Code:** 03020502PC02
c. **Prerequisite:** Data Structure, Computer Architecture and Organization
d. **Rationale**: Understand big data for business intelligence. Learn business case studies for big data analytics. Understand nosql big data management. Perform map-reduce analytics using Hadoop and related tool
e. **Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To make the students comfortable with tools and techniques required in handling large amounts of datasets. |
| **CLOBJ 2** | To provide an idea of using various deep learning methods in NLP, Neural Network etc. |
| **CLOBJ 3** | To gain the knowledge of several libraries and datasets publicly available will be used to illustrate the application of these algorithms. |

f. **Course Learning Outcomes:**

| | |
|---|---|
| **CO 1** | Able to understand the mathematics behind functioning of artificial neural networks |
| **CO 2** | Able to analyse the given dataset for designing a neural network-based solution |
| **CO 3** | Able to carry out design and implementation of deep learning models for signal/image processing applications |
| **CO 4** | Able to design and deploy simple TensorFlow-based deep learning solutions to classification problems |

g. **Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| - | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. List of Experiment:**

| Sr. NO. | Experiment List |
|---|---|
| 1 | Review the commands available for the Hadoop Distributed File System |
| 2 | Copy file foo.txt from local disk to the user's directory in HDFS |
| 3 | Get a directory listing of the user's home directory in HDFS |
| 4 | Display the contents of the HDFS file user/fred/bar.txt |
| 5 | Move that file to the local disk, named as baz.txt |
| 6 | Create a directory called input under the user's home directory |
| 7 | Delete the directory input_ old and all its contents |
| 8 | Review the commands available for PIG (high level scripting language that is used with Apache Hadoop) |
| 9 | Review the commands available for HIVE Query Language |
| 10 | Review the HBASE Shell Commands |
| 11 | Write a program of Word Count in Map Reduce over HDFS |

**(3)**

**a. Course Name:** Soft Computing
**b. Course Code:** 03020502PC03
**c. Prerequisite:** Basic knowledge of mathematics
**d. Rationale:** It provides an approach to problem-solving using means other than computers. With the human mind as a role model, soft computing is tolerant of partial truths, uncertainty, imprecision and approximation, unlike traditional computing models.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | It refers to principle components like fuzzy logic, neural networks and genetic algorithm, which have their roots in Artificial Intelligence. |
| **CLOBJ 2** | To apply ANN training algorithms for solving real world problems |
| **CLOBJ 3** | To understand and interpret fuzzy systems |
| **CLOBJ 4** | Healthy integration of all these techniques has resulted in extending the capabilities of the technologies to more effective and efficient problem solving methodologies |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Identify and describe soft computing techniques and their roles in building intelligent machines |
| **CLO 2** | Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems |
| **CLO 3** | Apply genetic algorithms to combinatorial optimization problems. |
| **CLO 4** | Evaluate and compare solutions by various soft computing approaches for a given problem. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction To Soft Computing And Neural Networks**<br>Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics | **10%** | 7 |
| 2 | **Fuzzy Logic**<br>Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making. | 20% | 8 |
| 3 | **Neural Networks**<br>Machine Learning Using Neural Network, Adaptive Networks, Feed forward Networks, Supervised Learning Neural Networks, Radial Basis Function Networks : Reinforcement Learning, Unsupervised Learning Neural Networks, Adaptive Resonance architectures, Advances in Neural networks | 20% | **10** |
| 4 | **Genetic Algorithms**<br>Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition. | **15%** | **5** |
| 5 | **Matlab/Python Lib**<br>Introduction to Matlab/Python, Arrays and array operations, Functions and Files, Study of neural network toolbox and fuzzy logic toolbox, Simple implementation of Artificial Neural Network and Fuzzy Logic | **15%** | **13** |
| 6 | **Recent Trends**<br>Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm. Implementation of recently proposed soft computing techniques. | **20%** | **5** |

**i. Text Book and Reference Book:**


1. C.M. Bishop, Neural Networks and Pattern Recognition, Oxford University Press (Indian Edition), 2003 (TextBook)
2. An Introduction to Fuzzy Control (TextBook) By Driankov, Dimitra | Narosa Publication | 2, Pub. Year 1996
3. Elements of Evolutionary Genetics (TextBook) By Brian Charlesworth, Deborah Charlesworth | Roberts & Company | 1st Edition, Pub. Year 2010
4. Essential MATLAB for Engineers and Scientist By Hahn Brian D. Valentine Daniel T. | Elsevier publications Ltd

**(4)**

**a. Course Name:** Soft Computing Laboratory
**b. Course Code:** 03020502PC04
**c. Prerequisite:** Basic knowledge of mathematics
**d. Rationale:** It provides an approach to problem-solving using means other than computers. With the human mind as a role model, soft computing is tolerant of partial truths, uncertainty, imprecision and approximation, unlike traditional computing models.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | It refers to principle components like fuzzy logic, neural networks and genetic algorithm, which have their roots in Artificial Intelligence. |
| **CLOBJ 2** | To apply ANN training algorithms for solving real world problems |
| **CLOBJ 3** | To understand and interpret fuzzy systems |
| **CLOBJ 4** | Healthy integration of all these techniques has resulted in extending the capabilities of the technologies to more effective and efficient problem solving methodologies |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Identify and describe soft computing techniques and their roles in building intelligent machines |
| **CLO 2** | Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems |
| **CLO 3** | Apply genetic algorithms to combinatorial optimization problems. |
| **CLO 4** | Evaluate and compare solutions by various soft computing approaches for a given problem. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. List of Experiment:**

| Sr. NO. | Experiment List |
|---|---|
| 1 | Implementation of Fuzzy Operations. |
| 2 | Implementation of Fuzzy Relations (Max min Composition) |
| 3 | Implementation of Fuzzy Controller (WM) |
| 4 | Implementation of Simple Neural Network (McCulloh Pitts model) |
| 5 | Implementation of Perceptron Learning Algorithm |
| 6 | Implementation of Unsupervised Learning Algorithm |
| 7 | Implementation of Simple Genetic Application |
| 8 | Study of ANFIS Architecture |
| 9 | Study of Derivative free Optimization |
| 10 | Study of research paper on Soft Computing |
| 11 | Implementation of Fuzzy Operations. |

**(5)**

**a. Course Name:** - Pedagogy Studies
**b. Course Code:** 03020002MC01
**c. Prerequisite:** A basic familiarity with education systems, classroom teaching–learning processes, and introductory research concepts is required.
**d. Rationale:** This course aims to develop a critical and research-informed understanding of pedagogical practices, curriculum, teacher education, and professional development, with a special focus on evidence-based approaches and contextual challenges.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Students will be able to design and articulate a research question or problem, select appropriate research methodologies, and develop a comprehensive research plan. |
| **CLOBJ 2** | Students will demonstrate advanced information literacy skills, including the ability to critically evaluate and synthesize information from various sources to support research objectives. |
| **CLOBJ 3** | Students will develop and apply critical thinking skills to analyze research findings, draw meaningful conclusions, and assess the implications of their research within the context of existing knowledge. |
| **CLOBJ 4** | Students will understand and adhere to ethical considerations in research, including responsible conduct, proper citation practices, and the ethical treatment of research subjects, ensuring the integrity of the research process. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Remember key concepts, theories of learning, and pedagogical terminology relevant to curriculum and teacher education. |
| **CLO 2** | Understand diverse pedagogical practices used in formal and informal classroom contexts. |
| **CLO 3** | Apply appropriate research methodologies to evaluate the effectiveness of pedagogical practices. |
| **CLO 4** | Analyze evidence from educational studies to assess strengths, limitations, and research gaps in pedagogy. |
| **CLO 5** | Evaluate professional development models and curriculum frameworks to recommend context-sensitive improvements. |

**g. Teaching & Examination Scheme:**

| Teaching Scheme | | | | Evaluation Scheme | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| L | T | P | C | Internal Evaluation | | | ESE | | Total |
| | | | | MSE | CE | P | Theory | P | |
| 2 | - | - | 0 | 50 | - | - | | - | 50 |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education Conceptual framework, Research questions Overview of methodology and Searching | **25%** | **4** |
| 2 | **Thematic overview** Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries Curriculum, Teacher education. | **13 %** | **2** |
| 3 | **Evidence on the effectiveness of pedagogical practices** Methodology for the in depth stage Quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change, Strength and nature of the body of evidence for effective pedagogical practices Pedagogic theory and pedagogical approaches, Teacherś attitudes and beliefs and Pedagogic strategies | **25%** | **4** |
| 4 | **Professional development** Alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community Curriculum and assessment Barriers to learning: limited resources and large class sizes | **25%** | **4** |
| 5 | **Research Gaps:** Research gaps and future directions, Research design, Contexts Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact. | **12%** | **2** |

**Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

## i. Reference Books:


1. Education for All, the Quality Imperative and the Problem of Pedagogy By Alexander, R | CREATE, University of Cambridge, Pub. Year 2008
2. Teaching for Quality Learning at University By Biggs, J. & Tang, C | Open University Press, Pub. Year 2011
3. Studying Teacher Education: The Report of the AERA Panel on Research and Teacher Education By Cochran-Smith, M., & Zeichner, K. | Lawrence Erlbaum Associates, Pub. Year 2005
4. Visible Learning: A Synthesis of Over 800 Meta-Analyses Relating to Achievement By Hattie, J. | Routledge, Pub. Year 2009
5. Education 2030: Incheon Declaration and Framework for Action By UNESCO | UNESCO, Pub. Year 2015
6. National Curriculum Framework By NCERT | NCERT, Pub. Year 2005

**(6)**

**a. Course Name:** - Personality Development through Life Enlightenment Skills
**b. Course Code:** 03020002MC02
**c. Prerequisite:** Learners should possess basic communication skills, self-awareness, and a foundational understanding of professional and academic environments.
**d. Rationale:** This course develops communication, leadership, and self-awareness skills to support holistic personality growth and professional readiness among students. It fosters reflective thinking, responsible decision-making, and adaptability for success in academic and professional environments.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To develop and improve qualities such as communication skills. |
| **CLOBJ 2** | To develop and improve confidence and emotional intelligence. |
| **CLOBJ 3** | To improve self-awareness and leadership abilities |
| **CLOBJ 4** | To develop and improve interpersonal skills, and overall personal effectiveness. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Remember key concepts of communication, leadership, and emotional intelligence. |
| **CLO 2** | Understand principles of group discussion, interviews, and professional conduct. |
| **CLO 3** | Apply leadership, time management, and emotional intelligence skills in real-life situations. |
| **CLO 4** | Analyze personal strengths, weaknesses, opportunities, and goals for career development. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **2** | **-** | **-** | **0** | **50** | **-** | **-** | | **-** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|
| | **Goal Setting and Tracking** | **10%** | **2** |

| | | | |
|---|---|---|---|
| 1 | Meaning and importance of goal setting<br>Types of goals<br>SMART goal framework<br>Goal prioritization and alignment with career objectives<br>Action planning and milestone setting | | |
| 2 | **SWOT & SOAR Analysis & bull;**<br>Identifying personal strengths and development areas • Opportunity mapping and goal alignment • Applying analysis for career planning • Reflection and action planning | **10%** | **2** |
| 3 | **Time Management:**<br>Time audit and productivity analysis Tools for time management (planners, digital tools)<br>Overcoming procrastination | **10%** | **2** |
| 4 | **Emotional Intelligence**<br>Self-awareness and regulation Stress Management and EI at the workplace Motivation and Emotional Resilience Empathy and Social Skills Managing stress and emotions at work | **10%** | **2** |
| 5 | **Decision Making**<br>Problem identification and goal Setting Evaluating alternatives and choosing solutions Decision making under risk and uncertainty | **10%** | **2** |
| 6 | **Conflict Management**<br>Conflict resolution styles and strategies Effective communication during conflict Negotiation and mediation skills Managing conflicts in teams and workplaces | **10%** | **2** |
| 7 | **Leadership Skills**<br>Leadership styles and decision-making Team building and ethical leadership Decision-making and problem-solving skills Team motivation and delegation Ethical leadership and accountability | **10%** | **2** |
| 8 | **Personal Branding and Professional Presence**<br>Resume structuring for technical professionals<br>Writing impactful profiles and summaries<br>LinkedIn optimization and professional networking Digital etiquette and online presence | **10%** | **4** |
| 9 | **Group Discussion**<br>Types and objectives of group discussions Initiation, participation, and conclusion strategies Critical thinking and developing the argument Handling disagreement and turn-taking Evaluation criteria and common mistakes | **10%** | **6** |
| 10 | **Personal Interview**<br>Interview preparation and strategies Answering situational and competency-based questions Non- | **10%** | **6** |

| | | | |
|---|---|---|---|
| | verbal communication and professional etiquette<br>Mock interviews and feedback | | |

**Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

**i. Reference Books:**


1. The 7 Habits of Highly Effective People By Stephen R. Covey | Simon & Schuster, Pub. Year 2020
2. How to Win Friends and Influence People By Dale Carnegie | Pocket Books
3. Speak with Impact By Allison Shapira | HarperCollins Leadership, Pub. Year 2018
4. Effective Communication Skills By Rizvi, M.A. | New Delhi: McGraw Hill Education, Pub. Year 2019
5. Mindset: The New Psychology of Success By Carol S. Dweck

**(7)**

**a. Course Name:** Indian Cyber Law and Ethics
**b. Course Code:** 03023302MC01
**c. Prerequisite:** Basic understanding of computers, internet, and cybersecurity concepts.
**d. Rationale:** Equips students with legal and ethical knowledge to address cybercrimes, privacy issues, and digital rights in India's growing digital ecosystem,
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To give a comprehensive knowledge about the Legal activity. |
| **CLOBJ 2** | To impart an in-depth knowledge of the different cybercrimes and privacy issues. |
| **CLOBJ 3** | To enable the scholars to master the digital rights in India's growing digital ecosystem. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Understand the evolution, scope, and foundational concepts of Indian Cyber Laws and the IT Act, 2000. |
| **CLO 2** | Analyze various types of cybercrimes and identify applicable legal sections and penalties under the IT Act and other statutory frameworks. |
| **CLO 3** | Evaluate ethical issues in cyberspace, including responsible digital behavior, cyber ethics, and intellectual property rights. |
| **CLO 4** | Interpret and apply data protection and privacy-related laws such as the Digital Personal Data Protection Act, 2023, and international standards like GDPR. |
| **CLO 5** | Demonstrate awareness of legal investigation procedures, digital evidence handling, and emerging trends such as AI regulations and cyber forensics. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **2** | **-** | **-** | **0** | **-** | **50** | **-** | **-** | **-** | **50** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 1 | **Foundations of Cyber Law**<br>Introduction to Cyber Space and Cyber Crime, Evolution and Need for Cyber Laws in India, Overview of IT Act 2000 & Amendments (2008, 2021), Definitions under the IT Act: Data, Computer, Access, Legal Recognition of Electronic Records and Signatures, Authorities under IT Act: CERT-IN, Adjudicating Officers, Appellate Tribunal | **20%** | **6** |
| 2 | **Cyber Crimes and Legal Provisions**<br>Types of Cyber Crimes: Hacking, Phishing, Identity Theft, Financial Fraud, Cyber Stalking, Online Harassment, Cyber Terrorism and National Security, Social Media Abuse and Legal Liabilities, Legal Provisions, Case Studies: Avnish Bajaj (Bazee.com), Shreya Singhal v. Union of India | **20%** | **6** |
| 3 | **Cyber Ethics and Digital Responsibility**<br>Introduction to Cyber Ethics: Concepts & Importance, Ethical vs Unethical Hacking, Digital Citizenship and Responsible Internet Use, Ethical Issues in AI, Blockchain, IoT, IPR in Cyberspace – Copyrights, Patents, Software Licensing, Global Ethical Guidelines (ACM/IEEE Codes, GDPR Principles) | **20%** | **6** |
| 4 | **Privacy, Data Protection & Regulatory Frameworks**<br>Understanding Privacy in the Digital Age,Right to Privacy – Puttaswamy Judgment, Digital Personal Data Protection Act (DPDP), 2023, GDPR vs. Indian Data Protection Laws – A Comparative View, Role and Responsibilities of Data Fiduciaries, Organizational Compliance – ISO 27001, Cybersecurity Policies | **20%** | **6** |
| 5 | **Investigation, Enforcement & Future Trends**<br>Investigation of Cyber Crimes: Processes and Tools, Cyber Forensics: Basics and Tools Used, Jurisdictional Issues in Cyberspace, Role of Law Enforcement and Challenges in Prosecution, Future of Cyber Law: Metaverse, AI Regulations, Quantum Security. | **20%** | **6** |

***Continuous Evaluation:**

It consists of Assignments/Seminars/Presentations/Quizzes/Surprise Tests (Summative/MCQ) etc.

**i. Reference Books:**


1. Cyberlaw in India By Pavan Duggal
2. Information Technology Law and Practice By Vakul Sharma
3. Bare Act: Information Technology Act, 2000
4. Digital Personal Data Protection Act, 2023

**(8)**

**a. Course Name:** Business Analytics

**b. Course Code:** 03020502UE01

**c. Prerequisite:** Inclination to learn machine Learning, basic knowledge of differential classification clustering and regression algorithms , Data Mining.

**d. Rationale:** The course will provide a strong foundation on business analytics and the basic concepts.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | To equip the students with basic understanding of business analytics and its role within an organization. |
| **CLOBJ 2** | To provide sound domain knowledge of business analytics and its critical concepts |
| **CLOBJ 3** | To prepare students for business intelligence systems and applications of business analytics. |
| **CLOBJ 4** | To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Explain business analytics and its role within an organization. |
| **CLO 2** | Acquire domain knowledge of business analytics and its critical concepts |
| **CLO 3** | Understand business intelligence systems and applications of business analytics |
| **CLO 4** | Formulate and solve business problems and to support managerial decision making. |

**g. Teaching & Examination Scheme:**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **0** | **0** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**L-** Lectures; **T**- Tutorial; **P-** Practical; **C**- Credit; **MSE-** Mid-Semester Evaluation, **CE**- Continuous Evaluation, **ESE-** End Semester Examination

**h. Course Content:**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|

| | | | |
|---|---|---|---|
| **1** | **Business analytics:** Overview of Business analytics, Scope of Business analytics, Business Analytics Process, Relationship of Business Analytics Process and organisation, competitive advantages of Business Analytics. Statistical Tools: Statistical Notation, Descriptive Statistical methods, Review of probability distribution and data modelling, sampling and estimation methods overview. | **15%** | **10** |
| **2** | **Trendiness and Regression Analysis:** Modelling Relationships and Trends in Data, simple Linear Regression. Important Resources, Business Analytics Personnel, Data and models for Business analytics, problem solving, Visualizing and Exploring Data, Business Analytics Technology. | **15%** | **10** |
| **3** | **Organization Structures of Business analytics,** Team management, Management Issues, Designing Information Policy, Outsourcing, Ensuring Data Quality, Measuring contribution of Business analytics, Managing Changes. Descriptive Analytics, predictive analytics, predicative Modeling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modeling, nonlinear Optimization. | **20%** | **12** |
| **4** | **Forecasting Techniques:** Qualitative and Judgmental Forecasting, Statistical Forecasting Models, Forecasting Models for Stationary Time Series, Forecasting Models for Time Series with a Linear Trend, Forecasting Time Series with Seasonality, Regression Forecasting with Casual Variables, Selecting Appropriate Forecasting Models.<br>Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model. | **20%** | **12** |
| **5** | **Decision Analysis:** Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making. | **20%** | **12** |
| **6** | **Recent Trends in:** Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism. | **10%** | **4** |

**i. Text Book and Reference Book:**

1. "Fundamentals of Business Analytics" by R.N.Prasad and Seema Acharya
2. "Business Analytics – The Science of DataDriven Decision Making" by U. Dinesh Kumar
3. "Data Analytics " by Anil Maheshwari
4. "Business Analytics for Managers: Taking Business Intelligence Beyond" by Jesper Thorlund & Gert H.N. Laursen
5. “Business Analytics ”, by Sahil Raj.

**(9)**

**a. Course Name:** Blockchain and Smart Contracts

**b. Course Code:** 03020502PE01

**c. Prerequisite:** Introduction to Cryptography.

**d. Rationale**: This course deals with the fundamental components of Blockchain and its potential applications. The course will introduce the students to the theoretical as well as practical aspects of distributed ledger systems and Smart Contracts. It will develop a strong understanding of the basic concepts underlying blockchain technology while covering the essential mechanisms, cryptographic principles, and consensus building. Further the course equips students with key concepts and developments around cryptocurrencies, Bitcoin and smart contracts. It also demonstrates some of the blockchain use cases in technology, business and enterprise products.

**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Understanding Blockchain Fundamentals |
| **CLOBJ 2** | Exploring Blockchain Applications |
| **CLOBJ 3** | Hands-on Experience with Blockchain Development |
| **CLOBJ 4** | Analyzing Challenges and Opportunities |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Develop a workable knowledge of basic concepts of blockchain technology and its underlying mechanisms. |
| **CLO 2** | Understand cryptographic primitives in blockchain and its impact on implementation related decisions. |
| **CLO 3** | Review the principles behind various consensus mechanism models |
| **CLO 4** | Develop a workable knowledge of basic concepts of smart contracts and Ethereum blockchain |
| **CLO 5** | Understand and implement the concepts of Solidity |
| **CLO 6** | Understand the security aspects of Smart contracts |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | - | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. Course Content**

| Sr. No. | Content | Weightage | Teaching Hours |
|---|---|---|---|
| 1 | **Introduction to Blockchain fundamentals and Cryptographic concepts in Blockchain:** Introduction, Asset, Transactions, Distributed Ledger Technology, , Blockchain network , Blockchain components, Types of Blockchain (Public, Consortium, and Private), Applications, Benefits of Blockchain Technology, Limitations of blockchain, Distributed systems, Consensus decision-making, Byzantine Generals Problem, Forks and Byzantine Fault Tolerance, Proof of Work, Proof of Stake, Proof of Work v Stake, Asymmetric and Symmetric Cryptography, Digital Signatures, Hashing- SHA256, Data Integrity, Merkle tree. Implications of Cryptography and Decentralization. | 16% | 8 |
| 2 | **Ethereum Blockchain and Smart contracts:** Ethereum Fundamentals: Ethereum, Adoption, Bitcoin vs Ethereum, Ether, Gas and fees, Ethereum Blockchain, Ethereum Nodes, Ethereum accounts- externally owned, contract accounts, Ethereum transactions and blocks, Signing Transactions, Mist wallet, MetaMask wallet Smart contracts: History, Introduction, How Smart Contract | 22% | 12 |
| 3 | **Introduction to Solidity programming basics:** Structure of a contract: Data types and global variables, Access Modifiers, Data Structures- Arrays, Structs, Enum, Mappings, Expressions and control structures, Error Handling, Assert, Require, Revert, Function modifiers and fallbacks, Events, Structure of contract, ERC20 Token Interface, Development workflow. | 20% | 8 |
| 4 | **Interacting with Smart contracts:** Deployment Environment, Differences, Application development life cycle management, The Truffle Development Environment for web, Testing with Truffle, Working with Injected Web3, Working with Web3 Provider | 22% | 12 |
| 5 | **Securing Smart Contracts:** Smart Contract, Errors, Smart contracts vulnerabilities, Attacks in Smart Contracts, Preventive Methodologies, DApp Safety, Proactive Controls, Security Measures | 20% | 5 |

**i. Reference Books**

1. Antonopoulos A.M., Mastering Bitcoin. 2nd ed. O'Reilly Media, 2017 (TextBook)
2. Hands-On Smart Contract Development with Solidity and Ethereum
3. Ritesh Modi," Solidity Programming Essentials", Packt Publishing, April 2018 (TextBook)
4. Reed, Jeff (2016). Smart contracts: The essential guide to using blockchain smart contracts for cryptocurrency exchange. CreateSpace Independent Publishing Platform. (ISBN-13: 9781539457442). (TextBook)

**(10)**

**a. Course Name:** Blockchain and Smart Contracts Laboratory
**b. Course Code:** 03020502PE02
**c. Prerequisite:** Introduction to Cryptography.
**d. Rationale**: This course deals with the fundamental components of Blockchain and its potential applications. The course will introduce the students to the theoretical as well as practical aspects of distributed ledger systems and Smart Contracts. It will develop a strong understanding of the basic concepts underlying blockchain technology while covering the essential mechanisms, cryptographic principles, and consensus building. Further the course equips students with key concepts and developments around cryptocurrencies, Bitcoin and smart contracts. It also demonstrates some of the blockchain use cases in technology, business and enterprise products.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | Understanding Blockchain Fundamentals |
| **CLOBJ 2** | Exploring Blockchain Applications |
| **CLOBJ 3** | Hands-on Experience with Blockchain Development |
| **CLOBJ 4** | Analyzing Challenges and Opportunities |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Develop a workable knowledge of basic concepts of blockchain technology and its underlying mechanisms. |
| **CLO 2** | Understand cryptographic primitives in blockchain and its impact on implementation related decisions. |
| **CLO 3** | Review the principles behind various consensus mechanism models |
| **CLO 4** | Develop a workable knowledge of basic concepts of smart contracts and Ethereum blockchain |
| **CLO 5** | Understand and implement the concepts of Solidity |
| **CLO 6** | Understand the security aspects of Smart contracts |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. Experiment List:**

| Sr. NO. | Experiment List |
|---|---|
| 1 | Demonstrate creation of blocks and block chain addition on a test network |
| 2 | Introduction to ETHEREUM tools and Solidity |
| 3 | Deploy a smart contract for printing “Hello World” using Java Script VM, Injected Web3 and Web3Provider using Metamask and Ganache. |
| 4 | Deploy a smart contract for arithmetic operations using Java Script VM, Injected Web3 and Web3Provider using Metamask and Ganache. |
| 5 | Deploy a smart contract for FINDING LARGEST NUMBER OUT OF THREE NUMBERS using Java Script VM, Injected Web3 and Web3Provider using Metamask and Ganache. |
| 6 | Create a Smart Contract for a banking application in solidity which allows users to do the following: Mint money into your account Withdraw money from your account Send money from your account to smart contract address Check balance After a contract is created, deploy the contract on Ethereum Testnet network |
| 7 | How to build a smart contract that lets user book rooms and pay for them with cryptocurrency |
| 8 | Building a blockchain raffle using Solidity programming language. Apart from a coin toss, the most straightforward example of gambling is probably a raffle. |
| 9 | Installation of Ether Wallet and deploying smart contract |
| 10 | To design an electronic voting system, using the ethereum blockchain (smart contracts) and more precisely the RPC test which enables account generation with a private and public key. Blockchain electronic voting system using smart contracts. |
| 11 | Building an improved P2P file system to provide originality and authenticity of published and posted free online digital content such as books, music, and movies. Our solution utilizes a blend of the latest emerging technologies that include IPFS and blockchain smart contracts. |

**(11)**

**a. Course Name:** Cloud computing & Application
**b. Course Code:** 03020502PE07
**c. Prerequisite:** Programming Skills, Familiarity with Databases, Basics of Security and Privacy, Knowledge of Agile Development.
**d. Rationale**: It helps in the delivery of storage, database, software, analytics, networking, and intelligence over the internet or "cloud" for backup storage.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | An insight into the basics of cloud computing along with virtualization |
| **CLOBJ 2** | To introduce concepts related to the analysis, design and implementation of computation and storage clouds. |
| **CLOBJ 3** | To assess services provided by lead players in cloud. |
| **CLOBJ 4** | To study the emergence of cloud as the next generation computing paradigm. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Identify security aspects of each cloud model |
| **CLO 2** | Develop a risk-management strategy for moving to the Cloud |
| **CLO 3** | Implement a public cloud instance using a public cloud service provider |
| **CLO 4** | Apply trust-based security model to different layer |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **3** | **-** | **-** | **3** | **20** | **20** | **-** | **60** | **-** | **100** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. Course Content**

| **Sr. No.** | **Content** | **Weightage** | **Teaching Hours** |
|---|---|---|---|
| **1** | **Introduction**<br>Cloud computing at a glance, Historical developments, Building cloud computing environments, The cloud reference model, Types | **10%** | **5** |

| | | | |
|---|---|---|---|
| | of clouds, Economics of the cloud, Open challenges | | |
| **2** | **Principles of Parallel and Distributed Computing**<br>Parallel vs. distributed computing, Elements of parallel computing, Elements of distributed computing, Technologies for distributed computing | **15%** | **6** |
| **3** | **Virtualization**<br>Introduction, Characteristics of virtualized environments, Taxonomy of virtualization techniques, Virtualization and cloud computing, Pros and cons of virtualization, Technology examples | **15%** | **6** |
| **4** | **Virtual Machines Provisioning and Migration Services**<br>Introduction, Broad approaches to migrating into the cloud, The seven-step model of migration into a cloud, Virtual machines provisioning and manageability, Virtual machine migration services, VM provisioning and migration in action, Provisioning in the Cloud Context, Future Research Directions | **20%** | **8** |
| **5** | **On the Management of Virtual Machines for Cloud Infrastructures**<br>The Anatomy of Cloud Infrastructures ,Distributed Management of Virtual Infrastructures ,Scheduling Techniques for Advance Reservation of Capacity, Capacity Management to meet SLA Commitments | **20%** | **8** |
| **6** | **Cloud Security**<br>Cloud security risks, Security: The top concern for cloud users, Privacy and privacy impact assessment, Trust, Operating system security, Virtual machine Security, Security of virtualization, Security risks posed by shared images, Security risks posed by a management OS, A trusted virtual machine monitor | **10%** | **5** |
| **7** | **Advanced Topics in Cloud Computing**<br>Energy efficiency in clouds, Market-based management of clouds, Federated clouds/InterCloud, Third-party cloud Services | **10%** | **5** |

**i. Reference Books**

1. Cloud Computing Principles and Paradigms (TextBook) By Rajkumar Buyya , James Broberg, Andrzej Goscinski | Willey
2. Cloud Computing Theory and Practice By Dan C Marinescu | Elsevier(MK)
3. Mastering Cloud Computing Foundations and Applications Programming By Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi
4. Cloud Computing for Dummies By Judith Hurwitz, R.Bloor, M.Kanfman, F.Halper | Wiley India Edition

**(12)**

**a. Course Name:** Cloud computing & Application Laboratory
**b. Course Code:** 03020502PE08
**c. Prerequisite:** Programming Skills, Familiarity with Databases, Basics of Security and Privacy, Knowledge of Agile Development.
**d. Rationale**: It helps in the delivery of storage, database, software, analytics, networking, and intelligence over the internet or "cloud" for backup storage.
**e. Course Learning Objective:**

| | |
|---|---|
| **CLOBJ 1** | An insight into the basics of cloud computing along with virtualization |
| **CLOBJ 2** | To introduce concepts related to the analysis, design and implementation of computation and storage clouds. |
| **CLOBJ 3** | To assess services provided by lead players in cloud. |
| **CLOBJ 4** | To study the emergence of cloud as the next generation computing paradigm. |

**f. Course Learning Outcomes:**

| | |
|---|---|
| **CLO 1** | Identify security aspects of each cloud model |
| **CLO 2** | Develop a risk-management strategy for moving to the Cloud |
| **CLO 3** | Implement a public cloud instance using a public cloud service provider |
| **CLO 4** | Apply trust-based security model to different layer |

**g. Teaching and Examination Scheme**

| **Teaching Scheme** | | | | **Evaluation Scheme** | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **L** | **T** | **P** | **C** | **Internal Evaluation** | | | **ESE** | | **Total** |
| | | | | **MSE** | **CE** | **P** | **Theory** | **P** | |
| **-** | **-** | **2** | **1** | **-** | **-** | **20** | **-** | **30** | **50** |

**SEE**-Semester End Examination, **CIA**- Continuous Internal Assessment (It consists of Assignments/Seminars/Presentations/MCQ Tests, etc.)

**h. Experiment List:**

| **Sr. NO.** | **Experiment List** |
|---|---|
| 1 | Study of Public Cloud : Amazon Web Services EC2, Google AppEngine, Microsoft Azure |

| | |
|---|---|
| 2 | Study of Open Source Cloud Technology : CloudSim, Aneka, Eucalyptus |
| 3 | Practical Approach for understanding virtualization concept using VmWare Workstation. |
| 4 | Create a Collaborative learning environment for a particular learning topic using Google Apps. Google Drive, Google Docs and Google Slides must be used for hosting e-books, important articles and presentations respectively. The instructor<br>must use the Google Sheets to convey the timetable for different events and for analyzing the scores for individual assignment submission. |
| 5 | Modeling and simulation Cloud computing environments, including Data Centers, Hosts and Cloudlets and perform VM provisioning using CloudSim. |
| 6 | Modeling and simulation Cloud computing environments, including Data Centers, Hosts and Cloudlets and perform VM provisioning using CloudSim: Design a host with two CPU cores, which receives request for hosting two VMs, such that each<br>one requires two cores and plans to host four tasks units. More specifically, tasks t1, t2, t3 and t4 to be hosted in VM1, while t5, t6, t7, and t8 to be hosted in VM2. Implement space-shared allocation policy and time-shared allocation policy. Compare the results. |
| 7 | Create and launch a virtual machine instance on Amazon web services EC2 cloud and access that virtual machine using putty client. |
| 8 | Demonstrate the use of Amazon simple storage services(S3). |
| 9 | create applications that write records to Amazon DynamoDB. |
| 10 | Create and launch a virtual machine instance on Eucalyptus cloud and access that virtual machine using putty client. |