**Detailed Syllabus for Master of Technology (M. Tech) in Data Science**

## Semester - I

| Course Code | Course Type | Course Name | L | T | P | Credit | Total Marks |
|---|---|---|---|---|---|---|---|
| MDS-101B | Core-1 | Probability and Random Processes | 4 | 0 | 0 | 4 | 100 |
| MDS -102C | Core-2 | Design and Analysis of Algorithms | 4 | 0 | 0 | 4 | 100 |
| MDS-101E | Professional Elective-1 (any one) | Data Science | 4 | 0 | 0 | 4 | 100 |
| MDS-102E | | Data Mining | | | | | |
| MDS-103E | | Databases | | | | | |
| MDS-104E | Professional Elective-2 (any one) | Machine Learning | 4 | 0 | 0 | 4 | 100 |
| MDS-105E | | Pattern Recognition | | | | | |
| MDS-106E | | | | | | | |
| MDS-101L | Lab-1 | Algorithm Lab | 0 | 0 | 4 | 2 | 100 |
| MDS-102L | Lab-2 | Data Science Programming Lab (Machine Learning related Programming) | 0 | 0 | 4 | 2 | 100 |
| MID-101F | Computer Skills 3 (Compulsory foundation) | Python Programming | 4 | 0 | 0 | 4 | 100 |
| | | **Total** | **20** | | **8** | **24** | **700** |

*70(Theory) + 30(Internal Assessment) B: Basic Science

## Semester - II

| Course Code | Course Type | Course Name | L | T | P | Credit | Total Marks |
|---|---|---|---|---|---|---|---|
| MDS-201B | Core-3 | Stochastic Models | 4 | 0 | 0 | 4 | 100 |
| MDS-202B | Core-4 | Optimization Techniques | 4 | 0 | 0 | 4 | 100 |
| MDS-201E | Professional Elective-3 (any one) | Data Visualization | 4 | 0 | 0 | 4 | 100 |
| MDS-202E | | Big Data Analytics | | | | | |
| MDS-203E | | Data Warehouse and Data Mining | | | | | |
| MDS-204E | Professional Elective-4 (any one) | Data Security and Access Control | 4 | 0 | 0 | 4 | 100 |
| MDS-205E | | Web Analytics & Development | | | | | |
| MDS-206E | | | | | | | |
| MDS-201S | Sessional-1 | Term Paper Leading to Thesis | 0 | 0 | 4 | 2 | 100 |
| MDS-202S | Sessional-2 | Design Project | 0 | 0 | 4 | 2 | 100 |
| | **Total** | | **16** | **0** | **8** | **20** | **600** |

*70(Theory) + 30(Internal Assessment) B: Basic Science

## Semester – III

| Course Code | Course Type | Course Name | L | T | P | Credit | Total Marks |
|---|---|---|---|---|---|---|---|
| MDS-301S | Sessional-3 | Thesis Report Interim | 0 | 0 | 8 | 4 | 100 |
| MDS-302S | Sessional-4 | Thesis Seminar Interim (Presentation and Viva Voce) | 0 | 0 | 8 | 4 | 200 |
| MDS-303S | Sessional-5 | Technical Communication | 0 | 0 | 4 | 2 | 100 |
| MDS-304S | Sessional-6 | Workshop and Seminars | 0 | 0 | 2 | 0 | 100 |
| MDS-301E | Professional Elective-5 (any one) | Interdisciplinary Open Elective Offered by Other Departments | 4 | 0 | 0 | 4 | 100 |
| MDS-302E | | | | | | | |
| MDS-303E | | | | | | | |
| MID-301A | Audit Course | Research Methodology and IPR | 2 | 0 | 0 | 0 | 100 |
| | **Total** | | **6** | **0** | **22** | **14** | **700** |

*70(Theory) + 30(Internal Assessment)

## Semester - IV

| Course Code | Course Type | Course Name | L | T | P | Credit | Total Marks |
|---|---|---|---|---|---|---|---|
| MDS-401S | Sessional-7 | Thesis Report Final | 0 | 0 | 08 | 4 | 200 |
| MDS-402S | Sessional-8 | Thesis Seminar Final (Presentation and Viva Voce) | 0 | 0 | 08 | 4 | 200 |
| MDS-403S | Sessional-9 | Workshop and Seminars | 0 | 0 | 02 | 2 | 100 |
| MVE-401O | Elective Paper (Offered by other department) | Interdisciplinary Open Elective Offered by Other Departments | 4 | 0 | 0 | 4 | 100 |
| MVE-402O | | | | | | | |
| MTE-401O | | | | | | | |
| MTE-402O | | | | | | | |
| MID-401A | Foundation Course | English for Research Paper Writing | 2 | 0 | 0 | 0 | 100 |
| MID-402A | | Disaster Management | | | | | |
| MID-403A | | Sanskrit for Technical Knowledge | | | | | |
| MID-404A | | Value Education | | | | | |
| MID-405A | | Constitution of India | | | | | |
| MID-406A | | Pedagogy Studies | | | | | |
| MID-407A | | Stress Management by Yoga | | | | | |
| MID-408A | | Personality Development through Life Enlightenment Skills | | | | | |
| | **Total** | | **06** | | **18** | **14** | **700** |

*70(Theory) + 30(Internal Assessment)

# First Semester Detailed Syllabus

**Core-I**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Probability and Random Processes | MDS-101B | 4hrs/week | 4 | 40 hours |

**COURSE OBJECTIVE**

To understand the mathematical fundamentals that is 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, Machine learning.

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Realize the basic notions of probability. |
| CO-2 | Realize the discrete and continuous distributions |
| CO-3 | Implement correct and meaningful statistical analyses of simple to moderate |
| CO-4 | Comprehend the methods of statistical inference, and the role that sampling distributions play in those methods. |

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|---|---|
| **Module-1** | Probability spaces, conditional probability, independence; Random variables, distribution functions, probability mass and density functions. |
| **Module-2** | Functions of random variables, standard univariate discrete and continuous distributions; Mathematical expectations, moments, moment generating functions, inequalities; Random vectors, joint, marginal and conditional distributions, conditional expectations, independence. |
| **Module-3** | Covariance, correlation, standard multivariate distributions, functions of random vectors; Law of large numbers, central limit theorem |
| **Module-4** | Sampling distributions; Point estimation - estimators, minimum variance unbiased estimation, maximum likelihood estimation, method of moments, consistency; Interval estimation; Testing of hypotheses - tests and critical regions, likelihood ratio tests; Linear regression. |

BOOKS AND REFERENCES:

1. K. Trivedi, Probability and Statistics with Reliability, Queuing, and Computer Science Applications, Wiley.
2. M. Mitzenmacher and E. Upfal. Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
3. A First Course in Probability and Markov Chains by Giuseppe Modica and Laura Poggiolini
4. Classic Problems of Probability by Prakash Gorroochurn.
5. PROBABILITY CONCEPTS AND THEORY FOR ENGINEERS by Harry Schwarzlander

**Core-2**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Design and Analysis of Algorithms | MDS-102C | **4hrs/week** | **4** | **40 hours** |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Analyze the complexity/performance of different algorithms. |
| CO-2 | Gather the concept about Greedy Algorithms and Divide and Conquer Method. |
| CO-3 | Analysis of various algorithms following dynamic programming strategy. |
| CO-4 | Recognize different kind of computational complexities. |

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|---|---|
| **Module-1** | Introduction: What is Algorithm? Algorithm and its specification. Time Complexity: Asymptotic Notation, Standard Notation and Common Functions, Asymptotic Analysis (Best, Worst, Average Case). Different cases of Time Complexity of Binary Search and Linear Search, Bubble Sort, Quick Sort, Merge Sort, Tournament Sort, Bucket Sort or Radix Sort, Insertion Sort, Selection Sort. |
| **Module-2** | Greedy Algorithm: Activity Selection Problem, Elements of the Greedy Policy, Hoffman Coding, Task Scheduling Problem, Coin Changing Problem/Algorithm, Prim's Algorithm and Kruskal's Algorithm And Comparisons. Knapsack Problem. Scheduling with Minimizing Time in the System. Shortest Path Algorithm: Dijkstra Algorithm, Divide and Conquer Method: Multiplying large integers. Strassen Matrix Multiplication. |
| **Module-3** | Dynamic Programming: Elements of Dynamic Programming, Making Change, Knapsack Problem, Shortest Path (Floyd Algorithm), Matrix Chained Multiplication, Assembly Line Scheduling. Exploring Graphs: Introduction, Traversing Trees: Pre order, Post order Numbering. DFS, BFS, Acyclic Graphs. Backtracking: Knapsack Problem, Eight Queen's Problem Branch and Bound: Assignment Problem. Graph Algorithms: Single Source Shortest Path: Bellman Ford Algorithm, Dijkstra Algorithm. All Pairs Shortest Path: Short Path of Floyd Warshall Algorithm, Johnson's Algorithm |
| **Module-4** | Computational Complexity: Introduction to NP completeness, The Classes P and NP, Polynomial Reduction, NP Cook's Theorem Complete Problems NP-completeness; Redundancy. Approximation algorithms; Randomized algorithms; Linear programming; Special topics: Geometric algorithms (range searching, convex hulls, segment intersections, closest pairs), Numerical algorithms (integer, matrix and polynomial multiplication, FFT, extended Euclid's algorithm, modular exponentiation, primality testing, cryptographic computations) |

BOOKS AND REFERENCES:

1. "Introduction to Algorithms" by Cormen, Leiserson, Rivest, Stein.

2. "The Design and Analysis of Computer Algorithms" by Aho, Hopcroft, Ullman.

3. "Algorithm Design" by Kleinberg and Tardos.

4. “Art of Computer Programming” by Donald John Fuller (Series Editor), Donald Knuth (Author)

**Professional Elective Paper -1**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Science | MDS-101E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Gain knowledge about the fundamentals of R for data science and basics of linear algebra related to data science |
| CO-2 | Critically analyse algebraic and geometric views of data science problems. |
| CO-3 | Gain knowledge of optimization in data science and understanding of regression model. |
| CO-4 | Classify and cluster data for solving different data science problems. |

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|---|---|
| **Module-1** | Introduction to R, Variables and data types in R, Data frames, Advanced programming in R : Functions, Control structures, Data visualization in R Basic graphics, Recasting and joining of data frames, Arithmetic, Logical and Matrix operations in R, Linear Algebra for Data science, Solving Linear Equations, Linear Algebra - Distance, Hyperplanes and Half spaces, Eigenvalues, Eigenvectors |
| **Module-2** | Algebraic view - vectors, matrices, product of matrix & vector, rank, null space, solution of over-determined set of equations and pseudo-inverse) , Geometric view - vectors, distance, projections, eigenvalue decomposition, descriptive statistics, notion of probability, distributions, mean, variance, covariance, covariance-matrix, understanding univariate and multivariate normal distributions, introduction to hypothesis testing, confidence interval for estimates, Central tendencies and distributions. |

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|---|---|
| **Module-3** | Optimization for Data Science, Unconstrained Multivariate Optimization, Gradient (Steepest) Descent (OR ) Learning Rule, Multivariate Optimization with Constraints, Linear Regression, Simple Linear Regression Model Building and Assessment, Maximum likelihood estimation, Logisitic Regression and its Implementation in R, Confusion matrix and ROC. |
| **Module-4** | Basic machine learning algorithms, Clustering analysis, Classification using k-means clustering, Hierarchical methods of clustering, K - Nearest Neighbors (kNN), classification and regression trees, Decision Trees, Multiple Linear Regression, Case study on classification. |

BOOKS AND REFERENCES


1. Introduction to linear algebra - by Gilbert Strang
2. Applied statistics and probability for engineers – by Douglas Montgomery
3. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk from The Frontline. O'Reilly.
4. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press


**Professional Elective Paper -1**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Mining | MDS-102E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Develop the abilities of critical analysis to data mining systems and applications |
| CO-2 | Learn about various data pre-processing techniques. |
| CO-3 | Implement practical and theoretical understanding of the technologies for data mining |
| CO-4 | Understand the strengths and limitations of various data mining models |

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|---|---|
| **Module-1** | Data mining Overview and Advanced Pattern Mining: Data mining tasks – mining frequent patterns, associations and correlations; Advanced pattern mining in multilevel, multidimensional space. Data Pre-processing: Need for Pre-processing the Data, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation. |

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|---|---|
| **Module-2** | Data Warehouse and OLAP Technology for Data Mining: Data Warehouse, Multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Implementation, Usage of Data Warehousing Online Analytical Processing and Mining. Data Cube Computation: Efficient Methods for simple Data Cube Computation |
| **Module-3** | Web and Text Mining: Introduction, web mining, web content mining, web structure mining, we usage mining, Text mining – unstructured text, episode rule discovery for texts, hierarchy of categories, text clustering |
| **Module-4** | Temporal and Spatial Data Mining: Introduction; Temporal Data Mining – Temporal Association Rules, Sequence Mining, GSP algorithm, SPADE, SPIRIT Episode Discovery, Time Series Analysis, |

BOOKS AND REFERENCES:


1. Data Mining Concepts and Techniques, Jiawei Hang Micheline Kamber, Jian pei, Morgan Kaufmannn.
2. Data Mining Techniques – Arun K pujari, Universities Press.
3. Introduction to Data Mining – Pang-Ning Tan, Vipin kumar, Michael Steinbach, Pearson.


**Professional Elective Paper -1**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Databases | MDS- 103E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Realize relational data models. |
| CO-2 | Perform database design with ER modelling |
| CO-3 | Apply the concepts of relational algebra. |
| CO-4 | Develop applications with stored procedures |

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|---|---|
| **Module-1** | Data Models: Data models with emphasis on the relational model |
| **Module-2** | Database Design: Database design with E-R model, From E-R model to relational database design |
| **Module-3** | Algebra: Relational algebra and calculus SQL queries, constraints, triggers |
| **Module-4** | Database application development: Stored procedures. |

**Professional Elective Paper –2**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Machine Learning | MDS- 104E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Gain knowledge about basic concepts of Machine Learning (Understanding) |
| CO-2 | Identify machine learning techniques suitable for a given problem (Comprehension) |
| CO-3 | Solve the problems using various machine learning techniques (Evaluation) |
| CO-4 | Design application using machine learning techniques (Application) |

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|---|---|
| **Module-1** | Introduction: Statistical Decision Theory - Regression, Classification, Bias Variance, Different Types of Learning, Hypothesis Space and Inductive Bias, Evaluation and Cross-Validation, Linear Regression, Introduction to Decision Trees, Learning Decision Tree, Over fitting, Regression Trees, Stopping Criterion & Pruning loss functions, Categorical Attributes, Multiway Splits, Missing Values, Decision Trees - Instability Evaluation Measure. Python or any other suitable programming language-based exercise on Decision Tree and Linear Regression |
| **Module-2** | K-Nearest Neighbour, Feature Selection, Feature Extraction, Collaborative Filtering, Multivariate Regression, Subset Selection, Shrinkage Methods, PCA, LDA, Partitioned Clustering, Hierarchical Clustering, Birch Algorithm, CURE Algorithm, Density-based Clustering, Gradient Boosting, Random Forests, Multi-class Classification, Bayesian Learning, Naive Baye's, Bayesian Network, Python or any other suitable programming language based exercise on Naive Baye's, PCA, LDA and KNN |
| **Module-3** | Logistic Regression, Introduction Support Vector Machine, SVM: Maximum Margin with Noise, Nonlinear SVM and Kernel Function, Introduction to Multiple Kernel Learning Python Exercise on SVM, Introduction to Clustering, K-means Clustering, Agglomerative Hierarchical Clustering, K-Means Clustering; DBSCAN; GMM; Mean-shift Clustering, Multilayer Perceptron; RBF Networks; Classification Performance Analysis; Python or any other suitable programming language-based exercise clustering. |
| **Module-4** | Hidden Markov Models, Introduction to Neural Network, CNN and RNN, Multilayer Neural Network, Neural Network and Back propagation Algorithm, RBF, Python or any other suitable programming language based exercise on Neural Network, Introduction to Ensembles, Bagging and Boosting, Introduction to Reinforcement Learning |

BOOKS AND REFERENCES

1. The Elements of Statistical Learning, by Trevor Hastie, Robert Tibshirani, Jerome H. Friedman (freely available online)
2. Pattern Recognition and Machine Learning, by Christopher Bishop (optional)

**Professional Elective Paper -2**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Pattern Recognition | MDS- 105E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Realize fundamental concepts of pattern recognition and learning. |
| CO-2 | Explore Supervised learning paradigms and classification. |
| CO-3 | Analyze different decision theories. |
| CO-4 | Apply different clustering methods. |

| | |
|---|---|
| **Module-1** | Introduction to pattern recognition and learning (supervised, unsupervised), training and test sets, feature selection |
| **Module-2** | Supervised learning and classification: Discriminant functions and decision boundaries Linear discriminant functions, relaxation procedure, non-separable behaviour Minimum distance classifier |
| **Module-3** | Bayesian decision theory. Maximum likelihood classification. Parameter estimation, sufficient statistics, component analysis and discriminants (PCA, Fisher's). Nonparametric techniques. Density estimation, Parzen window, K-NN estimation, Decision Tree, SVM. Unsupervised learning and clustering: Data description and clustering –similarity measures, criterion for clustering, |
| **Module-4** | Methods of clustering – partitioned: K Mean, K Mode, K Median, FCN, hierarchical, graph theoretic, density based Cluster validity, Feature extraction and feature selection: Problems of dimensionality- Feature extraction –PCA Feature selection –Karhunen Loeve, stochastic approximation, kernel approximation, divergence measures. |

BOOKS AND REFERENCES

1. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007

2. Pattern Recognition by Narasimha Murthy and Susheela Devi

3. Pattern Classification by Richard Duda, Peter Hart, David Stork.

## Compulsory Foundation

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Computer Skills 3 (Python Programming) | MID-101F | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | To realize basic programming skills in Python. |
| CO-2 | Explore control structures and lists in Python |
| CO-3 | To develop the ability to write functions in Python |
| CO-4 | To acquire programming skills for file handling in Python. |

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|---|---|
| **Module-1** | Fundamental concepts: Literals, variables and identifiers, operators, expressions and data types. |
| **Module-2** | Control structures: Boolean expressions, selection control, iterative control; Lists: List structures, Lists, (sequences), iterating over lists. |
| **Module-3** | Functions: Program routines, calling value-returning functions, calling non value-returning functions, parameter passing, variable scope. |
| **Module-4** | Dictionaries and Sets; Recursion; Text Files: Using text files, string passing, exception handling. |

BOOKS AND REFERENCES

1. Michael Urban and Joel Murach, Python Programming, Shroff/Murach, 2016

2. Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010

**Lab-1**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Algorithm Lab | MDS-101L | 4 hrs/week | 2 | 28 hours |

**At the end of the course, students will demonstrate the ability to-**

| | Course Outcome |
|---|---|
| **CO-1** | Implement various sorting algorithms and analyzing their complexities. |
| **CO-2** | Generate programs for greedy and divide and conquer algorithmic strategies. |
| **CO-3** | Develop programs for implementing various algorithms based on dynamic programming. |
| **CO-4** | Implementation of randomized, geometric and numerical algorithms. |

Programming assignments are based on the theory courses MDS- 102C TH algorithms.

**Lab-2**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Science Programming Lab | MDS-102L | 4 hrs/week | 2 | 28 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Explore the fundamentals of R Programming for data science and basics of linear algebra related to data science (Remembering) |
| CO-2 | Implementation of linear algebra related to data science in R |
| CO-3 | Develop programs for implementing optimization in data science and regression model. |
| CO-4 | Generate programs for Classifying and clustering data for solving different data science problems. |

Programming assignments are based on the theory courses MDS- 103E TH, Data Science.

# Second Semester Detailed Syllabus

**Core 3**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Stochastic Models | MDS- 201B | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Illustrate the definition and introductory concepts of Stochastic Processes. |
| CO-2 | Compare Discrete-time Markov chains and Continuous-time Markov chains |
| CO-3 | Conceptualize Bayesian statistics |
| CO-4 | Summarize the various samplers. |

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|---|---|
| **Module-1** | Stochastic Processes: Definition and classification of random processes |
| **Module-2** | Discrete-time Markov chains Poisson process; Continuous-time Markov chains |
| **Module-3** | Bayesian statistics; Monte Carlo; Gibbs Sampler: augmentation, burn-in, convergence |
| **Module-4** | Metropolis-Hastings algorithm: independent sampler, random walk Metropolis, scaling, multi-modality; Approximate Bayesian Computation |

BOOKS AND REFERENCES

1. Papoulis and S.U. Pillai, “Probability, Random Variables and Stochastic Processes”, 4th Edition, McGraw-Hill, 2002.

**Core 4**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Optimization Techniques | MDS- 202B | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Illustrate the introductory concepts of optimization techniques. |
| CO-2 | Conceptualize and perform unconstrained optimization. |
| CO-3 | Conceptualize and perform constrained optimization. |
| CO-4 | Explore various optimality conditions. |

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|---|---|
| **Module-1** | Optimization - sequences and limits, derivative matrix, level sets and gradients |
| **Module-2** | Taylor series; unconstrained optimization - necessary and sufficient conditions for optima, convex sets, convex functions, optima of convex functions |
| **Module-3** | Steepest descent, Newton and quasi Newton methods, conjugate direction methods; constrained optimization - linear and non-linear constraints, equality and inequality constraints, |
| **Module-4** | Optimality conditions, constrained convex optimization, projected gradient methods, penalty methods |

BOOKS AND REFERENCES

1. J.C. Pant, Introduction to Optimization: Operations Research, Jain Brothers, Delhi, 2008.

**Professional Elective Paper 3**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Visualization | MDS- 201E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Familiarize with the design process to develop visualization methods and visualization systems |
| CO-2 | Apply the evaluation methods of various systems |
| CO-3 | Preparation and processing of data, visual mapping and the visualization |
| CO-4 | Utilize abstract data for perception techniques. |

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|---|---|
| **Module-1** | Introduction of visual perception, visual representation of data, Gestalt principles, information overloads. Creating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications |
| **Module-2** | Classification of visualization systems, Interaction and visualization techniques misleading, Visualization of one, two and multi-dimensional data, text and text documents, Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization |
| **Module-3** | Visualization of volumetric data, vector fields, processes and simulations, Visualization of maps, geographic information, GIS systems, collaborative visualizations, evaluating visualizations |
| **Module-4** | Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization |

BOOKS AND REFERENCES:

1. WARD, GRINSTEIN, KEIM, Interactive Data Visualization: Foundations, Techniques, and Applications. Natick: A K Peters, Ltd.

2. E. Tufte, The Visual Display of Quantitative Information, Graphics Press.

**Professional Elective Paper 3**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Big Data Analytics | MDS- 202E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Describe big data and use cases from selected business domains |
| CO-2 | Explain NoSQL big data management |
| CO-3 | Install, configure, and run Hadoop related tools for data analysis and HDFS |
| CO-4 | Perform map-reduce analytics using Hadoop |

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|---|---|
| **Module-1** | 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. |
| **Module-2** | Introduction to NoSQL, aggregate data models, aggregates, key-value and document data models, relationships, graph databases, schema-less databases, materialized views, distribution models, sharding, master-slave replication, peer peer replication, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations. Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS Concepts. |
| **Module-3** | Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures Map Reduce workflows, unit tests with MR Unit, 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, Map Reduce types, input formats, output formats |
| **Module-4** | Hbase, data model and implementations, Hbase clients, Hbase examples, praxis. Cassandra, Cassandra data model, Cassandra examples, |

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|---|---|
| | Cassandra clients, Hadoop integration. Pig, runt, 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. |

BOOKS AND REFERENCES:


1. Minelli, Michelle Chambers, and Ambiga Dhiraj, "Big Data, Big Analytics: Emerging

2. Business Intelligence and Analytic Trends for Today's Businesses", Wiley, 2013.

3. P. J. Sadalage and M. Fowler, "NoSQL Distilled: A Brief Guide to the Emerging World ofPolyglot Persistence", Addison-Wesley Professional, 2012.

4. Tom White, "Hadoop: The Definitive Guide", Third Edition, O'Reilley, 2012.

5. Eric Sammer, "Hadoop Operations", O'Reilley, 2012.

6. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilley, 2012.

7. Lars George, "HBase: The Definitive Guide", O'Reilley, 2011.

8. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilley, 2010.

9. Alan Gates, "Programming Pig", O'Reilley, 2011.


**Professional Elective Paper 3**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Warehousing and Data Mining | MDS- 203E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Evaluate of different sequential pattern algorithms |
| CO-2 | Realize the technique to extract patterns from time series data and its application in real world. |
| CO-3 | Apply the Graph mining algorithms to Web mining |
| CO-4 | Identify the computing framework for Big Data |

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|---|---|
| **Module-1** | Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives, scalable methods; Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns. |

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|---|---|
| **Module-2** | Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis |
| **Module-3** | Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis |
| **Module-4** | Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.<br><br>Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis techniques. |

BOOKS AND REFERENCES:

1. Jiawei Han and M Kamber, Data Mining Concepts and Techniques, Second Edition, Elsevier Publication, 2011.

2. Vipin Kumar, Introduction to Data Mining - Pang-Ning Tan, Michael Steinbach, Addison Wesley, 2006. 3. G Dong and J Pei, Sequence Data Mining, Springer, 2007.

**Professional Elective Paper-4**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Security and Access Control | MDS- 204E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Implement classical models and algorithms. |
| CO-2 | Analyze the data, identify the problems, and choose the relevant models and algorithms to apply. |
| CO-3 | Realize recent trends on data security management. |
| CO-4 | Design quality assurance and testing schemes |

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|---|---|
| **Module-1** | Introduction to Access Control, Purpose and fundamentals of access control, brief history, Policies of Access Control, Models of Access Control, and Mechanisms, Discretionary Access Control (DAC), Non- Discretionary Access Control, Mandatory Access Control (MAC). Capabilities and Limitations of Access Control Mechanisms: Access Control List (ACL) and Limitations, Capability List and Limitations. |

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|---|---|
| **Module-2** | Role-Based Access Control (RBAC) and Limitations, Core RBAC, Hierarchical RBAC, Statically Constrained RBAC, Dynamically Constrained RBAC, Limitations of RBAC. Comparing RBAC to DAC and MAC Access control policy, Biba's intracity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view |
| **Module-3** | Role hierarchies- inheritance schemes, hierarchy structures and inheritance forms, using SoD in real system Temporal Constraints in RBAC, MAC AND DAC. Integrating RBAC with enterprise IT infrastructures: RBAC for WFMSs, RBAC for UNIX and JAVA environments Case study: Multi-line Insurance Company |
| **Module-4** | Smart Card based Information Security, Smart card operating system fundamentals, design and implantation principles, memory organization, smart card files, file management, atomic operation, smart card data transmission ATR, PPS Security techniques- user identification, smart card security, quality assurance and testing, smart card life cycle-5 phases, smart card terminals. Recent Trends related to data security management, vulnerabilities in different DBMS. |

BOOKS AND REFERENCES:

1. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, Ramaswamy Chandramouli.

2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial.

**Professional Elective Paper 4**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Web Analytics and Development | MDS- 205E | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Familiarize with core research communities and publications |
| CO-2 | Engage in web and social media analytics |
| CO-3 | Address research questions on social connects, affiliations and identity. |
| CO-4 | Comprehend research issues in web analysis, social involvements and web searches. |

| | |
|---|---|
| **Module-1** | Introduction – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization |
| **Module-2** | Web Analytics tools: Click Stream Analysis, A/B testing, Online Surveys, Web Search and Retrieval: Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models |
| **Module-3** | Making Connection: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity |
| **Module-4** | Connection: Connection Search, Collapse, Robustness Social involvements and diffusion of innovation |

BOOKS AND REFERENCES:

1. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analyzing Social Media Networks with NodeXL: Insights from a Connected World. Morgan Kaufmann.

2. Avinash Kaushik. 2009. Web Analytics 2.0: The Art of Online Accountability.

3. Easley, D. & Kleinberg, J. (2010). Networks, Crowds, and Markets: Reasoning About a Highly Connected World. New York: Cambridge University Press. http://www.cs.cornell.edu/home/kleinber/networks-book/

4. Wasserman, S. & Faust, K. (1994). Social network analysis: Methods and applications. New York: Cambridge University Press. Monge, P. R. & Contractor, N. S. (2003). Theories of communication networks. New York: Oxford University Press.

**Sessional-1**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Term Paper Leading to Thesis | MDS- 201S | 4 hrs/week | 2 | 28 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Identify the project of their expertise domain and interest. |
| CO-2 | Explain the recent trend of research and its recent developments through literature survey |
| CO3 | Make an in-depth study of a specific topic within suitable engineering design and specifications. |

**Syllabus Contents:**

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity

and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Identification of domain for research.
2) Literature review.
3) In-depth study for suitable engineering design and specifications.

**Sessional-2**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Design Project | MDS- 202S | 4 hrs/week | 2 | 28 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Outline the points to formulate problem corresponding to the project topic |
| CO-3 | Know how to organize, limit (scope), plan, do and act within a project thesis. |
| CO-4 | Define problem specific tools (i.e. hardware equipment and software) and its functionality. |

**Syllabus Contents:**

The project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The course should have the following-

1) Problem formulation.
2) Knowledge of how to organize, limit (scope), plan, do and act within a project thesis.
3) Familiarity with specific tools (i.e. hardware equipment and software) relevant to the project selected.

# Third Semester Detailed Syllabus

**Sessional-3**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Thesis Report Interim | MDS- 301S | 8 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Understand that how to write thesis with good readability |
| CO-2 | Learn to write section wise. |
| CO-3 | Understand the skills needed when writing a thesis |
| CO-4 | Ensure the quality of thesis report |

| | |
|---|---|
| **Module-1** | Planning and Preparation, Clarifying contributions of other authors, summarizing your findings, paraphrasing and plagiarism, sections of your thesis. |
| **Module-2** | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a thesis, 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. |
| **Module-3** | Skills are needed when writing about the methods and results, skills are needed when writing the discussion, skills are needed when writing the conclusions. |
| **Module-4** | Useful phrases, how to ensure thesis is as good as it could possibly be the first-time thesis writing. |

**Sessional-4**

| Name of the course | Course Code | Time/ Duration | Credit |
|---|---|---|---|
| Thesis Seminar Interim (Presentation and VIVAVOCE) | MDS- 302S | 8 hrs/week | 4 |

**At the end of the course, students will demonstrate the ability to-**

| | Course Outcome |
|---|---|
| **CO-1** | Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem. |
| **CO-2** | Identify from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design. |
| **CO-3** | Demonstrate the findings of their technical solution in a written report. |
| **CO-4** | Present the work in International/ National conference or reputed journals. |

**Syllabus Contents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

**A. The dissertation should have the following-**

i) Relevance to social needs of society
ii) Relevance to value addition to existing facilities in the institute
iii) Relevance to industry need
iv) Problems of national importance
v) Research and development in various domain

**B. The student should complete the following:**

i) Literature survey Problem Definition
ii) Motivation for study and Objectives
iii) Preliminary design / feasibility / modular approaches
iv) Implementation and Verification
v) Report and presentation

**Sessional-5**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Technical Communication | MDS- 303S | 4hrs/week | 2 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

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

| | |
|---|---|
| **Module-1** | Planning and Preparation, Word Order, breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness.<br><br>Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction |
| **Module-2** | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. 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. |
| **Module-3** | 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 |
| **Module-4** | Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission |

BOOKS AND REFERENCES:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)

2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press

3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook.

4. Adrian Wall work, English for Writing Research Papers, Springer New York DordrechtHeidelberg London, 2011

## Sessional-6

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Workshop and Seminars -I | MDS- 304S | 2hrs/week | 0 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments |
| CO-2 | Prepare appropriately to participate effectively and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience |
| CO-3 | Speak and debate with an appreciation for complex social and technical sensibilities |
| CO-4 | Offer compelling, articulate oral arguments, showing an understanding of the unique demands of oral presentation as opposed to writing |

**Syllabus Contents:**

1. Participate effectively in discussion of workshops and seminars [at least 02(two)].
2. Follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments and submit a comprehensive report to the department.
3. Demonstration of the ability to speak and defend (to be presented in the presentation seminar organized by the department).
4. Understanding of the unique demands of oral presentation as opposed to writing.( presentation skills will be evaluated)
5. Those who are unable to attend seminar / conferences/ workshops within the semester period needs to pass at least 01(one) NPTEL / MOOCs course of at least 04(four) weeks duration which should be relevant to project and thesis topic.

Grade/ percentage of marks obtained in the NPTEL / MOOCs course examination will be proportionately taken into account for final evaluation of sessional -6.

## Professional Elective-5

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Cloud Computing | MDS- 301E | 4hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

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

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|---|---|
| **Module-1** | Introduction to Cloud Computing Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing |
| **Module-2** | Cloud Computing Architecture Requirements, Introduction Cloud computing architecture, On Demand Computing Virtualization at the infrastructure level, Security in Cloud computing environments, CPU Virtualization, A discussion on Hypervisors Storage Virtualization Cloud Computing Defined, The Traditional Software Model, The Cloud Services Delivery Model Cloud Deployment Models Key Drivers to Adopting the Cloud. |
| **Module-3** | Security Issues in Cloud Computing Infrastructure Security, Infrastructure Security: The Network Level, The Host Level, The Application Level, Data Security and Storage, Aspects of Data Security, Data Security Mitigation Provider Data and Its Security Identity and Access Management Trust Boundaries, Cloud Authorization Management, Availability Management: SaaS, PaaS, IaaS |
| **Module-4** | Security Management in the Cloud Security Management Standards, Security Management in the Cloud. |

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|---|---|
| | Privacy Issues Privacy Issues, Data Life Cycle, Key Privacy Concerns in the Cloud, Protecting Privacy, Changes to Privacy Risk Management and Compliance in Relation to Cloud Computing,<br><br>Audit and Compliance Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Security-as-a-Cloud |

BOOKS AND REFERENCES:

1. Cloud Computing Explained: Implementation Handbook for Enterprises, John Rhoton, Publication Date: November 2, 2009

2. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance (Theory in Practice), Tim Mather, ISBN-10: 0596802765, O'Reilly Media, September 2009

## Professional Elective-5

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Preparation and Analysis | MDS- 302E | 4hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Realize data based on formats and scalability issues. |
| CO-2 | Comprehend after data cleaning, transforming and segmentation |
| CO-3 | Extract the data for performing the analysis. |
| CO-4 | Apply processed data in various areas of computing |

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|---|---|
| **Module-1** | Data Gathering and Preparation: Data formats, parsing and transformation, Scalability and real-time issues |
| **Module-2** | Data Cleaning: Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation |
| **Module-3** | Exploratory Analysis: Descriptive and comparative statistics, Clustering and association, Hypothesis generation |
| **Module-4** | Visualization: Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity |

Books and References:

1. Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, by Glenn J. Myatt

## Professional Elective-5

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Industry 4.0 and Industrial Internet of Things | MDS- 303E | 4hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Realize basic idea of Industry 4.0. |
| CO-2 | Understand Industrial Internet of Things(IIoT) |
| CO-3 | Explore IIoT analytics in data management. |
| CO-4 | Apply IIoT in various fields. |

| | |
|---|---|
| **Module-1** | Introduction: Sensing and Actuation, Introduction: IoT Connectivity, Introduction: IoT Networking , Industry 4.0: The Fourth Revolution Industry 4.0: Sustainability Assessment of Manufacturing Industry Industry 4.0: Lean Production System, Industry 4.0: Smart and Connected Business Perspective, Industry 4.0: Smart Factories, Industry 4.0: Cyber-Physical Systems and Next-Generation Sensors, Industry 4.0: Collaboration Platform and Product Lifecycle Management, Industry 4.0: Artificial Intelligence, Industry 4.0: Big Data and Advanced Analysis |
| **Module-2** | Industry 4.0: Cyber security, Basics of Industrial IoT: Introduction, Basics of Industrial IoT: Industrial Internet Systems, Basics of IIoT: Industrial Sensing & Actuation, Basics of Industrial IoT: Industrial Processes Business Models and Reference Architecture for IIoT: Business Models, Business Models and Reference Architecture for IIoT: Reference Architecture Key Enablers of Industrial IoT: Sensing-Part, Key Enablers of Industrial IoT: Connectivity-Part 1 |

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|---|---|
| **Module-3** | Key Enablers of Industrial IoT: Connectivity, Key Enablers of Industrial IoT: Processing, Key Enablers of Industrial IoT: Process Control IIoT Analytics and Data Management: Introduction, IIoT Analytics and Data Management: Machine Learning and Data Science, IIoT Analytics and Data Management: Cloud Computing in IIoT, Analytics and Data Management: Fog Computing in IIoT, IIoT Analytics and Data Management: Data Center Networks, Advanced Technologies: Software-Defined Networking (SDN) in IIoT |
| **Module-4** | Advanced Technologies: Security in IIoT, IIoT Applications: Factories and Assembly Line, IIoT Applications: Food Industry, IIoT Applications: Inventory Management & Quality Control, IIoT Applications: Plant Security and Safety, IIoT Applications: Facility Management, IIoT Applications: Oil, Chemical and Pharmaceutical Industry, IIoT Applications: UAVs in Industries, Case Studies for Industry 4.0 & IIoT, Milk Processing and Packaging Industries, Manufacturing Industries, Virtual Reality Lab |

BOOKS AND REFERENCES:


1. https://nptel.ac.in/
2. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things: Key Applications and Protocols, Wiley-Blackwell.


## Audit Course

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Research Methodology and IPR | MID-301A | 2hrs/week | 0 | 28 hours |

**At the end of the course, students will demonstrate the ability to-**

| | Course Outcome |
|---|---|
| **CO-1** | Understand and formulate research problem. |
| **CO-2** | Inculcate research ethics |
| **CO-3** | Classify Intellectual Property Right (IPR). |
| **CO-4** | Comprehend about Intellectual Property Right utility in general and engineering in particular. |

**Syllabus Contents:**

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|---|---|
| **Module-1** | Meaning of research problem, 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 |
| **Module-2** | Effective literature studies approaches, analysis Plagiarism, and Research ethics.Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee. |
| **Module-3** | Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT. |
| **Module-4** | Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs. |

BOOKS AND REFERENCES:


1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’”
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”
3. Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
4. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
5. Mayall , “Industrial Design”, McGraw Hill, 1992.
6. Niebel , “Product Design”, McGraw Hill, 1974.
7. Asimov , “Introduction to Design”, Prentice Hall, 1962.
8. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “Intellectual Property in New Technological Age”, 2016.
9. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

# Fourth Semester Detailed Syllabus

**Sessional-7**

| Name of the course | Course Code | Time/ Duration | Credit |
|---|---|---|---|
| Thesis Report Final | MDS-401S | 8 hrs/week | 4 |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Understand that how to write thesis with good readability |
| CO-2 | Learn to write section wise. |
| CO-3 | Understand the skills needed while writing a thesis |
| CO-4 | Ensure the quality of thesis report |

| | |
|---|---|
| **Module-1** | Planning and Preparation, Clarifying contributions of other authors, summarizing your findings, paraphrasing and plagiarism, sections of your thesis. |
| **Module-2** | Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check. key skills are needed when writing a thesis, 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. |
| **Module-3** | Skills are needed when writing about the methods and results, skills are needed when writing the discussion, skills are needed when writing the conclusions. |
| **Module-4** | Useful phrases, how to ensure thesis is as good as it could possibly be the first-time thesis writing. |

**Sessional-8**

| Name of the course | Course Code | Time/ Duration | Credit |
|---|---|---|---|
| Thesis Seminar Final (Presentation and Viva Voce) | MDS-402S | 8 hrs/week | 4 |

**At the end of the course, students will demonstrate the ability to-**

| | Course Outcome |
|---|---|

| | |
|---|---|
| **CO-1** | Synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem. |
| **CO-2** | Identify from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design. |
| **CO-3** | Demonstrate the findings of their technical solution in a written report. |
| **CO-4** | Present the work in International/ National conference or reputed journals. |

**Syllabus Contents:**

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study.

**A. The dissertation should have the following-**

vi) Relevance to social needs of society
vii) Relevance to value addition to existing facilities in the institute
viii) Relevance to industry need
ix) Problems of national importance
x) Research and development in various domain

**B. The student should complete the following:**

vi) Literature survey Problem Definition
vii) Motivation for study and Objectives
viii) Preliminary design / feasibility / modular approaches
ix) Implementation and Verification
x) Report and presentation

**Sessional-9**

| Name of the course | Course Code | Time/ Duration | Credit |
|---|---|---|---|
| Workshop and Seminars - II | MDS-403S | 2 hrs/week | 2 |

**At the end of the course, students will demonstrate the ability to-**

| | COURSE OUTCOMES |
|---|---|
| CO-1 | Follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments |
| CO-2 | Prepare appropriately to participate effectively and offer substantive replies to others' arguments, comments, and questions, while remaining sensitive to the original speaker and the classroom audience |
| CO-3 | Speak and debate with an appreciation for complex social and technical sensibilities |
| CO-4 | Offer compelling, articulate oral arguments, showing an understanding of the unique demands of oral presentation as opposed to writing |

**Syllabus Contents:**

1. Participate effectively in discussion of workshops and seminars [at least 02(two)].
2. Follow discussions, oral arguments, and presentations, noting main points or evidence and tracking threads through different comments and submit a comprehensive report to the department.
3. Demonstration of the ability to speak and defend (to be presented in the presentation seminar organized by the department).
4. Understanding of the unique demands of oral presentation as opposed to writing.( presentation skills will be evaluated)
5. Those who are unable to attend seminar / conferences/ workshops within the semester period needs to pass at least 01(one) NPTEL / MOOCs course of at least 04(four) weeks duration which should be relevant to project and thesis topic. Grade/ percentage of marks obtained in the NPTEL / MOOCs course examination will be proportionately taken into account for final evaluation of sessional -9.

**Open Elective**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Data Storage Technologies | MVE-401O | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | Course Outcome |
|---|---|
| **CO-1** | Understand and design random access memory and subsystems. |
| **CO-2** | Identify read only memory, fault models, modes and mechanisms in semiconductor memories and their testing procedures. |
| **CO-3** | Demonstrate the state-of-the-art memory chip design. |
| **CO-4** | Understanding of memory hybrids. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Random Access Memory Technologies: Static Random Access Memories (SRAMs), SRAM Cell Structures, MOS SRAM Architecture, MOS SRAM Cell and Peripheral Circuit, Bipolar SRAM, Advanced SRAM Architectures, Application Specific SRAMs. DRAMs, MOS DRAM Cell, BiC MOSDRAM, Error Failures in DRAM, Advanced DRAM Design and Architecture, Application Specific DRAMs.SRAM and DRAM Memory controllers. |
| **Module-2** | Non-Volatile Memories: Masked ROMs, PROMs, Bipolar & CMOS PROM, EEPROMs, Floating Gate, EPROM Cell, OTP EPROM, EEPROMs, Non-volatile SRAM, Flash Memories. Semiconductor Memory Reliability and Radiation Effects: General Reliability Issues, RAM Failure, Modes and Mechanism, Nonvolatile Memory, Radiation Effects, SEP, Radiation Hardening Techniques. Process and Design Issues. |
| **Module-3** | Advanced Memory Technologies and High-density Memory Packing Technologies: Ferroelectric Random Access Memories (FRAMs), Gallium Arsenide (GaAs) FRAMs, Analog Memories, Magneto Resistive Random Access Memories (MRAMs). |
| **Module-4** | Memory Hybrids (2D & 3D), Memory Stacks, Memory Testing and Reliability Issues, Memory Cards, High Density Memory Packaging. |

BOOKS AND REFERENCES:

- Ashok K Sharma, "Advanced Semiconductor Memories: Architectures, Designs and Applications", Wiley Interscience.
- Kiyoo Itoh, "VLSI memory chip design", Springer International Edition
- Ashok K Sharma," Semiconductor Memories: Technology, Testing and Reliability , PHI.

## Open Elective

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Cyber Security and Data Encryption | MVE-402O | 4 hrs/week | 4 | 40 hours |

**At the end of the course, students will demonstrate the ability to-**

| | Course Outcome |
|---|---|
| **CO-1** | Identify and utilize different forms of cryptography techniques. |
| **CO-2** | Compare number theory algorithms. |
| **CO-3** | Distinguish between private and public key cryptography. |
| **CO-4** | Demonstrate Authentication- IP and Web SecurityEncapsulating Security Payload. |
| **CO-5** | Understand System Security- Intruders Firewalls, Firewall Design Principles, Trusted Systems. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Security- Need, security services, Attacks, OSI Security Architecture, one time passwords, Model for Network security, Classical Encryption Techniques like substitution ciphers, Transposition ciphers, Cryptanalysis of Classical Encryption Techniques. |
| **Module-2** | Number Theory- Introduction, Fermat's and Euler's Theorem, The Chinese Remainder Theorem, Euclidean Algorithm, Extended Euclidean Algorithm, and Modular Arithmetic. |
| **Module-3** | Private-Key (Symmetric) Cryptography- Block Ciphers, Stream Ciphers, RC4 Stream cipher, Data Encryption Standard (DES), Advanced Encryption Standard (AES), Triple DES, RC5, IDEA, Linear and Differential Cryptanalysis.<br>Public-Key (Asymmetric) Cryptography - RSA, Key Distribution and Management, Diffie-Hellman Key Exchange, Elliptic Curve Cryptography, Message Authentication Code, hash functions, message digest algorithms:MD4 MD5, Secure Hash algorithm, RIPEMD-160, HMAC. |
| **Module-4** | Authentication- IP and Web Security Digital Signatures, Digital Signature Standards, Authentication Protocols, Kerberos, IP security Architecture, Encapsulating Security Payload, Key Management, Web Security Considerations, Secure Socket Layer and Transport Layer Security, Secure Electronic Transaction.<br>System Security- Intruders, Intrusion Detection, Password Management, Worms, viruses, Trojans, Virus Countermeasures, Firewalls, Firewall Design Principles, Trusted Systems. |

BOOKS AND REFERENCES:


- William Stallings, “Cryptography and Network Security, Principles and Practices”, Pearson Education, 3rd Edition.
- Charlie Kaufman, Radia Perlman and Mike Speciner, “Network Security, Private Communication in a Public World”, Prentice Hall, 2nd Edition
- Christopher M. King, ErtemOsmanoglu, Curtis Dalton, “Security Architecture, Design Deployment and Operations”, RSA Pres,
- Stephen Northcutt, LenyZeltser, Scott Winters, Karen Kent, and Ronald W. Ritchey, “Inside Network Perimeter Security”, Pearson Education, 2nd Edition
- Richard Bejtlich, “The Practice of Network Security Monitoring: Understanding Incident Detection and Response”, William Pollock Publisher, 2013.


**Open Elective**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Principles of Refrigeration and Cryogenics | MTE-401O | 4 hrs/week | 4 | 40 hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Learn the basics of refrigeration cycle and systems with its applicationarea. |
| **CO-2** | Design the refrigeration systems through proper selection of compressors, evaporators and condensers. |
| **CO-3** | Learn about refrigerants, ODP, GWP and related environmentissues. |
| **CO-4** | Analyze vapour absorption refrigeration, gas liquefaction systems and related applications. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Vapour compression refrigeration, actual cycle, second law efficiency, multistage compression with inter-cooling, multi-evaporator systems, cascade systems. |
| **Module-2** | Performance characteristics and capacity control of reciprocating and centrifugal compressors, screw compressor and scroll-compressor, design, selection of evaporators, condensers, control systems, motor selection. |
| **Module-3** | Refrigerants, alternative refrigerants, CFC/HCFC phase-outregulations, refrigeration applications, food preservation,transport. |
| **Module-4** | Introduction to vapour absorption refrigeration, single effect and double effect systems, gas liquefaction systems - Linde-Hampson, Linde dual pressure, Claude cycle. |

BOOK AND REFERENCES:


1. 1. R.J.Dossat, “Principles of Refrigeration”, Pearson Education Asia,2001.
2. C.P.Arora, “Refrigeration and Air-conditioning”, Tata McGraw-Hill,2000.
3. Stoecker& Jones, “Refrigeration and Air-conditioning”, McGraw Hill Book Company, New York,1982.

4. Jordan &Priester, “Refrigeration andAir-conditioning”.
5. A.R.Trott, “Refrigeration and Air-conditioning”, Butterworths,2000.
6. J.L.Threlkeld, “Thermal Environmental Engineering”, Prentice Hall,1970.
7. R.Barron, “Cryogenic systems”, McGraw–Hill Company, New Yourk,1985.
8. G.G.Hasseldon. “Cryogenic Fundamentals”, AcademicPress.
9. Bailey, “Advanced Cryogenics”, Plenum Press, London,1971.

**Open Elective**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Design and Application of Solar Thermal Systems | MTE-402O | 4 hrs/week | 4 | 40 hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Acquire the knowledge of different aspects and parameters of solar energy systems. |
| **CO-2** | Analyze the performance of various solar thermalsystems. |
| **CO-3** | Design, test, model, optimize and analyze different solar drying systems and associated impacts. |
| **CO-4** | Generate the scenarios of recent advances and applications of SAH integrated with SHS and LHS in solar dryers and predict the future trends. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | **Basics of Solar Thermal Systems:** Introduction to Solar Air Heater (SAH)**,** Different components of SAH; Radiation transmission and absorption through glazing; Selective surfaces: Ideal coating characteristics, Anti reflection coating, application of SAH in solar drying systems and case studies. |
| **Module-2** | **Solar Air Heater or Collector and Thermal Energy Storage:** Flat Plate Collector: Theory and basic design aspects; Thermal analysis and effective heat loss; Performance analysis methods; Concentrating Collector: Classification of concentrating collector; concentrating collector configurations; Thermal performance of concentrating collector; Optical and thermal performance of different concentrating collector designs; Solar thermal energy storage: LSH and SHS materials, Designing thermal storage systems, recent advances in solar air heater methods, technologies with applications and future trends. |
| **Module-3** | **Solar Drying Systems:** Basic concepts and classifications of Solar Drying systems (SDS), design, testing and modelling of SDS, environomical impact of |

| | |
|---|---|
| | SDS, innovations in SDS, `4 E` analysis of SDS, heat and moisture transfer and optimization of SDS. |
| **Module-4** | **Applications of Solar Thermal Systems:** Performance evaluation of Solar Dryer with SHS and SAH: design, fabrication and detailed instrumentation of solar dryer, Mathematical modelling of SAH, Performance of SAH and Solar Dryer, Environomical analysis and future trends. Performance analysis of Solar Dryer integrated with LHS and SAH: design, fabrication and detailed instrumentation, energy and energy analysis, performance test of solar dryer, future trends. |

BOOKS AND REFERENCES:


1. Duffie J. A. and Beckman W. A. (2013); *Solar Engineering of Thermal Processes*, John Wiley
2. Garg H. P. and Prakash S. (2000); *Solar Energy: Fundamental and Application*, Tata McGrawHill
3. Nayak J. K. and Sukhatme S. P. (2006); Solar Energy: Principles of Thermal Collection and Storage, Tata McGrawHill
4. Twidell J, Weir T (2015); *Renewable Energy Resources*,Routledge
5. Dincer I., and Rosen M. A. (2011); *Thermal Energy Storage: Systems andApplications*, Wiley
6. Dinçer, İ. and Zamfirescu, C., 2016. *Drying phenomena: theory and applications*. John Wiley & Sons.
7. Prakash, O. and Kumar, A. eds., 2017. *Solar drying technology: concept, design, testing, modeling, economics, and environment*. Springer.
8. Ataer, O.E., 2009. Storage of thermal energy. Energy storage systems, 1, p.97. Tyagi, H., Chakraborty, P.R., Powar, S. and Agarwal, A.K. eds., 2019. *Solar*


**Foundation Course**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| English for Research Paper Writing | MID-401F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| **At the end of the course students will be able to-** | |
|---|---|
| **CO-1** | Identify scope to improve writing skills and level of readability. |
| **CO-2** | Demonstrate technical paper writing skills. |
| **CO-3** | Develop the skills to write a good quality of paper. |
| **CO-4** | Present the Literature review, Methods, Results, Discussion, Conclusions and Final Check in result oriented manner. |

**Syllabus Contents:**

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

BOOKS AND REFERENCES:


- Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books).
- Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press.
- Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook .
- Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011.


## Foundation Course

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Disaster Management | MID-402F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| **At the end of the course students will be able to-** | |
|---|---|
| **CO-1** | Demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response. |
| **CO-2** | Understand Repercussions Of Disasters And Hazards. |
| **CO-3** | Illustrate natural and manmade disasters. |
| **CO-4** | Classify disaster prone areas in India. |
| **CO-5** | Analysis of disaster risk assessment and reduction mechanisms. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. |
| **Module-2** | Repercussions Of Disasters And Hazards: Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts. |
| **Module-3** | Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases |

| | |
|---|---|
| | And Epidemics. Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And CommModuley Preparedness. |
| **Module-4** | Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India. |

BOOKS AND REFERENCES:


- R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
- Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
- Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.


## Foundation Course

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Sanskrit for Technical Knowledge | MID-403F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Develop a working knowledge in illustrious Sanskrit, the scientific language in the world |
| **CO-2** | Learn Sanskrit to improve brain functioning |
| **CO-3** | Develop the logic in mathematics, science & other subjects enhancing the memory power |
| **CO-4** | Explore the technical knowledge from ancient literature. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences. |
| **Module-2** | Order, Introduction of roots. |
| **Module-3** | Technical information about Sanskrit Literature. |
| **Module-4** | Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics. |

BOOKS AND REFERENCES:


1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, NewDelhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

**Foundation Course**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Value Education | MID-404F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Understand value of education and self- development. |
| **CO-2** | Imbibe good values in students. |
| **CO-3** | Inculcate about the importance of character. |
| **CO-4** | Demonstrate mind training, Self-control, Honesty, Studying effectively. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Values and self-development –Social values and individual, attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements |
| **Module-2** | Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Moduley. Patriotism. Love for nature ,Discipline |
| **Module-3** | Personality and Behavior Development – Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. Universal brotherhood and religious tolerance. True friendship. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation. Doing best for saving nature |
| **Module-4** | Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence, Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively. |

BOOKS AND REFERENCES:


1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

**Foundation Course**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Constitution of India | MID-405F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| At the end of the course, students will be able to- | |
|---|---|
| **CO-1** | Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective. |
| **CO-2** | Understand the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism. |
| **CO-3** | Understand the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution. |
| **CO-4** | DemonstratetheRole and FunctioningofElection Commission,. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | History of Making of the Indian Constitution: History Drafting Committee, ( Composition & Working) |
| **Module-2** | Philosophy of the Indian Constitution: Preamble, Salient Features. Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties. |
| **Module-3** | Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy. |

| | |
|---|---|
| **Module-4** | Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women. |

BOOKS AND REFERENCES:


1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7thEdn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.


## Foundation Course

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Pedagogy studies | MID-406F | 2 hrs/week | 0 | 20hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Understand parameters and terminology of pedagogy. |
| **CO-2** | Compare pedagogical practices in developing countries. |
| **CO-3** | Measure effectiveness of pedagogical practices. |
| **CO-4** | Assess Professional development by alignment with classroom practices and follow-up support and Peer support. |
| **CO-5** | Identify Research gaps and future directions, Research design, Contexts, Pedagogy,etc. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-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. |
| **Module-2** | Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education. |
| **Module-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. Teachers' attitudes and beliefs and Pedagogic strategies. |
| **Module-4** | Professional development: alignment with classroom practices and follow-up support Peer support. Support from the head teacher and the commModuley. Curriculum and assessment. Barriers to learning: limited resources and large class sizes.Research gaps and future directions, Research design, Contexts, |

| | |
|---|---|
| | Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact. |

BOOKS AND REFERENCES:


1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.


**Foundation Course**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Stress Management by Yoga | MID-407F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Understand the role of yoga in developing overall health of body and mind. |
| **CO-2** | Understand the importance of Yoga in Overcoming stress. |
| **CO-3** | Experiment with various asanas and Pranayams. |
| **CO-4** | Implement breathing techniques. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Definitions of Eight parts of yog. ( Ashtanga ) |
| **Module-2** | Yam and Niyam. Do`s and Don't's in life. I) Ahinsa, satya, astheya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan. |
| **Module-3** | Asan and Pranayam- Various yog poses and their benefits for mind & body. |
| **Module-4** | Regularization of breathing techniques and its effects-Types of pranayam |

BOOKS AND REFERENCES:


1. 'Yogic Asanas for Group Tarining-Part-I" : Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata


**Foundation Course**

| Name of the course | Course Code | Time/ Duration | Credit | Total Classes |
|---|---|---|---|---|
| Personality Development Through Life Enlightenment Skills | MID-408F | 2 hrs/week | 0 | 20 hours |

**Course Outcomes:**

| At the end of the course students will be able to- | |
|---|---|
| **CO-1** | Understand the skill to achieve the highest goal happily. |
| **CO-2** | Develop the skills of a person with stable mind, pleasing personality and determination. |
| **CO-3** | Inculcate wisdom in them. |
| **CO-4** | Understand basic knowledge of Shrimad Bhagwad Geeta. |

**Syllabus Contents:**

| | |
|---|---|
| **Module-1** | Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom), Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue), Verses- 52,53,59 (dont's), Verses- 71,73,75,78 (do's). |
| **Module-2** | Approach to day to day work and duties. Shrimad BhagwadGeeta : Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35, Chapter 18-Verses 45, 46, 48. |
| **Module-3** | Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68, Chapter 12 -Verses 13, 14, 15, 16,17, 18. |
| **Module-4** | Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39, Chapter18 – Verses 37,38,63. |

BOOKS AND REFERENCES:


1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath, Rashtriya Sanskrit Sansthanam, New Delhi.