Annexure I: Course structure/syllabus for M.Tech in Data Science

Program Outcomes of M.Tech. in Data Science program:

The main outcomes of the M.Tech. in Data Science program are given here. At the end of the program, a student is expected to have:
1. An understanding of the theoretical foundations and the limits of computing.
2. An ability to adapt existing models, techniques, algorithms, data structures, etc., for efficiently solving problems.
3. An ability to design, develop, and evaluate new /computer based systems for novel applications that meet the desired needs of industry and society.
4. Understanding and ability to use advanced computing techniques and tools.
5. An ability to undertake original research at the cutting edge of computer science & its related areas.
6. An ability to function effectively individually or as a part of a team to accomplish a stated goal.
7. An understanding of professional and ethical responsibility.
8. An ability to communicate effectively with a wide range of audiences.
9. An ability to learn independently and engage in life¬long learning.
10. An understanding of the impact of IT-related solutions in an economic, social, and environmental context.

1st Semester						
S.N.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**Total Credits**
THEORY						
1	CSM101	Mathematical Foundations of Computer Science	3	0	0	3
2	CSM102	Advanced Data Structures	3	0	0	3
3	CSM103	Research Methodology and IPR	3	0	0	3
4	CSMEXX	Elective I	3	0	0	3
5	CSMEXX	Elective II	3	0	0	3
6	CSMAXX	Audit Course 1	2	0	0	2
PRACTICAL						
1	CSM111	Advanced Data Structures lab	0	0	3	1.5
2	CSM112	Advanced Machine Learning lab	0	0	3	1.5
Total Credits			**17**	**0**	**6**	**20**
2nd Semester						
S.N.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**Total Credits**
THEORY						

1	CSM201	Advance Algorithms	3	0	0	3
2	CSM202	Soft Computing	3	0	0	3
3	CSMAXX	Audit Course 2	2	0	0	2
4	CSMEXX	Elective III	3	0	0	3
5	CSMEXX	Elective IV	3	0	0	3
PRACTICAL						
1	CSM211	Advance Algorithm Lab	0	0	3	1.5
2	CSM212	Computer Vision Lab	0	0	3	1.5
3	CSM213	Mini project with Seminar	0	0	4	2
Total Credits			**14**	**0**	**10**	**19**
3rd Semester						
S.N.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**Total Credits**
1	CSMEXX	Elective V	3	0	0	3
2	CSMOEXX	Open Elective I	3	0	0	3
3	CSM311	Dissertation I	0	0	20	10
4	CSM312	Industrial Training*	0	0	0	non-credit
Total Credits			**6**	**0**	**20**	**16**
4th Semester						
1	CSM411	Dissertation II	0	0	32	16
Total Credits			**0**	**0**	**32**	**16**

*** At least 4 weeks of industrial training is required to pass this subject**

Total no. of Credits from 1st semester to 4th semester: 71 (Seventy-one)

List of Audit Courses

Sl. No.	Course Code	Course Title	L	T	P	Total Credits
1	CSMA01	English for Research Paper Writing	2	0	0	2
2	CSMA02	Disaster Management	2	0	0	2
3	CSMA03	Sanskrit for Technical Knowledge	2	0	0	2
4	CSMA04	Value Education	2	0	0	2
5	CSMA05	Constitution of India	2	0	0	2
6	CSMA06	Pedagogy Studies	2	0	0	2
7	CSMA07	Stress Management by Yoga	2	0	0	2
8	CSMA08	Personality Development through Life Enlightenment Skills	2	0	0	2

LIST OF ELECTIVE

Sl. No.	Course Code	Course Title	L	T	P	Total Credits
1	CSME01	Data Science	3	0	0	3
2	CSME02	Distributed Systems	3	0	0	3
3	CSME03	Data Preparation and Analysis	3	0	0	3
4	CSME04	Recommender System	3	0	0	3
5	CSME05	Machine Learning	3	0	0	3
6	CSME06	Data Storage Technologies and Networks	3	0	0	3
7	CSME07	Data Visualization	3	0	0	3
8	CSME08	Data Security and Access Control	3	0	0	3
9	CSME09	Web Analytics and Development	3	0	0	3
10	CSME10	Knowledge Discovery				
11	CSME11	GPU Computing	3	0	0	3
12	CSME12	Cloud Computing	3	0	0	3
13	CSME13	Distributed Databases	3	0	0	3
14	CSME14	Big Data Analytics	3	0	0	3

15	CSME15	Data Warehouse and Data Mining	3	0	0	3

LIST OF OPEN ELECTIVE

Sl. No.	Course Code	Course Title	L	T	P	Total Credits
1	CSMOE01	Business Analytics	3	0	0	3
2	CSMOE02	Industrial Safety	3	0	0	3
3	CSMOE03	Operations Research	3	0	0	3
4	CSMOE04	Cost Management of Engineering Projects	3	0	0	3
5	CSMOE05	Composite Materials	3	0	0	3
6	CSMOE06	Waste to Energy	3	0	0	3

Syllabus, course objective and course outcomes for various post graduation courses Core Subjects

Course Code	CSM101
Course Name	Mathematical Foundation of Computer Science
Credits	3
Pre-Requisites	Discrete Mathematics

Total Number of Lectures:48

COURSE OBJECTIVE
● To understand the mathematical fundamentals that is prerequisites for avariety of courses like Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.
● To developthe understanding ofthe mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.
● To study various sampling and classification problems.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 Probability mass, density, and cumulative distribution functions, Parametric families of distributions, Expected value, variance, conditional expectation, Applications of the univariate and multivariate Central Limit Theorem, Probabilistic inequalities, Markov chains	7
Unit 2 Random samples, sampling distributions of estimators**,** Methods of Moments and Maximum Likelihood**,**	7
Unit 3 Statistical inference**,** Introduction to multivariate statistical models: regression and classification problems, principal components analysis**,** The problem of overfitting model assessment.	8
Unit 4 Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles.	11

Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems	
Unit 5 **Computer science and engineering applications** Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.	10
Unit 6 Recent Trands in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision.	5

COURSE OUTCOMES
After completion of course, students would be able to:
● To understand the basic notions of discrete and continuous probability.
● To understand the methods of statistical inference, and the role that sampling distributions play in those methods.
● To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.

References:

1. John Vince, Foundation Mathematics for Computer Science, Springer.
2. K. Trivedi.Probability and Statistics with Reliability, Queuing, and Computer Science Applications. Wiley.
3. M. Mitzenmacher and E. Upfal.Probability and Computing: Randomized Algorithms and Probabilistic Analysis.
4. Alan Tucker, Applied Combinatorics, Wiley

Course Code	CSM102
Course Name	Advanced Data Structures
Credits	3
Pre-Requisites	UG level course in Data Structures

Total Number of Lectures:48

COURSE OBJECTIVE
● The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
● Students should be able to understand the necessary mathematical abstraction to solve problems.
● To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
● Student should be able to come up with analysis of efficiency and proofs of correctness.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1 **Dictionaries:** Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. **Hashing:** Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic	7

Probing, Double Hashing, Rehashing, Extendible Hashing.	
Unit 2 **Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	5
Unit 3 **Trees:** Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees	9
Unit 4 **Text Processing:** Sting Operations, Brute-Force Pattern Matching, The Boyer-Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	12
Unit 5 **Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quadtrees, k-D Trees.	10
Unit 6 Recent Trands in Hashing, Trees, and various computational geometry methods for effeciently solving the new evolving problem	5

COURSE OUTCOMES
After completion of course, students would be able to:
● Understand the implementation of symbol table using hashing techniques.
● Develop and analyze algorithms for red-black trees, B-trees and Splay trees.
● Develop algorithms for text processing applications.
● Identify suitable data structures and develop algorithms for computational geometry problems.

References:

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

Course Code	CSM201
Course Name	Advanced Algorithms
Credits	3
Pre-Requisites	UG level course in Algorithm Design and Analysis

Total Number of Lectures:48

COURSE OBJECTIVE
● Introduce students to the advanced methods of designing and analyzing algorithms.
● The student should be able to choose appropriate algorithms and use it for a specific problem.
● To familiarize students with basic paradigms and data structures used to solve advanced algorithmic problems.
● Students should be able to understand different classes of problems concerning their computation difficulties.
● To introduce the students to recent developments in the area of algorithmic design.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit1 **Sorting:** Review of various sorting algorithms, topological sorting **Graph:** Definitions and Elementary Algorithms: Shortest path by BFS, shortest path in edge-weighted case (Dijkasra's), depth-first search and computation of strongly connected components, emphasis on correctness proof of the algorithm and time/space analysis, example of amortized analysis.	6
Unit 2 **Matroids:** Introduction to greedy paradigm, algorithm to compute a maximum weight maximal independent set. Application to MST. **Graph Matching:** Algorithm to compute maximum matching. Characterization of maximum matching by augmenting paths, Edmond's Blossom algorithm to compute augmenting path.	8
Unit 3 **Flow-Networks:** Maxflow-mincut theorem, Ford-Fulkerson Method to compute maximum flow, Edmond-Karp maximum-flow algorithm. **Matrix Computations:** Strassen's algorithm and introduction to divide and conquer paradigm, inverse of a triangular matrix, relation between the time complexities of basic matrix operations, LUP-decomposition.	9
Unit 4 **Shortest Path in Graphs:** Floyd-Warshall algorithm and introduction to dynamic programming paradigm. More examples of dynamic programming. **Modulo Representation of integers/polynomials:** Chinese Remainder Theorem, Conversion between base-representation and modulo-representation. Extension to polynomials. Application: Interpolation problem. **Discrete Fourier Transform (DFT):** In complex field, DFT in modulo ring. Fast Fourier Transform algorithm. Schonhage-Strassen Integer Multiplication algorithm	10
Unit 5 **Linear Programming:** Geometry of the feasibility region and Simplex algorithm **NP-completeness:** Examples, proof of NP-hardness and NP-completeness. **One or more of the following topics based on time and interest** Approximation algorithms, Randomized Algorithms, Interior Point Method, Advanced Number Theoretic Algorithm	10
Unit 6 Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	5

COURSE OUTCOMES
After completion of course, students would be able to:
● Analyze the complexity/performance of different algorithms.
● Determine the appropriate data structure for solving a particular set of problems.
● Categorize the different problems in various classes according to their complexity.
● Students should have an insight of recent activities in the field of the advanced data structure.

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.

CSM103 **Research Methodology and IPR**

Teaching Scheme Lectures: 1hrs/week	

Course Outcomes:

At the end of this course, students will be able to

- Understand research problem formulation.
- Analyze research related information
- Follow research ethics
- Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
- Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
- Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn
  brings about, economic growth and social benefits.

Syllabus Contents:

Unit 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

Unit 2: Effective literature studies approaches, analysis Plagiarism, Research

ethics,

Unit 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

Unit 4: 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.

Unit 5: Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

Unit 6: 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.

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, 2 nd 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

Course Code	CSM202
Course Name	Soft Computing
Credits	3
Pre-Requisites	Basic knowledge of mathematics

Total Number of Lectures:48

COURSE OBJECTIVE
● To introduce soft computing concepts and techniques and foster their abilities in designing appropriate technique for a given scenario.
● To implement soft computing based solutions for real-world problems.
● To give students knowledge of non-traditional technologies and fundamentals of artificial neural networks, fuzzy sets, fuzzy logic, genetic algorithms.
● To provide studentan hand-on experience on MATLAB to implement various strategies.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1 **INTRODUCTION TO SOFT COMPUTING AND NEURAL NETWORKS:** Evolution of Computing: Soft Computing Constituents, From Conventional AI to Computational Intelligence: Machine Learning Basics	7
Unit 2 **FUZZY LOGIC:** Fuzzy Sets, Operations on Fuzzy Sets, Fuzzy Relations, Membership Functions: Fuzzy Rules and Fuzzy Reasoning, Fuzzy Inference Systems, Fuzzy Expert Systems, Fuzzy Decision Making.	8
Unit 3 **NEURAL NETWORKS:** 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	10
Unit 4 **GENETIC ALGORITHMS:** Introduction to Genetic Algorithms (GA), Applications of GA in Machine Learning : Machine Learning Approach to Knowledge Acquisition.	5
Unit 5 **Matlab/Python Lib:** 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	13
Unit 6 Recent Trands in deep learning, various classifiers, neural networks and genetic algorithm.	5

Implementation of recently proposed soft computing techniques.	
COURSE OUTCOMES	
After completion of course, students would be able to:	
● Identify and describe soft computing techniques and their roles in building intelligent machines	
● Apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.	
● Apply genetic algorithms to combinatorial optimization problems.	
● Evaluate and compare solutions by various soft computing approaches for a given problem.	

References:

1. Jyh:Shing Roger Jang, Chuen:Tsai Sun, EijiMizutani, Neuro:Fuzzy and Soft Computing , Prentice:Hall of India, 2003.
2. George J. Klir and Bo Yuan, Fuzzy Sets and Fuzzy Logic:Theory and Applications , Prentice Hall, 1995.
3. MATLAB Toolkit Manual

Elective Subjects

Course Code	CSME05
Course Name	Machine learning
Credits	3

Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE
● To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
● To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
● Explore supervised and unsupervised learning paradigms of machine learning.
● To explore Deep learning technique and various feature extraction strategies.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **Supervised Learning (Regression/Classification)** ● Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes ● Linear models: Linear Regression, Logistic Regression, Generalized Linear Models ● Support Vector Machines, Nonlinearity and Kernel Methods ● Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	10
Unit 2: **Unsupervised Learning** ● Clustering: K-means/Kernel K-means ● Dimensionality Reduction: PCA and kernel PCA ● Matrix Factorization and Matrix Completion ● Generative Models (mixture models and latent factor models)	7
Unit 3 Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random	6

Forests)	
Unit 4 Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9
Unit 5 Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	9
Unit 6: Recent trends in various learning techniques of machine learning and classification methods for IOT applications. Various models for IOT applications.	5

COURSE OUTCOMES
After completion of course, students would be able to:
● Extract features that can be used for a particular machine learning approach in various IOT applications.
● To compare and contrast pros and cons of various machine learning techniques and to get an insight of when to apply a particular machine learning approach.
● To mathematically analyse various machine learning approaches and paradigms.

References:

1. Kevin Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, Springer 2009 (freely available online)
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.

Course Code	CSME01
Course Name	Data Science
Credits	3
Pre-Requisites	

Total Number of Lectures:48

COURSE OBJECTIVE

● Provide you with the knowledge and expertise to become a proficient data scientist.
● Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
● Produce Python code to statistically analyse a dataset;
● Critically evaluate data visualisations based on their design and use for communicating stories from data;

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications.	6
Unit 2: Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources	7
Unit 3: Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance,Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes.	10
Unit 4: Data visualisation:Introduction, Types of data visualisation,Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	11
Unit 5: Applications of Data Science,Technologies for visualisation, Bokeh (Python)	7
Unit 6: Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	7

COURSE OUTCOMES
On completion of the course the student should be able to
● Explain how data is collected, managed and stored for data science;
● Understand the key concepts in data science, including their real-world applications and the toolkit used by data scientists;
● Implement data collection and management scripts using MongoDB

References:

1. Cathy O'Neil and Rachel Schutt. Doing Data Science, Straight Talk From The Frontline. O'Reilly.
2. Jure Leskovek, Anand Rajaraman and Jeffrey Ullman. Mining of Massive Datasets. v2.1, Cambridge University Press.

Course Code	CSME02
Course Name **Credits**	Distributed Systems 3
Pre-Requisites	Database Management Systems

Total Number of Lectures: 48

COURSE OBJECTIVE
• To introduce the fundamental concepts and issues of managing large volume of shared data in a parallel and distributed environment, and to provide insight into related research problems.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **INTRODUCTION** Distributed data processing; What is a DDBS; Advantages and disadvantages of DDBS; Problem areas; Overview of database and computer network concepts **DISTRIBUTED DATABASE MANAGEMENT SYSTEM ARCHITECTURE** Transparencies in a distributed DBMS; Distributed DBMS architecture; Global directory issues	8
Unit 2: **DISTRIBUTED DATABASE DESIGN** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation **SEMANTICS DATA CONTROL** View management; Data security; Semantic Integrity Control **QUERY PROCESSING ISSUES** Objectives of query processing; Characterization of query processors; Layers of query processing; Query decomposition; Localization of distributed data	11
Unit 3: **DISTRIBUTED QUERY OPTIMIZATION** Factors governing query optimization; Centralized query optimization; Ordering of fragment queries; Distributed query optimization algorithms **TRANSACTION MANAGEMENT** The transaction concept; Goals of transaction management; Characteristics of transactions; Taxonomy of transaction models **CONCURRENCY CONTROL** Concurrency control in centralized database systems; Concurrency control in DDBSs; Distributed concurrency control algorithms; Deadlock management	11
Unit 4: **RELIABILITY** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols	8
Unit 5: **PARALLEL DATABASE SYSTEMS** Parallel architectures; parallel query processing and optimization; load balancing	6
Unit 6:	4

ADVANCED TOPICS Mobile Databases, Distributed Object Management, Multi-databases	

COURSE OUTCOMES
After completion of course, students would be:
● Design trends in distributed systems.
● Apply network virtualization.
● Apply remote method invocation and objects.

References:

1. Principles of Distributed Database Systems, M.T. Ozsu and P. Valduriez, Prentice-Hall, 1991.
2. Distributed Database Systems, D. Bell and J. Grimson, Addison-Wesley, 1992.

Course Code	CSME13
Course Name	Distributed Database
Credits	3
Pre-Requisites	

Total Number of Lectures: 48

COURSE OBJECTIVE
The objective of course is to provide insight to distributed database, normalization techniques and integrity rules. It also includes parallel database systems along with object oriented models.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: Introduction: Distributed Data processing, Distributed database system (DDBMS), Promises of DDBMSs, Complicating factors and Problem areas in DDBMSs, Overview Of Relational DBMS Relational Database concepts, Normalization, Integrity rules, Relational Data Languages, Relational DBMS.	11
Unit 2: Distributed DBMS Architecture: DBMS Standardization, Architectural models for Distributed DBMS, Distributed DBMS Architecture. Distributed Database Design: Alternative design Strategies, Distribution design issues, Fragmentation, Allocation. Semantic Data Control: View Management, Data security, Semantic	8

Integrity Control.	
Unit 3: Overview of Query Processing: Query processing problem, Objectives of Query Processing, Complexity of Relational Algebra operations, characterization of Query processors, Layers of Query Processing. Introduction to Transaction Management: Definition of Transaction, Properties of transaction, types of transaction. Distributed Concurrency Control: Serializability theory, Taxonomy of concurrency control mechanisms, locking bases concurrency control algorithms.	9
Unit 4: Parallel Database Systems: Database servers, Parallel architecture, Parallel DBMS techniques, Parallel execution problems, Parallel execution for hierarchical architecture.	7
Unit 5: Distributed Object Database Management systems: Fundamental Object concepts and Object models, Object distribution design. Architectural issues, Object management, Distributed object storage, Object query processing. Transaction management. Database Interoperability: Database Integration, Query processing.	8
Unit 6: Recent approaches, models and current trends in improving the performance of Distributed Database.	5

COURSE OUTCOMES
After completion of course, students would be:
Abe to understand relational database management systems, normalization to make efficient retrieval from database and query.

References:

1. Principles of Distributed Database Systems, Second Edition, M. Tamer Ozsu Patrick Valduriez
2. Distributed Databases principles and systems, Stefano Ceri, Giuseppe Pelagatti, Tata McGraw Hill.

Course Code	CSME03
Course Name	Data Preparation and Analysis
Credits	3
Pre-Requisites	

Total Number of Lectures: 48

COURSE OBJECTIVE
● To prepare the data for analysis and develop meaningful Data Visualizations

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit1: **Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues	9
Unit2: **Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	11
Unit3: **Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis generation	13
Unit4: **Visualization:** Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	15

COURSE OUTCOMES
After completion of course, students would be:
● Able to extract the data for performing the Analysis.

References:

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

Course Code	CSME11
Course Name	GPU Computing
Credits	3
Pre-Requisites	

Total Number of Lectures: 48

COURSE OBJECTIVE	
• To learn parallel programming with Graphics Processing Units (GPUs).	
LECTURE WITH BREAKUP	**NO. OF LECTURES**

Unit 1: **Introduction**: History, Graphics Processors, Graphics Processing Units, GPGPUs. Clock speeds, CPU / GPU comparisons, Heterogeneity, Accelerators, Parallel programming, CUDA OpenCL / OpenACC, Hello World Computation Kernels, Launch parameters, Thread hierarchy, Warps / Wavefronts, Thread blocks / Workgroups, Streaming multiprocessors, 1D / 2D / 3D thread mapping, Device properties, Simple Programs	13
Unit 2: **Memory**: Memory hierarchy, DRAM / global, local / shared, private / local, textures, Constant Memory, Pointers, Parameter Passing, Arrays and dynamic Memory, Multi-dimensional Arrays, Memory Allocation, Memory copying across devices, Programs with matrices, Performance evaluation with different Memories	7
Unit 3: **Synchronization**: Memory Consistency, Barriers (local versus global), Atomics, Memory fence. Prefix sum, Reduction. Programs for concurrent Data Structures such as Worklists, Linked-lists. Synchronization across CPU and GPU **Functions**: Device functions, Host functions, Kernels functions, Using libraries (such as Thrust), and developing libraries.	10
Unit 4: **Support**: Debugging GPU Programs. Profiling, Profile tools, Performance aspects **Streams**: Asynchronous processing, tasks, Task-dependence, Overlapped data transfers, Default Stream, Synchronization with streams. Events, Event-based- Synchronization - Overlapping data transfer and kernel execution, pitfalls.	8
Unit 5: **Case Studies**: Image Processing, Graph algorithms, Simulations, Deep Learning	5
Unit 6: **Advanced topics**: Dynamic parallelism, Unified Virtual Memory, Multi-GPU processing, Peer access, Heterogeneous processing	5

COURSE OUTCOMES
After completion of course, students would be:
● Students would learn concepts in parallel programming, implementation of programs on GPUs, debugging and profiling parallel programs.

References:

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2010 (ISBN: 978-0123814722)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

COURSE OUTCOMES
After completion of course, students would be:

• Formulate optimization problems.
• Understand and apply the concept of optimality criteria for various types of optimization problems.
• Solve various constrained and unconstrained problems in Single variable as well as multivariable.
• Apply the methods of optimization in real life situation.

OPEN ELECTIVES
CSBOE01 Business Analytics

Teaching scheme Lecture: - 3

h/week

Course Code	**CSBOE01**
Course Name	**Business Analytics**
Credits **Prerequisites**	

Total Number of Lectures: 48

Course objective
1. Understand the role of business analytics within an organization. 2. Analyze data using statistical and data mining techniques and understand relationships between the underlying business processes of an organization. 3. To gain an understanding of how managers use business analytics to formulate and solve business problems and to support managerial decision making. 4. To become familiar with processes needed to develop, report, and analyze business data. 5. Use decision-making tools/Operations research techniques.

6. Mange business process using analytical and management tools. **7.** Analyze and solve problems from different industries such as manufacturing, service, retail, software, banking and finance, sports, pharmaceutical, aerospace etc.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit1: 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.	9
Unit 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.	8
Unit 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 Modelling, Predictive analytics analysis, Data Mining, Data Mining Methodologies, Prescriptive analytics and its step in the business analytics Process, Prescriptive Modelling, nonlinear Optimization.	9
Unit 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. Monte Carlo Simulation and Risk Analysis: Monte Carle Simulation Using	10

Analytic Solver Platform, New-Product Development Model, Newsvendor Model, Overbooking Model, Cash Budget Model.	
Unit 5: Decision Analysis: Formulating Decision Problems, Decision Strategies with the without Outcome Probabilities, Decision Trees, The Value of Information, Utility and Decision Making.	8
Unit 6: Recent Trends in : Embedded and collaborative business intelligence, Visual data recovery, Data Storytelling and Data journalism.	4

COURSE OUTCOMES	
1.	Students will demonstrate knowledge of data analytics.
2.	Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
3.	Students will demonstrate the ability to use technical skills in predicative and prescriptive modeling to support business decision-making.
4.	Students will demonstrate the ability to translate data into clear, actionable insights.

Reference:

1. Business analytics Principles, Concepts, and Applications by Marc J. Schniederjans, Dara G. Schniederjans, Christopher M. Starkey, Pearson FT Press.
2. Business Analytics by James Evans, persons Education.

OPEN ELECTIVES

CSBOE02 Industrial Safety

Teaching scheme

Lecture: - 3 h/week

Unit-I: Industrial safety: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing: Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one

machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance: Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

Reference:

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication.
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London.

OPEN ELECTIVES

CSBOE03 Operations Research

Teaching Scheme Lectures: 3

hrs/week

Course Outcomes: At the end of the course, the student should be able to

- Students should able to apply the dynamic programming to solve problems of discreet and continuous variables.
- Students should able to apply the concept of non-linear programming
- Students should able to carry out sensitivity analysis
- Student should able to model the real world problem and simulate it.

Syllabus Contents:

Unit 1:

Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models

Unit 2

Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming

Unit 3:

Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT

Unit 4

Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.

Unit 5

Competitive Models,Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation **References:**

1. H.A. Taha, Operations Research, An Introduction, PHI, 2008

2. H.M. Wagner, Principles of Operations Research, PHI, Delhi, 1982.
3. J.C. Pant, Introduction to Optimisation: Operations Research, Jain Brothers, Delhi, 2008
4. Hitler Libermann Operations Research: McGraw Hill Pub. 2009
5. Pannerselvam, Operations Research: Prentice Hall of India 2010
6. Harvey M Wagner, Principles of Operations Research: Prentice Hall of India 2010

CSBOE04 Cost Management of Engineering Projects

Teaching scheme

Lecture: - 3 h/week

Introduction and Overview of the Strategic Cost Management Process

Cost concepts in decision-making; Relevant cost, Differential cost, Incremental cost and Opportunity cost. Objectives of a Costing System; Inventory valuation; Creation of a Database for operational control; Provision of data for Decision-Making.

Project: meaning, Different types, why to manage, cost overruns centres, various stages of project execution: conception to commissioning. Project execution as conglomeration of technical and non- technical activities. Detailed Engineering activities. Pre project execution main clearances and documents Project team: Role of each member. Importance Project site: Data required with significance. Project contracts. Types and contents. Project execution Project cost control. Bar charts and Network diagram. Project commissioning: mechanical and process

Cost Behavior and Profit Planning Marginal Costing; Distinction between Marginal Costing and Absorption Costing; Break-even Analysis, Cost-Volume-Profit Analysis. Various decision-making problems. Standard Costing and Variance Analysis. Pricing strategies: Pareto Analysis. Target costing, Life Cycle Costing. Costing of service sector. Just-in-time approach, Material Requirement Planning, Enterprise Resource Planning, Total Quality Management and Theory of constraints. Activity-Based Cost Management, Bench Marking; Balanced Score Card and Value-Chain Analysis. Budgetary Control; Flexible Budgets; Performance budgets; Zero-based budgets. Measurement of Divisional profitability pricing decisions including transfer pricing.

Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.

References:

1. Cost Accounting A Managerial Emphasis, Prentice Hall of India, New Delhi
2. Charles T. Horngren and George Foster, Advanced Management Accounting
3. Robert S Kaplan Anthony A. Alkinson, Management & Cost Accounting
4. Ashish K. Bhattacharya, Principles & Practices of Cost Accounting A. H. Wheeler publisher
5. N.D. Vohra, Quantitative Techniques in Management, Tata McGraw Hill Book Co. Ltd.

Teaching scheme Lecture: - 3 h/week CSBOE05

Composite Material

UNIT–I: INTRODUCTION: Definition – Classification and characteristics of Composite materials. Advantages and application of composites. Functional requirements of reinforcement and matrix. Effect of reinforcement (size, shape, distribution, volume fraction) on overall composite performance.

UNIT – II: REINFORCEMENTS: Preparation-layup, curing, properties and applications of glass fibers, carbon fibers, Kevlar fibers and Boron fibers. Properties and applications of whiskers, particle reinforcements. Mechanical Behavior of composites: Rule of mixtures, Inverse rule of mixtures. Isostrain and Isostress conditions.

UNIT – III: Manufacturing of Metal Matrix Composites: Casting – Solid State diffusion technique, Cladding – Hot isostatic pressing. Properties and applications. Manufacturing of Ceramic Matrix Composites: Liquid Metal Infiltration – Liquid phase sintering. Manufacturing of Carbon – Carbon composites: Knitting, Braiding, Weaving. Properties and applications.

UNIT–IV: Manufacturing of Polymer Matrix Composites: Preparation of Moulding compounds and prepregs – hand layup method – Autoclave method – Filament winding method – Compression moulding – Reaction injection moulding. Properties and applications.

UNIT – V: Strength: Laminar Failure Criteria-strength ratio, maximum stress criteria, maximum strain criteria, interacting failure criteria, hygrothermal failure. Laminate first play failure-insight strength; Laminate strength-ply discount truncated maximum strain criterion; strength design using caplet plots; stress concentrations.

TEXT BOOKS:

1. Material Science and Technology – Vol 13 – Composites by R.W.Cahn – VCH, West Germany.
2. Materials Science and Engineering, An introduction. WD Callister, Jr., Adapted by R. Balasubramaniam, John Wiley & Sons, NY, Indian edition, 2007.

References:

1. Hand Book of Composite Materials-ed-Lubin.
2. Composite Materials – K.K.Chawla.
3. Composite Materials Science and Applications – Deborah D.L. Chung.
4. Composite Materials Design and Applications – Danial Gay, Suong V. Hoa, and Stephen W. Tasi.

CSBOE06 Waste to Energy

Teaching scheme

Lecture: - 3 h/week

Unit-I: Introduction to Energy from Waste: Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors

Unit-II: Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

Unit-III: Biomass Gasification: Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

Unit-IV: Biomass Combustion: Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

Unit-V: Biogas: Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

References:

1. Non Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990.
2. Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996.

AUDIT 1 and 2: CSMA01 ENGLISH FOR RESEARCH PAPER WRITING

Course objectives:

Students will be able to:

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

Syllabus

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

Suggested Studies:

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's book .

4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

AUDIT 1 and 2: CSMA02 DISASTER MANAGEMENT

Course Objectives: -Students will be able to:

1. learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in

Syllabus

Units	CONTENTS	Hours
1	**Introduction** Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
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.	4
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	4
4	**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 Community Preparedness.	4
5	**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.	4
6	**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.	4

SUGGESTED READINGS:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “’New Royal book Company.

2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep &Deep Publication Pvt. Ltd., New Delhi.

AUDIT 1 and 2: **CSMA03** SANSKRIT FOR TECHNICAL KNOWLEDGE

Course Objectives

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects
4. enhancing the memory power
5. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Syllabus

Unit	***Content***	***Hours***
1	● Alphabets in Sanskrit, ● Past/Present/Future Tense, ● Simple Sentences	8
2	● Order ● Introduction of roots ● Technical information about Sanskrit Literature	8
3	● Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Suggested reading

1. “Abhyaspustakam” – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. “Teach Yourself Sanskrit” Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. “India’s Glorious Scientific Tradition” Suresh Soni, Ocean books (P) Ltd., New Delhi.

Course Output

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

AUDIT 1 and 2:CSMA04 VALUE EDUCATION

Course Objectives

Students will be able to

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Syllabus

Unit	***Content***	***Hours***

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	4
2	● Importance of cultivation of values. ● Sense of duty. Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness. ● Honesty, Humanity. Power of faith, National Unity. ● Patriotism.Love for nature ,Discipline	6
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	6
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	6

Suggested reading

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

Course outcomes

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

AUDIT 1 and 2: CSMA05 CONSTITUTION OF INDIA

Course Objectives:

Students will be able to:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address 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.

3. To address 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.

Syllabus

Units	Content	Hours
1	● **History of Making of the Indian Constitution:** History Drafting Committee, (Composition & Working)	4
2	● **Philosophy of the Indian Constitution:** Preamble Salient Features	4
3	● **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.	4
4	● **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	4
5	● **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: Zila Pachayat. ● Elected officials and their roles, CEO Zila Pachayat: Position and role. ● Block level: Organizational Hierarchy (Different departments), ● Village level: Role of Elected and Appointed officials,	4

	● Importance of grass root democracy	
6	● **Election Commission:** ● 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.	4

Suggested reading

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, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

AUDIT 1 and 2: CSMA06 PEDAGOGY STUDIES

Course Objectives:

Students will be able to:

4. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
5. Identify critical evidence gaps to guide the development.

Syllabus		
Units	**Content**	**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.	4
2	● Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. ● Curriculum, Teacher education.	2
3	● Evidence on the effectiveness of pedagogical practices	4

	● 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.	
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	4
5	● **Research gaps and future directions** ● Research design ● Contexts ● Pedagogy ● Teacher education ● Curriculum and assessment ● Dissemination and research impact.	2

Suggested reading

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.

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

AUDIT 1 and 2: CSMA07 STRESS MANAGEMENT BY YOGA

Course Objectives

1. To achieve overall health of body and mind
2. To overcome stress

Syllabus

Unit	*Content*	*Hours*
1	● Definitions of Eight parts of yog. (Ashtanga)	8
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	8
3	● Asan and Pranayam i) Various yog poses and their benefits for mind & body ii)Regularization of breathing techniques and its effects-Types of pranayama	8

Suggested reading

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

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also
2. Improve efficiency

AUDIT 1 and 2: CSMA08 PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS

Course Objectives

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination

3. To awaken wisdom in students

Syllabus

Unit	Content	Hours
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)	8
2	● Approach to day to day work and duties. ● Shrimad Bhagwad Geeta : 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.	8

3	● Statements of basic knowledge. ● Shrimad Bhagwad Geeta: Chapter2-Verses 56, 62, 68 ● Chapter 12 -Verses 13, 14, 15, 16,17, 18 ● Personality of Role model. Shrimad Bhagwad Geeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, ● Chapter 4-Verses 18, 38,39 ● Chapter18 – Verses 37,38,63	8

Suggested reading

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

Course Outcomes

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of stude

Course Code	CSME04
Course Name	Recommender System
Credits **Prerequisites**	3

Total Number of Lectures: 48

COURSE OBJECTIVE
To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **Introduction:** Overview of Information Retrieval, Retrieval Models, Search and Filtering Techniques: Relevance Feedback, User Profiles, Recommender system functions, Matrix operations, covariance matrices, Understanding ratings, Applications of recommendation systems, Issues with recommender system.	9
Unit 2: **Content-based Filtering:** High level architecture of content-based systems, Advantages and drawbacks of content based filtering, Item profiles, Discovering features of documents, pre-processing and feature extraction, Obtaining item features from tags, Methods for learning user profiles, Similarity based retrieval, Classification algorithms.	8
Unit 3: **Collaborative Filtering:** User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.	9

Unit 4: **Hybrid approaches:** Opportunities for hybridization, Monolithic hybridization design: Feature combination, Feature augmentation, Parallelized hybridization design: Weighted, Switching, Mixed, Pipelined hybridization design: Cascade Meta-level, Limitations of hybridization strategies	8
Unit 5: **Evaluating Recommender System:** Introduction, General properties of evaluation research, Evaluation designs: Accuracy, Coverage, confidence, novelty, diversity, scalability, serendipity, Evaluation on historical datasets, Offline evaluations.	6
Unit 6: **Types of Recommender Systems:** Recommender systems in personalized web search, knowledge-based recommender system, Social tagging recommender systems, Trust-centric recommendations, Group recommender systems.	8

COURSE OUTCOMES
After completion of course, students would be able to:
Design recommendation system for a particular application domain. Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity

References:

1. Jannach D., Zanker M. and FelFering A., Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
2. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer (2016), 1st ed.
3. Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.
4. Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.

Course Code	CSME06
Course Name	Data Storage Technologies and Networks
Credits	3
Pre-Requisites	Basic knowledge of Computer Architecture, Operating Systems, and Computer Networking is required.

Total Number of Lectures: 48

COURSE OBJECTIVE
to provide learners with a basic understanding of Enterprise Data Storage and Management Technologies

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **Storage Media and Technologies**–Magnetic, Optical and Semiconductor Media, Techniques for read/write Operations, Issues and Limitations.	8
Unit 2: **Usage and Access**–Positioning in the Memory Hierarchy, Hardware and Software Design for Access, Performance issues.	9
Unit 3: **Large Storages**– Hard Disks, Networked Attached Storage, Scalability issues,	7
Networking issues.	
Unit 4: **Storage Architecture** - Storage Partitioning, Storage System Design, Caching, Legacy Systems.	9
Unit 5: **Storage Area Networks** – Hardware and Software Components, Storage Clusters/Grids. **Storage QoS**–Performance, Reliability, and Security issues.	10
Unit 6: Recent Trends related to Copy data management, Erasure coding, and Software-defined storage appliances.	5
COURSE OUTCOMES	
After completion of course, students would be:	
Learn Storage System Architecture	
Overview of Virtualization Technologies, Storage Area Network	

References:

1. The Complete Guide to Data Storage Technologies for Network-centric ComputingPaperback–Import, Mar 1998 by Computer Technology Research Corporation
2. Data Storage Networking: Real World Skills for the CompTIA Storage by Nigel Poulton

Course Code	CSME14
Course Name	Big Data Analytics
Credits	3

Pre-Requisites	Data Structure, Computer Architecture and Organization

Total Number of Lectures: 48

COURSE OBJECTIVE
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 tools

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 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.	8
Unit 2: 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, partitioning and combining, composing map-reduce calculations.	8
Unit 3: Data format, analyzing data with Hadoop, scaling out, Hadoop streaming, Hadoop pipes, design of Hadoop distributed file system (HDFS), HDFS concepts, Java interface, data flow, Hadoop I/O, data integrity, compression, serialization, Avro, file-based data structures	9

Unit 4: 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 formats	10
Unit 5: Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	7
Unit 6: 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.	6

COURSE OUTCOMES
After completion of course, students would be:
Describe big data and use cases from selected business domains Explain NoSQL big data management Install, configure, and run Hadoop and HDFS Perform map-reduce analytics using Hadoop Use Hadoop related tools such as HBase, Cassandra, Pig, and Hive for big data analytics

References:

1. Michael 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 of Polyglot 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.

Course Code	CSME08
Course Name	Data Security and Access Control
Credits	3
Pre-Requisites	Database Management

Total Number of Lectures: 48

COURSE OBJECTIVE
The objective of the course is to provide fundamentals of database security. Various access control techniques mechanisms were introduced along with application areas of access control techniques.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit1: 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.	9
Unit 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.	8
Unit 3: Biba'sintrigity model, Clark-Wilson model, Domain type enforcement model, mapping the enterprise view to the system view, 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	10
Unit 4: Smart Card based Information Security, Smart card operating system-fundamentals, design and implantation principles, memory organization, smart	10

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.	
Unit 5: Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.	7
Unit 6: Recent Trends related to data security management, vulnerabilities in different DBMS.	4

COURSE OUTCOMES
After completion of course, students would be:
In this course, the students will be enabled to understand and implement classical models and algorithms
They will learn how to analyse the data, identify the problems, and choose the relevant models and algorithms to apply.
They will further be able to assess the strengths and weaknesses of various access control models and to analyse their behaviour.

References:

1. Role Based Access Control: David F. Ferraiolo, D. Richard Kuhn, RamaswamyChandramouli. 2. http://www.smartcard.co.uk/tutorials/sct-itsc.pdf : Smart Card Tutorial

Course Code	CSME09
Course Name	Web Analytics and Development
Credits	3
Pre-Requisites	

Total Number of Lectures: 48

COURSE OBJECTIVE
The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.

LECTURE WITH BREAKUP	**NO. OF LECTURES**
Unit 1: **Introduction**–Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization	10

Unit 2: **Web Analytics tools:** Click Stream Analysis, A/B testing, Online Surveys	8
Unit 3: **Web Search and Retrieval:** Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models	9
Unit 4: **Making Connection**: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity	12
Unit 5: **Connection:** Connection Search, Collapse, Robustness Social involvements and diffusion of innovation	9

COURSE OUTCOMES
After completion of course, students would be:
Become familiar with core research communities, publications, focused on web and social media analytics and research questions engaged in

References:

1. Hansen, Derek, Ben Sheiderman, Marc Smith. 2011. Analyzing Social Media Networks with NodeXL: Insights from a Connected World. Morgan Kaufmann, 304.
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.

Course Code	CSME10
Course Name	Knowledge Discovery
Credits	3
Prerequisites	Data structures, Basic Statistics

Total Number of Lectures: 48

COURSE OBJECTIVE
Conduct case studies on real data mining examples

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **Introduction KDD and Data Mining -** Data Mining and Machine Learning, Machine Learning and Statistics, Generalization as Search,Data Mining and Ethics	7
Unit 2: **Knowledge Representation** - Decision Tables, Decision Trees, Classification Rules, Association Rules, Rules involving Relations, Trees for Numeric Predictions, Neural Networks, Clusters	10
Unit 3: **Decision Trees** - Divide and Conquer, Calculating Information, Entropy, Pruning, Estimating Error Rates, The C4.5 Algorithm **Evaluation of Learned Results**- Training and Testing, Predicting Performance, Cross-Validation	9
Unit 4: **Classification Rules** - Inferring Rudimentary Rules, Covering Algorithms for Rule Construction, Probability Measure for Rule Evaluation, Association Rules, Item Sets, Rule Efficiency	8
Unit 5: **Numeric Predictions** - Linear Models for Classification and Numeric Predictions, Numeric Predictions with Regression Trees, Evaluating Numeric Predictions	7
Unit 6: **Artificial Neural Networks** – Perceptrons, Multilayer Networks, The Backpropagation Algorithm **Clustering** - Iterative Distance-based Clustering, Incremental Clustering, The EM Algorithm	7

COURSE OUTCOMES
After completion of course, students would be:
Able to have knowledge of various knowledge representation methods.

References:

1. Data mining and knowledge discovery handbook by Maimon, oded(et al.) 2. Data Cleansing : A Prelude to knowledge Discovery

Course Code	CSME12
Course Name	Cloud Computing
Credits	3
Pre-Requisites	

Total Number of Lectures: 48

COURSE OBJECTIVE
The student will also learn how to apply trust-based security model to real-world security problems.
An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
Students will learn the basic Cloud types and delivery models and develop an understanding of the risk and compliance responsibilities and Challenges for each Cloud type and service delivery model.

LECTURE WITH BREAKUP	NO. OF LECTURES
Unit 1: **Introduction to Cloud Computing** Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing	4

Unit 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 SPI Framework for Cloud Computing, The Traditional Software Model, The Cloud Services Delivery Model **Cloud Deployment Models** Key Drivers to Adopting the Cloud, The Impact of Cloud Computing on Users, Governance in the Cloud, Barriers to Cloud Computing Adoption in the Enterprise	11
Unit 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 and IAM, IAM Challenges, Relevant IAM Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management	10
Unit 4: **Security Management in the Cloud** Security Management Standards, Security Management in the Cloud,	11

Availability Management: SaaS, PaaS, IaaS **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, Legal and Regulatory Implications, U.S. Laws and Regulations, International Laws and Regulations	

Unit 5: **Audit and Compliance** Internal Policy Compliance, Governance, Risk, and Compliance (GRC), Regulatory/External Compliance, Cloud Security Alliance, Auditing the Cloud for Compliance, Security-as-a-Cloud	8
Unit 6: **ADVANCED TOPICS** Recent devlopments in hybrid cloud and cloud security .	4

COURSE OUTCOMES
After completion of course, students would be able to:
Identify security aspects of each cloud model
Develop a risk-management strategy for moving to the Cloud
Implement a public cloud instance using a public cloud service provider
Apply trust-based security model to different layer

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