MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Curriculum Structure

Sem-I.

Course Number	Subject	Scheme Of Studies Per Week			Credits
		L	T	P	
PGIT(DS)101	Program Core I- Mathematical foundationsof Computer Science	3	0	0	3
PGIT(DS)102	Program Core II- Advanced Data Structures	3	0	0	3
PGIT(DS)103A/B/C	Program Elective I- Data Science/ Distributed Systems/Data Preparation and Analysis	3	0	0	3
PGIT(DS)104A/B/C	Program Elective II- Recommender Systems /Machine Learning/ Data Visualization	3	0	0	3
PGIT(DS)105	Research Methodology and IPR	2	0	0	2
PGIT(DS)106A/B/C/D	Audit Course	2	0	0	0
PGIT(DS)192	Laboratory 1 (Advanced Data Structures)	0	0	4	2
PGIT(DS)193A/B/C/D	Laboratory 2 (Based on Elective1)	0	0	4	2
PGIT(DS)194A/B/C/D	Laboratory 3 (Based on Elective 2)	0	0	4	2
Total Credits:20					

Sem- II

Course Number	Subject	Scheme Of Studies Per Week			Credits
		L	T	P	
PGIT(DS)201	Program Core III – Advanced Computer Architecture	3	0	0	3
PGIT(DS)202	Program Core IV – Advanced Database	3	0	0	3
PGIT(DS)203A/B	Program Elective III – Big Data Analytics/ Data Warehouse and Data Mining	3	0	0	3
PGIT(DS)204A/B/C	Program Elective IV – Data Security/ Web Analytics and Development/Knowledge Discovery	3	0	0	3
PGIT(DS)205A/B/C/D	Audit Course	2	0	0	0
PGIT(DS)291	Advanced Computer Architecture Lab	0	0	4	2
PGIT(DS)292	Advanced Database Lab	0	0	4	2
PGIT(DS)293A/B	Big Data Analytics lab/ Data Warehouse and Data Mining lab	0	0	4	2
PGIT(DS)281	Term Paper with Seminar	0	0	4	2
Total Credits:20					

*Students be encouraged to go to Industrial Training/Internship for at least 2-3 months during semester break.

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Sem* III

Course No.	Subject	Scheme of Studies Periods Per Week			Credits
		L	T	P	
PGIT(DS)301A/B/C/D	Program Elective V – GPU Computing/ Cloud Computing/ Distributed Databases/ Deep Learning	3	0	0	03
PGIT(DS)302A/B/C/D/E/F	**Open Elective** A. Business Analytics B. Industrial Safety C. Operations Research D. Cost Management of Engineering Projects E. Composite Materials F. Waste to Energy	3	0	0	03
PGIT(DS)381	Dissertation-I /Industrial Project	0	0	20	10
Total Credits 16					

*Students going for Industrial Project/Thesis will complete these courses through MOOCs.

Sem-IV

Course No.	Subject	Scheme of Studies Periods Per Week			Credits
		L	T	P	
PGIT(DS)481	Dissertation II	0	0	32	16
Total Credits: 16					

The program offers several elective courses, focusing on different aspects of Data Science. A student can choose to do any course from given program elective set.

Audit course 1 & 2

106A-English for Research Paper Writing
106B-Disaster Management
106C-Sanskrit for Technical Knowledge
106D-Value Education
205A-Constitution of India
205B-Pedagogy Studies
205C-Stress Management by Yoga
205DPersonality Development through Life Enlightenment Skills.

Detailed Syllabus

Name of the Course: M. Tech. in Data Science			
Subject: Mathematical foundations of Computer Science			
Course Code: PGIT(DS)101	Semester: I		
Duration: 48 Hours	Maximum Marks: 100		
Teaching Scheme	Examination Scheme		
Theory:**3**	End Semester Exam:**70**		
Tutorial:**0**	Attendance: **5**		
Practical:**0**	Continuous Assessment:**25**		
Credit: **3**	Practical Sessional internal continuous evaluation:		
	Practical Sessional external examination:		
Aim:			
Sl. No.			
1.	To understand the basic notions of discrete and continuous probability.		
2.	To understand the methods of statistical inference, and the role that sampling distributions play in those methods.		
3.	To be able to perform correct and meaningful statistical analyses of simple to moderate complexity.		
Objective:			
Sl. No.			
1.	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.		
2.	To develop the understanding of the mathematical and logical basis to many modern techniques in information technology like machine learning, programming language design, and concurrency.		
3.	To study various sampling and classification problems.		
Pre-Requisite:			
Sl. No.			
1.	**Discrete Mathematics**		
Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	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**	**10**
02	Random samples, sampling distributions of estimators, Methods of Moments and Maximum Likelihood.	**7**	**10**
03	Statistical inference, Introduction to multivariate statistical models: regression and classification problems, principal components analysis, The problem of overfitting model assessment.	**8**	**10**
04	Graph Theory: Isomorphism, Planar graphs, graph colouring, hamilton circuits and euler cycles. Permutations and Combinations with and without repetition. Specialized techniques to solve combinatorial enumeration problems	**11**	**15**
05	Information Technology Applications, Data mining, Network protocols, analysis of Web traffic, Computer security, Software engineering, Computer architecture, operating systems, distributed systems, Bioinformatics, Machine learning.	**10**	**15**

06	Recent Trends in various distribution functions in mathmatical field of computer science for varying fields like bioinformatic, soft computing, and computer vision.	5	10
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
John Vince	Foundation Mathematics for Computer Science		Springer
K. Trivedi	Probability and Statistics with Reliability, Queuing, and Computer Science Applications		Wiley
M. Mitzenmacher and E. Upfal	Probability and Computing: Randomized Algorithms and Probabilistic Analysis		
R. Agor	Elements of mathematical Analysis		Khanna Book Publishing

Reference Books:

Alan Tucker	Applied Combinatorics		Wiley

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted- 3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5,6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered

A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Advanced Data Structures	
Course Code: PGIT(DS)102 & PGIT(DS)109	Semester: I
Duration: 48 Hours	Maximum Marks:100+100
Teaching Scheme	Examination Scheme
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation:**40**
	Practical Sessional external examination:**60**

Aim:

Sl. No.	
1.	Single Linked, Double Linked Lists, Stacks, Queues, Searching and Sorting techniques, Trees, Binary trees, representation, traversal, Graphs- storage, traversal.
2.	Dictionaries, ADT for List, Stack, Queue, Hash table representation, Hash functions, Priority queues, Priority queues using heaps, Search trees.
3.	AVL trees, operations of AVL trees, Red- Black trees, Splay trees, comparison of search trees.

Objective:

Sl. No.	
1.	The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem.
2.	Students should be able to understand the necessary mathematical abstraction to solve problems.
3.	To familiarize students with advanced paradigms and data structure used to solve algorithmic problems.
4.	Student should be able to come up with analysis of efficiency and proofs of correctness.

Pre-Requisite:

Sl. No.	
1.	UG level course in Data Structures

Contents		Hrs./week	
Chapter	Name of the Topic	Hours	Marks
01	**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 Probing, Double Hashing, Rehashing, Extendible Hashing.	7	10
02	**Skip Lists:** Need for Randomizing Data Structures and Algorithms, Search andUpdate Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists	5	5
03	**Trees:**	9	10

	Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees			
04	**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 CommonSubsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem.	**12**	**20**	
05	**Computational Geometry:** One Dimensional Range Searching, Two Dimensional Range Searching, Constructing a Priority Search Tree, Searching a Priority SearchTree, Priority Range Trees, Quadtrees, k-D Trees.	**10**	**15**	
06	Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem	**5**	**10**	
	Sub Total:	**48**	**70**	
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**	
	Total:	**52**	**100**	

Practical:
Skills to be developed:
Intellectual skills:
1. Skill to analyze algorithms and to determine algorithm correctness and their time efficiency.
2. Knowledge of tree and searching algorithms and their implementations.
3. Ability to implement algorithms to perform various operations on data structures.

List of Practical: Sl. No. 1& 2 compulsory & at least three from the rest)Assignments:

Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Jeeva Jose	Taming Python by Programming	9789386173348	Khanna Publishing
Michael H. Goldwasser, Michael T. Goodrich, and Roberto Tamassia	Data Structures and Algorithms in Python	1118476735, 9781118476734	John Wiley & Sons
Rance D Necaise	Data Structures and Algorithms Using Python	9788126562169	John Wiley & Sons
Reference Books:			
Sartaj Sahni	DataStructures, Algorithms and applications in C++	Second Edition	Universities Press
R.S. Salaria	Programming in Python	9789389139013	Khanna Publishing

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with moderate configuration

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the	Subjective Questions

		correct answer)					
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5, 6**	**10**	**10**				
B	**1,2,3,4,5, 6**			**5**	**3**	**5**	**60**
C	**1,2,3,4,5, 6**			**5**	**3**	**15**	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	**ALL**	**1**	**10**	**10**
B	**ALL**	**5**	**5**	**3**
C	**ALL**	**15**	**5**	**3**

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation			**40**

External Examination: Examiner-

Signed Lab Note Book		**10**	
On Spot Experiment(one for each group consisting 5 students)		**40**	
Viva voce		**10**	**60**

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Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Name of the Course: M. Tech. in Data Science	
Subject: Data Science	
Course Code: PGIT(DS)103A &PGIT(DS)193A	**Semester: I**
Duration: 48 Hours	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation:**40**
	Practical Sessional external examination:**60**

Aim:	
Sl. No.	
1.	To gain basic knowledge of data and information.
	To gain basic knowledge of data science.
	To understand the history, potential application area and future of data science.
	To gain basic knowledge of machine learning.

Objective:	
Sl. No.	
1.	Provide you with the knowledge and expertise to become a proficient data scientist.
2.	Demonstrate an understanding of statistics and machine learning concepts that are vital for data science;
3.	Produce Python code to statistically analyse a dataset;
4.	Critically evaluate data visualisations based on their design and use for communicating stories from data;

Pre-Requisite:	
Sl. No.	
1.	Knowledge of basic mathematics.
2.	Analytical and Logical skills

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to core concepts and technologies:** Introduction, Terminology, datascience process, data science toolkit, Types of data, Example applications.	6	5
02	**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	10
03	**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	15
04	**Data visualisation:** Introduction, Types of data visualisation,Data for visualisation:Data types, Data encodings, Retinal variables, Mapping variables to encodings, Visual encodings.	11	20
05	**Applications of Data Science:** Technologies for visualisation, Bokeh (Python)	7	10

06	**Recent trends :** various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.	**7**	**10**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**

Practical:
Skills to be developed:
Intellectual skills:
Students who complete this course will be able to
• Gain the knowledge of problems associated with Data Science in various domains.
• Apply tools and techniques to analyze Data.

List of Practical:
Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Cathy O'Neil and Rachel Schutt	Doing Data Science, Straight Talk From The Frontline		O'Reilly.
Jeeva Jose	Beginner's Guide for Data Analysis using R Programming	9789386173454	Khanna Book Publishing
Jure Leskovek, AnandRajaraman and Jeffrey Ullman	Mining of Massive Datasets. v2.1		Cambridge University Press

Reference Books:

Kevin P. Murphy	Machine Learning: A Probabilistic Perspective	ISBN 0262018020	
Foster Provost and Tom Fawcett	Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking	ISBN 1449361323. 2013	
Trevor Hastie, Robert Tibshirani and Jerome Friedman	Elements of Statistical Learning	Second Edition. ISBN 0387952845. 2009. (free online)	

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with moderate configuration
2.	Python 2.7 or higher and other softwares as required.

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)	Subjective Questions

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		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A B	**1,2,3,4,5,6**	10	10				
C				5	3	5	60
	1,2,3,4,5,6			5	3	15	
	1,2,3,4,5,6						

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation			
Internal Examination:			
Continuous evaluation			40
External Examination: Examiner-			
Signed Lab Note Book	10		
On Spot Experiment(one for each group consisting 5 students)	40		
Viva voce	10		60

Name of the Course: M. Tech. in Data Science			
Subject: Distributed Systems			
Course Code: PGIT(DS)103B &PGIT(DS)193B	Semester: I		
Duration: 48 Hours	Maximum Marks: 100+100		
Teaching Scheme	Examination Scheme		
Theory:3	End Semester Exam:70		
Tutorial:0	Attendance: 5		
Practical:4	Continuous Assessment:25		
Credit: 3+2	Practical Sessional internal continuous evaluation:40		
	Practical Sessional external examination:60		
Aim:			
Sl. No.			
1.	Learn new ways to query and model data. Become familiar with the expanding role of database technology.		
2.	To understand and use columnar and distributed database patterns		
Objective:			
Sl. No.			
1	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.		
Pre-Requisite:			
Sl. No.			
1.	Database Management Systems		
Contents			3 Hrs./week
Chapter	Name of the Topic	Hours	Marks
01	**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	10
02	**Distributed Database Design** Alternative design strategies; Distributed design issues; Fragmentation; Data allocation	11	15
	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		

03	**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	20
04	**Reliability** Reliability issues in DDBSs; Types of failures; Reliability techniques; Commit protocols; Recovery protocols	8	10
05	**Parallel Database Systems** Parallel architectures; parallel query processing and optimization; load balancing	6	10
06	**Advanced Topics** Mobile Databases, Distributed Object Management, Multi-databases	4	5
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Practical:
Skills to be developed:
Intellectual skills:
Students will be able to:
 Work with different data models to suit various data representation and storage needs.

List of Practical: Sl. No. 1& 2 compulsory & at least three from the rest)

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
M.T. Ozsu and P. Valduriez	Principles of Distributed Database Systems		Prentice-Hall
Prentice-Hall	Distributed Database Systems		Addison-Wesley
R.P. Mahapatra	Database Management Systems	Latest Edition	Khanna Book Publishing Co.

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
2.	Computer with moderate configuration
3.	MySql/Oracle and other software as required.

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End Semester Examination Scheme.		Maximum Marks-70.			Time allotted- 3hrs.		
Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)		**Subjective Questions**			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5, 6**	**10**	**10**				
B				**5**	**3**	**5**	
C	**1,2,3,4,5, 6**			**5**	**3**	**15**	**60**
	1,2,3,4,5, 6						

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	**ALL**	**1**	**10**	**10**
B	**ALL**	**5**	**5**	**3**
C	**ALL**	**15**	**5**	**3**

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation				**40**

External Examination: Examiner-

Signed Lab Note Book		**10**	
On Spot Experiment(one for each group consisting 5 students)		**40**	
Viva voce		**10**	**60**

Name of the Course: M. Tech. in Data Science	
Subject: Data Preparation and Analysis	
Course Code: PGIT(DS)103C&PGIT(DS)193C	**Semester: I**
Duration: 48 Hours	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation:**40**
	Practical Sessional external examination:**60**

Aim:	
Sl. No.	
1.	To gain ability to extract the data for performing the Analysis.

Objective:	
Sl. No.	
1	To prepare the data for analysis and develop meaningful Data Visualizations

Pre-Requisite:	
Sl. No.	
1.	Basic Programming Knowledge

Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues	9	10
02	**Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	11	10
03	**Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis generation	13	20
04	**Visualization:** Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	15	30
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Practical:
Skills to be developed:
Intellectual skills:
1. Identify the data related to the problem.
2. Gain knowledge about the good data and bad data.

List of Practical:
Hand on practical based on theory paper.
Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the**

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				Publisher
GlennJ. Myatt	Making sense of Data : A practical Guide to Exploratory Data Analysis and Data Mining			
Jeeva Jose	Beginner's Guide for Data Analysis Using R Programming	Second		Khanna Book Publishing

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with moderate configuration
2.	Python 2.7 or higher and other softwares as required.

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4	10	10				
B	1,2,3,4			5	3	5	60
C	1,2,3,4			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation				40

External Examination: Examiner-

Signed Lab Note Book		10	
On Spot Experiment(one for each group consisting 5 students)		40	
Viva voce		10	60

Name of the Course: M. Tech. in Data Science	
Subject: Recommender System	
Course Code: PGIT(DS)104A &PGIT(DS)194A	Semester: I
Duration: 48 Hours	Maximum Marks: 100+100
Teaching Scheme	Examination Scheme
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation:**40**
	Practical Sessional external examination:**60**

Aim:	
Sl. No.	
1.	Design recommendation system for a particular application domain.
2.	Evaluate recommender systems on the basis of metrics such as accuracy, rank accuracy, diversity, product coverage, and serendipity

Objective:	
Sl. No.	
1	To learn techniques for making recommendations, including non-personalized, content-based, and collaborative filtering
2	To automate a variety of choice-making strategies with the goal of providing affordable, personal, and high-quality recommendations

Pre-Requisite:	
Sl. No.	
1.	Basic Programming Knowledge

Contents		3 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**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**	**10**
02	**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**	**15**
03	**Collaborative Filtering:** User-based recommendation, Item-based recommendation, Model based approaches, Matrix factorization, Attacks on collaborative recommender systems.	**9**	**15**
04	**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**	**15**
05	**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**	**5**

06	**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	10
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Practical:
Skills to be developed:
Intellectual skills:

List of Practical:
Hand on practical based on theory paper

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Jannach D., Zanker M. and FelFering A.	Recommender Systems: An Introduction	1st Edition	Cambridge University Press
Charu C. Aggarwal	Recommender Systems: The Textbook	1st Edition	Springer

Reference Books:

Manouselis N., Drachsler H., Verbert K., Duval E.,	Recommender Systems For Learning	1st Edition	
Ricci F., Rokach L., Shapira D., Kantor B.P.	Recommender Systems Handbook	1st Edition	Springer(2011)

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with modern configuration

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5,6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation			**40**

External Examination: Examiner-

Signed Lab Note Book		**10**	
On Spot Experiment(one for each group consisting 5 students)		**40**	
Viva voce		**10**	**60**

Name of the Course: M. Tech. in Data Science	
Subject: Machine learning	
Course Code: PGIT(DS)104B & PGIT(DS)194B	**Semester: I**
Duration: 46 Hours	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation:**40**
	Practical Sessional external examination:**60**

Aim:

Sl. No.	
1.	Use data analysis for machine learning
2.	Use the Python programming for machine learning.
3.	Use decision trees and statistics models

Objective:

Sl. No.	
1	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various IOT nodes.
2	To design and analyse various machine learning algorithms and techniques with a modern outlook focusing on recent advances.
3	Explore supervised and unsupervised learning paradigms of machine learning.
4	Explore supervised and unsupervised learning paradigms of machine learning

Pre-Requisite:

Sl. No.	
1.	Basic Programming Knowledge

Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**

01	**Supervised Learning (Regression/Classification)** ● Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes	10	10
02	● Linear models: Linear Regression, Logistic Regression, Generalized Linear Models ● Support Vector Machines, Nonlinearity and Kernel Methods ● Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	7	10
03	**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)	6	10
04	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	9	15
05	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	9	15
06	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	5	10
	Sub Total:	46	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	50	100

Practical:
Skills to be developed:
Intellectual skills:
After completion of course, students would be able to:
1. Extract features that can be used for a particular machine learning approach in various applications.
2. 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.

List of Practical:
1. Exercises to solve the real-world problems using the following machine learning methods:
   • Linear Regression
   • Logistic Regression
   • Multi-Class Classification
   • Neural Networks
   • Support Vector Machines
   • K-Means Clustering & PCA
2. Develop programs to implement Anomaly Detection & Recommendation Systems.
3. Implement GPU computing models to solving some of the problems mentioned in Problem

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Kevin Murphy	Machine Learning: A Probabilistic Perspective		MIT Press
Trevor Hastie, Robert Tibshirani, Jerome Friedman	The Elements of Statistical Learning		Springer
Reference Books:			
Christopher Bishop	Pattern Recognition and Machine Learning		Springer

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with modern configuration
2.	Python/R software

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5,6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation				40

External Examination: Examiner-

Signed Lab Note Book	10	
On Spot Experiment(one for	40	

each group consisting 5 students)			
Viva voce		**10**	**60**

Name of the Course: M. Tech. in Data Science	
Subject: Data Visualisation	
Course Code: PGIT(DS)104C &PGIT(DS)194C	**Semester: I**
Duration: 48 Hours	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation:**40**
	Practical Sessional external examination:**60**

Aim:	
Sl. No.	
1.	To introduce the domain of data visualization.
2.	To expose the various techniques in data visualization.
3.	To showcase the applications of data visualization.

Objective:	
Sl. No.	
1	Familiarize students with the basic and advanced techniques of information visualization and scientific visualization,
2	To learn key techniques of the visualization process
3	A detailed view of visual perception, the visualized data and the actual visualization, interaction and distorting techniques

Pre-Requisite:	
Sl. No.	
1.	Basic Programming knowledge

Contents			**3 Hrs./week**
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.	**8**	**10**
02	Unsupervised LeCreating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.	**8**	**15**
03	Classification of visualization systems, Interaction and visualization techniquesmisleading, Visualization of one, two and multi-dimensional data, text and text documents.	**10**	**15**
04	Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization	**11**	**15**
05	Visualization of volumetric data, vector fields, processes and simulations,Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations	**7**	**10**
06	Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.	**4**	**5**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester	**4**	**30**

	Examination			
	Total:		**52**	**100**

Practical:
Skills to be developed:
Intellectual skills:
Students who complete this course will be able to
1. explain the different visualization models.
2. classify the basic visualization and clustering techniques.
3. apply these techniques to mine real-life situations.

List of Practical:
Hand on practical based on theory paper

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
WARD, GRINSTEIN, KEIM	Interactive Data Visualization: Foundations, Techniques, and Applications		Natick : A K Peters, Ltd.
E. Tufte	The Visual Display of Quantitative information		Graphics Press

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with modern configuration
2.	Python/R software

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5,6**	**10**	**10**				
B	**1,2,3,4,5,6**			**5**	**3**	**5**	**60**
C	**1,2,3,4,5,6**			**5**	**3**	**15**	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:			
Practical Internal Sessional Continuous Evaluation			
Internal Examination:			
Continuous evaluation			40
External Examination: Examiner-			
Signed Lab Note Book	10		
On Spot Experiment(one for each group consisting 5 students)	40		
Viva voce	10		60

Name of the Course: M. Tech. in Data Science	
Subject: Research Methodology and IPR	
Course Code: PGIT(DS)105	**Semester: I**
Duration: 36 Hours	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory:**2**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:	Continuous Assessment:**25**
Credit:**2**	Practical Sessional internal continuous evaluation:
	Practical Sessional external examination:

Aim:

Sl. No.	
1.	Understand research problem formulation.
2.	Analyze research related information
3.	Follow research ethics

Objective:

Sl. No.	
1	Understand research problem formulation.
2	Analyze research related information
3	Follow research ethics
4.	Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
5.	Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasise the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
6.	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.		
Pre-Requisite:			
Sl. No.			
Contents		**2 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction:** 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.	6	14
02	**Effective literature studies approaches**: analysis Plagiarism, Research ethics	6	10
03	**Effective technical writing**: how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.	6	14
04	**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.	6	14
05	**Patent Rights:** Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.	6	14
06	**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.	6	4
	Sub Total:	36	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	**Name of the Publisher**
Stuart Melville and Wayne Goddard	Research methodology: an introduction for science & engineering students		
Ranjit Kumar	Research Methodology: A Step by Step Guide for beginners	2nd Edition	
Reference Books:			
T. Ramappa, S. Chand,	"Intellectual Property Rights Under WTO",	2008	
Robert P. Merges, Peter S. Menell, Mark A. Lemley,	" Intellectual Property in New Technological Age",	2016.	

Asimov,	"Introduction to Design", Prentice Hall,	1962.	
Mayall,	"Industrial Design",		McGraw Hill, 1992.
Halbert,	"Resisting Intellectual Property",		Taylor & Francis Ltd ,2007.
Niebel,	"Product Design",		McGraw Hill, 1974.

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5,6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: English for research paper writing	
Course Code: PGIT(DS)106A	**Semester: I**
Duration: 24 hours	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory:02	End Semester Exam:70
Tutorial:	Attendance: **5**
Practical:	Continuous Assessment:**25**
Credit:0	End Semester Exam:70
Aim:	
Sl. No.	
1.	Ensure the good quality of paper at very first-time submission
Objective:	
Sl. No.	
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		

Pre-Requisite:

Sl. No.			
1.	Basic Knowledge of English		

Contents		2 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	14
02	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper.	4	14
03	Abstracts Introduction Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4	10
04	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	4
05	Skills are needed when writing the Methods, skills needed when writingthe Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4	14
06	Useful phrases, how to ensure paper is as good as it could possibly bethe first- time submission	4	14
	Sub Total:	24	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	28	100

Assignments: Based on theory

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
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

Reference Books:

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.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science
Subject: Disaster management

Course Code: PGIT(DS)106B	Semester: I
Duration:24 hrs	Maximum Marks:100
Teaching Scheme	Examination Scheme
Theory:02	End Semester Exam:70
Tutorial:0	Attendance: **5**
Practical:0	Continuous Assessment:**25**
Credit: 0	

Aim:	
Sl. No.	
1.	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2.	Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or thecountries they work in

Objective:	
Sl. No.	
1.	Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2.	Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or thecountries they work in
3.	Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
4.	Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.

Pre-Requisite:	
Sl. No.	

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

1.			
2.			
Contents		**2 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude. 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.	6	16
02	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	6	17
03	Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: ApplicationOf Remote Sensing, Data FromMeteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4	15
04	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	8
05	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	14
	Sub Total:	24	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	28	100

Assignments: Based on theory

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
S.C. Sharma	Disaster Management		Khanna Publishing
R. Nishith, Singh AK,	"Disaster Management		New Royal book

	in India: Perspectives, issues and strategies "		Company.
Reference Books:			
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.

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data ScienceSubject: Sanskrit for technical knowledge	
Course Code: PGIT(DS)106C	
Duration: 24 hours	**Semester: I**
Teaching Scheme	**Maximum Marks:100**
Theory:02	**Examination Scheme**
Tutorial:0	End Semester Exam:70
Practical:0	Attendance: **5**
Credit: 0	Continuous Assessment:**25**
	End Semester Exam:70
Aim:	
Sl. No.	
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

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Objective:	
Sl. No.	
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
6.	huge knowledge from
Pre-Requisite:	
Sl. No.	
1.	
2.	

Contents			2 Hrs./week	
Chapter	**Name of the Topic**		**Hours**	**Marks**
01	• **Alphabets in Sanskrit,** • **Past/Present/Future Tense,** • **Simple Sentences**		8	25
02	• **Order** • **Introduction of roots** • **Technical information about Sanskrit Literature**		8	25
03	• **Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics**		8	20
	Sub Total:		24	70
	Internal Assessment Examination & Preparation of Semester Examination		4	30
	Total:		28	100

Assignments: Based on theory

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Dr.Vishwas, Samskrita-Sansthanam, New Delhi Publication	"Abhyaspustakam" –		Bharti Publication, New Delhi

Reference Books:

Prathama Deeksha-	"Teach Yourself Sanskrit"		VempatiKutumbshastri, Rashtriya Sanskrit
Suresh Soni,	"India's Glorious Scientific Tradition"		Ocean books (P) Ltd., New Delhi.

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)	Subjective Questions

		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation				40

External Examination: Examiner-

Signed Lab Assignments	10	
On Spot Experiment	40	
Viva voce	10	60

Name of the Course: M. Tech. in Data Science	
Subject: Value education	
Course Code: PGIT(DS)106D	**Semester: I**
Duration: 36 hours	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory:02	End Semester Exam:70
Tutorial:0	Attendance: **5**
Practical:0	Continuous Assessment:**25**
Credit:0	End Semester Exam:70

Aim:

Sl. No.	
1.	Knowledge of self-development
2.	Learn the importance of Human values
3.	Developing the overall personality

Objective:

Sl. No.	
1.	Understand value of education and self- development
2.	Imbibe good values in students
3.	Let the should know about the importance of character

Pre-Requisite:

Sl. No.	
1.	

2.			
Contents		**2 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	• 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	**6**	**10**
02	• 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**	**20**
03	• 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**	**20**
04	• 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**	**20**
	Sub Total:	**24**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**28**	**100**

Assignments: Based on theory

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Premvir Kapoor	Professional Ethics and Human Values		Khanna Book Publishing
Chakroborty, S.K.	"Values and Ethics for organizations Theory and practice"		Oxford University Press, New Delhi
Reference Books:			
End Semester Examination Scheme.	**Maximum Marks-70.**		**Time allotted-**

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Syllabus for M. Tech in Data Science
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3hrs.							
Group	**Unit**	**Objective Questions (MCQ only with the correct answer)**		**Subjective Questions**			
		No of question to be set	**Total Marks**	**No of question to be set**	**To answer**	**Marks per question**	**Total Marks**
A	**ALL**	10	10				
B	**ALL**			5	3	5	70
C	**ALL**			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	**ALL**	1	10	10
B	**ALL**	5	5	3
C	**ALL**	15	5	3

Semester II

Name of the Course: M. Tech. in Data Science			
Subject: Advanced Computer Architecture			
Course Code: PGIT(DS)201 and PGIT(DS)291	**Semester: II**		
Duration: 48 Hours	**Maximum Marks:100+100**		
Teaching Scheme	**Examination Scheme**		
Theory:**3**	End Semester Exam:**70**		
Tutorial:**0**	Attendance: **5**		
Practical:**4**	Continuous Assessment:**25**		
Credit:**3+2**	Practical Sessional internal continuous evaluation:40		
	Practical Sessional external examination:60		
Aim:			
Sl. No.			
1.	To learn the advanced concepts of Computer Architecture		
2.	To Understand the classification & architecture of modern computer systems.		
3.	Understanding & Implementation of performance enhancements techniques in advanced processors.		
Objective:			
Sl. No.			
1	Understand the micro-architectural design of processors		
2	Learn about the various techniques used to obtain performance improvement and power savings in current processors		
Pre-Requisite:			
Sl. No.			
1.	Knowledge in basic computer architecture		
Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**FUNDAMENTALS OF COMPUTER DESIGN** Computer Architecture and Organization-Review, Fundamentals of Computer Design, Technology Trends Cost Performance Analysis Parallel Processing Architectures- Taxonomy- SISD, MISD, SIMD,MIMD, PRAM models Data and Resource Dependencies, Program Partitioning and Scheduling, Control Flow vs. Data Flow	**11**	**15**
02	**INSTRUCTION LEVEL PARALLELISM** Network topologies-Static, Dynamic, Types of Networks RISC vs. CISC, Memory Hierarchy, Virtual Memory Concepts of Pipelining, Instruction Pipelining, dynamic pipelining, arithmetic pipelines.	**11**	**15**
03	**DATA-LEVEL PARALLELISM I** Multiprocessors- Multistage Networks, Cache Coherence, Synchronization, Message- passing ,Vector Processing Principles-Instruction types, Compound, Vector Loops, Chaining , Array Processors- Structure, Algorithms	**11**	**15**
04	**DATA-LEVEL PARALLELISM II** Data Flow Architecture- Graphs. Petri Nets, Static and Dynamic DFA, VLSI Computations ,Parallel Programming Models, Languages, Compilers	**11**	**15**

05	Recent Trands in problem solving paradigms using recent searching and sorting techniques by applying recently proposed data structures.	4	10
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Practical:
Skills to be developed:
Intellectual skills:
1. To learn the parallel models and processors
2. Pipelining and scalable architectures
3. Memory organization
4. To learn the multithreaded and data flow architecture
List of Practical:
Hand on practical based on theory paper
Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
John L Hennessey and David A Patterson	Computer Architecture A Quantitative Approach	5th	Elsevier
Kai Hwang and A. Brigggs	Computer Architecture and Parallel Processing		McGraw Hill

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
AB	1,2,3,4,5	10	10				
C	1,2,3,4,5			5	3	5	60
	1,2,3,4,5			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation			
Internal Examination:			
Continuous evaluation			**40**
External Examination: Examiner-			
Signed Lab Note Book		**10**	
On Spot Experiment(one for each group consisting 5 students)		**40**	
Viva voce		**10**	**60**

Name of the Course: M. Tech. in Data Science	
Subject: Advanced Database	
Course Code: PGIT(DS)202 and PGIT(DS)292	**Semester: II**
Duration:36 Hours	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit:**3+2**	Practical Sessional internal continuous evaluation: 40
	Practical Sessional external examination: 60
Aim:	
Sl. No.	
	Use an automated database design tool to design complex database systems.
	Apply object-relational data model concepts in database modeling and design.
	Optimize recovery of database transactions in relevant application.
Objective:	
Sl. No.	
1	To provide an insight into the practical and theoretical aspects of advanced topics in databases, such as object-relational databases and security issues.
2	To construct simple and moderately advanced database queries using Structured Query Language (SQL).
3	To expose the main techniques for developing database systems.
Pre-Requisite:	
Sl. No.	
	Knowledge of RDBMS

Contents		3 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Structure of relational Databases, Relational Algebra, Relational Calculus, Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Lossless Decomposition ,Boyce-Codd Normal Form, 3NF, Normalization using multi-valued depedencies, 4NF, 5NF	8	15
02	Transaction processing, Concurrency control and Recovery Management, conflict and view serializability, lock base protocols, two phase locking.	8	15

03	Distributed DBMS features and needs. Reference architecture. Levels of distribution transparency, replication. Distributed database design - fragmentation, allocation criteria. Distributed deadlocks. Time based and quorum based protocols. Comparison. Reliability- non-blocking commitment protocols.		**9**	**15**
04	Partitioned networks. Checkpoints and cold starts. Management of distributed transactions- 2 phase protocols. Architectural aspects. Node and link failure recoveries. Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled.		**9**	**15**
05	Introduction to Oracle RDBMS		**2**	**10**
	Sub Total:		**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination		**4**	**30**
	Total:		**40**	**100**

Practical:
Skills to be developed:

Intellectual skills:
1. Implement parallel and distributed databases.
2. Learn advanced data models
3. Learn emerging databases

List of Practical:
Hand on practical based on theory paper

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Leon & Leon	Essentials Of Dbms		McGraw Hill
Henry F. Korth and Silberschatz Abraham	Database System Concepts		McGraw Hill
R.P. Mahapatra	Database Management Systems		Khanna Book Publishing

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer /Laptop

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
AB	**1,2,3,4,5**	**10**	**10**				
C	**1,2,3,4,5**			5	3	5	
	1,2,3,4,5			5	3	15	60

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation			40

External Examination: Examiner-

Signed Lab Note Book	10	
On Spot Experiment(one for	40	
each group consisting 5 students)		
Viva voce	10	60

Name of the Course: M. Tech. in Data Science	
Subject: Big Data Analytics	
Course Code: PGIT(DS)203A and PGIT(DS)293A	**Semester: II**
Duration: 48 Hours	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit:**3+2**	Practical Sessional internal continuous evaluation: 40
	Practical Sessional external examination: 60
Aim:	

Sl. No.	
1.	Understand big data for business intelligence
2.	Learn business case studies for big data analytics.
3.	Understand nosql big data management.
4.	Perform map-reduce analytics using Hadoop and related tools

Objective:	
Sl. No.	
1.	Understand the fundamentals of Big cloud and data architectures.
2.	Understand HDFS file structure and Mapreduce frameworks, and use them to solve complex problems, which require massive computation power
3.	Use relational data in a Hadoop environment, using Hive and Hbase tools of the Hadoop Ecosystem..
4.	Understand the Comparison with traditional databases.

Pre-Requisite:	
Sl. No.	
1.	Data Structure
2.	Computer Architecture and Organization

Contents	**3 Hrs./week**

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Chapter	Name of the Topic	Hours	Marks
01	**Big Data** 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	10
02	**Introduction to NoSQL** 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,	8	10
	sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.		
03	**Data format, analysing data with Hadoop** 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	15
04	**MapReduce and YARN** 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	15
05	**Hbase** Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	7	10
06	**Pig** 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	10
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Practical:
Skills to be developed:
Intellectual skills:
1. The HDFS file system, MapReduce frameworks are studied in detail.
2. Hadoop tools like Hive, and Hbase, which provide interface to relational databases, are also covered as part of this course work.
3. Ability to implement algorithms to perform various operations on Mapreduce,Pig,Hive

List of Practical:
1. Basic Linux command
2. Installation of Hadoop .
3. Create a directory in HDFS at given path(s).
4. Copy a file from/To Local file system to HDFS
5. Remove a file or directory in HDFS.
6. Display the aggregate length of a file.
7. Word Count Map Reduce program to understand Map Reduce Paradigm
8. Implementing Matrix Multiplication with Hadoop Map Reduce
9. Pig Latin scripts to sort,group, join,project, and filter your data.
10. Hive Databases,Tables,Views,Functions and Indexes

Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Michael Minelli, Michelle Chambers, and AmbigaDhiraj	Big Data, Big Analytics: EmergingBusiness Intelligence and Analytic Trends for Today's Businesses		Wiley
Tom White	"Hadoop: The Definitive Guide"	Third Edition	O'Reilley
V.K. Jain	Big Data and Hadoop		Khanna Book Publishing House

Reference Books:

List of equipment/apparatus for laboratory experiments:

1.	Computer with moderate configuration
2.	Linux os or VM
3.	Hadoop 2.x or higher and other software as required.

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks

A	1,2,3,4,5,6	10	10				
B				5	3	5	60
	1,2,3,4,5,6						
C				5	3	15	
	1,2,3,4,5.6						

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation			40

External Examination: Examiner-

Signed Lab Note Book	10	
On Spot Experiment(one for each group consisting 5 students)	40	
Viva voce	10	60

Name of the Course: M. Tech. in Data Science	
Subject: Data Warehousing and Data Mining	
Course Code: PGIT(DS)203B and PGIT(DS)293B	Semester: II
Duration: 46 Hours	Maximum Marks: 100+100
Teaching Scheme	Examination Scheme
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**4**	Continuous Assessment:**25**
Credit: **3+2**	Practical Sessional internal continuous evaluation: 40
	Practical Sessional external examination: 60

Aim:	
Sl. No.	
1.	To learn about various data preprocessing techniques.
2.	To learn about data warehousing.
3.	To learn about various data mining functionalities such as association rule mining, clustering, classification and outlier analysis.

Objective:	
Sl. No.	
1	The objective of this course is to introduce data warehousing and mining techniques. Application of data mining in web mining, pattern matching and cluster analysis is included to aware students of broad data mining areas.

Pre-Requisite:	
Sl. No.	
1.	Data Structure, Computer Architecture and Organization

Contents		Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to Data Warehousing** Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives,scalable methods;	7	10
02	**Classification and prediction** Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,	8	10
03	**Mining Time series Data** Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;	8	15
04	**Mining Data Streams** 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;	11	15
05	**Web Mining, Mining the web page layout structure**	7	10

	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.			
06	**Recent trends** Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis		**5**	**10**
	Sub Total:		**46**	**70**
	Internal Assessment Examination & Preparation of Semester Examination		**4**	**30**
	Total:		**50**	**100**

Practical:
Skills to be developed:
Intellectual skills:
After completion of course, students would be:
1. Study of different sequential pattern algorithms
2. Study the technique to extract patterns from time series data and it application in real world.
3. Can extend the Graph mining algorithms to Web mining

List of Practical:
Hand on lab experiments based on theory paper.
Assignments: Based on Theory Lecture.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Jiawei Han and M Kamber	Data Mining Concepts and Techniques	2nd	Elsevier
G Dong and J Pei	"Hadoop: The Definitive Guide"	Third Edition	O'Reilley

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer with modern specification

End Semester Examination Scheme. **Maximum Marks-70.** **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5,6**	**10**	**10**				
B	**1,2,3,4,5,6**			**5**	**3**	**5**	**60**
C	**1,2,3,4,5.6**			**5**	**3**	**15**	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the

objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation			

External Examination: Examiner-

Signed Lab Note Book	10	
On Spot Experiment(one for each group consisting 5 students)	40	
Viva voce	10	

Name of the Course: M. Tech. in Data Science	
Subject: Data Security	
Course Code: PGIT(DS)204A	**Semester: II**
Duration: 48 Hours	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit:**3**	Practical Sessional internal continuous evaluation:NA
	Practical Sessional external examination:NA

Aim:	
Sl. No.	
1.	To understand and implement classical models and Algorithms
2.	To analyse the data, identify the problems, and choose the relevant models and algorithms to apply.
3.	To assess the strengths and weaknesses of various access control models and to analyse their behaviour.

Objective:	
Sl. No.	
1	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.

Pre-Requisite:	
Sl. No.	
	Database Management

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Contents		3 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	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	15
02	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	10
03	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	15
04	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.	10	15
05	Recent trends in Database security and access control mechanisms. Case study of Role-Based Access Control (RBAC) systems.	7	10
06	Recent Trends related to data security management, vulnerabilities in different DBMS.	4	5
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
David F. Ferraiolo, D. Richard Kuhn, RamaswamyChandra mouli	Role Based Access Control		
Reference Books:			

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Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5.6			5	3	15	

End Semester Examination Scheme. Maximum Marks-70. Time allotted-3hrs.

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Name of the Course: M. Tech. in Data Science	
Subject: Web Analytics and Development	
Course Code: PGIT(DS)204B	**Semester: II**
Duration: 48 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:NA
	Practical Sessional external examination:NA

Aim:

Sl. No.	
1.	To provide overview and establish the need for web analytics.
2.	To understand and apply metrics to analyze the web data.
3.	To provide exposure to usage of web analytic tools.

Objective:

Sl. No.	
1	The course explores use of social network analysis to understand growing connectivity and complexity in the world ranging from small groups to WWW.
2	To Become familiar with core research communities, publications, focused on web and social media analytics and research questions engaged in

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Pre-Requisite:			
Sl. No.			
Contents			**3 Hrs./week**

Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction** – Social network and Web data and methods, Graph and Matrices, Basic measures for individuals and networks, Information Visualization	10	15
02	**Web Analytics tools:** Click Stream Analysis, A/B testing, Online Surveys	8	15
03	**Web Search and Retrieval:** Search Engine Optimization, Web Crawling and indexing, Ranking Algorithms, Web traffic models	9	15
04	**Making Connection**: Link Analysis, Random Graphs and Network evolution, Social Connects: Affiliation and identity	12	15
05	**Connection:** Connection Search, Collapse, Robustness Social involvements and diffusion of innovation	9	10
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Hansen, Derek, Ben Sheiderman, Marc Smith	Analyzing Social Media Networks with NodeXL: Insights from a Connected World		Morgan Kaufmann

Reference Books:

Avinash Kaushik	Web Analytics 2.0: The Art of Online Accountability		

End Semester Examination Scheme. **Maximum Marks-70.** **Time allotted-3hrs.**

Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)		**Subjective Questions**			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5**	10	10				
B	**1,2,3,4,5**			5	3	5	60
C	**1,2,3,4,5**			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Examination Scheme for end semester examination:				
Group	**Chapter**	**Marks of each question**	**Question to be set**	**Question to be answered**
A	**ALL**	**1**	**10**	**10**
B	**ALL**	**5**	**5**	**3**
C	**ALL**	**15**	**5**	**3**

Name of the Course: M. Tech. in Data Science	
Subject: Knowledge Discovery	
Course Code: PGIT(DS)204C	**Semester: II**
Duration: 48 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:NA
	Practical Sessional external examination:NA

Aim:	
Sl. No.	
1.	To introduce Knowledge Discovery techniques/methods and their application.
2.	To help the students to extract useful knowledge from large volumes of data
3.	by prediction and clustering methods.
4.	To understand the sequence in which the data mining projects should be performed.

Objective:	
Sl. No.	
1	To preprocess the data and apply appropriate algorithms.
2	To integrate knowledge discovery tools.
3	To map data mining techniques with the applications that handle uncertainty,

Pre-Requisite:	
Sl. No.	
	Basic Programming Skill

Contents		3 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction KDD and Data Mining - Data Mining and Machine Learning, Machine Learning and Statistics, Generalization as Search,Data Mining and Ethics	**7**	**10**
02	Knowledge Representation - Decision Tables, Decision Trees, Classification Rules, Association Rules, Rules involving Relations, Trees for Numeric Predictions, Neural Networks, Clusters	**10**	**15**
03	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**	**15**

04	Classification Rules - Inferring Rudimentary Rules, Covering Algorithms for Rule Construction, Probability Measure for Rule Evaluation, Association Rules, Item Sets, Rule Efficiency	8	15
05	Numeric Predictions - Linear Models for Classification and Numeric Predictions, Numeric Predictions with Regression Trees, Evaluating Numeric Predictions	7	8
06	Artificial Neural Networks – Perceptrons, Multilayer Networks, The Backpropagation Algorithm Clustering - Iterative Distance-based Clustering, Incremental Clustering, The EM Algorithm	7	7
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
David Skillicorn	Knowledge Discovery for Counterterrorism and Law Enforcement	1st Edition	Chapman & Hall/CRC Data Mining and Knowledge Discovery Series, 2008

Reference Books:

Krzysztof J. Cios, Witold Pedrycz, Roman W. Swiniarski, Lukasz Andrzej Kurgan	Data Mining: A Knowledge Discovery Approach	1st Edition	Springer Science & Business Media LLC, 2007.

End Semester Examination Scheme.　　　**Maximum Marks-70.**　　　**Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5,6**	10	10				
B	**1,2,3,4,5,6**			5	3	5	60
C	**1,2,3,4,5.6**			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the

	objective part.
•	Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3
Viva voce		10		

Name of the Course: M. Tech. in Data Science	
Subject: Constitution of India	
Course Code: PGIT(DS)205A	**Semester: II**
Duration: 24 Hours	**Maximum Marks:** 100
Teaching Scheme	**Examination Scheme**
Theory:02	**End Semester Exam:** 70
Tutorial:	**Attendance :** 5
Practical:	**Continuous Assessment:** 25
Credit: 0	
Aim:	
Sl. No.	
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.
Objective:	
Sl. No.	
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 initial drafting of the Indian Constitution.
Pre-Requisite:	
Sl. No.	
1.	
2.	

Contents		2 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**History of Making of the Indian Constitution:** HistoryDrafting Committee, (Composition & Working)	4	14
02	**Philosophy of the Indian Constitution:** Preamble Salient Features	4	14

03	**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	14
04	**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	14
05	**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	4	4
06	**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	10
	Sub Total:	24	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	28	100

Practical:
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
The Constitution of India, 1950 (Bare Act),			Government Publication.
Reference Books:			

Dr. S. N. Busi, Dr. B. R. Ambedkar	framing of Indian Constitution,	1st Edition, 2015.	
M. P. Jain,	Indian Constitution Law,	7th Edn.,	Lexis Nexis, 2014.
D.D. Basu,	Introduction to the Constitution of India,		Lexis Nexis, 2015.

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Pedagogy Studies	
Course Code: PGIT(DS)205B	**Semester: II**
Duration: 24 Hours	**Maximum Marks:** 100
Teaching Scheme	**Examination Scheme**
Theory:02	**End Semester Exam:** 70
Tutorial:0	**Attendance :** 5
Practical:0	**Continuous Assessment:** 25
Credit:0	

Aim:	
Sl. No.	
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?
Objective:	
Sl. No.	
1.	Review existing evidence on the review topic to inform programme design and policy

	making undertaken by the DfID, other agencies and researchers.		
2.	Identify critical evidence gaps to guide the development.		
3.			
Pre-Requisite:			
Sl. No.			
1.			
2.			

Contents		2 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**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	14
02	**Thematic overview: Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.** • Curriculum, Teacher education.	4	14
03	**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.	4	14
04	**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	14
05	**Research gaps and future directions** • Research design • Contexts	4	4
06	**Pedagogy** • Teacher education • Curriculum and assessment • Dissemination and research impact.	4	10
	Sub Total:	24	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	28	100

Assignments:
Based on theory

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
The Constitution of India, 1950 (Bare Act),			Government Publication.
Chavan M	(2003) Read India: A mass scale, rapid, 'learning to read' campaign.		

Reference Books:

The Constitution of India, 1950 (Bare Act),			Government Publication.
Agrawal M	(2004) Curricular reform in schools: The importance of evaluation,		Journal of Curriculum Studies, 36 (3): 361-379.
Akyeampong K	(2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1.		London: DFID.
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.
Alexander RJ	(2001) Culture and pedagogy: International comparisons in primary education.		Oxford and Boston: Blackwell.
	www.pratham.org/images/resource%20working%20paper%202.pdf.		

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70

C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science
Subject: Stress management by Yoga

Course Code: PGIT(DS)205C	Semester: II
Duration: 24 Hours	**Maximum Marks:** 100
Teaching Scheme	**Examination Scheme**
Theory:02	**End Semester Exam:** 70
Tutorial:0	**Attendance :** 5
Practical:0	**Continuous Assessment:** 25
Credit: 0	

Aim:

Sl. No.	
1.	Develop healthy mind in a healthy body thus improving social health
2.	Improve efficiency

Objective:

Sl. No.	
1.	To achieve overall health of body and mind
2.	To overcome stress
3.	

Pre-Requisite:

Sl. No.	
1.	

Contents		2 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Definitions of Eight parts of yog. (Ashtanga)**	8	20
02	**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	30
03	**Asan and Pranayam** i) Various yog poses and their benefits for mind & body ii) Regularization of breathing techniques and its effects- Types of pranayam	8	20
	Sub Total:	24	70
	Internal Assessment Axamination & Preparation of Semester Examination	4	30
	Total:	28	100

Assignments: Based on theory

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
1. Janardan Swami Yogabhyasi Mandal, Nagpur	'Yogic Asanas for Group Tarining-Part-I"		

Reference Books:

Swami Vivekananda, AdvaitaAshrama	"Rajayoga or conquering the Internal Nature"		(Publication Department), Kolkata

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Personality development through life enlightenment skills	
Course Code: PGIT(DS)205D	Semester: II
Duration: 24 Hours	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory:02	End Semester Exam: 70
Tutorial:0	Attendance : 5
Practical:0	Continuous Assessment: 25
Credit:0	

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Aim:	
Sl. No.	
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 students.
Objective:	
Sl. No.	
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
Pre-Requisite:	
Sl. No.	
1.	

Contents		2 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**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)	8	20
02	• Verses- 71,73,75,78 (do's) • 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.	8	20
03	• Statements of basic knowledge. • Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 • Chapter 12 -Verses 13, 14, 15, 16,17, 18 • 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	8	30
	Sub Total:	24	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	28	100

Assignments:

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
1.Swami SwarupanandaAdvaita Ashram	"Srimad Bhagavad Gita"		(Publication Department), Kolkata
Reference Books:			

2.P.Gopinath,	Bhartrihari's Three Satakam (Niti-sringar-vairagya)		Rashtriya Sanskrit Sansthanam, New Delhi.

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				
B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Term Paper with Seminar	
Course Code: PGIT(DS)281	**Semester: II**
Duration:24 hrs	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme100**
Theory:0	End Semester Exam:
Tutorial:0	Teacher's Assessment:0
Practical:04	Internal Assessment:0
Credit:2	Practical Sessional internal continuous evaluation:40
	Practical Sessional external examination:60
Contents Students will do projects on application areas of latest technologies and current topics of societal relevance.	

Semester: III

Name of the Course: M. Tech. in Data Science			
Subject: GPU Computing			
Course Code: PGIT(DS)301A	Semester: III		
Duration: 48 Hours	Maximum Marks: 100		
Teaching Scheme	Examination Scheme		
Theory:**3**	End Semester Exam:**70**		
Tutorial:**0**	Attendance: **5**		
Practical:**0**	Continuous Assessment:**25**		
Credit: **3**	Practical Sessional internal continuous evaluation:		
	Practical Sessional external examination:		
Aim:			
Sl. No.			
1.	To learn concepts in parallel programming		
2.	Implementation of programs on GPUs		
3.	Debugging and profiling parallel programs.		
Objective:			
Sl. No.			
1	To learn parallel programming with Graphics Processing Units (GPUs).		
Pre-Requisite:			
Sl. No.			
1.	Basic Computer Architecture		
Contents			**3 Hrs./week**
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**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	20
02	**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	10
03	**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	15
04	**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-	8	10
05	Synchronization - Overlapping data transfer and kernel execution, pitfalls.	5	8
06	**Unit 5:**	5	7

	Case Studies: Image Processing, Graph algorithms, Simulations, Deep Learning		
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
David Kirk, Wen-meiHwu; Morgan Kaufman	Programming Massively Parallel Processors: A Hands-on Approach	ISBN: 978-0123814722	
Shane Cook; Morgan Kaufman	CUDA Programming: A Developer's Guide to Parallel Computing with GPUs	ISBN: 978-0124159334	

Reference Books:

End Semester Examination Scheme.　　　**Maximum Marks-70.**　　　**Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5.6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Cloud Computing	
Course Code: PGIT(DS)301B	**Semester: III**
Duration: 48 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:
	Practical Sessional external examination:

Aim:

Sl. No.	
1.	To explore the basic cloud architecture.
2.	To analyze the application need and design an infrastructure.
3.	To extend the cloud capacity understanding the different loop holes.
4.	To learn the implementation of cloud services

Objective:

Sl. No.	
1	To apply trust-based security model to real-world security problems.
2	An overview of the concepts, processes, and best practices needed to successfully secure information within Cloud infrastructures.
3	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.

Pre-Requisite:

Sl. No.	**Networking**

Contents		3 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to Cloud Computing** Online Social Networks and Applications, Cloud introduction and overview, Different clouds, Risks, Novel applications of cloud computing	4	10
02	**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	15

03	**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	10	15
	Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management		
04	**Security Management in the Cloud** Security Management Standards, Security Management in the Cloud, 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	11	15
05	**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	8
06	**ADVANCED TOPICS** Recent devlopments in hybrid cloud and cloud security.	4	7
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
John Rhoton	Cloud Computing Explained: Implementation Handbook for Enterprises		

Reference Books:

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks

A	1,2,3,4,5, 6	10	10				
BC	1,2,3,4,5, 6			5 5	3 3	5 15	60
	1,2,3,4,5. 6						

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Distributed Databases	
Course Code: PGIT(DS)301C	**Semester: III**
Duration: 36 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:
	Practical Sessional external examination:
Aim:	
Sl. No.	
1.	To identify and describe soft computing techniques and their roles in building intelligent machines
2.	To apply fuzzy logic and reasoning to handle uncertainty and solve various engineering problems.
3.	To apply genetic algorithms to combinatorial optimization problems.
	To evaluate and compare solutions by various soft computing approaches for a given problem.
Objective:	
Sl. No.	
1	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.
Pre-Requisite:	
Sl. No.	**Database Management Systems**
Contents	**3 Hrs./week**
Chapter	**Name of the Topic**	**Hours**	**Marks**

01	Structure of relational Databases, Relational Algebra, Relational Calculus, Functional Dependency, Different anomalies in designing a Database., Normalization using functional dependencies, Lossless Decomposition ,Boyce-Codd Normal Form, 3NF, Normalization using multi-valued depedencies, 4NF, 5NF	**8**	**15**
02	Transaction processing, Concurrency control and Recovery Management, conflict and view serializability, lock base protocols, two phase locking.	**10**	**15**
03	Distributed DBMS features and needs. Reference architecture.	**10**	**15**
	Levels of distribution transparency, replication. Distributed database design - fragmentation, allocation criteria. Distributed deadlocks. Time based and quorum based protocols. Comparison. Reliability- non-blocking commitment protocols.		
04	Module-4 Partitioned networks. Checkpoints and cold starts. Management of distributed transactions- 2 phase protocols. Architectural aspects. Node and link failure recoveries. Distributed data dictionary management. Distributed database administration. Heterogeneous databases-federated database, reference architecture, loosely and tightly coupled.	**6**	**15**
05	Module -5 Introduction to Oracle RDBMS	**2**	**10**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
M.T. Ozsu and P. Valduriez	Principles of Distributed Database Systems		Prentice-Hall

Reference Books:

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A **BC**	**1,2,3,4,5, 6** **1,2,3,4,5, 6** **1,2,3,4,5. 6**	**10**	**10**	**5** **5**	**3** **3**	**5** **15**	**60**

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science			
Subject: **Deep Learning**			
Course Code: PGIT(DS)301D	**Semester: III**		
Duration: 36 Hrs.	**Maximum Marks:** 100		
Teaching Scheme	**Examination Scheme**		
Theory: 3	**End Semester Exam:** 70		
Tutorial: 0	**Attendance :** 5		
Practical: 0	**Continuous Assessment:** 25		
Credit: 3	**Practical Sessional internal continuous evaluation:** NA		
	Practical Sessional external examination: NA		
Aim:			
Sl. No.			
1.			
Objective:			
Sl. No.			
1.	Apply deep learning approach to solve real life complex problem.		
Pre-Requisite:			
Sl. No.			
1.	Artificial Intelligence, Probability and Statistics, Linear Algebra		

Contents		Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction Feedforward Neural networks. Gradient descent and the backpropagation algorithm. Unit saturation, aka the vanishing gradient problem, and ways to mitigate it. RelU Heuristics for avoiding bad local minima. Heuristics for faster training. Nestors accelerated gradient descent. Regularization. Dropout. Convolutional Neural Networks Architectures, convolution / pooling layers Recurrent Neural Networks LSTM, GRU, Encoder Decoder architectures Deep Unsupervised Learning	6	14
02	Autoencoders (standard, sparse, denoising, contractive, etc), Variational Autoencoders, Adversarial Generative Networks, Autoencoder and DBM Attention and memory models,	6	14
	Dynamic memory networks		

03	Applications of Deep Learning to NLP: Introduction to NLP and Vector Space Model of Semantics	6	14
04	Word Vector Representations: Continuous Skip-Gram Model, Continuous Bag-of Words model (CBOW), Glove, Evaluations and Applications in word similarity, analogy reasoning	6	14
05	Dialogue Generation with LSTMs Applications of Dynamic Memory Networks in NLP	6	10
06	Recent Reseearch in NLP using Deep Learning: Factoid Question Asnwering, similar question detection, Dialogue topic tracking, Neural Summarization, Smart Reply	6	4
	Sub Total:	36	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	40	100

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Rajeev Chopra	Deep Learning		Khanna Book Publishing House
Bengio, Yoshua, Ian J. Goodfellow, and Aaron Courville	Deep learning."		MIT Press book
Bengio, Yoshua.	Learning deep architectures for AI." Foundations and trends in Machine Learning		

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1.	Computer

End Semester Examination Scheme.　　　Maximum Marks-70.　　　Time allotted-3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	ALL	10	10				

B	ALL			5	3	5	70
C	ALL			5	3	15	

- Only multiple choice type questions (MCQ) with one correct answer are to be set in the objective part.

- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation				40

External Examination: Examiner-

Signed Lab Assignments	10	
On Spot Experiment	40	
Viva voce	10	60

Name of the Course: M. Tech. in Data Science	
Subject: Business Analytics	
Course Code: PGIT(DS)302A	**Semester: III**
Duration: 48 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:
	Practical Sessional external examination:
Aim:	
Sl. No.	
1.	To identify the association between various types of data.
2.	To apply statistical inference techniques.
3.	To apply methods of inference to applied business situations.
4.	To identify, build and validate appropriate statistical regression models.
Objective:	
Sl. No.	
1	The main objective of this course is to give the student a comprehensive understanding of business analytics methods.
Pre-Requisite:	
Sl. No.	
	Mathematical knowledge
Contents	**3 Hrs./week**
Chapter	**Name of the Topic**	**Hours**	**Marks**

01	**Unit 1:** Business Analysis: Overview of Business Analysis, Overview of Requirements, Role of the Business Analyst. Stakeholders: the project team, management, and the front line, Handling Stakeholder Conflicts.	7	10
02	**Unit 2:** Life Cycles: Systems Development Life Cycles, Project Life Cycles, Product Life Cycles, Requirement Life Cycles.	8	15
03	**Unit 3:** Forming Requirements: Overview of Requirements, Attributes of Good Requirements, Types of Requirements, Requirement Sources, Gathering Requirements from Stakeholders, Common Requirements Documents.	9	15
04	**Unit 4:** Transforming Requirements: Stakeholder Needs Analysis, Decomposition Analysis, Additive/Subtractive Analysis, Gap Analysis, Notations (UML & BPMN), Flowcharts, Swim Lane Flowcharts, Entity-Relationship Diagrams, State-Transition Diagrams, Data Flow Diagrams, Use Case Modeling, Business Process Modeling	10	10
05	**Unit 5:** Finalizing Requirements: Presenting Requirements, Socializing Requirements and Gaining Acceptance, Prioritizing Requirements. Managing Requirements Assets: Change Control, Requirements Tools	10	15
06	**Unit 6** Recent Trands in: Embedded and colloborative business intelligence, Visual data recovery, Data Storytelling and Data Journalism.	4	5
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
 Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Erik Larson and, Clifford Gray	Project Management: The Managerial Process		
Premvir Kapoor	Sociology and Economics for Engineers		Khanna Book Publishing House
Reference Books:			
Paul Newbold, William L. Carlson, Betty Thorne	Statistics for Business and economics	6th edition	Pearson Education
Keller Gerald	Statistics for	1oth edition	Cengage

		Management and Economics",		Learning,		

End Semester Examination Scheme.   Maximum Marks-70.   Time allotted- 3hrs.

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5, 6	10	10				
B	1,2,3,4,5, 6			5	3	5	60
C	1,2,3,4,5. 6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science	
Subject: Cost Management of Engineering Projects	
Course Code: PGIT(DS)302D	**Semester: III**
Duration: 48 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:**0**	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:
	Practical Sessional external examination:
Aim:	

Sl. No.	
1.	Prepare basic project estimates including pricing of labour, material and equipment
2.	Understand and prepare basic cost plans
3.	Understand and prepare cost control formats
4.	Understand estimating processes & learn to apply them

Objective:	
Sl. No.	
1.	To disseminate application of project management processes involved in Project Cost Management
2.	To disseminate application of project management processes involved in Project Cost Management

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Pre-Requisite:			
Sl. No.			
Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**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.	12	15
02	**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	12	20
03	**Cost Behavior and Profit Planning Marginal Costing** 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.	12	20
04	**Quantitative techniques for cost management** Quantitative techniques for cost management, Linear Programming, PERT/CPM, Transportation problems, Assignment problems, Simulation, Learning Curve Theory.	12	15
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100
	Assignments: Based on Theory Lecture. **List of Books**		

MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
Syllabus for M. Tech in Data Science
(Effective from 2021-22 Admission Session)

Text Books:			
Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Charles T. Horngren and George Foster	Advanced Management Accounting		
Reference Books:			
Charles T. Horngren and George Foster	Advanced Management Accounting		
Robert S Kaplan Anthony A. Alkinson	Management & Cost Accounting		
Ashish K. Bhattacharya	& Practices of Cost Accounting A. H		Wheeler publisher
N.D. Vohra	Quantitative Techniques in Management		Tata McGraw Hill Book Co. Ltd
Gupta & Sharma	The Practice of Business Statistics		Khanna Book Publishing House

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted- 3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1,2,3,4,5,6**	10	10				
B				5	3	5	
C	**1,2,3,4,5,6**			5	3	15	60
	1,2,3,4,5,6						

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science			
Subject: Composite Materials			
Course Code: PGIT(DS)302E	**Semester: III**		
Duration: 48Hours	**Maximum Marks: 100**		
Teaching Scheme	**Examination Scheme**		
Theory:**3**	End Semester Exam:**70**		
Tutorial:**0**	Attendance: **5**		
Practical:**0**	Continuous Assessment:**25**		
Credit: **3**	Practical Sessional internal continuous evaluation:		
	Practical Sessional external examination:		
Aim:			
Sl. No.			
1.	Recognise the fundamentals of orthotropic materials and mechanics of materials		
2.	Demonstrate the fundamentals of directional stresses and strains		
3.	Develop a solid understanding in the properties of composite materials		
Objective:			
Sl. No.			
1.	To understand the use of fibre-reinforced composites in structural applications		
2.	To develop a basic understanding of the use of composite materials, micromechanics of layered composites, analysis and design of composite structures and failure analysis of laminated panels.		
Pre-Requisite:			
Sl. No.			

Contents		3 Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**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.	8	10
02	**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.	10	15
03	**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.	10	15

04	**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.	10	15
05	**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.	10	15
	Sub Total:	48	70
	Internal Assessment Examination & Preparation of Semester Examination	4	30
	Total:	52	100

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
R.W.Cahn	Material Science and Technology		

Reference Books:

ed-Lubin	Hand Book of Composite Materials		
Deborah D.L. Chung	Composite Materials Science and Applications		
Danial Gay, Suong V. Hoa, and Stephen W. Tasi	Composite Materials Design and Applications		

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	1,2,3,4,5,6	10	10				
B	1,2,3,4,5,6			5	3	5	60
C	1,2,3,4,5,6			5	3	15	

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech. in Data Science			
Subject: Waste to Energy			
Course Code: PGIT(DS)302F		**Semester: III**	
Duration: Hours		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory:**3**		End Semester Exam:**70**	
Tutorial:**0**		Attendance: **5**	
Practical:**0**		Continuous Assessment:**25**	
Credit: **3**		Practical Sessional internal continuous evaluation:	
		Practical Sessional external examination:	
Aim:			
Sl. No.			
	To understand technologies for generation of energy from solid waste		
	To compare methods of solid waste disposal		
	To identify sources of energy from bio-chemical conversion		
	To analyze methods for management of e-waste		
Objective:			
Sl. No.			
	To classify solid waste sources		
	To identify methods of solid waste disposal		
	To study various energy generation methods		
	To analyse biogas production methods and recycling of e-waste		
Pre-Requisite:			
Sl. No.			
	Environmental Studies		

Contents			3 Hrs./week	
Chapter	**Name of the Topic**		**Hours**	**Marks**
01	**Introduction to Energy from Waste** Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors		8	10
02	**Biomass Pyrolysis** Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.		10	15
03	**Biomass Gasification** 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.		10	15

04	**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.		**10**	**15**
05	**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		**10**	**15**
	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.			
	Sub Total:		**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination		**4**	**30**
	Total:		**52**	**100**

Assignments: Based on Theory Lecture.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
O.P. Gupta	Energy Technology		Khanna Book Publishing House
O.P. Gupta	Elements of Fuel and Combustion technology		Khanna Book Publishing House
Desai, Ashok V	Non Conventional Energy		Wiley Eastern Ltd.
Reference Books:			
Khandelwal, K. C. and Mahdi, S. S.	Biogas Technology - A Practical Hand Book	Vol. I & II	Tata McGraw Hill Publishing Co. Ltd., 1983
Challal, D. S.	Food, Feed and Fuel from Biomass		IBH Publishing Co. Pvt. Ltd., 1991
C. Y. WereKo-Brobby and E. B. Hagan	Biomass Conversion and Technology		John Wiley & Sons, 1996
Ashish Chandra	Non-Conventional Energy Resources		Khanna Book Publishing House

End Semester Examination Scheme.   **Maximum Marks-70.**   **Time allotted-3hrs.**

Group	Unit	Objective Questions (MCQ only with the correct answer)		Subjective Questions			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks

A	1,2,3,4,5,6	10	10				
B				5	3	5	60
	1,2,3,4,5,6						
C				5	3	15	
	1,2,3,4,5,6						

- Only multiple choice type question (MCQ) with one correct answer are to be set in the objective part.
- Specific instruction to the students to maintain the order in answering objective questions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	Chapter	Marks of each question	Question to be set	Question to be answered
A	ALL	1	10	10
B	ALL	5	5	3
C	ALL	15	5	3

Name of the Course: M. Tech in Data Science	
Subject: Dissertation-I /Industrial Project	
Course Code: PGIT(DS)381	**Semester: III**
Duration:	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**0**	End Semester Exam:**NA**
Tutorial:**0**	Attendance: **NA**
Practical:**20**	Continuous Assessment:**NA**
Credit: **10**	Practical Sessional internal continuous evaluation:40
	Practical Sessional external examination:60

Aim:	
Sl. No.	
1.	To Present the work in International/ National conference or reputed journals.

Objective:	
Sl. No.	
1.	Build ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2.	To select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3.	To present the findings of their technical solution in a written report. ·
4.	To synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.

Contents	20 **Hrs./week**

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. The dissertation should have the following
· Relevance to social needs of society
· Relevance to value addition to existing facilities in the institute · Relevance to industry need
· Problems of national importance
· Research and development in various
domain The student should complete the following:
· Literature survey Problem
Definition · Motivation for study
and Objectives
· Preliminary design / feasibility / modular
approaches · Implementation and Verification
· Report and presentation
The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:
· Experimental verification / Proof of concept.
· Design, fabrication, testing of Communication System.
· The viva-voce examination will be based on the above report and work.

Name of the Course: M. Tech in Data Science	
Subject: Dissertation II	
Course Code: PGIT(DS)-481	Semester: IV
Duration:	Maximum Marks: 100
Teaching Scheme	Examination Scheme
Theory:**0**	End Semester Exam:**NA**
Tutorial:**0**	Attendance: **NA**
Practical:32	Continuous Assessment:**NA**
Credit: **16**	Practical Sessional internal continuous evaluation:40
	Practical Sessional external examination:60

Aim:	
Sl. No.	
2.	To Present the work in International/ National conference or reputed journals.

Objective:	
Sl. No.	
5.	Build ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
6.	To select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
7.	To present the findings of their technical solution in a written report. ·
8.	To synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.

Contents	32 **Hrs./week**

Guidelines for Dissertation Phase II

· As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

· The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

· After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

· Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

· Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

· Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

· During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

· Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

· Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A.

In case of unsatisfactory performance, committee may recommend for extension or repeating the work