Course Scheme for M.Sc. in Information Technology(Data Science)

M.Sc,Sem-I.

Code	Course Title	Hours per week			Credits
		L	T	P	
MITDS-101	Program Core I- Advanced Statistics	3	0	0	3
MITDS-102	Program Core II- Advanced Data Structures and Algorithms	3	0	0	3
MITDS–103	Program Core III- Introduction to Data Science	3	0	0	3
MITDS-104	Program Core IV- Data Visualization	3	0	0	3
MITDS-105	Research Methodology and IPR	2	0	0	2
MITDS-106A/106B/106C/106D	Elective I (Cloud Computing / Pattern Recognition / Internet of Things/ Computer Vision)	3	0	0	3
MITDS-192	Laboratory 1 (Advanced Data Structures and Algorithms)	0	0	4	2
MITDS-194	Laboratory 2 (Data Visualization)	0	0	4	2
MITDS-196A/196B/196C/1	Laboratory 3 (Based on Elective I)	0	0	4	2

96D/196E					
Total Credits: 23					

M.Sc, Sem- II

Code	Course Title	Hours per week			Credits
		L	T	P	
MITDS-201	Program Core V Big Data Analytics	3	0	0	3
MITDS-202	Program Core VI – Machine Learning	3	0	0	3
MITDS–203	Program CoreVII – Data Preparation and Analysis	3	0	0	3
MITDS-204A/204B/204C/204D	Program Elective II- Optimization Techniques / Social Media Analytics / Advanced Data Mining/ Time Series Analysis and Forecasting Techniques	3	0	0	3
MITDS-205A/B/C/D	Audit Course-2	2	0	0	0
MITDS-291	Laboratory 1 (Big Data Analytics)	0	0	4	2
MITDS-292	Laboratory 2 (Machine Learning)	0	0	4	2
MITDS-293	Laboratory 2 (Data Preparation and Analysis)	0	0	4	2
MITDS-293	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.

M.Sc, IIISem*

Code	Course Title	Hours per week			Credits
		L	T	P	

MITDS– 301	Program Core IX – Deep Learning	3	0	0	03
MITCNS-302	Open Elective A. Business Analytics B. Project Management & Entrepreneurship C. Industrial Safety D. Operations Research E. Cost Management of Engineering Projects F. Composite Materials G. Waste to Energy	3	0	0	03
MITDS-391	Laboratory (Deep Learning)	0	0	4	2
MITCNS-393	Dissertation-I /Industrial Project	0	0	20	10
Total Credits: 18					

*Students going for Industrial Project/Thesis will complete these courses through MOOCs. M.Sc, Sem-IV

	Course Title	Hours per week			Credits
		L	T	P	
MITCNS-491	Dissertation II	0	2	24	14
	Seminar	0	2	0	2
Total Credits: 16					

Name of the Course: M.Sc in Data Science **Subject:** Advanced Statistics	
Course Code: MITDS-101	**Semester: I**
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:**NA**

	Practical Sessional external examination:**NA**		
Aim:			
Sl. No.			
1.	To determine multiplicative inverses, modulo n and use to solve linear congruences graph theory.		
2	To solve different engineering problems using counting techniques.		
Objective:			
Sl. No.			
1.	Develop mathematical thinking and problem solving skills associated with research and writing proofs.		
2.	Get exposure to a wide variety of mathematical concepts used in computer science discipline like probability.		
3.	Use Graph Theory for solving problems.		
4.	Acquire basic knowledge of sampling and estimation.		
5.	Understand basic concepts of hypothesis.		
Pre-Requisite:			
Sl. No.			
1.	Knowledge of basic mathematics.		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Unit 1:**Probability mass, density, and cumulative distribution functions, Parametric families of distributions (Binomial and Multinomial, Poisson and Normal distribution), Expected value, variance, conditional expectation, Markov and Chebyshev Inequalities ,Central Limit Theorem, Markov chains	**7**	**15**
02	**Unit 2:**Samples, populations, statistical modelling, graphical methods and data description, Random samples, sampling distributions (t-distribution and F-distribution)	**7**	**15**
03	**Unit 3:** Statistical inference, Classical Methods of estimation(Point Estimation Methods, Method of Moments and Maximum Likelihood), Statistical hypothesis: general concepts	**7**	**15**
04	**Unit 4:** Graph Theory: Isomorphism, Planar graphs, graph coloring theorem: Art Gallery problem, Hamilton circuitsand Euler cycles, Permutations and Combinations with and	**7**	**10**

	without repetition. Techniques to solve combinatorial enumeration problems: Binomial coefficients, Multinomial coefficients.		
05	**HYPOTHESIS TESTING** Uniformly most powerful tests - the Neyman-Pearson fundamental Lemma -Distributions with monotone likelihood ratio - Problems - Generalization of the fundamental lemma, two sided hypotheses - testing the mean and variance of a normal distribution.	**8**	**15**
	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**
Ronald E. Walpole, Raymond H. Myers, Sharon L. Myers and Keying Ye, ,	Probability and Statistics For Engineers and Scientists		Pearson Education
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.		

Reference Books

Alan Tucker, ,.	Applied		Wiley

	Combinatorics		

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.Sc in Data Science **Subject:** Advanced Data Structures and Algorithms	
Course Code: MITDS-102 & MITDS-192	**Semester: I**

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.	
1	To understand the data structures, their advantages and drawbacks, how to implement them in programming language, how their drawbacks can be overcome and what the applications are and where they can be used.

Objective:

Sl. No.	
1	To learn about the data structures/ methods/algorithms mentioned in the course with a comparative perspective .
2	To make use of the most appropriate data structure/ method/algorithm in a program
3	To enhance the efficiency (i.e. reduce the run-time) or for better memory utilization
4	To understand at least the efficiency aspects of the graph and sorting algorithms covered in this course.
5	To convert an inefficient program into an efficient one using the knowledge gathered from this course.

Pre-Requisite:

Sl. No.	
1	Basic Computation and Principles of C
2	Mathematics
3	basics of set theory

Contents		**Hrs./week**	
Chapte	**Name of the Topic**	**Hour**	**Marks**

r		s	
01	Module -I. [8L] Linear Data Structure Introduction (2L): Why we need data structure? Concepts of data structures: a) Data and data structure b) Abstract Data Type and Data Type. Algorithms and programs, basic idea of pseudo-code. Algorithm efficiency and analysis, time and space analysis of algorithms – order notations. Array (2L): Different representations – row major, column major. Sparse matrix - its implementation and usage. Array representation of polynomials. Linked List (4L): Singly linked list, circular linked list, doubly linked list, linked list representation of polynomial and applications.	**8**	**5**
02	Module -II: [7L] Linear Data Structure [Stack and Queue (5L): Stack and its implementations (using array, using linked list), applications. Queue, circular queue, dequeue. Implementation of queue- both linear and circular (using array, using linked list), applications. Recursion (2L): Principles of recursion – use of stack, differences between recursion and iteration, tail recursion. Applications - The Tower of Hanoi, Eight Queens Puzzle.	**7**	**20**
03	Module -III. [11L] Nonlinear Data structures Trees (7L): Basic terminologies, forest, tree representation (using array, using linked list). Binary trees - binary tree traversal (pre-, in-, post- order), threaded binary tree (left, right, full) - non-recursive traversal algorithms using threaded binary tree, expression tree. Binary search tree- operations (creation, insertion, deletion, searching). Height balanced binary tree – AVL tree (insertion, deletion with examples only). B- Trees – operations (insertion, deletion with examples only). Graphs (4L): Graph definitions and concepts (directed/undirected graph, weighted/un-weighted edges, sub-graph, degree, cutvertex/articulation point, pendant node, clique, complete graph, connected components – strongly connected component, weakly connected component, path, shortest path, isomorphism). Graph representations/storage implementations – adjacency matrix, adjacency list, adjacency multi-list. Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, forward-edge), applications. Minimal spanning tree – Prim's algorithm (basic idea of greedy methods).	**11**	**25**
04	Module - IV. Searching, Sorting (10L): Sorting Algorithms (5L): Bubble sort and its optimizations, insertion sort, shell sort, selection sort, merge sort, quick sort, heap sort (concept of max heap, application – priority queue), radix sort. Searching (2L): Sequential search, binary search, interpolation search. Hashing (3L): Hashing functions, collision resolution techniques.	**10**	**20**

	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

List of Practical:

- Implementation of array operations:
- Stacks and Queues: adding, deleting elements Circular Queue: Adding & deleting elements Merging Problem :
- Evaluation of expressions operations on Multiple stacks & queues :
- Implementation of linked lists: inserting, deleting, inverting a linked list. Implementation of stacks & queues using linked lists:
- Polynomial addition, Polynomial multiplication
- Sparse Matrices : Multiplication, addition.
- Recursive and Nonrecursive traversal of Trees
- Threaded binary tree traversal. AVL tree implementation
- Application of Trees. Application of sorting and searching algorithms
- Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
2/E by Robert L. Kruse, Bruce P. Leung.	"Data Structures And Program Design In C"		
Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed.	"Fundamentals of Data Structures of C"		
Aaron M. Tenenbaum.	"Data Structures in C"		
Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein.	"Introduction to Algorithms"		

Reference Books			
S. Lipschutz.	"Data Structures"		
Reema Thareja	"Data Structures Using C"		
2/e by A.K. Rath, A. K. Jagadev	"Data Structure Using C"		

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	**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.Sc in Data Science **Subject:** Introduction to Data Science	
Course Code: MITDS-103	**Semester: I**
Duration: 48 Hours	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory:**3**	End Semester Exam:**70**
Tutorial:**0**	Attendance: **5**
Practical:	Continuous Assessment:**25**
Credit: **3**	Practical Sessional internal continuous evaluation:**NA**
	Practical Sessional external examination:**NA**

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

4	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**

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.
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.	
2.	Computer with moderate configuration
3.	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	**1,2,3,4,5,6**	**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:

Name of the Course: M.Sc in Data Science **Subject: Data Visualisation**	
Course Code: MITDS-104 & MITDS-194	**Semester: I**
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.	
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	**Hrs./week**

Chapter	Name of the Topic	Hours	Marks
01	Introduction of visual perception, visual representation of data, Gestalt principles, information overloads.	**6**	**10**
02	Unsupervised LeCreating visual representations, visualization reference model, visual mapping, visual analytics, Design of visualization applications.	**6**	**15**
03	Classification of visualization systems, Interaction and visualization techniquesmisleading, Visualization of one, two and multi-dimensional data, text and text documents.	**6**	**15**
04	Visualization of groups, trees, graphs, clusters, networks, software, Metaphorical visualization	**6**	**15**
05	Visualization of volumetric data, vector fields, processes and simulations,Visualization of maps, geographic information, GIS systems, collaborative visualizations, Evaluating visualizations	**6**	**10**
06	Recent trends in various perception techniques, various visualization techniques, data structures used in data visualization.	**6**	**5**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**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.Sc in Data Science **Subject: Research Methodology and IPR**	
Course Code: MITDS-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		**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,	**6**	**14**

	interpretation, Necessary instrumentations.		
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	2nd Edition	

	beginners		
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.Sc in Data Science **Subject: Cloud Computing**	
Course Code: MITDS- 106A & MITDS- 196A	**Semester: I**
Duration: 36 Hours	**Maximum Marks: 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 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.			
1	**Networking**		
Contents		**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	**8**	**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 Standards and Protocols for Cloud Services, IAM Practices in the Cloud, Cloud Authorization Management	**8**	**15**
04	**Security Management in the Cloud** Security Management Standards, Security Management in the Cloud, Availability Management: SaaS, PaaS, IaaS	**8**	**15**

	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		
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	**4**	**8**
06	**ADVANCED TOPICS** Recent devlopments in hybrid cloud and cloud security.	**4**	**7**
	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**
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	Total	No of question	To	Marks per	Total

		to be set	Marks	to be set	answer	question	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.Sc in Data Science **Subject:** Pattern Recognition	
Course Code: MITDS- 106B & MITDS- 196B	**Semester:I**
Duration:36 Hrs.	**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.	Ability to Understand and apply both supervised and unsupervised classification methods to detect and characterize patterns in real-world data

Objective:	
Sl. No.	
1.	Understand the concept of a pattern and the basic approach to the development of pattern recognition and machine intelligence algorithms
2.	Understand the basic methods of feature extraction, feature evaluation, and data mining.

Pre-Requisite:	
Sl. No.	
1.	Fundamentals of Programming
2.	Mathematics

Contents		Hrs./week	
Chapter	Name of the Topic	Hours	Marks
01	**Introduction to pattern recognition :** Basic concepts- Definitions, data sets for Pattern Recognition, Structure of a typical pattern recognition system. Different Paradigms of Pattern Recognition. Representations of Patterns and Classes. Metric and non-metric proximity measures.	6	14
02	**Features selection** Feature vectors - Feature spaces - Different approaches to Feature Selection-Branch and Bound Schemes. Sequential Feature Selection.	6	14
03	**Features extraction** Principal Component Analysis (PCA), Kernel PCA	6	14
04	**Pattern classification** Pattern classification using Statistical classifiers - Bayes' classifier - Classification performance measures – Risk and error probabilities. Linear Discriminant Function, Mahalanobis Distance, K-NN Classifier, Fisher's LDA, Single Layer Perceptron, Multi-layer Perceptron, Training set, test set; standardization and normalization	12	14
05	**Clustering** Basics of Clustering; similarity / dissimilarity measures; clustering criteria. Different distance functions and similarity measures. K-means algorithm, K-medoids, DBSCAN	6	14
	Sub Total:	**36**	**70**

	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**
	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**
Sheldon M Ross	Introduction to Probability and Statistics for Engineers and Scientists		Elsevier Academic Press
B. Lubanovic	Introducing Python		O'Reilly
Reference Books			
Murray R. Spiegel, Larry J. Stephens	Schaum's Outlines on Statistics		McGraw-Hill
Eric Matthes	Python Crash Course		No Starch Press
Ivan Idris	Numpy Beginner's Guide		Packt Publishing

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	**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.Sc in Data Science

Subject: Internet of Things

Course Code: MITDS- 106C & MITDS- 196C	**Semester:I**
Duration:36 Hrs.	**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.	Able to realize the revolution of Internet in Mobile Devices, Cloud & Sensor Networks
2	Able to understand the application areas of IOT

3	Able to understand building blocks of Internet of Things and characteristics		
Objective:			
Sl. No.			
1.	To Understand the vision of IoT from a global context.		
2	To Determine the Market perspective of IoT.		
3	To Use of Devices, Gateways and Data Management in IoT.		
4	To Application of IoT in Industrial and Commercial Building Automation and Real World Design Constraints.		
5	To Building state of the art architecture in IoT.		
Pre-Requisite:			
Sl. No.			
1.	Fundamentals of Programming		
2.	Mathematics		
3	Digital Electronics		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	INTRODUCTION TO IoT Introduction to IoT - Definition and Characteristics, Physical Design Things- Protocols, Logical Design- Functional Blocks, Communication Models- Communication APIs- Introduction to measure the physical quantities, IoT Enabling Technologies - Wireless Sensor Networks, Cloud Computing Big Data Analytics, Communication Protocols- Embedded System- IoT Levels and Deployment Templates.	7	12
02	**IoT PROGRAMMING** Introduction to Smart Systems using IoT - IoT Design Methodology- IoT Boards (Rasberry Pi, Arduino) and IDE - Case Study: Weather Monitoring- Logical Design using Python, Data types & Data Structures- Control Flow, Functions- Modules- Packages, File Handling - Date/Time Operations, Classes- Python Packages of Interest for IoT.	8	12
03	**IoT APPLICATIONS** Home Automation – Smart Cities- Environment, Energy- Retail, Logistics- Agriculture, Industry- Health and Lifestyle- IoT and M2M.	7	12
04	**NETWORK OF WIRELESS SENSOR NODES** Sensing and Sensors - Wireless Sensor Networks,	7	12

	Challenges and Constraints - Applications: Structural Health Monitoring, Traffic Control, Health Care - Node Architecture - Operating system.		
06	**MAC, ROUTING AND TRANSPORT CONTROL IN WSN** Introduction – Fundamentals of MAC Protocols – MAC protocols for WSN – Sensor MAC Case Study – Routing Challenges and Design Issues – Routing Strategies – Transport Control Protocols – Transport Protocol Design Issues – Performance of Transport Protocols	7	10
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**
	Total:	**52**	**100**

Practical:

List of Practical:

1. Introduction to ICs and Sensors. A basic program can be shown which makes use of logic gates ICs for understanding the basics of sensor nodes. Different sensors which find application in IoT projects can be shown, their working explained.

2. Introduction to Arduino/Raspberry Pi. Sample sketches or code can be selected from the Arduino software and executed, making use of different sensors.

1. Use of sensors to detect the temperature/humidity in a room and having appropriate actions performed such as changing the LED color and turning the speaker on as an alarm and using serial monitor to see these values.

3. A basic parking system making use of multiple IR sensors, Ultrasonic Sensors, LED bulbs, Speakers etc, to identify if a slot is empty or full and using the LED and speakers to alert the user about the availability.

4. An Agricultural System (Greenhouse System) that makes use of sensors like humidity, temperature etc, to identify the current situation of the agricultural area and taking necessary measures such as activating the water spraying motor, the alarm system (to indicate if there is excess heat) etc.

5. Create a basic sound system by making use of knobs, speakers, LED bulbs etc., to mimic the sound produced by a race car, ambulance, siren etc.

1. A basic obstacle avoiding robot by making use of Ultrasonic sensors, dc motors, and the chassis kit for robotic car.

6. Making use of GSM for communication in the obstacle avoiding robot. Using sensors such as flame sensors, PIR human motion sensor, IR sensor, LED bulbs etc for better inputs regarding the environment.

7. A garbage level indicator which makes use of IR proximity sensors, WiFi modules etc to detect the rising amount of garbage and sending data to a server and channelling that data to the owner of the module. Can be introduced as the application IoT. If needed, IoT introduction can be done much earlier and the sharing of data can be shown, for better functionality of later projects.

8. Elderly care: We want to monitor very senior citizens whether they had a sudden fall. If a very senior citizen falls suddenly while walking, due to stroke or slippery ground etc, a notification should be sent out so that he/she can get immediate medical attention.

9. Smart street lights: The street lights should increase or decrease their intensity based on the actual requirements of the amount of light needed at that time of the day. This will save a lot of energy for the municipal corporation.

10. Implement 3-bit Binary Counter using 3 LED Module.

Glow RED if the Binary bit is '0'. Glow GREEN if the binary bit is '1'
For example:
i. 000 = 0 (all LED should be RED)
ii. 001 = 1 (Two LEDs Should be RED , and one LED should be GREEN)
iii. If Button is pressed in between, Reset the counter and Re-start from 0.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Yasuura, H., Kyung, C.-M., Liu, Y., Lin, Y.-L.	Smart Sensors at the IoT Frontier		Springer International Publishing
ArshdeepBahga and Vijay Madisetti	Internet of Things: Hands-on Approach,		Hyderabad University Press, 2015.
KazemSohraby, Daniel Minoli and TaiebZnati	Wireless Sensor Networks: Technology. Protocols and Application		Wiley Publications, 2010.
Reference Books			
Kyung, C.-M., Yasuura, H., Liu, Y., Lin, Y.-L.	Smart Sensors and Systems		Springer International Publishing
Edgar Callaway	Wireless Sensor Networks: Architecture and Protocols		Auerbach Publications, 2003.
Holger Karl and Andreas Willig	Protocols and Architectures for Wireless Sensor Networks		John Wiley & Sons Inc., 2005
Carlos De MoraisCordeiro and Dharma PrakashAgrawal	Ad Hoc and Sensor Networks: Theory and Applications		World Scientific Publishing, 2011

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

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.Sc in Data Science **Subject:** Computer Vision	
Course Code: MITDS- 106D & MITDS- 196D	**Semester:** I
Duration: 36 Hrs.	**Maximum Marks:** 200
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 Study the image formation models and feature extraction for computer vision Identify the segmentation and motion detection and estimation techniques

Objective:	
Sl. No.	
1.	ToDevelop small applications and detect the objects in various applications
Pre-Requisite:	
Sl. No.	
1.	Should have knowledge of one Programming Language (Java preferably), Practice of SQL (queries and sub queries), exposure to Linux Environment

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Image Formation Models** Monocular imaging system ,Orthographic & Perspective Projection Camera model and Camera calibration,Binocular imaging systems, Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3-D reconstruction framework; Auto-calibration. Apparel, Stereo vision	**6**	**14**
02	**Feature Extraction** Image representations (continuous and discrete) ,Edge detection, Edge linking, corner detection, texture, binary shape analysis, boundary pattern analysis, circle and ellipse detection, Light at Surfaces; Phong Model; Reflectance Map; Albedo estimation; Photometric Stereo; Use of Surface Smoothness Constraint; Shape from Texture, color, motion and edges.	**6**	**14**
03	**Shape Representation and Segmentation** Deformable curves and surfaces , Snakes and active contours , Level set representations Fourier and wavelet descriptors , Medial representations , Multi-resolution analysis, Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation	**6**	**14**
04	**Motion Detection and Estimation** Regularization theory ,Optical computation , Stereo Vision ,Motion estimation, Background Subtraction and Modelling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo; Motion parameter estimation •,Structure from motion, Motion Tracking in Video	**6**	**14**
05	**Object Recognition** Hough transforms and other simple object recognition methods,Shape correspondence and shape matching ,	**6**	**10**

	Principal component analysis ,Shape priors for recognition		
06	**Applications of Computer Vision** Automated Visual Inspection, Inspection of Cereal Grains, Surveillance, In-Vehicle Vision Systems, CBIR, CBVR, Activity Recognition, computational photography, Biometrics	**6**	**4**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

List of Practical:

1. Based on theory lectures.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
D. Forsyth and J. Ponce	Computer Vision		

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**

M.Sc, Sem- II

Name of the Course: M.Sc in Data Science **Subject: Big Data Analytics**	
Course Code: MITDS- 201 & MITDS- 201	**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		**Hrs./week**	
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.	**6**	**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, sharding and replication, consistency, relaxing consistency, version stamps, map-reduce, partitioning and combining, composing map-reduce calculations.	**6**	**10**
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	**6**	**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	**6**	**15**

05	**Hbase** Hbase, data model and implementations, Hbase clients, Hbase examples, praxis.Cassandra, Cassandra data model, Cassandra examples, Cassandra clients, Hadoop integration.	**6**	**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:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**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

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	**1,2,3,4,5,6**			**5**	**3**	**5**	**60**
C	**1,2,3,4,5**			**5**	**3**	**15**	

	.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.Sc in Data Science **Subject: Machine learning**	
Course Code: MITDS-202 & MITDS-292	**Semester: II**
Duration:36 hours	**Maximum Marks:200**

Teaching Scheme	**Examination Scheme**
Theory:3	End Semester Exam:70
Tutorial:0	End Semester Exam:70
Practical:4	Attendance : 5
Credit:3+2	Continuous Assessment: 25
	Practical Sessional internal continuous evaluation:40
	Practical Sessional external examination:60

Aim:

Sl. No.	
1.	Extract features that can be used for a particular machine learning approach in various AI 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.
3.	To mathematically analyse various machine learning approaches and paradigms.

Objective:

Sl. No.	
1.	To learn the concept of how to learn patterns and concepts from data without being explicitly programmed in various 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.	To explore Deep learning technique and various feature extraction strategies.

Pre-Requisite:

Sl. No.	
1.	Algorithm and Data Structure

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

		s	
01	Supervised Learning (Regression/Classification) Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Nave Bayes ● Linear models: Linear Regression, Logistic Regression, Generalized Linear Models ● Support Vector Machines, Nonlinearity and Kernel Methods ● Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	8	10
02	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)	8	14
03	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	6	14
04	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	4	10
05	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	14
06	Recent trends classification applications.in various methods for learning techniques applications of machine learning.	5	8
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

List of Practical

Based on Theory

Assignments: Based on Theory

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, 2012
Trevor Hastie, Robert Tibshirani, Jerome Friedman,	The Elements of Statistical Learning,		Springer 2009 (freely available online)
Reference Books:			
3.Christopher Bishop,	Pattern Recognition and Machine Learning,		Springer, 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	**ALL**	**10**	**10**	**5**	**3**	**15**	**70**
B	**ALL**			**5**	**3**	**45**	
C							

- 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.Sc in Data Science

Subject: Data Preparation and Analysis

Course Code:MITDS-203 & MITDS-293	**Semester:II**
Duration:36 Hrs.	**Maximum Marks:200**
Teaching Scheme	**Examination Scheme**
Theory:3	**EndSemester 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.	Ability to read and understand execution, and write programs in Python
2.	Skill to source and export data from different sources
3.	Ability to manipulate data for analysis and modelling

Objective:

Sl. No.	
1	To develop executable Python code
2.	To systematically import and manipulate raw data
3.	To analyse and process data for modelling

Pre-Requisite:

Sl. No.	
1.	Higher-secondary Statistics

Contents		Hrs./week	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Python Programming Language**	6	10
02	**Data Gathering and Preparation:** Data formats, parsing and transformation, Scalability and real-time issues	6	12
03	**Data Cleaning:** Consistency checking, Heterogeneous and missing data, Data Transformation and segmentation	6	12
04	**Exploratory Analysis:** Descriptive and comparative statistics, Clustering and association, Hypothesis generation	6	11
05	**Visualization:** Designing visualizations, Time series, Geolocated data, Correlations and connections, Hierarchies and networks, interactivity	6	15
06	**Dimensionality reduction**	6	10
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

Skills to be developed:

1. Python programming skills
2. Data import/export skills
3. Data cleaning skills
4. Data manipulation skills
5. Data interpretation skills

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

1. Ask a user to input a number in n. Write a Python program to print a dictionary where the keys are numbers between 1 and 15 (both included) and the values are square of keys. Use for loop to judiciously automate the code.
2. Write a Python program to create two dictionaries and print a third dictionary by taking the union of their keys.
3. Write a Python program to create a .csv file in your systems. Read the file with the csv package.Read files delimited by tab, colon, semicolon or any other standard delimiters.
4. Write a Python program to write a csv file using for loop to store the marks you had obtained in the B.Tech semesters. Ask the user for input.
5. Write a Python program to create a pandas Series with the departments in your college.Create a pandas Dataframe to fit in the above Series along with the names of the respective HODs and the overall student strength and the names of the CRs.
6. Write a Python program to import a .csv file using pandasdataframe.List out the column names and datatypes.Sort the dataframe created in question 3 using the marks obtained in Mathematics.
7. Write a Python program to create a pandas DataFrame with the marks obtained by you and your friends in 5 different subjects. Specify the names of the subjects as column headings and the indices as the roll numbers.Arrange the columns in an order of your choice for both of the dataframes.
8. Write a Python program to create a .csv file to store the following table:
   Movie Name, Year, Country, Genre, Director, Lead Actor, Revenue, Average Rating
9. Write a Python program to find out the mean revenue generated by the movies of the UK listed under .csv created in Assignment 8. Normalize the “Revenue” and the “Average Rating” column. One-hot encode the “Country” column.

Assignments (based on theory class):

1. Explain the DIKW pyramid.
2. Write a csv file using for loop to store the marks you had obtained in the B.Tech semesters. Ask the user for input. Read the csv file into a dictionary.
3. Create a pandas DataFrame with the marks obtained by you and your friends in 5 different subjects. Specify the names of the subjects as column headings and the indices as the roll numbers. Sort the dataframe created using the marks obtained in Mathematics.
4. Explain the Standardization, Normalization and Binarization with the help of an example.
5. Apply PCA to derive the new dataset from:

Age 44 27 30 38 40 35 48 50

Salary 72000 48000 54000 61000 58000 52000 79000 83000

6. Construct regular expressions to generate the following set of strings:
    a) Matches a string beginning with 'Where' and ending in a '?'.
    b) Matches any number in between 259 – 959
    c) Matches an email address where the username can contain letters, numbers and characters or only letters and numbers or only letters and characters but not only numbers and characters.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
B. Lubanovic	Introducing Python		O'Reilly
Sheldon M Ross	Introduction to Probability and Statistics for Engineers and Scientists		Elsevier Academic Press
Reference Books:			
W McKinney	Python for Data Analysis		O'Reilly
Brockwell and Davis	Introduction to Time Series and Forecasting		Springer
G James, D Witten, T Hastie, R Tibshirani	An Introduction to Statistical Learning		Springer
AGeron	Hands-on Machine Learning with Scikit-Learn and Tensorflow		O'Reilly

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

2.	Software : Python

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		10	10				
B				5	3	15	70
C				5	3	45	

- 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.Sc in Data Science **Subject:** Optimization Techniques	
Course Code: MITDS-204A	**Semester: II**
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:**NA**
	Practical Sessional external examination:**NA**

Aim:	
Sl. No.	
1	Introduction to optimization techniques using both linear and non-linear programming. The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization too. After an adequate introduction to linear algebra and probability theory, students will learn to frame engineering minima maxima problems in the framework of optimization problems.

Objective:	
Sl. No.	
1	Cast engineering minima/maxima problems into optimization framework.
2	Learn efficient computational procedures to solve optimization problems.

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

Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Mathematical preliminaries Linear algebra and matrices Vector space, eigen analysis	**6**	**10**

	Elements of probability theory Elementary multivariable calculus		
02	Linear Programming Simplex method Introduction to linear programming model Duality Karmarkar's method	**10**	**15**
03	Unconstrained optimization Conjugate direction and quasi-Newton methods Gradient-based methods One-dimensional search methods	**8**	**15**
04	Constrained Optimization Lagrange theorem FONC, SONC, and SOSC conditions	**6**	**20**
05	Projection methods KKT conditions Non-linear constrained optimization models Non-linear problems	**6**	**10**
	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**
Edwin P K Chong, Stainslaw Zak	An introduction to Optimization		

Reference Books

Dimitri Bertsekas	Nonlinear Programming		

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.

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.Sc in Data Science **Subject:** Social Media Analytics			
Course Code: MITDS-204B		**Semester: II**	
Duration: 36Hours		**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**	
Objective:			
Sl. No.			
1	Familiarize the learners with the concept of social media analytics and understand its significance.		
2	Familiarize the learners with the tools of social media analytics.		
3	Enable the learners to develop skills required for analyzing the effectiveness of social media for business purposes		
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 Social Media Analytics (SMA): Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas Network fundamentals and models: The social networks	**9**	**15**

	perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization		
02	Making connections: Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing. Natural Language Processing Techniques for Micro-text Analysis	**9**	**15**
03	Facebook Analytics: Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction. (Websites)	**9**	**20**
04	Processing and Visualizing Data, Influence Maximization, Link Prediction, Collective Classification, Applications in Advertising and Game Analytics Introduction to Python Programming, Collecting and analyzing social media data; visualization and exploration	**9**	**20**
	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**
Matthew Ganis, Avinash Kohirkar	Social Media Analytics: Techniques and Insights for Extracting Business Value Out of		Social Media Pearson 2016

Jim Sterne	Social Media Metrics: How to Measure and Optimize Your Marketing Investment		Wiley, Latest edition
Reference Books			
Oliver Blanchard	Social Media ROI: Managing and Measuring Social		Que Publishing Latest edition Media Efforts in Your Organization (Que Biz-Tech)
Marshall Sponder	Social Media Analytics		McGraw Hill
Tracy L. Tuten, Michael R. Solomon	Social Media Marketing		Sage

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**				
	1,2,3,4						
B				**5**	**3**	**5**	
	1,2,3,4						**60**
C				**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.Sc in Data Science **Subject:** Advanced Data Mining	
Course Code: MITDS- 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	This course titled, "Advanced Data Mining," involves learning a collection of techniques for extracting and discovering new patterns and trends in large amounts of data. This course will also provide a hands-on introduction to the Advanced Data Mining concepts with an emphasis on features useful to Engineering, Business and Management.

Objective:			
Sl. No.			
1	To explain the fundamental issues involved in the use of the training/test methodology, cross-validation and the bootstrap to provide accuracy assessments.		
2	To demonstrate accurate and efficient use of classification and related data mining techniques, using Python Programming for the computations.		
3	To demonstrate capacity for mathematical reasoning through analyzing, proving and explaining concepts from the theory that underpins clustering and related data mining methods.		
4	To Understand and explain ideas of source and target sample, and their relevance to the practical application relevance to the society of proximity based and clustering methods and other data mining techniques.		
5	To design data mining solutions to analyze real-world data sets.		
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** A multidimensional Data Model, Data preprocessing, Data cleaning, Data integration and Transformation, Correlation analysis and Data Reduction Data Objects and Attribute Types, Basic Statistical Descriptions of Data, Data Visualization, Data Matrix versus Dissimilarity Matrix, Proximity Measures for Nominal Attributes, Binary Attributes, Numeric Data, Ordinal Attributes,Dissimilarity for Attributes of Mixed Types.	**6**	**10**
02	**Pattern Mining** Mining Frequent Patterns-basic concepts-apriori principle, Pattern Mining in Multilevel, Multidimensional Space,	**7**	**10**

	Constraint-Based Frequent Pattern Mining, Mining High-Dimensional Data and Colossal Patterns.		
03	**Classification Methods** Bayesian Belief Networks, Classification by Backpropagation, Support Vector Machines, kNearest-Neighbour Classifiers, Genetic Algorithms, Rough Set Approach, Fuzzy Set, Model Evaluation and Selection, Approaches, Techniques to Improve Classification Accuracy.	**8**	**15**
04	**Cluster Analysis** k-Means: A Centroid-Based Technique, k-Medoids, Hierarchical Methods, Probabilistic Model-Based Clustering, Clustering High-Dimensional Data, Clustering Graph and Network Data, Evaluation of Clustering.	**8**	**20**
05	**Outlier Detection** Proximity-Based Methods, and Clustering-Based Methods, Outlier Detection in HighDimensional Data. Case Study: Data Mining Applications: Recommender Systems, Intrusion Detection and Prevention and Financial Data Analysis.	**7**	**15**
	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**
Pang-Ning Tan, Michael Steinbach, Vipin Kumar	Introduction to Data Mining		Pearson, First Edition, 2014.

Reference Books

Mohammed J.Zaki,	Data Mining and Analysis:		First Edition, Cambridge

Wagneermeira	Fundamental concepts and algorithms		University Press India, 2015.
Ian H. Witten, &Eibe Frank,	Data Mining – Practical Machine Learning Tools and Techniques		3rd Edition, Elesvier, 2011.

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**

Name of the Course:M.Sc in Data Science

Subject: Time Series Analysis and Forecasting Techniques	
Course Code: MITDS- 204D	**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**

Objective:

Sl. No.	
1	Understand the fundamental advantage and necessity of forecasting in various situations.
2	Know how to choose an appropriate forecasting method in a particular environment.
3	Know how to apply various forecasting methods, which includes obtaining the relevant data and carrying out the necessary computation (running suitable statistical software, if necessary).
4	Improve forecast with better statistical models based on statistical analysis

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	Stochastic process and its main characteristics Stochastic process. Time series as a discrete stochastic process. Stationarity. Main characteristics of stochastic processes (means, autocovariation and autocorrelation functions). Stationary stochastic processes. Stationarity as	**6**	**5**

	the main characteristic of stochastic component of time series. Wold decomposition. Lag operator.		
02	Autoregressive-moving average models ARMA (p,q) Moving average models MA(q). Condition of invertability. Autoregressive models AR(p). Yull-Worker equations. Stationarity conditions. Autoregressive-moving average models ARMA (p,q).	**6**	**10**
03	Coefficient estimation in ARMA (p,q) processes. Box-Jenkins' approach Coefficients estimation in autoregressive models. Coefficient estimation in ARMA (p) processes. Quality of adjustment of time series models. AIC information criterion. BIC information criterion. "Portmonto"-statistics. Box-Jenkins methodology to identification of stationary time series models.	**6**	**15**
04	Forecasting in the framework of Box-Jenkins model Forecasting, trend and seasonality in Box-Jenkins model. Non-stationary time series Non-stationary time series. Time series with non-stationary variance. Non-stationary mean. ARIMA (p,d,q) models. The use of Box-Jenkins methodology to determination of order of integration.	**6**	**20**
05	The unit root problem The unit root problem. Spurious trends and regressions. Unit root tests (Dickey-Fuller). ADF test and the choice of the number of lags. Other unit root tests. Unit root and structure changes Non-stationary time series, TSP or DSP: methodology of research. Segmented trends and structure changes.	**6**	**10**
06	Regressive dynamic models Regressive dynamic models. Autoregressive models with distributed lags (ADL). Vector auto regression model and co-integration Time series co-integration. Co-integration regression. Testing of co-integration. Vector auto regression and co-integration. Co-integration and error correction model.	**6**	**10**

	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**
Enders W.	Applied Econometric Time Series. John		Wiley & Sons, Inc., 1995
Mills, T.C.	The Econometric Modelling of Financial Time Series.		Cambridge University Press, 1999
Andrew C. Harvey	Time Series Models		Harvester wheatsheaf, 1993.
Reference Books			
Andrew C. Harvey	The Econometric Analysis of Time Series		Philip Allan, 1990.
Banerjee, A., J.J. Dolado, and D.V. Hendry	Co-Integration, Error Correction, and Econometric Analysis of Non-Stationary Data.		Oxford University Press, 1993
P. J. Brockwell, R. A. Davis	Introduction to Time Series and Forecasting		Springer, 1996

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 **B** **C**	**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.Sc in Data Science **Subject:** Deep Learning	
Course Code: MITDS– 301	**Semester:** III
Duration: 36 Hrs.	**Maximum Marks:** 200
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 Convolutional Neural Networks
2	To learnNeural networks

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), VariationalAutoencoders, Adversarial Generative Networks, Autoencoder and DBM Attention and memory models, Dynamic memory networks	6	14

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-ofWords 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

Practical:

Skills to be developed:

List of Practical:

1. Based on theory lectures.

List of Books

Text Books:

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

			Publisher
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.Sc in Data Science **Subject: Business Analytics**	
Course Code: MITCNS-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 colleborative 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		
Reference Books:			
Paul Newbold, William L. Carlson,	Statistics for Business and	6th edition	Pearson Education

Betty Thorne	economics		
Keller Gerald	Statistics for Management and Economics",	1oth edition	Cengage 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.Sc in Data Science

Subject: Industrial Safety

Course Code: MITCNS-302C	**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 recognize and evaluate occupational safety and health hazards in the workplace, and to determine appropriate hazard controls following the hierarchy of controls.
2.	To analyze the effects of workplace exposures, injuries and illnesses, fatalities and the methods to prevent incidents using the hierarchy of controls, effective safety and health management systems and task-oriented training.
3.	To understand the basic safety terms.
4.	To Identify the hazards around the work environment and industries.
5.	To Use the safe measures while performing work in and around the work area of the available laboratories.

Objective:			
Sl. No.			
1	The primary **objective** of workplace **safety** is preventing workplace injuries, illnesses and fatalities. Employers develop detailed plans that provide guidance in the event of an accident, fire, natural disaster or other emergency.		
Pre-Requisite:			
Sl. No.			
Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Industrial safety** Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	**10**	**15**
02	**Fundamentals of maintenance engineering** Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.	**10**	**15**
03	**Wear and Corrosion and their prevention** Wear and Corrosion and their prevention: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition,principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.	**10**	**15**
04	**Fault tracing** Fault tracing-concept and importance, decision treeconcept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic,automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.	**8**	**10**
05	**Periodic and preventive maintenance** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating	**10**	**15**

	(DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance		
	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**
Higgins & Morrow	Maintenance Engineering Handbook		
Reference Books:			
L M Deshmukh	Industrial Safety and Management	ISBN-13: 978-0-07-061768-1, ISBN-10: 0-07-061768-6	McGraw Hill Education (India) private Limited
S.Rao, R K Jain and Saluja	Electrical Safety, fire safety and safety management	ISBN: 978-81-7409-306-6	Khanna Publishers

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.

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.Sc in Data Science **Subject: Operations Research**	
Course Code: MITCNS-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.	To use quantitive methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.
2.	To understand the mathematical tools that are needed to solve optimisation problems. Use mathematical software to solve the proposed models
3.	To understand the mathematical tools that are needed to solve optimisation problems. Use mathematical software to solve the proposed models

Objective:	
Sl. No.	
1	To apply the dynamic programming to solve problems of discreet and continuous variables.
2	To apply the concept of non-linear programming
3	To model the real world problem and simulate it.

Pre-Requisite:	
Sl. No.	
	Basic courses in Calculus, Discrete Mathematics

Contents		**3 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Optimization Techniques, Model Formulation, models, General L.R Formulation, Simplex Techniques, Sensitivity Analysis, Inventory Control Models	**8**	**10**
02	Formulation of a LPP - Graphical solution revised simplex method - duality theory - dual simplex method - sensitivity analysis - parametric programming	**10**	**15**
03	Nonlinear programming problem - Kuhn-Tucker conditions min cost flow problem - max flow problem - CPM/PERT	**10**	**15**
04	Scheduling and sequencing - single server and multiple server models - deterministic inventory models - Probabilistic inventory control models - Geometric Programming.	**10**	**15**
05	Competitive Models, Single and Multi-channel Problems, Sequencing Models, Dynamic Programming, Flow in Networks, Elementary Graph Theory, Game Theory Simulation	**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**
H.A. Taha	Operations Research,		

	An Introduction		
Reference Books:			
Harvey M Wagner	Principles of Operations Research		

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.

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.Sc in Data Science **Subject: Cost Management of Engineering Projects**	
Course Code: MITCNS-302E	**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

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
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

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.Sc in Data Science **Subject: Composite Materials**	
Course Code: MITCNS-302F	**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.Sc in Data Science **Subject: Waste to Energy**	
Course Code: MITCNS-302	**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.			
1	To understand technologies for generation of energy from solid waste		
2	To compare methods of solid waste disposal		
3	To identify sources of energy from bio-chemical conversion		
4	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 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	**10**	**15**

	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**
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

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.Sc in Data Science	
Subject: Dissertation-I /Industrial Project	
Course Code: MITCNS-393	**Semester: III**

Duration: 6 Months	**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.Sc in Data Science **Subject: Dissertation II**	
Course Code: MITCNS-491	**Semester: IV**
Duration: 6 Months	**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