MAULANA ABUL KALAM AZAD UNIVERSITY OF TECHNOLOGY, WEST BENGAL
NH-12 (Old NH-34), Simhat, Haringhata, Nadia -741249

Department of Information Technology

B.Sc. in Information Technology (Data Science)

Effective from academic session 2020-21

Semester I							
Sl. No.	**CBCS Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
Theory + Practical							
1	CC-1	BITDSC101 BITDSC191	Programming Fundamentals	4	0	4	**6**
2	CC-2	BITDSC102	Discrete Structures	5	1	0	**6**
3	AECC-1	BITDSA101	Soft skill	2	0	0	**2**
4	GE-1	BITDSG101 BITDSG102 BITDSG103 BITDSG104	1. MOOCS Basket 1 2. MOOCS Basket 2 3. MOOCS Basket 3 4. MOOCS Basket 4	4 / 5	0 / 1	4 / 0	**6**
				Total Credit			**20**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Programming Fundamentals	
Course Code: BITDSC101 & BITDSC191	**Semester: I**
Duration: 36 Hrs.	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical: 4	**Continuous Assessment: 25**
Credit: 4 + 2	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60

Aim:	
Sl. No.	
1.	Implement your algorithms to build programs in the C programming language
2.	Use data structures like arrays, linked lists, and stacks to solve various problems
3.	Understand and use file handling in the C programming language
Objective:	
Sl. No.	
1.	To write efficient algorithms to solve various problems
2.	To understand and use various constructs of the programming language
3.	To apply such as conditionals, iteration, and recursion in programming

Pre-Requisite:			
Sl. No.			
1.	**Basic Knowledge of Computer System**		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to Computers** Computer Systems, Computing Environments, Computer Languages, Creating and Running Programs, Software Development, Flow charts. Number Systems: Binary, Octal, Decimal, Hexadecimal Introduction to C Language - Background, C Programs, Identifiers, Data Types, Variables, Constants, Input / Output Statements Arithmetic Operators and Expressions: Evaluating Expressions, Precedence and Associativity of Operators, Type Conversions.	**6**	**10**
02	**Conditional Control Statements** Bitwise Operators, Relational and Logical Operators, If, If- Else, Switch-Statement and Examples. Loop Control Statements: For, While, DoWhile and Examples. Continue, Break and Goto statements Functions: Function Basics, User-defined Functions, Inter Function Communication, Standard Functions, Methods of Parameter Passing. Recursion- Recursive Functions.. Storage Classes: Auto, Register, Static, Extern, Scope Rules, and Type Qualifiers.	**8**	**10**
03	**Preprocessors and Arrays** Preprocessor Commands Arrays - Concepts, Using Arrays in C, Inter-Function Communication, Array Applications, Two-Dimensional Arrays, Multidimensional Arrays, Linear and Binary Search, Selection and Bubble Sort.	**8**	**16**
04	**Pointers** Pointers for Inter-Function Communication, Pointers to Pointers, Compatibility, Lvalue and Rvalue, Arrays and Pointers, Pointer Arithmetic and Arrays, Passing an Array to a Function, Memory Allocation Functions, Array of Pointers, Programming Applications, Pointers to void, Pointers to Functions, Command Line Arguments. Strings - Concepts, C Strings, String Input/Output Functions, Arrays of Strings, String Manipulation Functions.	**8**	**16**
05	**Structures and File** Definition and Initialization of Structures, Accessing Structures, Nested Structures, Arrays of Structures, Structures and Functions, Pointers to Structures, Self-Referential Structures, Unions, Type Definition (typedef), Enumerated Types. Input and Output: Introduction to Files, Modes of Files, Streams, Standard Library Input/Output Functions, Character Input/Output Functions.	**6**	**18**

	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 ability to learn concepts and apply them to other problems. ...
2. Basic mathematical skills.
3. A passion for problem solving.
4. Confidence around a computer programming Language.

List of Practical: Sl. No. 1 to10 compulsory & at least three from the rest)

1. Write a c program to display the word "welcome".
2. Write a c program to take a variable int and input the value from the user and displayit.
3. Write a c program to add 2 numbers entered by the user and display theresult.
4. Write a c program to calculate the area and perimeter of acircle.
5. Write a C program to find maximum between two numbers.
6. Write a C program to check whether a number is divisible by 5 and 11 ornot.
7. Write a C program to input angles of a triangle and check whether triangle is valid ornot.
8. Write a C program to check whether a year is leap year or not.
9. Write a C program to input basic salary of an employee and calculate its Gross salary according to following:
   Basic Salary <= 10000 : HRA = 20%, DA = 80%
   Basic Salary <= 20000 : HRA = 25%, DA = 90%
   Basic Salary > 20000 : HRA = 30%, DA = 95%
10. Write a c program to print “welcome” 10 times.
11. Write a c program to print first n natural numbers using whileloop.
12. Write a c program to print all the odd numbers in a givenrange.
13. Write a c program to add first n numbers using while loop.
14. Write a c program to print all numbers divisible by 3 or 5 in a givenrange.
15. Write a c program to add even numbers in a given range.
16. Write a c program to find the factorial of a givennumber.

17. Write a c program to find whether a number is prime ornot.
18. Write a c program to print the reverse of a number.
19. Write a c program to add the digits of a number.
20. Write a c program to print the Fibonacci series in a given range usingrecursion.
21. Write a c program to check whether a number is an Armstrong number ornot.
22. Write a c program to find g.c.d. and l.c.m. of two numbers usingfunction.

Assignments:

1. Based on theory lectures.

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
YashavantKanetkar,	Let us C	13th Edition	BPB Publication
E. Balaguruswamy	Programming in ANSI C		Tata McGraw-Hill
Gary J. Bronson	A First Book of ANSI C	4th Edition	ACM
Reference Books:			
Byron Gottfried	Schaum's Outline of Programming with C		McGraw-Hill
Kenneth A. Reek	Pointers on C		Pearson
Brian W. Kernighan and Dennis M. Ritchie	The C Programming Language		Prentice Hall of India

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	1,2,3,4,5	10	10				
B	3, 4, 5			5	3	5	60
C	1,2,3,4,5			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 objectivequestions 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: B.Sc. in Information Technology (Data Science) **Subject:** Discrete Structures	
Course Code: BITDSC102	**Semester: I**
Duration: 48 Hrs	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: 70**
Tutorial:1	**Attendance: 5**
Practical:0	**Continuous Assessment: 25**
Credit:6	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Aim:

Sl. No.	
1.	The aim of this course is to introduce you with a new branch of mathematics which is discrete mathematics, the backbone of Computer Science.
2.	In order to be able to formulate what a computer system is supposed to do, or to prove that it does meet its specification, or to reason about its efficiency, one needs the precision of mathematical notation and techniques. The Discrete Mathematics course aims to provide this mathematical background.

Objective: Throughout the course, students will be expected to demonstrate their understandingof
Discrete Mathematics by being able to do each of the following

Sl. No.	
1.	Use mathematically correct terminology and notation.

2.	Construct correct direct and indirect proofs.
3.	Use division into cases in a proof.
4.	Use counterexamples.
5.	Apply logical reasoning to solve a variety of problems.
Pre-Requisite:	
Sl. No.	
1.	**Knowledge of basic algebra**
2.	**Ability to follow logical arguments.**

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Set Theory** Definition of Sets, Venn Diagrams, complements, Cartesian products, power sets, counting principle, cardinality and countability (Countable and Uncountable sets), proofs of some general identities on sets, pigeonhole principle. Relation: Definition, types of relation, composition of relations, domain and range of a relation, pictorial representation of relation, properties of relation, partial ordering relation. Function: Definition and types of function, composition of functions, recursively defined functions.	**10**	**14**
02	**Propositional logic** Proposition logic, basic logic, logical connectives, truth tables, tautologies, contradictions, normal forms (conjunctive and disjunctive), modus ponens and modus tollens, validity, predicate logic, universal and existential quantification. Notion of proof: proof by implication, converse, inverse, contrapositive, negation, and contradiction, direct proof, proof by using truth table, proof by counter example.	**10**	**14**
03	**Combinatorics** Mathematical induction, recursive mathematical definitions, basics of counting, permutations, combinations, inclusion-exclusion, recurrence relations (nth order recurrence relation with constant coefficients, Homogeneous recurrence relations, Inhomogeneous recurrence relation), generating function (closed form expression,	**10**	**14**

	properties of G.F., solution of recurrence relation using G.F, solution of combinatorial problem using G.F.)		
04	**Algebraic Structure** Binary composition and its properties definition of algebraic structure, Groyas Semi group, Monoid Groups, Abelian Group, properties of groups, Permutation Groups, Sub Group, Cyclic Group, Rings and Fields (definition and standard results).	**8**	**10**
05	**Graphs** Graph terminology, types of graph connected graphs, components of graph, Euler graph, Hamiltonian path and circuits, Graph coloring, Chromatic number. Tree: Definition, types of tree(rooted, binary), properties of trees, binary search tree, tree traversing (preorder, inorder, post order). Finite Automata: Basic concepts of Automation theory, Deterministic finite Automation (DFA), transition function, transition table, Non Deterministic Finite Automata (NDFA), Mealy and Moore Machine, Minimization of finite Automation.	**10**	**18**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Kenneth H. Rosen	Discrete Mathematics and its Applications		Tata Mc.Graw Hill
eymourLipschutz, M.Lipson	Discrete Mathematics		Tata Mc.Graw Hill
Reference Books:			
V. Krishnamurthy	Combinatorics:Theory and Applications		East-West Press
Kolman, Busby Ross	Discrete Mathematical Structures		Prentice Hall International

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

Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)		**Subjective Questions**			
		No of	Total	No of	To	Marks	Total Marks

		question to be set	Marks	question to be set	answer	per question	
A	**1 to 5**	**10**	**10**				
B	**1 to 5**			**5**	**3**	**5**	**60**
C	**1 to 5**			**5**	**3**	**15**	

- Only multiple choice type question (MCQ) with one correct answer are to be set in theobjective part.
- Specific instruction to the students to maintain the order in answering objectivequestions 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: B.Sc. in Information Technology (Data Science) **Subject:** Soft Skills	
Course Code: BITDSA101	**Semester: I**
Duration: 36 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 2	**End Semester Exam: 70**
Tutorial: 0	**Attendance: 5**
Practical: 2	**Continuous Assessment: 25**
Credit: 2	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Aim:

Sl. No.	
1.	Ability to read English with ability to read English with understanding and decipher paragraph patterns, writer techniques and conclusions
2.	Skill to develop the ability to write English correctly and master the mechanics of writing the use of correct punctuation marks and capital letter
3.	Ability to understand English when it is spoken in various contexts.

Objective:

Sl. No.	
1.	To enable the learner to communicate effectively and appropriately in real life situation

2.	Touse English effectively for study purpose across the curriculum		
3.	To use R,W,L,S and integrate the use of four language skills, Reading, writing , listening and speaking.		
4.	To revise and reinforce structures already learnt.		
Pre-Requisite:			
Sl. No.			
1.	Basic knowledge of English Language.		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Grammar** Correction of sentence, Vocabulary/word formation, Single word for a group of words, Fill in the blank, transformation of sentences, Structure of sentences – Active / Passive Voice – Direct / Indirect Narration.	**6**	**15**
02	**Essay Writing** Descriptive – Comparative – Argumentative – Thesis statement- Structure of opening / concluding paragraphs – Body of the essay.	**5**	**5**
03	**Reading Comprehension** Global – Contextual – Inferential – Select passages from recommended text.	**5**	**10**
04	**Business Correspondence** Letter Writing – Formal.Drafting.Biodata- Resume′- Curriculum Vitae.	**5**	**8**
05	**Report Writing** Structure, Types of report – Practice Writing.	**5**	**5**
06	**Communication skills** Public Speaking skills, Features of effective speech, verbal-nonverbal.	**5**	**15**
07	**Group discussion** Group discussion – principle – practice	**5**	**12**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

Skills to be developed:
Intellectual skills:
1. Skill of Grammar

2. Various writing skills
3. Skill of reading English text
4. Skill of effective written communication

Motor Skills:

1. Skill of using Correct body language while giving a presentation
2. Various non-verbal communication skills
3. Skill of using correct gestures and expressions while speaking publicly
4. Essential approach and attitude in Group Discussion or Viva

List of Practical:

1. Honing 'Listening Skill' and its sub skills through Language Lab Audio device.
2. Honing 'Speaking Skill' and its sub skills.
3. Helping them master Linguistic/Paralinguistic features (Pronunciation/Phonetics/Voice modulation/ Stress/ Intonation/ Pitch & Accent) of connected speech.
4. Honing 'Conversation Skill' using Language Lab Audio –Visual input, Conversational Practice Sessions (Face to Face / via Telephone, Mobile phone & Role Play Mode).
5. Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success.
6. GD Practice Sessions for helping them internalize basic Principles (turn- taking, creative intervention, by using correct body language, courtesies & other soft skills) of GD.
7. Honing 'Reading Skills' and its sub skills using Visual / Graphics/Diagrams /Chart Display/Technical/Non Technical Passages, Learning Global / Contextual / Inferential Comprehension.
8. Honing 'Writing Skill' and its sub skills by using Language Lab Audio –Visual input, Practice Sessions

Assignments:
Based on theory lectures.

List of Books
Text Books:

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

R.C. Sharma and K.Mohan	Business Correspondence and Report Writing		Tata McGraw Hill , New Delhi , 1994
.Gartside	Model Business Letters		Pitman , London , 1992
Reference Books:			
Mark MaCormack	Communication		
John Metchell	How to write reports		
S R Inthira&amp, V Saraswathi	Enrich your English – a) Communication skills b) Academic skills		CIEFL &amp, OUP
Longman	Longman Dictionary of Contemporary English/Oxford Advanced Learner's Dictionary of Current English		OUP , 1998
Maxwell Nurnberg and Rosenblum Morris	All About Words		General Book Depot, New Delhi , 1995
	A Text Book for English for Engineers &amp, Technologists		

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1.	Computer
2.	Audio Devices
3.	Visual Devices
4.	Language lab Devices and the dedicated 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	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 theobjective part.
- Specific instruction to the students to maintain the order in answering objectivequestions 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: B.Sc. in Information Technology (Data Science) **Subject:** MOOCS	
Course Code: BITDSG101/BITDSG102/BITDSG103/ BITDSG104	**Semester: I**
Duration: 36 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: NA**
Tutorial: 1	**Attendance: 0**
Practical: 0	**Continuous Assessment: 0**
Credit: 6	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA
Contents	
Students will select subjects from MOOCS Basket which is provided them.	

Semester II							
Sl. No.		**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
Theory + Practical							
1	CC-3	BITDSC201 BITDSC291	Data Structure and Algorithm with Python	4	0	4	**6**
2	CC-4	BITDSC202 BITDSC292	Operating System	4	0	4	**6**
3	AECC-2	BITDSA201	Environmental Science	2	0	0	**2**
4	GE-2	BITDSG201 BITDSG202 BITDSG203 BITDSG204	1. MOOCS Basket 1 2. MOOCS Basket 2 3. MOOCS Basket 3 4. MOOCS Basket 4	4/5	0/1	4/0	**6**
Sessional							
5	SEC-1	BITDSS281	Project and Entrepreneurship	0	0	4	**2**
						Total Credit	**22**

Name of the Course: BSc. in Information Technology (Data Science) **Subject:** Data Structure and Algorithm with Python	
Course Code: BITDSC201 & BITDSC201	**Semester: II**
Duration: 36 Hrs	**Maximum Marks:100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam:70**
Tutorial: 0	**Attendance: 5**
Practical: 4	**Continuous Assessment: 25**
Credit: 4+2	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60

Aim:	
Sl. No.	
1.	The point of this course is to give you a vibe for algorithms and data structures as a focal area of what it is to be a computer science student.
2.	You ought to know about the way that there are regularly a few calculations for some issue, and one calculation might be superior to another, or one calculation better in certain conditions and another better in others.
3.	You should have some idea of how to work out the efficiency of an algorithm.
4.	You will be able to use and design linked data structures
5.	You will learn why it is good programming style to hide the details of a data structure

	within an abstract data type.
6.	You should have some idea of how to implement various algorithm using python programming.
Objective:	
Sl. No.	
1.	To impart the basic concepts of data structures and algorithms.
2.	To understand concepts about searching and sorting techniques.
3.	To understand basic concepts about stacks,queues,lists,trees and graphs.
4.	To understanding about writing algorithms and step by step approach in solving problems with the help of fundamental data structures
Pre-Requisite:	
Sl. No.	
1.	**Basics of programming language.**
2.	**Logic building skills.**

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to Data Structure** Abstract Data Type.	**1**	**2**
02	**Arrays** 1D, 2D and Multi-dimensional Arrays, Sparse Matrices.Polynomial representation .	**3**	**4**
03	**Linked Lists** Singly, Doubly and Circular Lists, Normal and Circular representation of Self Organizing Lists, Skip Lists, Polynomial representation.	**4**	**7**
04	**Stacks** Implementing single / multiple stack/s in an Array, Prefix, Infix and Postfix expressions, Utility and conversion of these expressions from one to another, Applications of stack, Limitations of Array representation of stack.	**4**	**10**
05	**Queues** Array and Linked representation of Queue, Circular Queue, De-queue, Priority Queues.	**4**	**7**
06	**Recursion** Developing Recursive Definition of Simple Problems and their implementation, Advantages and Limitations of Recursion,	**4**	**5**

	Understanding what goes behind Recursion (Internal Stack Implementation)		
07	**Trees** Introduction to Tree as a data structure, Binary Trees (Insertion, Deletion, Recursive and Iterative Traversals of Binary Search Trees), Threaded Binary Trees (Insertion, Deletion, Traversals), Height-Balanced Trees (Various operations on AVL Trees).	**5**	**15**
08	**Searching and Sorting** Linear Search, Binary Search, Comparison of Linear and Binary Search, Selection Sort, Insertion Sort, Merge Sort, Quick sort, Shell Sort, Comparison of Sorting Techniques	**6**	**15**
09	**Hashing** Introduction to Hashing, Deleting from Hash Table, Efficiency of Rehash Methods, Hash Table Reordering, Resolving collision by Open Addressing, Coalesced Hashing, Separate Chaining, Dynamic and Extendible Hashing, Choosing a Hash Function, Perfect Hashing Function.	**5**	**5**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

Skills to be developed:

Intellectual skills:

1. Skill to analyze algorithms and to determine algorithm correctness and their time efficiency.
2. Knowledge of advanced abstract data type (ADT) and data structures and their implementations.
3. Ability to implement algorithms to perform various operations on datastructures.

List of Practical:

1. Implementation of array operations.
2. Stacks and Queues: adding, deleting elements .
3. Circular Queue: Adding & deleting elements
4. Merging Problem : Evaluation of expressions operations on Multiple stacks & queues
5. Implementation of linked lists: inserting, deleting, inverting a linked list.
6. Implementation of stacks & queues using linked lists:

7. Polynomial addition, Polynomial multiplication
8. Sparse Matrices : Multiplication, addition.
9. Recursive and Non Recursive traversal of Trees Threaded binary tree traversal.AVL tree implementation Application of Trees.
10. Application of sorting and searching algorithms Hash tables implementation: searching, inserting and deleting, searching & sorting techniques.

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Michael H. Goldwasser, Michael T. Goodrich, and Roberto Tamassia	**Data Structures and Algorithms in Python**	**1118476735, 9781118476734**	**John Wiley & Sons**
Rance D Necaise	**Data Structures and Algorithms Using Python**	**9788126562169**	**John Wiley & Sons**
Reference Books:			
Sartaj Sahni	**DataStructures, Algorithms and applications in C++**	**Second Edition**	**Universities Press**

List of equipment/apparatus for laboratory experiments:

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

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

Group	**Unit**	**Objective Questions** (MCQ only with the correct answer)		**Subjective Questions**			
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1 to 9**	**10**	**10**				

B	**1 to 9**			**5**	**3**	**5**	**60**
C	**1 to 9**			**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 objectivequestions 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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Operating System & Operating System Lab	
Course Code: BITDSC202 & BITDSC292	**Semester: II**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**
	Practical Sessional external examination:60

Aim:

Sl. No.	
1.	General understanding of structure of modern computers

2.	Purpose, structure and functions of operating systems
3.	Illustration of key OS aspects by example

Objective:	
Sl. No.	
1.	To learn the fundamentals of Operating Systems.
2.	To learn the mechanisms of OS to handle processes and threads and their communication
3.	To learn the mechanisms involved in memory management in contemporary OS
4.	To gain knowledge on distributed operating system concepts that includes architecture, Mutual exclusion algorithms, deadlock detection algorithms and agreement protocols
5.	To know the components and management aspects of concurrency management
6.	To learn programmatically to implement simple OS mechanisms

Pre-Requisite:	
Sl. No.	
1.	Strong programming skills (Knowledge of C)
2.	Computer architecture
3.	Elementary data structures and algorithms

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction** Concept of Operating Systems, Generations of Operating systems, Types of Operating Systems, OS Services, System Calls, Structure of an OS - Layered, Monolithic, Microkernel Operating Systems, Concept of Virtual Machine. Case study on UNIX and WINDOWS Operating System.	**3**	**5**
02	**Processes** Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching Thread: Definition, Various states, Benefits of threads, Types of threads, Concept of multithreads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time; Scheduling algorithms: Pre-emptive and Non pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.	**8**	**20**
03	**Inter-process Communication:** Critical Section, Race Conditions, Mutual Exclusion, Hardware	**4**	**5**

	Solution, Strict Alternation, Peterson's Solution, The Producer\ Consumer Problem, Semaphores, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader's & Writer Problem, Dinning Philosopher Problem etc.		
04	**Deadlocks** Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker's algorithm, Deadlock detection and Recovery.	**4**	**10**
05	**Memory Management** Basic concept, Logical and Physical address map, Memory allocation: Contiguous Memory allocation – Fixed and variable partition– Internal and External fragmentation and Compaction; Paging: Principle of operation – Page allocation – Hardware support for paging, Protection and sharing, Disadvantages of paging. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault , Working Set , Dirty page/Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU).	**8**	**10**
06	**I/O Hardware** I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, Device independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.	**6**	**10**
07	**Disk Management** Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C-SCAN, Disk reliability, Disk formatting, Boot-block, Bad blocks.	**3**	**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. Can be able to Identify the purpose of the analysis.
2. Can be considered a reliable source of information.
3. Can able to use a variety of techniques to extend the original idea.

List of Practical:
1. Basics of UNIX commands.
2. Shell programming
3. Implementation of CPU scheduling. a) Round Robin b) SJF c) FCFS d) Priority
4. Implement all file allocation strategies
5. Implement Semaphores
6. Implement Bankers algorithm for Dead Lock Avoidance
7. Implement an Algorithm for Dead Lock Detection
9. Implement the all page replacement algorithms a) FIFO b) LRU c) LFU 10. Implement Shared memory and IPC
10. Implement Paging Technique f memory management.
11. Implement Threading & Synchronization Applications

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
AviSilberschatz, Peter Galvin, Greg Gagne, Wiley Asia	Operating System Concepts Essentials	978-1-119-32091-3	
William Stallings	Operating Systems: Internals and Design Principles	5th Edition	Prentice Hall of India
Reference Books:			
Charles Crowley	Operating System: A Design-oriented Approach	1st Edition	Irwin Publishing
J. Nutt, Addison-Wesley	Operating Systems: A Modern Perspective	2nd Edition	
Maurice Bach	Design of the Unix Operating Systems	8th Edition	Prentice-Hall of India
Daniel P. Bovet, Marco Cesati	Understanding the Linux Kernel	3rd Edition	O'Reilly and Associates

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1.	**Computer**
2.	**Linux/Ubantu operating system**

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

Group	Unit	Objective Questions (MCQ only with the	Subjective Questions

		correct answer)					
		No of question to be set	Total Marks	No of question to be set	To answer	Marks per question	Total Marks
A	**1 to 7**	**10**	**10**				**60**
B	**1 to 7**			**5**	**3**	**5**	
C	**1 to 7**			**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 objectivequestions 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Environmental Science

Course Code: BITDSA201	**Semester: II**
Duration: 36 Hrs	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 2	**End Semester Exam: 70**
Tutorial:0	**Attendance: 5**
Practical:0	**Continuous Assessment: 25**
Credit: 2	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Aim:

Sl. No.	
1.	To enable critical thinking in relation to environmental affairs.

2.	Understanding about interdisciplinary nature of environmental issues		
3.	Independent research regarding environmental problems in form of project report		
Objective:			
Sl. No.			
1.	To create awareness about environmental issues.		
2.	To nurture the curiosity of students particularly in relation to natural environment.		
3.	To develop an attitude among students to actively participate in all the activities regarding environment protection		
4.	To develop an attitude among students to actively participate in all the activities regarding environment protection		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction** Basic ideas of environment, basic concepts, man, society &amp, environment, their interrelationship. Mathematics of population growth and associated problems, Importance of population study in environmental engineering, definition of resource, types of resource, renewable, non- renewable, potentially renewable, effect of excessive use vis-à-vis population growth, Sustainable Development. Materials balance: Steady state conservation system, steady state system with non-conservative pollutants, step function. Environmental degradation: Natural environmental Hazards like Flood, earthquake, Landslide-causes, effects and control/management, Anthropogenic degradation like Acid rain-cause, effects and control. Nature and scope of Environmental Science and Engineering.	**3**	**10**
02	**Ecology** Elements of ecology: System, open system, closed system, definition of ecology, species, population, community, definition of ecosystem- components types and function. Structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems, Mangrove ecosystem (special reference to Sundar ban), Food chain [definition and one example of each food chain], Food web. Biogeochemical Cycle- definition, significance, flow chart of different cycles with only elementary reaction [Oxygen, carbon, Nitrogen, Phosphate, Sulphur]. Biodiversity- types, importance, Endemic species, Biodiversity Hot-spot, Threats to biodiversity, Conservation of biodiversity.	**7**	**10**

03	**Air pollution and control** Atmospheric Composition: Troposphere, Stratosphere, Mesosphere, Thermosphere,Tropopause and Mesopause. Energy balance:Conductive and Convective heat transfer, radiation heat transfer, simple global temperature model [Earth as a black body, earth as albedo], Problems.Green house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food.Global warming and its consequence, Control of Global warming. Earth's heat budget. Lapse rate: Ambient lapse rate Adiabatic lapse rate, atmospheric stability, temperature inversion (radiation inversion). Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, effective stack height, smokestack plumes and Gaussian plume model. Definition of pollutants and contaminants, Primary and secondary pollutants: emission standard, criteria pollutant. Sources and effect of different air pollutants- Suspended particulate matter, oxides of carbon, oxides of nitrogen, oxides of sulphur, particulate, PAN. Smog, Photochemical smog and London smog. Depletion Ozone layer: CFC, destruction of ozone layer by CFC, impact of other green house gases, effect of ozone modification. Standards and control measures: Industrial, commercial and residential air quality standard, control measure (ESP. cyclone separator, bag house, catalytic converter, scrubber (ventury), Statement with brief reference).	**6**	**10**
04	**Water Pollution and Control** Hydrosphere, Hydrological cycle and Natural water. Pollutants of water, their origin and effects: Oxygen demanding wastes, pathogens, nutrients, Salts, thermal application, heavy metals, pesticides, volatile organic compounds. River/Lake/ground water pollution: River: DO, 5 day BOD test, Seeded BOD test, BOD reaction rate constants, Effect of oxygen demanding wastes on river[deoxygenation, reaeration], COD, Oil, Greases, pH. Lake: Eutrophication [Definition, source and effect]. Ground water: Aquifers, hydraulic gradient, ground water flow (Definition only) Standard and control: Waste water standard [BOD, COD, Oil, Grease], Water Treatment system [coagulation and flocculation, sedimentation and filtration, disinfection, hardness and alkalinity, softening] Wastewater treatment system, primary and secondary treatments [Trickling filters, rotating biological contractor, Activated sludge, sludge treatment, oxidation ponds] tertiary treatment definition. Water pollution due to the toxic elements and their biochemical effects: Lead, Mercury, Cadmium, and Arsenic.	**6**	**15**
05	**Land Pollution** Lithosphere, Internal structure of earth, rock and soil 1L Solid	**4**	**10**

	Waste: Municipal, industrial, commercial, agricultural, domestic, pathological and hazardous solid wastes, Recovery and disposal method- Open dumping, Land filling, incineration, composting, recycling. Solid waste management and control (hazardous and biomedical waste).		
06	**Pollution** Definition of noise, effect of noise pollution, noise classification [Transport noise, occupational noise, neighbourhood noise] Definition of noise frequency, noise pressure, noise intensity, noise threshold limit value, equivalent noise level,(18hr Index), Ldn. Noise pollution control.	**5**	**10**
07	**Environmental Management** Environmental impact assessment, Environmental Audit, Environmental laws and protection act of India, Different international environmental treaty/ agreement/ protocol.	**5**	**5**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
G. M.Masters,	Introduction to Environmental Engineering and Science		Prentice-Hall of India Pvt. Ltd., 1991
Reference Books:			
A. K. De	Environmental Chemistry		New Age International

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 to 5**	**10**	**10**				
B	**1 to 5**			**5**	**3**	**5**	**60**
C	**1 to 5**			**5**	**3**	**15**	

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

objective part.

- Specific instruction to the students to maintain the order in answering objectivequestions 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: **B.Sc. in Information Technology (Data Science)** **Subject:** MOOCS	
Course Code: BITDSG201/BITDSG202/BITDSG20/BITDSG204	**Semester: II**
Duration: Min 8 Weeks	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: NA**
Tutorial: 1	**Attendance: 0**
Practical:	**Continuous Assessment: 0**
Credit: 6	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA
Contents	
Students will select subjects from MOOCS Basket which is provided them.	

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Project and Entrepreneurship	
Course Code: BITDSS281	**Semester: II**
Duration: 48 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 0	**End Semester Exam: 100**
Tutorial: 0	**Attendance: 0**
Practical: 4	**Continuous Assessment: 0**
Credit: 2	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60
Contents	
Students will do projects on application areas of latest technologies and current topics of societal relevance.	

Semester III							
Sl. No.	**CBCS Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
Theory + Practical							
1	CC-5	BITDSC301 BITDSC391	Database Management System	4	0	4	**6**
2	CC-6	BITDSC302	Foundation of Data Science	5	1	0	**6**
3	CC-7	BITDSC303	Data Mining & Data Warehousing	5	1	0	**6**
4	GE-3	BITDSG301 BITDSG302 BITDSG303 BITDSG304	1. MOOCS Basket 1 2. MOOCS Basket 2 3. MOOCS Basket 3 4. MOOCS Basket 4	4 / 5	0 / 1	4 / 0	**6**
5	SEC-2	BITCSS381	Object Oriented Programming	1	0	4	**3**
						Total Credit	**27**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Database Management System & Database Management System Lab	
Course Code: BITDSC301 & BITDSC391	**Semester: III**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**
	Practical Sessional external examination:60

Aim:

Sl. No.	
1.	To store and transform data into information
2.	To organize the data in the form of table, schema and report forms
3.	To provide security of data

4.	Data is stored in either hierarchical form or a navigational form
Objective:	
Sl. No.	
1.	Understand the uses the database schema and need for normalization
2.	Experience with SQL
3.	Use different types of physical implementation of database
4.	Use database for concurrent use
Pre-Requisite:	
Sl. No.	
3.	Elementary knowledge about computers including some experience using UNIX or Windows
4.	Computer Programming & Utilization

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Database system architecture** Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML). Data models: Entity-relationship model, network model, relational and object oriented data models, integrity constraints, data manipulation operations.	**6**	**15**
02	**Relational query languages** Relational algebra, Tuple and domain relational calculus, SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL, ORACLE, DB2, SQL server. Relational database design: Domain and data dependency, Armstrong's axioms, Normal forms, Dependency preservation, Lossless design. Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms.	**12**	**25**
03	**Storage strategies** Indices, B-trees, hashing.	**6**	**10**
04	**Transaction processing** Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.	**8**	**15**
05	**Advanced topics** Object oriented and object relational databases, Logical databases, Web databases, Distributed databases, Data warehousing and data mining.	**4**	**5**

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

Practical:

Skills to be developed:

Intellectual skills:

1. Can be able to implement the plan .
2. Can be able to use a variety of techniques to extend the originalidea.
3. Can be able to analyze relevant data.
4. Can be considered valid by the fact of it.

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

1. Design a Database and create required tables. For e.g. Bank, College Database
2. Apply the constraints like Primary Key , Foreign key, NOT NULL to thetables.
3. Write a sql statement for implementing ALTER,UPDATE and DELETE
4. Write the queries to implement the joins
5. Write the query for implementing the following functions: MAX(),MIN(),AVG(),COUNT()
6. Write the query to implement the concept of Intergrity constrains
7. Write the query to create the views
8. Perform the queries for triggers
9. Perform the following operation for demonstrating the insertion , updation and deletion using the referential integrity constraints.
10. Write the query for creating the users and their role.

Assignments:

Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Abraham Silberschatz, Henry F. Korth, S. Sudarshan	Database System Concepts	6th Edition	McGraw-Hill
R. Elmasri and S. Navathe	Fundamentals of Database Systems	5th Edition	Pearson Education
Reference Books:			
J. D. Ullman	Principles of Database and Knowledge – Base Systems		Computer Science Press
Abiteboul, Richard Hull, Victor Vianu, Addison-Wesley	Foundations of Databases		

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1.	Computer/Laptop
2.	Oracle /Mysql

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 to 5**	**10**	**10**				**60**
B	**1 to 5**			**5**	**3**	**5**	
C	**1 to 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 answeringobjective 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Foundation of Data Science

Course Code: BITDSC302	**Semester: III**
Duration: 36	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: 70**
Tutorial: 1	**Attendance : 5**
Practical:0	**Continuous Assessment:25**
Credit: 6	**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: What is Data Science? Big Data and Data Science – Datafication - Current landscape of perspectives - Skill sets needed; Matrices - Matrices to represent relations between data, and necessary linear algebraic operations on matrices -		

	Approximately representing matrices by decompositions (SVD and PCA); Statistics: Descriptive Statistics: distributions and probability - Statistical Inference: Populations and samples - Statistical modeling - probability distributions - fitting a model - Hypothesis Testing - Intro to R/ Python.		
02	Data preprocessing: Data cleaning - data integration - Data Reduction Data Transformation and Data Discretization.Evaluation of classification methods – Confusion matrix, Students T-tests and ROC curves-Exploratory Data Analysis - Basic tools (plots, graphs and summary statistics) of EDA, Philosophy of EDA - The Data Science Process.		
03	Basic Machine Learning Algorithms: Association Rule mining - Linear Regression- Logistic Regression - Classifiers - k-Nearest Neighbors (k-NN), k-means -Decision tree - Naive Bayes- Ensemble Methods - Random Forest. Feature Generation and Feature Selection - Feature Selection algorithms - Filters; Wrappers; Decision Trees; Random Forests.		
04	Clustering: Choosing distance metrics - Different clustering approaches - hierarchical agglomerative clustering, k-means (Lloyd's algorithm), - DBSCAN - Relative merits of each method - clustering tendency and quality. Data Visualization: Basic principles, ideas and tools for data visualization.		
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.
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, 2014.
Jiawei Han, Micheline Kamber and Jian Pei	Data Mining: Concepts and Techniques		Third Edition. ISBN 0123814790, 2011
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)	

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 **B**	**1 to 5** **1 to 5**	**10**	**10**	**5**	**3**	**5**	**60**

C	**1 to 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 answeringobjective 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**	**3**	**3**

Examination Scheme for Practical Sessional examination:

Practical Internal Sessional Continuous Evaluation

Internal Examination:

Continuous evaluation			**40**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Data Mining & Data Warehousing	
Course Code: BITDSC303	**Semester: III**
Duration: 48	**Maximum Marks:100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: 70**
Tutorial: 1	**Attendance : 5**
Practical:0	**Continuous Assessment:25**
Credit: 6	**Practical Sessional internal continuous evaluation:NA**
	Practical Sessional external examination:NA

Aim:

Sl. No.	
1	Understand the functionality of the various data mining and data warehousing component
2	Appreciate the strengths and limitations of various data mining and data warehousing models

Objective:

Sl. No.	
1.	Be familiar with mathematical foundations of data mining tools..
2.	Understand and implement classical models and algorithms in data warehouses and data mining
3.	Characterize the kinds of patterns that can be discovered by association rule mining, classification and clustering.

4.	Master data mining techniques in various applications like social, scientific and environmental context.		
5.	Develop skill in selecting the appropriate data mining algorithm for solving practical problems.		
Pre-Requisite:			
Sl. No.			
1.	**Knowledge of DBMS**		
2.	**Analytical Knowledge**		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction to Data Warehousing; Data Mining: Mining frequent patterns, association and correlations; Sequential Pattern Mining concepts, primitives,scalable methods;	**8**	**10**
02	Classification and prediction; Cluster Analysis – Types of Data in Cluster Analysis, Partitioning methods, Hierarchical Methods; Transactional Patterns and other temporal based frequent patterns,	**8**	**10**
03	Mining Time series Data, Periodicity Analysis for time related sequence data, Trend analysis, Similarity search in Time-series analysis;	**8**	**10**
04	Mining Data Streams, Methodologies for stream data processing and stream data systems, Frequent pattern mining in stream data, Sequential Pattern Mining in Data Streams, Classification of dynamic data streams, Class Imbalance Problem; Graph Mining; Social Network Analysis;modulation for communication, filtering, feedback control systems.	**11**	**20**
05	Web Mining, Mining the web page layout structure, mining web link structure, mining multimedia data on the web, Automatic classification of web documents and web usage mining; Distributed Data Mining.	**9**	**10**
06	Recent trends in Distributed Warehousing and Data Mining, Class Imbalance Problem; Graph Mining; Social Network Analysis.	**4**	**10**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**

Practical:

Skills to be developed:

Intellectual skills:

1. Explain the analyzing techniques of various data
2. Describe different methodologies used in data mining and data warehousing
3. Compare different approaches of data ware housing and data mining with various technologies.
4. Can use a variety of techniques to extend the originalidea.

Assignments:

Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Paulraj Ponniah	Data Warehousing Fundamentals for IT Professionals		Wiley India
Alex Berson and Stephen J. Smith	Data Warehousing, Data Mining, & OLAP	Second Edition	Tata McGraw Hill Education
Reference Books:			
Ralph Kimball	Data warehouse Toolkit		Wiley India
Jiawei Han and M Kamber	Data Mining Concepts and Techniques	Second Edition	Elsevier Publication
G Dong and J Pei	Sequence Data Mining		Springer

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 to 6**	**10**	**10**				**60**
B	**1 to 6**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions should be given on top of the question paper.

Examination Scheme for end semester examination:

Group	**Chapter**	**Marks of each**	**Question to be**	**Question to be**

		question	set	answered
A	**All**	**1**	**10**	**10**
B	**All**	**5**	**5**	**3**
C	**All**	**15**	**3**	**3**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** MOOCS	
Course Code: BITDSG301/BITDSG302/BITDSG303/ BITDSG304	**Semester: III**
Duration: 36 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: NA**
Tutorial: 1	**Attendance: 0**
Practical:	**Continuous Assessment: 0**
Credit: 6	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA
Contents	
Students will select subjects from MOOCS Basket which is provided them.	

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Object-Oriented Programming	
Course Code: BITCSS381	**Semester: III**
Duration: 12	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 1	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**

	Practical Sessional external examination:60
Aim:	
Sl. No.	
1.	To understand Basic concepts of OOPs
2.	To Learn programming by class and object model
3.	Get knowledge Java programming
Objective:	
Sl. No.	
1.	To learn the fundamentals of Java programming such as data types, variables and arrays.
2.	To study the syntax and necessity of decision making and iterative statements.
3.	To create a class and invoke the methods.
4.	To instigate programming in overloading of methods.
5.	To emphasize the concept of packages.
6.	To learn the exception handling routines.
Pre-Requisite:	
Sl. No.	
1.	The fundamental point in learning programming
2.	Basic knowledge of algorithms and procedural programming

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction:**	**4**	**20**

	Why object orientation, History and development of object oriented programming language, concepts of object oriented programming language. Difference between OOP and other conventional programming – advantages and disadvantages. Data types, variables. Array, operators. String, I/O. Control statements. Object oriented design: Major and minor elements, class fundamentals. Declaring objects, instantiation of class, introducing methods. Constructing objects using constructor. Static variable, constants. Visibility modifiers.		
02	**Object Properties:** Introduction to basic features of a class (encapsulation, polymorphism etc) Data field encapsulation. Passing objects to methods. Array of objects, 'This' keyword Relationships among objects: aggregation, composition, dependency, links. Relationship among classes: association, aggregation. Meta class, meta object. Grouping constructs.	**4**	**25**
03	**Basic concepts of object oriented programming using Java:** Using objects as parameters, closure look at argument passing, returning objects. Introducing access control, Final keyword, garbage collection, Nested and inner classes. Class abstraction and encapsulation, Overloading of methods (overloading of constructor). Super class, subclasses, super keyword, inheritance, types, member access. Multilevel hierarchy, process of constructor calling in inheritance. Overriding methods, overriding vs. overloading, polymorphism. Abstract class, interface & comparison between abstract class and interface Packages, importing packages. Exception handling basics, types, using try &catch, throw, throws & finally. Threading, synchronization & priorities, thread class, creating thread. Basic applet programming. Life cycle.	**4**	**25**
	Sub Total:	**12**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**18**	**100**
Practical: **Skills to be developed:**			

Intellectual skills:

1. Students will be able to implement basic data structure and control statements in object oriented programming.
2. Student will be able to design class with its basic features.
3. Students can write programs using Java to implement OOP
4. Student will be able to design object oriented programs with the concept of object, class, abstraction, encapsulation, inheritance etc. to provide flexibility, modularity and re-usability in programming.
5. They can also be able to design Meta classes and grouping construct.

List of Practical:

1. Introduction to Java and JDK
2. Java Fundamentals - Data Types, Control Loops
3. Java Fundamentals - Wrapper Classes, Arrays
4. Classes and Objects 5 Inheritance
5. Abstract Class & Interface
6. File I/O and Exception Handling
7. Graphical User Interface (GUI) Programming with Java Swing
8. Applets
9. Java Threads

Assignments:

Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Rambaugh, James Michael, Blaha	Object Oriented Modelling and Design		Prentice Hall
Patrick Naughton, Herbert Schildt	The complete reference-Java2		TMH

Reference Books:

Sourav Sahay	”Object-Oriented		Oxford

	Programming with C++		
Blaha, Rumbaugh	Object-Oriented Modeling and Design with UML		Pearson Ed
. Ali Bahrami	Object Oriented System Development		Mc Graw Hill

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	**Computer**
2.	**JDK**

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 to 3**	**10**	**10**				**60**
B	**1 to 3**			**5**	**3**	**5**	
C	**1 to 3**			**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 objectivequestions 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**	**3**	**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		**40**		
Viva voce		**10**	**60**	

Semester IV							
Sl. No.	**CBCS Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
Theory + Practical							
1	CC-8	BITDSC401 BITDSC491	Computer Networks	4	0	4	**6**
2	CC-9	BITDSC402 BITDSC492	Software Engineering	4	0	4	**6**
3	CC-10	BITDSC403	Machine Learning for Data Science	5	1	0	**6**
4	GE-4	BITDSG401	1. MOOCS Basket 1 2. MOOCS Basket 2 3. MOOCS Basket 3 4. MOOCS Basket 4	4 / 5	0 / 1	4 / 0	**6**
Sessional							
6	SEC-3	BITDSS481	Minor Project and Entrepreneurship I	0	0	4	**4**
			Total Credit				**28**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Computer Networking & Computer Networking Lab			
Course Code: BITDSC401 & BITDSC491		**Semester: IV**	
Duration: 36 Hrs.		**Maximum Marks: 100+100**	
Teaching Scheme		**Examination Scheme**	
Theory: 4		**End Semester Exam: 70**	
Tutorial: 0		**Attendance : 5**	
Practical: 4		**Continuous Assessment: 25**	
Credit: 4 + 2		**Practical Sessional internal continuous evaluation: 40**	
		Practical Sessional external examination: 60	
Aim:			
Sl. No.			
1.	To gain Knowledge of uses and services of Computer Network		
2.	To enhance Ability to identify types and topologies of network.		
3.	To gain Understanding of analog and digital transmission of data.		
Objective:			
Sl. No.			
1.	To deliver comprehensive view of Computer Network.		
2.	To enable the students to understand the Network Architecture, Network type and topologies		
3.	To understand the design issues and working of each layer of OSI model.		
4.	To familiarize with the benefits and issues regarding Network Security.		
Pre-Requisite:			
Sl. No.			
1.	**Basic Knowledge of Computer System**		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction Introduction to communication systems, Data, signal and Transmission: Analog and Digital, Transmission modes, components, Transmission Impairments, Performance criteria of a communication system. Goals of computer Network, Networks: Classification,	**3**	**10**

	Components and Topology, categories of network [LAN, MAN,WAN];Internet: brief history, internet today; Protocols and standards; OSI and TCP/IP model.		
02	Data link layer: Types of errors, framing [character and bit stuffing], error detection & correction methods; Flow control; Protocols: Stop & wait ARQ	**6**	**10**
03	Medium access sub layer: Point to point protocol, FDDI, token bus, token ring; Reservation, polling, concentration; Multiple access protocols: ALOHA, CSMA,FDMA, TDMA, CDMA; Ethernet	**4**	**10**
04	Network layer: Internetworking & devices: Repeaters, Hubs, Bridges, Switches, Router, Gateway; Addressing : Internet address, classful address,Routing : techniques,static vs. dynamic routing ,Protocols: IP, IPV6	**6**	**10**
05	Transport layer: Process to process delivery; UDP; TCP; Congestion control algorithm: Leaky bucket algorithm, Token buc ket algorithm, Quality of services [Qos]	**6**	**10**
06	Application Layer DNS, SMTP, FTP, HTTP & WWW; Security: Cryptography [Public, Private Key based], Digital Signature, Firewalls [technology & applications]	**6**	**10**
07	Physical Layer: Overview of data[analog & digital], signal[analog &digital], transmission [analog & digital] & transmission media [guided & unguided]; Circuit switching: time division & space division switch, TDM bus; Telephone Network	**5**	**10**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:
List of Practical: Implementation of practicals are adhered to the theoretical curriculum.
Assignments:
Based on the curriculum as covered by subject teacher.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
B. A. Forouzan	Data Communications and Networking		TMH
A. S. Tanenbaum	Computer Networks		Pearson Education/PHI
W. Stallings	Data and Computer Communications		PHI/ Pearson Education

Reference Books:			

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1	Computer with moderate configuration
2	Network simulator package

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	1-7	10	10				
B	1-7			5	3	5	60
C	1-7			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 objectivequestions 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: B.Sc. in Information Technology (Data Science)	
Subject: Software Engineering & Software Engineering Lab	
Course Code: BITDSC402 &	**Semester: IV**

BITDSC492	
Duration: 36 Hrs.	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical: 4	**Continuous Assessment: 25**
Credit: 4 + 2	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60

Aim:

Sl. No.	
1.	Familiarization with the concept of software engineering and its relevance.
2.	Understanding of various methods or models for developing a software product.
3.	Ability to analyze existing system to gather requirements for proposed system
4.	Gain skill to design and develop software.

Objective:

Sl. No.	
1.	To introduce the students to a branch of study associated with the development of a software product.
2.	To gain basic knowledge about the pre-requisites for planning a software project.
3.	To learn how to design of software
4.	To enable the students to perform testing of a software

Pre-Requisite:

Sl. No.	
2.	**Basic Knowledge of Computer System**

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Overview of Computer Based Information System- TPS, OAS, MIS, DSS, KBS Development Life Cycles- SDLC and its phases Models Waterfall, Prototype, Spiral, Evolutionary Requirement Analysis and Specification, SRS System analysis- DFD, Data Modeling with ERD	**12**	**20**
02	Feasibility Analysis System design tools- data dictionary, structure chart, decision table, decision tree. Concept of User Interface, Essence of UML. CASE tool.	**7**	**15**
03	Testing- Test case, Test suit, Types of testing- unit testing, system testing, integration testing, acceptance testing Design methodologies: top down and bottom up approach, stub, driver, black box and white box testing.	**7**	**20**

04	ERP, MRP, CRM, Software maintenance SCM, concept of standards [ISO and CMM]	**10**	**15**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:

Assignments:

Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Igor Hawryszkiewycz	System analysis and design		PEARSON
V Rajaraman	Analysis and design of Information System		PHI
Ian Sommerville	Software Engineering		Addison-Wesley

Reference Books:

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer

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

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

Examination Scheme for end semester examination:

Group	Chapter	Marks of each	Question to be	Question to be

		question	set	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: B.Sc. in Information Technology (Data Science) **Subject:** Machine Learning for Data Science	
Course Code: BITDSC403	**Semester: IV**
Duration: 36	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: 70**
Tutorial:1	**Attendance : 5**
Practical:0	**Continuous Assessment:25**
Credit: 6	**Practical Sessional internal continuous evaluation:NA**
	Practical Sessional external examination:NA
Aim:	
Sl. No.	
1.	To learn R
2.	To introduce the basic concepts and techniques of Machine Learning
3.	To develop the skills in using recent machine learning software for solving practical problems
Objective:	
Sl. No.	
1	To expose to basic terms and terminologies of Machine Learning.
2	To study the various algorithms related to supervised and unsupervised learning.
3	To understand the different types of Machine Learning models and how to use them.
Pre-Requisite:	
Sl. No.	
1.	Strong programming skills (Knowledge of C)
2.	Data computational skill

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction To R** Introduction to mechanism for statistics, data analysis, and machine learning; Introduction of R Programming, How to install and run R, Use of R help files, R Sessions, R Objects Vectors, Attributes, Matrices, Array, Class, List, Data Frames etc. Operators in R. R Programming Structures, Control Statements, Loops, Repeat and Break, R-Function, RVector Function, Recursive Function in R. R Packages (Install and Use), Input/Output Features in R, Reading or Writing in File. Data Manipulation in R. Rearranging data, Random Number and Simulation, Statistical methods like min, max, median, mean, length R Programming Structures, Control Statements, Loops, Repeat and Break, R-Function, RVector Function, Recursive Function in R.	**3**	**5**
02	**Supervised Learning (Regression/Classification)** Basic methods: Distance-based methods, Nearest-Neighbours, Decision Trees, Naive Bayes. Linear models: Linear Regression, Logistic Regression, Generalized Linear Models Support Vector Machines, Nonlinearity and Kernel Methods Beyond Binary Classification: Multi-class/Structured Outputs, Ranking	**8**	**15**
03	**Unsupervised Learning** Clustering: K-means/Kernel K-means Dimensionality Reduction: PCA and kernel PCA Matrix Factorization and Matrix Completion Generative Models (mixture models and latent factor models)	**4**	**10**
04	Evaluating Machine Learning algorithms and Model Selection, Introduction to Statistical Learning Theory, Ensemble Methods (Boosting, Bagging, Random Forests)	**4**	**10**
05	Sparse Modeling and Estimation, Modeling Sequence/Time-Series Data, Deep Learning and Feature Representation Learning	**8**	**10**

06	Scalable Machine Learning (Online and Distributed Learning) A selection from some other advanced topics, e.g., Semi-supervised Learning, Active Learning, Reinforcement Learning, Inference in Graphical Models, Introduction to Bayesian Learning and Inference	**6**	**10**
07	Recent trends in various learning techniques of machine learning and classification methods	**3**	**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. Identify the purpose of the analysis.
2. To describe the relationship between factors of theanalysis.
3. Information can be useful, used to create new things to achieveobjective.
4. Can use a variety of techniques to extend the originalidea.

List of Practical:
1. Implement and demonstrate the FIND-S algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSVfile.
2. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithm to output a description of the set of all hypotheses consistent with the training examples.
3. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. 4. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.
5. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test datasets.
6. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.
7. Write a program to construct a Bayesian network considering medical data. Use this model to demonstrate the diagnosis of heart patients using standard Heart Disease Data Set. You can use Java/Python ML library classes/API.
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add Java/Python ML library classes/API in theprogram.
9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for thisproblem.

10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Joseph Adler	R in a Nutshell		Oreilly
Kevin Murphy	Machine Learning: A Probabilistic Perspective		MIT Press
Reference Books:			
Trevor Hastie, Robert Tibshirani, Jerome Friedman	The Elements of Statistical Learning		Springer
Christopher Bishop	Pattern Recognition and Machine Learning		Springer
Jared P. Lander	R for Everyone: Advanced Analytics and Graphics		Paperback

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	**Computer**
2.	**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 to 7**	**10**	**10**				**60**
B	**1 to 7**			**5**	**3**	**5**	
C	**1 to 7**			**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 objectivequestions 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**	**3**	**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			**40**	
Viva voce			**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** MOOCS	
Course Code: BITDSG401/BITDSG402/BITDSG403/ BITDSG404	**Semester: IV**
Duration: 36 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: NA**
Tutorial: 1	**Attendance: 0**
Practical: 0	**Continuous Assessment: 0**
Credit: 6	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA
Contents	
Students will select subjects from MOOCS Basket which is provided them.	

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Minor Project and Entrepreneurship I	
Course Code: BITDSS481	**Semester: IV**
Duration: 48 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 0	**End Semester Exam: 100**
Tutorial: 0	**Attendance: 0**
Practical: 4	**Continuous Assessment: 0**
Credit: 4	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60
Contents	
Students will do projects on application areas of latest technologies and current topics of societal relevance.	

Semester V							
Sl. No.	**CBCS Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
Theory + Practical							
1	CC-11	BITDSC501 BITDSC591	Internet of Things	4	0	4	**6**
2	CC-12	BITDSC502 BITDSC592	Artificial Intelligence	4	1	4	**6**
3	DSE-1	BITDSD501 BITDSD591	Elective-I	4	0	4	**6**
			A. Deep Learning				
			B. Descriptive Analytics				
			C. Real Time Analytics				
			D. Natural Language Processing				
4	DSE-2	BITDSD502	Elective-II	5	1	0	**6**
			A. Translational Bioinformatics				
			B. Information and Coding Theory				
			C. Predictive & Prognostic Analytics				
			D. Optimisation Techniques in Data Analysis				
Sessional							
5	SEC-4	BITDSS581	Industrial Training and Internship	0	0	0	**2**
			Total Credit				**26**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Internet of Things		
Course Code: BITDSC501 & BITDSC591		**Semester: V**
Duration: 36 Hours		**Maximum Marks: 100 + 100**
Teaching Scheme		**Examination Scheme**
Theory: 4		**End Semester Exam: 70**
Tutorial: 0		**Attendance : 5**
Practical: 4		**Continuous Assessment: 25**
Credit: 4 + 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.	8	15
02	**IoT & M2M** Machine to Machine, Difference between IoT and M2M, Software define Network **Challenges in IoT** Design challenges, Development challenges, Security challenges, Other challenges	8	15
03	**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.	12	25
04	**Domain specific applications of IoT** Home automation, Industry applications, Surveillance applications, Other IoT applications	8	15
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination		**30**
	Total:		**100**

Practical

List of Practical:

1. As compatible to theory syllabus.

Assignments:

Based on the curriculum as covered by subject teacher.

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	Total Marks	No of question to	To answer	Marks per question	Total Marks

		be set		be set			
A	1 to 5	10	10				
B	1 to 5			5	3	5	70
C	1 to 5			5	3	15	

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

Five No of Experiments			

External Examination: Examiner-

Signed Lab Note Book(for five experiments)	**5*2=10**	
On Spot Experiment(one for each group consisting 5 students)	**10**	
Viva voce	**5**	

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Artificial Intelligence & Artificial Intelligence Lab

Course Code: BITDSC502 & BITDSC592	**Semester: V**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**
	Practical Sessional external examination:60

Aim:

Sl. No.	

Objective:	
Sl. No.	
1.	To learn the difference between optimal reasoning Vs human like reasoning
2.	To understand the notions of state space representation, exhaustive search, heuristic search along with the time and space complexities
3.	To learn different knowledge representation techniques
4.	To understand the applications of AI: namely Game Playing, Theorem Proving, Expert Systems, Machine Learning and Natural Language Processing
Pre-Requisite:	
Sl. No.	
1.	
2.	

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	UNIT-I Introduction: What is AI? Foundations of AI, History of AI, Agents and environments, The nature of the Environment, Problem solving Agents, Problem Formulation, Search Strategies	**8**	**10**
02	UNIT-II Knowledge and Reasoning: Knowledge-based Agents, Representation, Reasoning and Logic, Prepositional logic, First-order logic, Using First-order logic, Inference in First-order logic, forward and Backward Chaining	**8**	**20**
03	UNIT-III Learning: Learning from observations, Forms of Learning, Inductive Learning, Learning decision trees, why learning works, Learning in Neural and Belief networks	**6**	**15**
04	UNIT-IV Practical Natural Language Processing: Practical applications, Efficient parsing, Scaling up the lexicon, Scaling up the Grammar, Ambiguity, Perception, Image formation, Image processing operations for Early vision, Speech recognition and Speech Synthesis	**6**	**15**

05	UNIT-V Robotics: Introduction, Tasks, parts, effectors, Sensors, Architectures, Configuration spaces, Navigation and motion planning, Introduction to AI based programming Tools	**8**	**10**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:
List of Practical: Hands-on experiments related to the course contents
Assignments:
Based on the curriculum as covered by subject teacher.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Stuart Russell, Peter Norvig	Artificial Intelligence: A Modern Approach		2nd Edition, Pearson Education, 2007
B. Yagna Narayana	Artificial Neural Networks		PHI
Reference Books:			
E.Rich and K.Knight (TMH).	Artificial Intelligence		2nd Edition
Simon Haykin	Neural Networks		PHI
Patterson PHI.	Artificial Intelligence and Expert Systems		

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	**Computer with high configuration**
2.	**Python / Matlab/R**

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 to 5**	**10**	**10**				**60**

B	**1 to 5**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Deep Learning

Course Code: BITDSD501A & BITDSD591A	**Semester: V**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60

Aim:

Sl. No.	
1.	To improve the performance of a Deep Learning model
2.	to the reduce the optimization function which could be divided based on the classification and the regression problems

Objective:

Sl. No.	

1	To acquire knowledge on the basics of neural networks.
2	To implement neural networks using computational tools for variety of problems.
3	To explore various deep learning algorithms.

Pre-Requisite:	
Sl. No.	
1	Calculus, Linear Algebra
2	Probability & Statistics
3	Ability to code in R/Python

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction** Various paradigms of earning problems, Perspectives and Issues in deep learning framework, review of fundamental learning techniques.	**3**	**5**
02	**Feed forward neural network** Artificial Neural Network, activation function, multi-layer neural network,cardinality, operations, and properties of fuzzy relations.	**6**	**10**
03	**Training Neural Network** Risk minimization, loss function, backpropagation, regularization, model selection, and optimization.	**6**	**15**
04	**Conditional Random Fields** Linear chain, partition function, Markov network, Belief propagation, Training CRFs, Hidden Markov Model, Entropy.	**9**	**15**
05	**Deep Learning** Deep Feed Forward network, regularizations, training deep models, dropouts, Convolutional Neural Network, Recurrent Neural Network, Deep Belief Network.	**6**	**15**
06	**Deep Learning research** Object recognition, sparse coding, computer vision, natural language	**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. Can be able to analyze relevant data.
2. Can be able to identify a solution for the problem.
3. Can be able to provide the basis for the analysis.

List of Practical:
Practical based on theory paper Deep Learning

Assignments:
Based on the curriculum as covered by subject teacher.
List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Goodfellow, I.,Bengio,Y., and Courville A.,	Deep Learning		MIT Press
Satish Kumar	Neural Networks: A Classroom Approach		Tata McGraw-Hill
Reference Books:			
Bishop, C. ,M.	Pattern Recognition and Machine Learning		Springer
Yegnanarayana, B.	Artificial Neural Networks		PHI Learning Pvt. Ltd
Golub, G.,H., and Van Loan,C.,F.	Matrix Computations		JHU Press
List of equipment/apparatus for laboratory experiments:			
Sl. No.			
3.	**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 to 6**	**10**	**10**				**60**
B	**1 to 6**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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	3	3

Examination Scheme for Practical Sessional examination:

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Descriptive Analytics & Descriptive Analytics Lab

Course Code: BITDSD501B & BITDSD591B	**Semester: V**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**
	Practical Sessional external examination:60

Aim:

Sl. No.	
1.	To interpretation of historical data to better understand.
2.	Make decision by obtain analysis of data.

Objective:

Sl. No.	
1	To understand the four measurement scales
2	To interpret the utilization of mean values to describe group results.
3	To identify the areas of strength and weakness in an organization.

Pre-Requisite:

Sl. No.	
1	Programming skills (Knowledge of R)
2	Elementary knowledge of data structures and algorithms

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to R Software** Basics and R as a Calculator. Calculation with Data Vectors. Built-in Commands and Missing Data Handling, Operation with Matrices. Introduction to descriptive statistics, Absolute Frequency, Relative Frequency, Frequency Distribution and Cumulative Distribution Function.	**8**	**15**
02	**Graphics and Plots, Bar Diagram** Subdivided Bar, Pie Diagrams, Histogram, Kernel Density and Stem - Leaf Plots. Central tendency of Data, Arithmetic Mean, Median, Quantiles, Mode, Geometric Mean and Harmonic Mean, Range, Interquartile Range and Quartile Deviation.	**10**	**20**
03	**Variation in Data** Absolute Deviation and Absolute Mean Deviation, Mean Squre Error, Variance and Standard Deviation, Coeffivient of Variation and Boxplots. Moments, Association of Variables, Raw and Central Moments. Sheppard's Correction, Absolute Moments and computation of moments, Skewness and Kurtosis.	**8**	**20**
04	**Association of Variables** Univariate and Bivariate Scatter Plots, Smooth Scatter Plots, Quantile and Three Dimensional Plots, Correlation Coefficient, Rank Correlation Coefficent, Measures of Association of Discrete and counting Variables, Least Squre Method	**10**	**15**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:
Skills to be developed:
Intellectual skills:
1. Can provide the basis for the analysis.
2. Can determine the cause of the problem.
3. Can improve the solution to the problem.

List of Practical:
Data exploration (histograms, bar chart, box plot, line graph, scatter plot)

Qualitative and Quantitative Data

Measure of Central Tendency (Mean, Median and Mode),

Measure of Positions (Quartiles, Deciles, Percentiles and Quantiles),

Measure of Dispersion (Range, Median, Absolute deviation about median, Variance and Standard deviation), Anscombe's quartet Other Measures: Quartile and Percentile, Interquartile Range

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
John Fox	An R Companion to Applied Regression	Second Edition	Sage Publications

Reference Books:

Phil Spector	Data Manipulation with R		Springer
John Fox	Applied Regression Analysis and Generalized Linear Models		Sage Publications
Robert A. Muenchen, Joseph Hilbe	R for Stata Users		Springer

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	Computer
2.	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 to 4**	**10**	**10**				**60**
B	**1 to 4**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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	3	3

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Real Time Analytics & Real Time Analytics Lab

Course Code: BITDSD501C & BITDSD591C	**Semester: V**
Duration: 36 Hrs	**Maximum Marks:100 + 100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam:70**
Tutorial: 0	**Attendance: 5**
Practical: 4	**Continuous Assessment: 25**
Credit: 6	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60

Aim:

Sl. No.	
1.	To be processed and analyzed as they arrive in real time
2.	Learn business case studies for big data analytics.
3.	It is important in situations where real-time processing and analysis can deliver important insights and yield business value

Objective:

Sl. No.	
1.	Understand the fundamentals of real time streaming data.
2.	Understand how to process real time data and store them.
3.	To visualize real time data

Pre-Requisite:

Sl. No.	
1.	Database Management Systems.
2.	Object Oriented Programming Through Java

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to Streaming Data** Source of streaming data, why streaming data is different, infrastructure and algorithms	**6**	**10**
02	**Designing Real-Time Streaming Architectures** Real time architecture components, features of a real time architecture, language of real time programming, real time architecture checklist, Maintaining distributed states, apache zookeeper	**10**	**20**
03	**Data Flow Management, processing and storing in Streaming Analysis** Distributed data flows, apache kafka, apache flume Distributed Processing Streaming Data, Strome, Samza, Consitent hashing, NoSQL and other technologies	**12**	**20**
04	**Analysis and Visualization** Delivering Streaming Metrics,Exact Aggregation and Delivery,Statistical Approximation of Streaming Data Approximating Streaming Data with Sketching Beyond Aggregation	**8**	**20**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:
Skills to be developed:
Intellectual skills:

1. Ability to implement algorithms to perform various operations on strome, smaza
2. Ability to process real time streaming data

List of Practical:
Hand on experiments based on theory paper

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Wily	Real time Analytics		Byron Ellis
Reference Books:			
Anand Rajaraman and Jeffrey David Ullman	Mining of Massive Datasets		CUP
Tom White	Hadoop: The Definitive Guide	Third Edition	O'reilly Media
Chris Eaton, Dirk DeRoos, Tom Deutsch, George Lapis, Paul Zikopoulos	Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data		McGrawHill Publishing
Pete Warden	Big Data Glossary		O'Reilly

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
3.	Computer with moderate configuration
4.	Linux os or VM
5.	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 to 4**	**10**	**10**				
B	**1 to 4**			**5**	**3**	**5**	**60**
C	**1 to 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 objectivequestions 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: B.Sc. in Information Technology (Data Science) **Subject:** Natural Language Processing & Natural Language Processing Lab			
Course Code: BITDSD501D & BITDSD591D		**Semester: V**	
Duration: 48		**Maximum Marks: 100+100**	
Teaching Scheme		**Examination Scheme**	
Theory: 4		**End Semester Exam: 70**	
Tutorial: 0		**Attendance : 5**	
Practical: 4		**Continuous Assessment:25**	
Credit: 4+2		**Practical Sessional internal continuous evaluation:40**	
		Practical Sessional external examination:60	
Aim:			
Sl. No.			
1.	Process the text data at syntactic and semantic level.		
2.	Extract the ¬key information from Text data.		
3.	Analyze the text content to provide predictions related to a specific domain using language models.		
Objective:			
Sl. No.			
1.	To get introduced to language processing technologies for processing the text data		
2.	To understand the role of Information Retrieval and Information Extraction in Text Analytics.		
3.	To acquire knowledge on text data analytics using language models.		
Pre-Requisite:			
Sl. No.			
1.	Programming Knowledge		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**

01	**Regular Expressions and Automata Recap-** Introduction to NLP, Regular Expression, Finite State Automata **Tokenization –** Word Tokenization, Normalization, Sentence Segmentation, Named Entity Recognition, Multi Word Extraction, Spell Checking – Bayesian Approach, Minimum Edit Distance **Morphology** – Inflectional and Derivational Morphology, Finite State Morphological Parsing, The Lexicon and Morphotactics, Morphological Parsing with Finite State Transducers, Orthographic Rules and Finite State Transducers, Porter Stemmer	**12**	**20**
02	**Language Modeling** Introduction to N-grams, Chain Rule, Smoothing – Add-One Smoothing, Witten-Bell Discounting; Backoff, Deleted Interpolation, N-grams for Spelling and Word Prediction, Evaluation of language models. **Hidden Markov Models and POS Tagging** Markov Chain, Hidden Markov Models, Forward Algorithm, Viterbi Algorithm, Part of Speech Tagging – Rule based and Machine Learning based approaches, Evaluation.	**12**	**20**
03	**Text Classification** Text Classification, Naïve Bayes' Text Classification, Evaluation, Sentiment Analysis – Opinion Mining and Emotion Analysis, Resources and Techniques. **Context Free Grammar** Context Free Grammar and Constituency, Some common CFG phenomena for English, Top-Down and Bottom-up parsing, Probabilistic Context Free Grammar, Dependency Parsing	**12**	**20**
04	**Computational Lexical Semantics** I ntroduction to Lexical Semantics – Homonymy, Polysemy, Synonymy, Thesaurus – WordNet, Computational Lexical Semantics – Thesaurus based and Distributional Word Similarity **Information Retrieval** Boolean Retrieval, Term-document incidence, The Inverted Index, Query Optimization, Phrase Queries, Ranked Retrieval – Term Frequency – Inverse Document Frequency based ranking, Zone Indexing, Query term proximity, Cosine ranking, Combining different features for ranking, Search Engine Evaluation, Relevance Feedback	**12**	**10**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**
List of Practical: Hand on experiments based on theory paper			

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Jurafsky and Martin,	Speech and Language Processing		Pearson Education
Manning and Schutze	Foundation of Statistical Natural Language Processing		MIT Press

Reference Books:

	Multilingual Natural Language Processing Applications from Theory to Practice		Bikel, Pearson
Matthew A. Russell	Mining the Social Web		O'Reilly

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 to 4**	**10**	**10**				**60**
B	**1 to 4**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**3**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Translational Bioinformatics			
Course Code: BITDSD502A		**Semester: V**	
Duration: 36		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 5		**End Semester Exam: 70**	
Tutorial: 1		**Attendance : 5**	
Practical:0		**Continuous Assessment:25**	
Credit: 6		**Practical Sessional internal continuous evaluation: NA**	
		Practical Sessional external examination: NA	
Aim:			
Sl. No.			
1.	To provide an elementary knowledge in Bioinformatics and Biological Information on the web.		
Objective:			
Sl. No.			
1.	To enable the students to understand scope of Bioinformatics		
2.	Understanding of popular bioinformatics database		
3.	Learn Fundamentals of Databases and Sequence alignment		
4.	Approaches to drug discovery using bioinformatics techniques		
Pre-Requisite:			
Sl. No.			
1	Programming Knowledge(such as C)		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction to bioinformatics • Biological databases, with main focus on DNA and protein sequences • Comparison and alignment of sequences, similarity-based searches in databases • Discovery of protein sequence motifs and sequence features; metabolic pathway data Genome browsers and sources of gene expression data; gene lists and the concept of enrichment Micro-RNAs and their targets; protein visualization	**8**	**10**
02	Phylogenetics	**8**	**20**

	Introduction to phylogenetics, and essentials of evolution as background Data types for phylogenetic analysis and parsimony Distance based methods, distance matrices, nucleotide substitution models Model based methods: maximum likelihood and Bayesian phylogenetics Auxiliary methods: bootstrapping, consensus trees, tree comparison Visualization of phylogenetic trees		
03	Structural bioinformatics Basics of protein structures and structure determination. Simple validation of models by Ramachandran plots. Basic use of molecular graphics software. Molecular graphics: illustrating and highlighting molecular details on screen and print; generating molecular surfaces. Comparison of structures: overlaying molecules and measuring their structural similarity Molecular animations Theory of protein modeling and protein dynamics Validation and analysis of models and project work.	**6**	**15**
04	Biological data analysis with R Introduction to R: Installation, package management, basic operations Sequences and sequence analysis Annotating gene groups: Ontologies, pathways, enrichment analysis Proteomics: mass spectometry Reconstructing gene regulation networks Network analysis: iGraph	**6**	**10**

05	High-throughput data analysis with R Flow cytometry: counting and sorting stained cells Next-generation sequencing: introduction and genomic applications Quantitative transcriptomics: qRT-PCR Advanced transcriptomics: gene expression microarrays Next-generation sequencing in transcriptomics: RNA-seq experiments Analysis of transcription factor binding	**8**	**15**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:
Skills to be developed:
Intellectual skills:
Students will be able to:
Explore bioinformatics from computing perspective.
Apply data mining techniques to provide better health care services.
Explore and extract hidden information from bio informatics databases.

List of Practical: Hands-on experiments related to the course contents
Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Robert Gentleman	R Programming for Bioinformatics		CRC Press
Reference Books:			
Arthur M. Lesk	Introduction to bioinformatics	978-0199651566	Oxford University Press

Sunil Mathur	Statistical Bioinformatics with R	9780123751041	Elesevier

List of equipment/apparatus for laboratory experiments:

Sl. No.	
1.	**Computer**
2.	

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 to 5**	**10**	**10**				**60**
B	**1 to 5**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Information and Coding Theory		
Course Code: BITDSD502B	**Semester: V**	
Duration: 48	**Maximum Marks: 100**	
Teaching Scheme	**Examination Scheme**	
Theory: 5	**End Semester Exam: 70**	
Tutorial: 1	**Attendance : 5**	
Practical:0	**Continuous Assessment:25**	
Credit: 6	**Practical Sessional internal continuous evaluation: NA**	
	Practical Sessional external examination: NA	

Aim:	
Sl. No.	
1.	The aim of this course is to provide a basic understanding of the nature of information, the effects of noise in analogue and digital transmission systems and the construction of both source codes and error-detection/-correction codes.
Objective:	
Sl. No.	
1	To equip students with the basic understanding of the fundamental concept of source coding, error correction and information as they are used in communications.
2	To enhance knowledge of probabilities, entropy and measures of information.
3	To guide the student through the implications and consequences of information theory and coding theory with reference to the application in modern communication and computer systems.
Pre-Requisite:	
Sl. No.	
1	Strong mathematical knowledge on probability and abstract algebra.
2	And the ability to understand new mathematical concepts as needed.

Contents		**4 Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Source Coding:** Uncertainty and information, average mutual information and entropy, information measures for continuous random variables, source coding theorem, Huffman codes.	**7**	**10**
02	**Channel Capacity And Coding:** Channel models, channel capacity, channel coding, information capacity theorem, The Shannon limit.	**12**	**20**

03	**Linear And Block Codes For Error Correction:** Matrix description of linear block codes, equivalent codes, parity check matrix, decoding of a linear block code, perfect codes, Hamming codes.	**12**	**20**
04	**Cyclic Codes:** Polynomials, division algorithm for polynomials, a method for generating cyclic codes, matrix description of cyclic codes, Golay codes. BCH Codes Primitive elements, minimal polynomials, generator polynomials in terms of minimal polynomials, examples of BCH codes.	**7**	**10**
05	**Convolutional Codes** Tree codes, trellis codes, polynomial description of convolutional codes, distance notions for convolutional codes, the generating function, matrix representation of convolutional codes, decoding of convolutional codes, distance and performance bounds for convolutional codes, examples of convolutional codes, Turbo codes, Turbo decoding.	**10**	**10**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.
List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Ranjan Bose	Information theory, coding and cryptography		TMH
N Abramson	Information and Coding		McGraw Hil
Reference Books:			
M Mansurpur	Introduction to Information Theory		McGraw Hill
R B Ash	Information Theory		Prentice Hall.

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 to 5**	**10**	**10**				**60**
B	**1 to 5**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**3**

Name of the Course: B.Sc. in Information Technology (Data Science)	
Subject: Predictive & Prognostic Analytics	
Course Code: BITDSD502C	**Semester: V**
Duration: 36	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: 70**
Tutorial: 1	**Attendance : 5**
Practical:0	**Continuous Assessment:25**
Credit: 6	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Aim:	
Sl. No.	
1.	Understand the process of formulating business objectives, data selection/collection, preparation and process to successfully design, build, evaluate and implement predictive models for a various business application.
2.	Compare the underlying predictive modeling techniques.
3.	Select appropriate predictive modeling approaches to identify cases to progress with.
4.	Apply predictive modeling approaches using a suitable package such as SPSS Modeler
Objective:	
Sl. No.	

1	To learn, how to develop models to predict categorical and continuous outcomes, using such techniques as neural networks, decision trees, logistic regression, support vector machines and Bayesian network models.
2	To know the use of the binary classifier and numeric predictor nodes to automate model selection.
3	To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

Pre-Requisite:	
Sl. No.	
1	**Analytical skill**

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Introduction to Data Mining Introduction, what is Data Mining? Concepts of Data mining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on various kinds of data, Applications of Data Mining, Challenges of Data Mining.	**8**	**10**
02	Data Understanding and Preparation Introduction, Reading data from various sources, Data visualization, Distributions and summary statistics, Relationships among variables, Extent of Missing Data. Segmentation, Outlier detection, Automated Data Preparation, Combining data files, Aggregate Data, Duplicate Removal, Sampling DATA, Data Caching, Partitioning data, Missing Values.	**8**	**20**
03	Model development & techniques Data Partitioning, Model selection, Model Development Techniques, Neural networks, Decision trees, Logistic regression, Discriminant analysis, Support vector machine, Bayesian Networks, Linear Regression, Cox Regression, Association rules.	**10**	**20**
04	Model Evaluation and Deployment Introduction, Model Validation, Rule Induction Using CHAID, Automating Models for Categorical and Continuous targets, Comparing and Combining Models, Evaluation Charts for Model Comparison, MetaLevel Modeling, Deploying Model, Assessing Model Performance, Updating a Model.	**10**	**20**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.
List of Books
Text Books:

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

			Publisher
	Predictive & Advanced Analytics		IBM
Reference Books:			
Eric Siegel	Predictive Analytics		
List of equipment/apparatus for laboratory experiments:			
Sl. No.			
1.	Computer		
2.	Software R/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	**1 to 4**	**10**	**10**				**60**
B	**1 to 4**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Optimisation Techniques in Data Analysis			
Course Code: BITDSD502D		**Semester:V**	
Duration: 48		**Maximum Marks: 100**	
Teaching Scheme		**Examination Scheme**	
Theory: 5		**End Semester Exam: 70**	
Tutorial: 1		**Attendance : 5**	
Practical:0		**Continuous Assessment:25**	
Credit: 6		**Practical Sessional internal continuous evaluation:NA**	
		Practical Sessional external examination:NA	
Aim:			
Sl. No.			
1.	The aim of this course is to provide a basic understanding of the Optimisation Techniques		
Objective:			
Sl. No.			
1	To impart knowledge in concepts and tools of Operations Research		
2	To understand mathematical models used in Operations Research		
3	To apply these techniques constructively to make effective business decisions		
Pre-Requisite:			
Sl. No.			
1	Strong mathematical background.		
2	And the ability to understand new mathematical concept as needed.		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to Operation Research:** Operation Research approach, scientific methods, introduction to models and modeling techniques, general methods for Operation Research models, methodology and advantages of Operation Research, history of Operation Research.	**3**	**5**
02	**Linear Programming (LP):** Introduction to LP and formulation of Linear Programming problems, Graphical solution method, alternative or multiple optimal solutions, Unbounded solutions, Infeasible solutions, Maximization – Simplex Algorithm, Minimization – Simplex Algorithm using Big-M method, Two phase method, Duality in linear programming, Integer linear programming.	**8**	**10**
03	**Transportation & Assignment Problems:** Introduction to Transportation problems, various methods of Transportation	**7**	**10**

	problem, Variations in Transportation problem, introduction to Assignment problems, variations in Assignment problems.		
04	**Network Analysis:** Network definition and Network diagram, probability in PERT analysis, project time cost trade off, introduction to resource smoothing and allocation.	**7**	**10**
05	**Sequencing:** Introduction, processing N jobs through two machines, processing N jobs through three machines, processing N jobs through m machines.	**4**	**5**
06	**Inventory Model:** Introduction to inventory control, deterministic inventory model, EOQ model with quantity discount.	**4**	**5**
07	**Queuing Models:** Concepts relating to queuing systems, basic elements of queuing model, role of Poison & exponential distribution, concepts of birth and death process.	**7**	**10**
08	**Replacement & Maintenance Models:** Replacement of items, subject to deterioration of items subject to random failure group vs. individual replacement policies.	**4**	**5**
09	**Simulation:** Introduction & steps of simulation method, distribution functions and random number generation.	**4**	**10**
	Sub Total:	**48**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**52**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
J K Sharma	Operations Research Theory and Applications		MacMillan India Ltd
N D Vohra	Quantitative Techniques in management		Tata McGraw Hill
Reference Books:			
Handy A Taha	Operations Research – An Introduction		Prentice Hall of India, New Delhi.
Wagner H M	Principles of Operations Research: With Applications to Management Decisions		Prentice-Hall of India, New Delhi.
Hillier F S and	Operations Research		Holden Day Inc., San

Lieberman G J			Francisco
Payne T A	Quantitative Techniques for Management: A Practical Approach		Reston Publishing Co. Inc., Virginia.

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 to 9**	**10**	**10**				**60**
B	**1 to 9**			**5**	**3**	**5**	
C	**1 to 9**			**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 objectivequestions 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**	**3**	**3**

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Industrial Training and Internship

Course Code: BITDSS581	**Semester: V**
Duration: 0	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 0	**End Semester Exam: 100**
Tutorial: 0	**Attendance: 0**
Practical: 0	**Continuous Assessment: 0**
Credit: 2	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA

Contents

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

Semester VI							
Sl. No.	**CBCS Category**	**Course Code**	**Course Name**	**L**	**T**	**P**	**Credits**
Theory							
1	CC-13	BITDSC601 BITDSC691	Cloud Computing	4	0	4	**6**
2	CC-14	BITDSC602 BITDSC692	Computer Vision & Image Processing	4	0	4	**6**
3	DSE-4	BITDSD601	Elective-III [MOOCS]				
			A. Machine Learning for Financial Modelling and Forecasting	5	1	0	**6**
			B. Machine Learning for Industrial Application				
			C. Big Data Analytics(Hadoop)				
Sessional							
4	SEC-5	BITCSS681	Grand Viva	0	0	2	**1**
5	SEC-6	BITCSS682	Seminar	0	2	0	**2**
6	DSE-5	BITCSD683	Major Project & Entrepreneurship II	0	0	8	**4**
						Total Credit	25

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Cloud Computing & Cloud Computing Lab	
Course Code: BITDSC601 & BITDSC691	**Semester: VI**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 1	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**
	Practical Sessional external examination:60
Aim: The main aim of this subject to enhance student knowledge with following concept	
Sl. No.	
1.	Core concepts of the cloud computing
2.	Concepts in cloud infrastructures
3.	Concepts of cloud storage

4.	Cloud programming models		
Objective:			
Sl. No.			
1.	To learn how to use Cloud Services.		
2.	To implement Virtualization		
3.	To implement Task Scheduling algorithms.		
4.	Understand the impact of engineering on legal and societal issues involved and different security aspect.		
Pre-Requisite:			
Sl. No.			
1.	Knowledge of computer systems, programming and debugging, with a strong competency in at least one language (such as Java/Python), and the ability to pick up other languages as needed.		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Definition of Cloud Computing and its Basics** Defining a Cloud, Cloud Types – NIST model, Cloud Cube mode Deployment models (Public , Private, Hybrid and Community Clouds), Service Platform as a Service, Software as a Service with examples of services/ service providers, models – Infrastructure as a Service, Cloud Reference model, Characteristics of Cloud Computing – a shift in paradigm Benefits and advantages of Cloud Computing, A brief introduction on Composability, Infrastructure Platforms, Virtual Appliances, Communication Protocols Applications, Connecting to the Cloud by Clients, IaaS – Basic concept, Workload, partitioning of virtual private server instances, Pods, aggregations, silos PaaS – Basic concept, tools and development environment with examples SaaS - Basic concept and characteristics, Open SaaS and SOA, examples of SaaS platform Identity as a Service (IDaaS) Compliance as a Service (CaaS)	**6**	**15**
02	**Use of Platforms in Cloud Computing** Concepts of Abstraction and Virtualization Virtualization technologies : Types of virtualization (access, application, CPU, storage), Mobility patterns (P2V, V2V, V2P, P2P, D2C, C2C, C2D, D2D) Load Balancing and Virtualization: Basic Concepts, Network resources for load balancing, Advanced load balancing (including Application Delivery Controller and Application Delivery Network), Mention of The Google Cloud as an example of use of load balancing Hypervisors: Virtual machine technology and types, VMware vSphere Machine Imaging (including mention of Open	**14**	**20**

	Virtualization Format – OVF) Porting of applications in the Cloud: The simple Cloud API and AppZero Virtual Application appliance,Concepts of Platform as a Service, Definition of services, Distinction between SaaS and PaaS (knowledge of Salesforce.com and Force.com), Application development Use of PaaS Application frameworks, Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service., Discussion of Google Applications Portfolio – Indexed search, Dark Web, Aggregation and disintermediation, Productivity applications and service, Adwords, Google Analytics, Google Translate, a brief discussion on Google Toolkit (including introduction of Google APIs in brief), major features of Google App Engine service, Windows Azure platform: Microsoft's approach, architecture, and main elements, overview of Windows Azure AppFabric, Content Delivery Network, SQL Azure, and Windows Live services,		
03	**Cloud Infrastructure** Cloud Management: An overview of the features of network management systems and a brief introduction of related products from large cloud vendors, Monitoring of an entire cloud computing deployment stack – an overview with mention of some products, Lifecycle management of cloud services (six stages of lifecycle). Concepts of Cloud Security: Cloud security concerns, Security boundary, Security service boundary Overview of security mapping Security of data: Brokered cloud storage access, Storage location and tenancy, encryption, and auditing and compliance Identity management (awareness of Identity protocol standards)	**8**	**20**
04	**Concepts of Services and Applications** Service Oriented Architecture: Basic concepts of message-based transactions, Protocol stack for an SOA architecture, Event-driven SOA, Enterprise Service Bus, Service catalogs, Applications in the Cloud: Concepts of cloud transactions, functionality mapping, Application attributes, Cloud service attributes, System abstraction and Cloud Bursting, Applications and Cloud APIs Cloud-based Storage: Cloud storage definition – Manned and Unmanned	**8**	**15**

	Webmail Services: Cloud mail services including Google Gmail, Mail2Web, Windows Live Hotmail, Yahoo mail, concepts of Syndication services		
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Practical:
Skills to be developed:
Intellectual skills:

1. Students are able to develop different algorithms related to Cloud Computing.
2. Students are able to assess cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.
3.

List of Practical: Hands-on experiments related to the course contents
Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Barrie Sosinsky	Cloud Computing Bible	2013	Wiley India Pvt. Ltd
Rajkumar Buyya ,Christian Vecchiola, S. Thamarai Selvi	Mastering Cloud Computing	2013	McGraw Hill Education (India) Private Limited
Reference Books:			
Anthony T. Velte	Cloud computing: A practical approach		Tata Mcgraw-Hill
Dr. Kumar Saurabh	Cloud Computing		Wiley India
Moyer	Building applications in cloud:Concept, Patterns and Projects		Pearson

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1.	**Computer with moderate configuration with high speed internet connection**
2.	**Python , java,**

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 to 4**	**10**	**10**				**60**
B	**1 to 4**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Computer Vision & Image Processing & Computer Vision & Image Processing Lab

Course Code: BITDSC602 & BITDSC692	**Semester: VI**
Duration: 36	**Maximum Marks: 100+100**
Teaching Scheme	**Examination Scheme**
Theory: 4	**End Semester Exam: 70**
Tutorial: 0	**Attendance : 5**
Practical:4	**Continuous Assessment:25**
Credit: 4+2	**Practical Sessional internal continuous evaluation:40**

	Practical Sessional external examination:60		
Aim:			
Sl. No.			
1.	Students will learn basic principles of image formation, image processing algorithms and different algorithms for reconstruction and recognition from single or multiple images		
Objective:			
Sl. No.			
1.	To implement fundamental image processing techniques required for computer vision		
2.	Understand Image formation process		
3.	Extract features form Images and do analysis of Images		
	To develop applications using computer vision techniques		
Pre-Requisite:			
Sl. No.			
1.	Programming		
2.	Mathematic course		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	Overview, computer imaging systems, lenses, Image formation and sensing, Image analysis, pre-processing and Binary image analysis	**3**	**10**
02	Edge detection, Edge detection performance, Hough transform, corner detection	**6**	**10**
03	Segmentation, Morphological filtering, Fourier transform	**3**	**10**
04	Feature extraction, shape, histogram, color, spectral, texture, using CVIPtools, Feature analysis, feature vectors, distance /similarity measures, data preprocessing	**9**	**10**
05	**Pattern Analysis:** Clustering: K-Means, K-Medoids, Mixture of Gaussians Classification: Discriminant Function, Supervised, Un-supervised, Semisupervised Classifiers: Bayes, KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA, and Non-parametric methods.	**9**	**20**
06	Recent trends in Activity Recognition, computational photography, Biometrics	**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. Ability to pre process the image
2. Ability to image feature identification
3. Can be able to apply recent machine learning methods for different purpose.

List of Practical:
Based on theory Paper
Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Richard Szeliski	Computer Vision: Algorithms and Applications		
Goodfellow, Bengio, and Courville	Deep Learning		
Reference Books:			
Fisher et al	. Dictionary of Computer Vision and Image Processing		

List of equipment/apparatus for laboratory experiments:	
Sl. No.	
1.	**Computer**
2.	**Matlab/python/R**

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 to 6**	**10**	**10**				**60**
B	**1 to 6**			**5**	**3**	**5**	
C	**1 to 6**			**5**	**3**	**15**	

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

objective part.

- Specific instruction to the students to maintain the order in answering objectivequestions 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**	**3**	**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	**40**	
Viva voce	**10**	**60**

Name of the Course: B.Sc. in Information Technology (Data Science)
Subject: Machine Learning for Financial Modelling and Forecasting

Course Code: BITDSD601A	**Semester: VI**
Duration: 36	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	End Semester Exam: 70
Tutorial: 1	Attendance : 5
Practical:0	Continuous Assessment:25
Credit: 6	Practical Sessional internal continuous evaluation:NA
	Practical Sessional external examination:NA

Aim:

Sl. No.	
1.	Aim of this study to predict supply/demand/inventory of the market, and improve business performance.

Objective:

Sl. No.	
1	To acquire expertise in the mechanics of the most popular machine learning models, and their inter-relationship, in order to do proper model selection and fitting.
2	To understand the behavior of financial time series, their statistical properties, and learn to design and assess financial forecasting models and investment strategies based on supervised learning models or other models that use different types (quantitative and qualitative) of information sets.

Pre-Requisite:

Sl. No.	
1	Foundations of Data Science. Basic Statistics.
2	Knowledge of R or Python

Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Understanding Financial Time Series Data:** Asset's price and return. Basic statistics of returns. Measures of dependence. Stationarity. Forecasting. Volatility. Technical and Fundamental Financial indicators as information set.	**8**	**15**
02	**Financial Time Series Modeling:** Linear regression models and GARCH nonlinear model (quick review). Kernels in Statistical Machine Learning. Support Vector Regression. Neural Networks. Feed-forward networks. Multilayered Networks (Deep Learners). Recurrent networks. LSTM. Data preprocessing and Evaluation of Model Estimation.	**10**	**20**
03	**Optimization** Heuristics in Finance. Random search. Simulated Annealing, Genetic Programming, and other heuristics. Using heuristics for parameter estimation of GARCH, SVM, and Neural networks.	**8**	**15**
04	**Applications** Estimating and Forecasting Financial time series. Algorithmic trading. Porfolio selection. Portfolio optimization under different constraints sets. Credit scoring.	**10**	**20**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books

Text Books:

Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
A. Arratia	Computational Finance, An Introductory Course with R		Atlantis Press & Springer, 2014
P. Cortez	Modern Optimization with R	2014	
Reference Books:			
R. Tsay	Analysis of Financial		Wiley, 2013

	Time Series		
Cover, T. A., and Thomas, J. A.,	Elements of Information Theory	Second ed.	(Wiley, 2006).

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 to 4**	**10**	**10**				**60**
B	**1 to 4**			**5**	**3**	**5**	
C	**1 to 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 objectivequestions 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**	**3**	**3**

Name of the Course: B.Sc. in Information Technology (Data Science)	
Subject: Machine Learning for Industrial Application	
Course Code: BITDSD601B	**Semester: VI**
Duration: 36	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 5	**End Semester Exam: 70**
Tutorial: 1	**Attendance : 5**
Practical:0	**Continuous Assessment:25**
Credit: 6	**Practical Sessional internal continuous evaluation:NA**
	Practical Sessional external examination:NA
Aim:	
Sl. No.	

1	Familiarity with vision and medical image computing based on machine learning approach.		
Objective:			
Sl. No.			
1.	Each student will gain an understanding of the breadth of methods used in medical image segmentation		
2.	Each student will gain a detailed understanding of one particular approach.		
Pre-Requisite:			
Sl. No.			
1	Digital image processing		
2	Mathematical Knowledge		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction** Similarity between images. Image preprocessing. Image matching and registration. Basics. Advanced image registration techniques. Applications of image registration. Evaluating image registration for medical applications.	**9**	**20**
02	**Medical Image Segmentation and Applications:** Introduction to Computer Aided Detection (CADe). Image preprocessing. Clustering segmentation techniques. Region-based segmentation in 2D and 3D images. Free-form Segmentation and active contours. Deformable template matching and active shape models. Evaluation of detection algorithms for medical applications	**12**	**25**
03	**Computer Aided Diagnosis:** Introduction to diagnosis and CADx. Object and image characterization. Morphological, texture, and shape descriptors. Interest point detectors and descriptors. Classification and diagnosis. CADx evaluation. Applications through machine learning.	**15**	**25**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**
Practical: **Skills to be developed:** **Assignments:** Based on the curriculum as covered by subject teacher. **List of Books**			

Text Books:			
Name of Author	**Title of the Book**	**Edition/ISSN/ISBN**	**Name of the Publisher**
Rafael C. Gonzalez	Digital Image Processing Using MATLAB	978-0130085191	
Oleg S. Pianykh (Author)	Digital Imaging and Communications in Medicine (DICOM)	978-3540745709	
Reference Books:			
Barton F. Branstetter	Practical Imaging Informatics: Foundations and Applications for PACS	978-1441904836	
Bettyann H. Kevles	Naked to the Bone		

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 to 3**	**10**	**10**				**60**
B	**1 to 3**			**5**	**3**	**5**	
C	**1 to 3**			**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 objectivequestions 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**	**3**	**3**

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Big Data Analytics(Hadoop)			
Course Code: BITDSD601C		**Semester: VI**	
Duration: 36 Hrs		**Maximum Marks:100**	
Teaching Scheme		**Examination Scheme**	
Theory: 5		**End Semester Exam:70**	
Tutorial:1		**Attendance: 5**	
Practical: 0		**Continuous Assessment: 25**	
Credit: 6		**Practical Sessional internal continuous evaluation: NA**	
		Practical Sessional external examination: NA	
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.	Database Management Systems.		
2.	Object Oriented Programming Through Java		
Contents		**Hrs./week**	
Chapter	**Name of the Topic**	**Hours**	**Marks**
01	**Introduction to big data**	**6**	**10**

	Introduction to Big Data Platform – Challenges of Conventional Systems - Intelligent data analysis – Nature of Data - Analytic Processes and Tools - Analysis vs Reporting.		
02	**Mining data streams** Introduction To Streams Concepts – Stream Data Model and Architecture - Stream Computing - Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Moments – Counting Oneness in a Window – Decaying Window - Real time Analytics Platform(RTAP) Applications - Case Studies - Real Time Sentiment Analysis- Stock Market Predictions.	**10**	**20**
03	**Hadoop** History of Hadoop- the Hadoop Distributed File System – Components of Hadoop Analysing the Data with Hadoop- Scaling Out- Hadoop Streaming- Design of HDFS-Java interfaces to HDFS Basics- Developing a Map Reduce Application-How Map Reduce Works-Anatomy of a Map Reduce Job run-Failures-Job Scheduling-Shuffle and Sort – Task execution - Map Reduce Types and Formats- Map Reduce FeaturesHadoop environment.	**12**	**20**
04	**Frameworks** Applications on Big Data Using Pig and Hive – Data processing operators in Pig – Hive services – HiveQL – Querying Data in Hive - fundamentals of HBase and ZooKeeper - IBM InfoSphere BigInsights and Streams. Predictive Analytics- Simple linear regression- Multiple linear regression- Interpretation 5 of regression coefficients. Visualizations - Visual data analysis techniques- interaction techniques - Systems and applications.	**8**	**20**
	Sub Total:	**36**	**70**
	Internal Assessment Examination & Preparation of Semester Examination	**4**	**30**
	Total:	**40**	**100**

Assignments:
Based on the curriculum as covered by subject teacher.

List of Books
Text Books:

Name of Author	Title of the Book	Edition/ISSN/ISBN	Name of the Publisher
Tom White	Hadoop: The Definitive Guide	Third Edition	O'reilly Media
Chris Eaton, Dirk DeRoos, Tom	Understanding Big Data: Analytics for		McGrawHill Publishing

Deutsch, George Lapis, Paul Zikopoulos	Enterprise Class Hadoop and Streaming Data		
Reference Books:			
Anand Rajaraman and Jeffrey David Ullman	Mining of Massive Datasets		CUP
Bill Franks	Taming the Big Data Tidal Wave: Finding Opportunities in Huge Data Streams with Advanced Analytics		John Wiley& sons
Glenn J. Myatt	Making Sense of Data		John Wiley & Sons
Pete Warden	Big Data Glossary		O'Reilly
List of equipment/apparatus for laboratory experiments:			
Sl. No.			
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 to 4**	**10**	**10**				
B	**1 to 4**			**5**	**3**	**5**	**60**
C	**1 to 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 objectivequestions 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: B.Sc. in Information Technology (Data Science) **Subject:** Grand Viva Voce	
Course Code: BITCSS681	**Semester: VI**
Duration: 24Hrs	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 0	**End Semester Exam: 100**
Tutorial: 0	**Attendance: 0**
Practical: 2	**Continuous Assessment: 0**
Credit: 1	**Practical Sessional internal continuous evaluation: NA**
	Practical Sessional external examination: NA
Contents	
Students will give a viva from all the subject that they have covered in the course.	

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Seminar	
Course Code: BITCSS682	**Semester: VI**
Duration:	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 0	**End Semester Exam: 100**
Tutorial: 2	**Attendance: 0**
Practical: 0	**Continuous Assessment: 0**
Credit: 2	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60
Contents	
Students will present a presentation on application areas of latest technologies and current topics of societal relevance.	

Name of the Course: B.Sc. in Information Technology (Data Science) **Subject:** Major Project & Entrepreneurship II	
Course Code: BITDS683	**Semester: VI**
Duration: 36 Hrs.	**Maximum Marks: 100**
Teaching Scheme	**Examination Scheme**
Theory: 0	**End Semester Exam: 100**
Tutorial: 0	**Attendance: 0**
Practical: 8	**Continuous Assessment: 0**
Credit: 4	**Practical Sessional internal continuous evaluation: 40**
	Practical Sessional external examination: 60
Contents	
Students will do projects on application areas of latest technologies and current topics of societal relevance.	