R23 Curriculum and Syllabus for Under Autonomy (NEP 2020 Implemented)

B.Sc. in Data Science (BDS)

(Effective from 2024-25 admission batch)

JIS University
Agarpara, Kolkata

SEMESTER-1							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YED1001	Professional communication	2	0	0	2
2		YMT1005	Mathematics I	3	1	0	4
3		YDT1003	Fundamentals of C Programming	2	1	0	3
4		YDT1004	Introduction to Data Science	3	0	0	3
5		YDT1005	Computer Organization	3	0	0	3
B. PRACTICAL							
6		YDT1103	Computer Programming with C Lab	0	0	3	1.5
7		YED1101	Professional communication Laboratory	0	0	2	1.5
8		YDT1104	Data Science with Excel Lab/SPSS	0	0	3	1.5
C. MANDATORYACTIVITIES/COURSES(Non-CGPA)							
9		JSC1502	Seminar/Group Discussion	1	0	0	1
10		JSC1501	Universal Human Value	0	0	0	1
11		JSC1503	SkillX	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses				**14**	**2**	**8**	**19.5**

SEMESTER-2							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YDT2001	Statistics I	3	1	0	4
2		YDT2002	Operating System	3	0	0	3
3		YDT2003	Data Structures and Algorithm	3	0	0	3
4		YDT2004	Computer Programming with Python	3	0	0	3
5		YMT2005	Mathematics II	3	1	0	4
B. PRACTICAL							
6		YDT2103	Data Structure and Algorithms Laboratory	0	0	3	1.5
7		YDT2104	Data Science Lab using Python	0	0	3	1.5
8		YDT2102	Operating System Lab	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)							
9		JSC2502	Seminar / Group Discussion	1	0	0	1
10		JSC2504	NSS/Physical Activities /Meditation Yoga/ Photography	0	0	3	1
11		JSC2503	SkillX	0	0	0	1
Total of Theory, Practical and Mandatory Activities/Courses				**16**	**2**	**9**	**21.5**

First internship (After 1st Year Examinations): Community Service Project. To inculcate social responsibility and compassionate commitment among the students, the summer vacation in the intervening 1st and 2nd years of study shall be for Community Service Project

SEMESTER-3							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YDT3001	Computer Networks	3	0	0	3
2		YDT3002	Data Base Management System	3	0	0	3
3		YDT3003	Data Analytics using R	3	0	0	3
4		YDT3004	Artificial Intelligence	3	0	0	3
5		YDT3005	Statistics II	3	1	0	4
B. PRACTICAL							
6		YDT3102	Data Base Management System Lab	0	0	3	1.5
7		YDT3104	Artificial Intelligence Lab using python	0	0	3	1.5
8		YDT3103	Data Analytics Lab with python and R	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)							
9		JSC3502	Seminar / Group Discussion	1	0	0	1
10		JSC3504	NSS/Physical Activities /Meditation Yoga/ Photography	0	0	3	1
11		JSC3503	SkillX	0	0	0	1
Total of Theory, Practical and Mandatory Activities/Courses				**16**	**1**	**9**	**20.5**

SEMESTER-4							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT4001	Data Visualization with AI	3	0	0	3
2		YDT4002	Machine Learning	3	0	0	3
3		YDT4003	Data Security & Privacy	3	0	0	3
4		YDT4004	Professional Ethics and Life Skills	2	0	0	2
5		YDT4005	IOT and Cloud Technologies	3	1	0	4
B.PRACTICAL							
6		YDT4101	Data Visualization with AI Lab	0	0	3	1.5
7		YDT4102	Machine Learning Lab using python	0	0	3	1.5
8		YDT4103	Data Security & Privacy Lab	0	0	3	1.5
9		YDT4105	IOT and Cloud Technologies Lab	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)							
10		JSC4502	Seminar / Group Discussion	1	0	0	0
11		JSC4504	NSS/Physical Activities /Meditation Yoga/ Photography	0	0	3	0
12		JSC4503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**14**	**0**	**15**	**21**

Second Internship (After 2nd Year Examinations): Apprenticeship / Internship / on the job training / In-house Project / Off-site Project. To make the students employable, this shall be undertaken by the students in the intervening summer vacation between the 2nd and 3rd years

SEMESTER-5							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YDT5001	Deep Learning	3	0	0	3
2		YDT5002	Techniques And Tools for Data Science	3	0	0	3
3		YDT5003	Social and web media analytics	3	0	0	3
4		YDT5004	Time Series Analysis	3	0	0	3
5		**Elective II**		3	0	0	3
		YDT5005	Analytics for Service Industry				
		YDT5006	Financial Analytics				
B. PRACTICAL							
7		YDT5102	Techniques And Tools for Data Science Lab	0	0	3	1.5
8		YDT5101	Deep Learning Lab using Python	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
9		JSC5501	Behavioral an Interpersonal skills	3	0	0	0
10		JSC5503	SkillX	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses				**18**	**0**	**6**	**18**

SEMESTER-6							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT6001	Data warehousing and data mining	3	0	0	3
2		YDT6002	Operations Research	3	0	0	3
3		YDT6003	Information Retrieval and Processing	3	0	0	3
4		YDT6004	Image Processing	3	0	0	3
		Elective III					
5		YDT6005	Marketing Analytics	3	0	0	3
		YDT6006	Data Administration & Support				
B.PRACTICAL							
6		YDT6101	Data mining Lab	0	0	3	1.5
7		YDT6103	Information Retrieval and Processing	0	0	3	1.5
8		YDT6104	Image Processing with MATLAB	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
9		JSC6501	Innovation, Entrepreneurship & IPR	3	0	0	0
10		JSC6503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**18**	**0**	**9**	**19.5**

Third internship/Project work (6th Semester Period):

During the entire 6th Semester, the student shall undergo Apprenticeship / Internship / On the Job Training. This is to ensure that the students develop hands on technical skills which will be of great help in facing the world of work

SEMESTER-7							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT7001	Values and Ethics in Profession	2	0	0	2
2		YDT7002	Big Data Analytics	3	0	0	3
3		YDT7003	Predictive Analytics	3	0	0	3
4		YDT7004	Digital Marketing	3	0	0	3
5		YDT7005	Business Research Methods	3	0	0	3
B.PRACTICAL							
6		YDT7102	Big Data and Analytics Lab	0	0	3	1.5
7		YDT7103	Predictive Analytics Lab	0	0	3	1.5
8		YDT7201	Mini Project	0	0	3	3
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
9		JSC7501	Constitution of India	3	0	0	0
10		JSC7503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**17**	**0**	**9**	**20**

SEMESTER-8							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT8001	Business Analytics	3	0	0	3
2		YDT8002	Natural Language Processing	3	0	0	3
B.PRACTICAL							
3		YDT8102	Natural Language Processing Lab	0	0	3	1.5
4		YDT8201	Project	0	0	24	9
5		YDT8202	Grand Viva	0	0	3	3
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
6		JSC8501	Essence of Indian Knowledge Tradition	0	0	3	0
7		JSC8503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**6**	**2**	**30**	**19.5**

SCHEME OF INSTRUCTION

Credits in Each Semester									
	Sem-I	Sem-II	Sem-III	Sem-IV	Sem-V	Sem-VI	Sem VII	Sem VIII	Total
Total	19.5	21.5	20.5	20.5	21	19.5	20	19.5	162

The R23 Curriculum for B.Sc. in Data Science

SEMESTER-1							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YED1001	Professional communication	2	0	0	2
2		YMT1005	Mathematics I	3	1	0	4
3		YDT1003	Fundamentals of C Programming	2	1	0	3
4		YDT1004	Introduction to Data Science	3	0	0	3
5		YDT1005	Computer Organization	3	0	0	3
B. PRACTICAL							
6		YDT1103	Computer Programming with C Lab	0	0	3	1.5
7		YED1101	Professional communication Laboratory	0	0	2	1.5
8		YDT1104	Data Science with Excel Lab/SPSS	0	0	3	1.5
C. MANDATORYACTIVITIES/COURSES(Non-CGPA)							
9		JSC1502	Seminar/Group Discussion	1	0	0	1
10		JSC1501	Universal Human Value	0	0	0	1
11		JSC1503	SkillX	0	0	0	1
Total of Theory, Practical and Mandatory Activities /Courses				**14**	**2**	**8**	**19.5**

Course Code	YED1001			
Course Title	Professional communication			
Category	Humanities			
LTP & Credits	L	T	P	Credits
	2	0	0	2
Total Contact Hours	24			
Pre-requisites	10+2 English			

Learning Objective:

In this course, the students will develop communicative competence in English so as to make them industry-ready, with special emphasis on knowledge in grammar and English writing.

Course Outcome:
CO1: To learn how to employ communication skills in the workplace
CO2: To understand and learn about the use of the different elements of English
CO3: To develop requisite skills for effective reading and comprehension of texts
CO4: To learn how to compose formal, written communication
CO5: To enhance listening skills for effective communication.

Course Content:

Module 1: Communication in a Globalized World [4L]

Communication skills: definition and practical dimension. Use of technology in contemporary communication, communication in workplaces. Dimensions of workplace communication: ethics, cross-cultural contexts and virtual contexts.

Module 2: Functional Grammar [8L]

Articles and prepositions. Direct and indirect verbs, subject-verb agreement. Tense and voice, phrases and clauses, direct and indirect speech.

Module 3: Reading Comprehension [6L]

Reading purposes and skills: skimming, scanning and intensive reading. Reading comprehension: fictional and non-fictional prose. One-word substitution and sentence meeting.

Module 4: Writing Skills [6L]

Business emails: enquiry, order, complaint, job application and formal invitations. Minutes of meeting, proposals, notices. Importance of punctuation in writing.

Text / Reference Books:

1. Wren and Martin (Revised by N. D. V. Prasada Rao), "High School English Grammar and Composition", S. Chand Publishing.
2. S. A. Beebe and T. P. Mottet, "Business and Professional Communication – Principles and Skills and Leadership", Pearson Education.
3. Sethi and B. Adhikari, "Business Communication", Tata McGraw-Hill.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Course Code	YMT1005			
Course Title	Mathematics I			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	10+2 Mathematics			

Learning Objective(s):

In this course the students will learn about the basic arithmetic operations on vectors and matrices, including determinants, using technology where appropriate. the basic knowledge of matrix algebra, function of several variables and Improper integral. At the end of the course, the students will be able to solve decision making problems.

Course Outcome:

CO1: Explain the process to solve systems of linear equations using methods by Gaussian elimination and Cramer's rule.

CO2: Determine eigen values and eigenvectors and solve eigenvalue problems.

CO3: Demonstrate understanding of the concepts of vector space, linear independence and basis.

CO4: To explain the concept of definite and improper integral

CO5: To explain the concept of functions of several variables and apply the concept to solve problems

Course Content:

Module 1: System of Linear Equation **[6L]**

Matrices, Rank of a matrix, Determinants, Cramer's Rule, ; Consistency and inconsistency of linear systems of equations, Solution of linear system of equation by Gauss elimination.

Module 2: Eigen values and Eigen vectors **[8L]**

Eigen values and Eigen vectors, The characteristic equation, Diagonalization.

Module 3: Vector Spaces: **[8L]**

Introduction to vector spaces, Some properties of vector spaces, Linear combination, Linear independence, Linear dependence, Basis and Dimension of a vector space, Row space, Column, Subspace;

Module 4: Definite and Improper integral **[8L]**

Evaluation of definite and improper integrals; Beta and Gamma functions and their properties.

Module 5: Calculus **[6L]**

Calculus: Rolle's Theorem, Mean value theorems, Indeterminate forms and L'Hospital's rule; Maxima and minima.

Module 6: Function of Several variables **[12L]**

Function of several variables, Concept of limit, continuity and differentiability; Partial derivatives, Total derivative and its application; Chain rules, Derivatives of implicit functions Euler's theorem on homogeneous function, Jacobian, Maxima and minima of functions of two variables.

Text /Reference Books:

1. E. Kreyszig, "Advanced Engineering Mathematics, 9th Edition", John Wiley & Sons.
2. B.V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill.
3. T. Veerarajan, "Engineering Mathematics for First Year", Tata McGraw-Hill.
4. B.S. Grewal, "Higher Engineering Mathematics", Khanna Publishers.
5. N.P. Bali and M.Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**
CO1	3	1	1	2	3	2	-	-	3	-	-	3
CO2	3	2	1	1	1	1	-	-	-	-	-	3
CO3	1	3	1	1	1	1	-	-	-	-	-	3
CO4	2	2	2	1	1	1	-	-	-	-	-	3
CO5	3	2	1	1	2	2	-	-	-	-	-	3

Course Code	YDT1005			
Course Title	Computer Organisation			
Category	Humanities			
LTP & Credits	L	T	P	Credits
	2	0	0	2
Total Contact Hours	24			
Pre-requisites	10+2 English			

Learning Objective:

To make students understand the basic structure and operation of computer system. • To familiarize with implementation of Datapath unit and control unit for ALU operation. • To study the design consideration of Datapath unit and control unit for pipelining performance • To understand the concepts of various memories. • To introduce the concept of interfacing and organization of multiple processors.

Course Outcome:
CO1: Describe data representation, instruction formats and the operation of a digital computer
CO2: Illustrate the fixed point and floating-point arithmetic for ALU operation
CO3: Discuss about design aspects of control unit and pipeline performance
CO4: Explain the concept of various memories.
CO5: Explain the concept of interfacing and organization of multiple processors

Course Content:

Module 1: Fundamentals of Digital Electronics [4L]

Decimal Number, Binary Number, Octal Number, Hexadecimal Number, Binary Arithmetic, 1's and 2's Complement, Logic Gates: OR, AND, NOT, NAND, NOR, Exclusive – OR, Exclusive – NOR, Boolean Algebra: Boolean Logic Operations, Basic Law of Boolean Algebra, Demorgan's Theorem

Module 2: BASIC STRUCTURE OF COMPUTERS [8L]

Functional units – Basic operational concepts – Bus structures – Performance and metrics – Instructions and instruction sequencing – Instruction set architecture – Addressing modes- Basic I/O Operation.

Module 2: BASIC PROCESSING UNIT [8L]

Fundamental concepts – Execution of a complete instruction – Multiple bus organization – Hardwired control – Micro programmed control – computer arithmetic - Addition and Subtraction –Multiplication Algorithm – Division Algorithm – Floating Point Arithmetic operations – Decimal Arithmetic Unit – Decimal Arithmetic Operations.

Module 3: PIPELINING [8L]

Basic concepts – Semiconductor RAM – ROM – Speed – Size and cost – Cache memories – Improving cache performance – Virtual memory – Memory management requirements – Associative memories– Secondary storage devices

Module 4: I/O ORGANIZATION **[8L]**

Accessing I/O devices – Programmed Input/output -Interrupts – Direct Memory Access – Buses –Interface circuits – Standard I/O Interfaces (PCI, SCSI and USB), I/O devices and processors.

Text / Reference Books:

1. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware/Software interface", Elsevier, Third Edition, 2005
2. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, "Computer Organization", Tata McGraw Hill, Fifth Edition, 2022.
3. William Stallings, "Computer Organization and Architecture – Designing for Performance", Pearson Education, Ninth Edition, 2012
4. John P. Hayes, "Computer Architecture and Organization", Tata McGraw Hill, Third illustrated Edition, 2007.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Course Code	YDT1003			
Course Title	Fundamentals of C Programming			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	2	1	0	3
Total Contact Hours	36			
Pre-requisites	Basic Problem Solving			

Learning Objective:

In this course, the students will learn about the C programming language, the various language constructs, and how to use them in common applications.

Course Outcome:

CO1: To understand the basics of computer generations and system architecture

CO2: To explain the way of design, execution and debug programs in C language.

CO3: To explain and learn the data types, loops, functions

CO4: To explore the dynamic behavior of memory by the use of pointers

CO5: To design and analyze modular programs using control structure, and file handling.

Course Content:

Module 1: Fundamentals of Computer and Algorithm, Flowchart [6L]

History of Computer - Generation of Computer - Classification of Computers - Basic structure of Computer System - Primary & Secondary Memory, Processing Unit, Input & Output devices Overview of Procedural vs Structural language, compiler and assembler.

Module 2: Introduction to C Programming [5L]

Modular Programming, Structure vs Object oriented programming, C Fundamentals - Variable and Data Types: The C character set identifiers and keywords, data type & sizes - variable names, declaration, statements - Arithmetic operators, relational operators, logical operators, increment and decrement operators, bitwise operators, assignment operators, conditional operators, special operators - type conversion - C expressions, precedence and associativity, Input and Output: Standard input and output, formatted output - printf, formatted input scanf, bit fields.

Module 3: Branching, Decision making and Looping [9L]

Statement and blocks, if - else, switch case - goto and labels, Loops - while, for, do while - break and continue - One-dimensional arrays, Two-dimensional arrays - Multidimensional arrays. Passing an array to a function Character array and string - array of strings, Passing a string to a function - String related functions.

Module 4: Functions and Pointers in C [11L]

Function types, function prototypes, functions returning values - functions not returning values, scope rules - function recursion - auto, external, static and register variables Functions - C preprocessor and

macro - Pointers, Pointer and Array, Pointer and String - Pointer and functions - Dynamic memory allocation.

Module 5: Structures and File handling in C **[5L]**

Basic of structures, arrays of structures - structures and pointers, structures and functions - formatted and unformatted files - fopen, fclose, fgetc, fputc, fprintf, fscanf function - Command line arguments.

Text/Reference Books:

1. B. W. Kerninghan and D. M. Ritchie, "The C Programming Language (16th Ed.)", PHI/ Pearson Education.
2. Y. Kanetkar, "Let us C (15th Ed.)", BPB Publication.
3. E. Balagurusamy, "Programming in ANSI C (15th Ed.)", Tata-McGraw Hill.
4. K. R. Venugopal & S. R. Prasad, "Mastering C (7th Ed.)", Tata-McGraw Hill.
5. R. Thareja, "Introduction to C Programming (4thEd.)", Oxford University Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	-	-	-	-	-	-	-
CO2	2	1	2	-	1	-	-	-	-	-	-	2
CO3	2	2	-	-	1	-	-	-	-	-	-	2
CO4	2	2	1	-	1	-	-	-	-	-	-	2
CO5	2	3	2	-	1	-	-	-	-	-	-	2

Course Code	YDT1004			
Course Title	Introduction to Data Science			
Category				
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	NA			

Learning Objective(s):

In this course the students will learn about the basic of data science concept. At the end of the course, the students will be able to solve decision making problems.

Course Outcome:

CO1: Explore the fundamental concepts of data science

CO2: Understand the concept of data collection and processing

CO3: To explain data analytics Demonstrate understanding of the concepts of vector space, linear independence and basis.

CO4: To explain the process of model development

CO5: To explain the concept of model evaluation

Course Content:

Module 1: Introduction **[6L]**
Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Module 2: Data Collection and Data Pre-Processing **[6L]**
Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

Module 3: Exploratory Data Analytics **[8L]**
Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.

Module 4: Model Development **[8L]**
Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.

Module 5: Model Evaluation **[8L]**
Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search.

Text /Reference Books:

1. Jojo Moolayil, “Smarter Decisions: The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global..

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	2	3	2	-	-	3	-	-	3
CO2	3	2	1	1	1	1	-	-	-	-	-	3
CO3	1	3	1	1	1	1	-	-	-	-	-	3
CO4	2	2	2	1	1	1	-	-	-	-	-	3
CO5	3	2	1	1	2	2	-	-	-	-	-	3

Course Code	YDT1103			
Course Title	Computer Programming with C Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	NIL			

Learning Objective:

The course is oriented to those who want to advance structured and procedural programming understating and to improve C programming skills. The major objective is to provide students with understanding of code organization and functional hierarchical decomposition with using complex data types.

Course Outcomes:

CO1: Learn and understand the DOS system commands and familiarize with C programming environment

CO2: Learn and translate the algorithms into simple programs and understand the flowchart design and test

CO3: Understand and implement conditional branching, iteration and recursion

CO4: Apply and analyze various C programs with Arrays, Pointers, Structures, Union along with functions

CO5: Apply programming to solve matrix addition and multiplication problems and understand the file handling

Suggestive List of Experiments:

1. Familiarization with basic DOS commands and programming design with the help of Flowcharts using Raptor.

   [1 day]

2. Familiarization with C programming environment, Variable types and type Conversions, Simple computational problems using arithmetic expressions Tutorial.

   [1 day]

3. Branching and logical expressions, Problems involving if-then-else structures.

   [1 day]

4. Loops, while and for loops, Iterative problems e.g., sum of series, patterns print.

   [2 days]

5. 1D Arrays: searching, sorting, 1D Array manipulation, 2D arrays and Strings, Matrix problems, String operations.

   [2 days]

6. Functions, call by value, Simple functions implementations, function recursion.

   [2 days]

7. Pointers, structures and dynamic memory allocation, Union.

   [2 days]

8. File handling, file reading, writing, copying etc.

[1 day]

Text / Reference Books:

1. B. W. Kerninghan & D. M. Ritchie, "The C Programming Language (16th Ed.)", PHI/ Pearson Education.
2. Y. Kanetkar, "Let us C (15th Ed.)", BPB Publication.
3. E. Balagurusamy, "Programming in ANSI C (15th Ed.)", Tata-McGraw Hill.
4. K. R. Venugopal & S. R. Prasad, "Mastering C (7th Ed.)", Tata-McGraw Hill.
5. R. Thareja, "Introduction to C Programming (4thEd.)", Oxford University Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	1	-	-	-	-	-	-	2
CO3	3	2	-	-	1	-	-	-	-	-	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	2
CO5	3	3	2	-	1	-	-	-	-	-	-	2

Course Code	YED1101			
Course Title	Professional communication Laboratory			
Category	Humanities			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	24			
Pre-requisites	10+2 English			

Learning Objective:

In this laboratory course, the students will be exposed to the need of English in workplace, and to equip them with good language skills, communication skills and soft skills.

Course Outcome:

CO1: To apply different skills of technical communication in English

CO2: To use correct pronunciation when speaking English

CO3: To use appropriate techniques for effective and active listening

CO4: To learn to speak clearly and coherently in the professional arena

CO5: Demonstrate effective verbal and non-verbal communication skills in various professional scenarios, including presentations, meetings, and interviews

Suggestive List of Experiments:

1. Learn about phonetics and pronunciation guide (Introduction of phonetics and phonetic table, tongue and lip movements for vowels and consonants, monophthongs/diphthongs, voiced/unvoiced, aspirated/unaspirated, minimal pairs, syllables, stress and intonation).
   [4 hours]
2. Training on listening and comprehension (Active listening and its techniques, academic listening versus business listening, listening activities: answering questions, form filling, summarizing news bulletin, presentation, video clip, lecture, story).
   [6 hours]
3. Training on speaking skills (Basic parameters of speaking, fluency-focused activities: JAM, conversational role plays, speaking using picture, group discussions and personal interviews).
   [6 hours]
4. Laboratory project work (Making 5-minute animation video with voiceover, OR making a 10-minute documentary film).
   [8 hours]

Text / Reference Books:

1. P. Ladefoged, “A Course in Phonetics”, Harcourt Brace Jovanovich College Publishers.
2. J. Sullivan, “Simply Said: Communicating Better at Work and Beyond”, Wiley.

3. N. Leonardo, “Active Listening Techniques: 30 Practical Tooms to Hone your Communication Skills”, Rockridge Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	-	-	3	-	-	3
CO2	2	2	1	1	1	1	-	-	-	-	-	3
CO3	1	3	1	2	2	1	-	-	1	-	-	3
CO4	2	2	2	1	1	1	-	-	1	-	-	3
CO5	2	1	1	1	2	2	-	-	2	-	-	3

Course Code	YDT1104			
Course Title	Data Science with Excel Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Mathematics			

Learning Objective:

The main objectives of this course are to:
1. Construct formulas, including the use of built-in functions, and relative and absolute references.
2. Convert text and validate and consolidate data.
3. Create pivot tables and charts.

Course Outcomes:

CO1: Develop organized data format using sorting and filtering components

CO2: Design advanced graphic presentations on stored data

CO3: Sort, search, and extract knowledge from historical data

CO4: To learn the data analysis

CO5: Apply concept to create chart and graph of the data

Suggestive List of Experiments:

1. **Introduction To Spreadsheets**:
Introduction to spreadsheets, reading data, manipulating data. Basic spreadsheet operations and Functions
2. **Data Cleaning and Working with Conditions Using Excel**:
Conditional expression (IF and nested IF), Logical Function (AND, OR, NOT),
Concatenate functions in Excel-Left, Right, Upper and Lower, Data filtering capabilities of Excel, the construction of Pivot Tables to organize data and introduction to chart sin Excel, Using Ranges, Selecting Ranges, Entering Information sinto a Range, Using AutoFill
3.Data Manipulation Using Excel:
Using Formulas, Formula Functions – Sum, Average, if, Count, max, min, Proper, Upper, Lower, Using AutoSum, Vlookup, VlookUP with Exact Match, Approximate Match, Nested VlookUP, Hlookup, Match, Countif, Text, Trim
4.Data Analysis:
What-if-Analysis- Goal Seek, Data Table, Scenario Manager, Formatting Charts, 3D Graphs,
5.**Advanced Graphing and Charting:**
Formatting and customizing Pivot tables, Using advanced options of Pivot tables, Pivot charts, Line, Bar and Pie charts, , Scatter plots, Histograms.

Text / Reference Books:

1. Microsoft Excel 2019 Data Analysis and Business Modeling, Wayne Winston, 2019

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	2	2	-	1	-	-	-	-	-	-	2
CO3	3	2	-	-	1	-	-	-	-	-	-	2
CO4	3	2	1	-	1	-	-	-	-	-	-	2
CO5	3	3	2	-	1	-	-	-	-	-	-	2

The R23 Curriculum for B.Sc. in Data Science

Curriculum and Detailed Syllabus of 2nd Semester

SEMESTER-2							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YDT2001	Statistics I	3	1	0	4
2		YDT2002	Operating System	3	0	0	3
3		YDT2003	Data Structures and Algorithm	3	0	0	3
4		YDT2004	Computer Programming with Python	3	0	0	3
5		YMT2005	Mathematics II	3	1	0	4
B. PRACTICAL							
6		YDT2102	Operating System Laboratory	0	0	3	1.5
7		YDT2103	Data Structure and Algorithms Laboratory	0	0	3	1.5
8		YDT2104	Programming Using Python Laboratory	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)							
9		JSC2502	Seminar / Group Discussion	1	0	0	1
10		JSC2501	NSS/Physical Activities /Meditation Yoga/ Photography	0	0	3	1
11		JSC2503	SkillX	0	0	0	1
Total of Theory, Practical and Mandatory Activities/Courses				**16**	**2**	**9**	**21.5**

Course Code	YDT2001			
Course Title	Statistics I			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	10+2 Mathematics			

Learning Objective

The main objectives of this course are to: 1. Understand the significance and computational aspects of statistical analysis 2. Understand the patterns of distribution of data 3. Understand the concepts of predictive analytics

Course Outcome:

CO1: To understand the collection, analysis, interpretation, and presentation of data

CO2: To understand the difference between discrete and continuous random variables and the meaning of probability

CO3: To evaluate problems on discrete and continuous probability distributions.

CO4: To understand the concept of testing hypothesis for large and small samples.

CO5: Ability to explore certain statistical concepts in practical applications of computer science areas

Course Content:

Module 1: Descriptive Statistics & Probability [10L]

Collection of data, Classification and Tabulation of data, Diagrammatic and Graphical representation of data, Measures of Central value (mean, median, mode), Measures of Dispersion (Quartile deviation, mean deviation, standard deviation),

Definition of probability, Addition theorem, Multiplication theorem, Bayes' theorem.

Module 2: Discrete Probability Distributions [7L]

Mathematical expectation, Random variable and Probability Distribution, Binomial distribution, Poisson distribution.

Module 3: Continuous Probability Distributions [4L]

Normal distribution, Properties of the Normal distribution, Area under the Normal curve, fitting a normal curve.

Module 4: Statistical Inference – I [9L]

Procedure of Testing Hypothesis, Standard error and Sampling Distribution, Estimation, Test of significance large samples: Difference between small and large samples, Two tailed test for difference between the means of two samples, Standard error of the difference between two standard deviations

Module 5: Statistical Inference–II [6L]

Tests of significance for small samples, Student's t-distribution, chi square test and goodness of fit, F-test.

Text/Reference Books:

1. B.L.Agarwal, (2021). Basic Statistics, New Age International Private Limited, New Delhi, India.
2. N. G. Das, "Statistical Methods (Combined Volume)", Tata-McGraw Hill.
3. J. E. Freund and R. E. Walpole, "Mathematical Statistics", Prentice Hall.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	-	-	-	-	-	-	-	-	1

Course Code	YDT2002			
Course Title	Operating System			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Fundamentals of Programming C			

Learning Objective:

In this course, students will learn about the role of an operating system as the interface between application programs and computer hardware. They will understand how the operating system manages various computer resources, which is essential for handling large software projects effectively.

Course Outcome:

CO1: An ability to understand basic concepts of operating system.

CO2: An ability to understand linux shell and scheduling.

CO3: An ability to analyze memory management and deadlocks

CO4: An ability to describe memory management and concurrency control mechanisms.

CO5: An ability to compare various file systems

Course Content:

Module 1: Introduction to Operating Systems [4L]

Functionalities of an operating system – hardware/software interface. Evolution of operating systems – batch, multi-programmed, time-sharing, real-time, distributed. Simultaneous Peripheral Operations On-Line (SPOOL).Protection and Security – user/supervisory mode, privileged instructions, system calls (invoking OS services).

Module 2: Processes and Threads [8L]

Processes – basic concept, process control block (PCB), process state transition diagram. Process scheduling – independent and cooperating processes, inter-process communication using shared memory and message passing. Case studies from Unix/Linux. Threads – lightweight process concept, benefits of threads, user and kernel-level threads, using thread library in Unix/Linux. CPU Scheduling – scheduling criteria, preemptive and non-preemptive scheduling. Scheduling algorithms – FCFS, SJF, SRTF, RR, priority, multi-level feedback queue.

Module 3: Process Synchronization and Deadlocks [8L]

Classical problems of process synchronization – producer-consumer, reader-writer, dining philosopher, etc. Critical section problem – illustration, software solutions, solution using synchronization hardware: test-and-set (TST) and SWAP instructions. Semaphores – definition, binary and counting semaphores, implementation of semaphores, minimizing busy waiting. Case studies from Unix/Linux. Deadlocks – deadlock characterization, methods of handling deadlock, deadlock prevention versus deadlock avoidance, Banker's algorithm.

Module 4: Memory Management **[8L]**

Logical versus physical address space, swapping, contiguous memory allocation, memory protection using fence registers. Paging – basic concept, performance analysis, translation look-aside buffer (TLB). Segmentation. Virtual memory – separation of logical and physical address space, demand paging, locality of reference. Page replacement algorithms – FCFS, LRU, Optimal, Belady's anomaly. Thrashing, working set model. Page table structure and its optimization techniques. Segmentation with paging (combined scheme). Memory protection and access control mechanisms. Shared memory and memory mapped files. Case studies on memory management in modern operating systems (e.g., Windows, macOS, Linux)

Module 5: Device and File Management **[8L]**

Disk structure – cylinders, tracks, and sectors. Disk scheduling algorithms – FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK. File system – file concept, access methods, directory and file system structure, allocation methods (contiguous, linked, indexed), free space management. Case study for Unix/Linux. Disk management optimizations (e.g., track skewing, clustering, buffering), RAID levels and their implications for performance and fault tolerance. File system reliability and recovery mechanisms (e.g., journaling, shadowing), Network file systems and distributed file systems (e.g., NFS, AFS, CIFS). Case studies on file systems used in cloud computing and distributed systems.

Text/Reference Books:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, "Operating System Concepts", Wiley Asia.
2. D. M. Dhamdhere, "Operating Systems: A Concept-Based Approach", Tata McGraw-Hill.
3. M. Bach, "Design of the Unix Operating System", Prentice-Hall of India.
4. W. Stallings, "Operating Systems: Internals and Design Principles", Prentice-Hall of India.
5. C. Crowley, "Operating System: A Design-Oriented Approach", Irwin Publishing.
6. G. J. Nutt, "Operating Systems: A Modern Perspective", Addison-Wesley.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	-	-	2	-	-	3
CO2	2	2	1	1	1	1	-	-	-	-	-	3
CO3	1	3	1	2	2	-	-	-	1	-	-	3
CO4	2	1	1	1	1	-	-	-	1	-	-	3
CO5	2	1	1	2	1	-	-	-	-	-	-	3

Course Code	YDT2003			
Course Title	Data Structures and Algorithms			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Fundamentals of Programming C and Problem-solving Concept			

Learning Objective:

In this course, the students will be taught about the significance of non-linear data structures with respect to the access and organization of data, various algorithmic approaches to write programs to solve problems in different engineering domains by using different data structures, merits, and demerits of altered algorithms in terms of time-complexity.

Course Outcome:

CO1: To differentiate how the choices of data structure & algorithm methods impact the performance of program.

CO2: To solve problems based upon different data structure & also write programs.

CO3: To identify appropriate data structure & algorithmic methods in solving problem.

CO4: To discuss the computational efficiency of the principal algorithms for sorting, searching, and hashing

CO5: To compare and contrast the benefits of dynamic and static data structures implementations.

Course Content:

Module 1: Introduction of Data Structure [11L]

Concepts of data structures, Abstract Data Type.
Algorithms and programs, basic idea of pseudo-code, Properties of an algorithm.
Algorithm efficiency and analysis, time and space analysis of algorithms – order notations.
Array: Different representations – row major, column major.
Sparse matrix - its implementation and usage, Array representation of polynomials.
Linked List: Singly linked list – operations, Doubly linked list – operations.
Circular linked list – operations, Linked list representation of polynomial and applications.

Module 2: Linear Data Structure [10L]

Stack and its implementations (using array and linked list).
Applications (Infix, Prefix, and Postfix with their conversions, Postfix Evaluation).
Queue, circular queue, de-queue.
Implementation of queue- linear and circular (using array and linked list).
Recursion:Principles of recursion - use of stack, tail recursion.
Applications - The Tower of Hanoi, Eight-queen problem.

Module 3: Nonlinear Data structures [18L]

Trees: Basic terminologies, forest, tree representation (using array and linked list).

Binary trees - binary tree traversal (pre-, in-, post- order).

Threaded binary tree – operations.

Binary search tree- operations (creation, insertion, deletion, searching).

Concept of Max-Heap and Min-Heap (creation, deletion).

Height balanced binary tree – AVL tree (insertion, deletion with examples only).

Graph traversal and connectivity – Depth-first search (DFS), Breadth-first search (BFS) – concepts of edges used in DFS and BFS (tree-edge, back-edge, cross-edge, and forward-edge). Minimal spanning tree – Prim's algorithm, Kruskal's algorithm (basic idea of greedy methods).

Module 4: Searching and Sorting [9L]

Sorting Algorithms: Bubble sort, Insertion sort, Selection sort – with notion of complexity, Quick sort, Merge sort – with complexity, Radix sort – with complexity. Searching: Sequential search, Binary search, Interpolation Search– with complexity. Hashing: Hashing functions, Collision resolution techniques.

Text/Reference Books:

1. E. Horowitz, S. Sahni and S. Anderson-Freed, "Fundamentals of Data Structures of C", Universities Press.
2. S. Lipschutz, "Data Structures", Tata McGraw Hill Education (India) Private Limited.
3. A. M. Tanenbaum, "Data Structures in C", Pearson.
4. R. Thareja, "Data Structures Using C", Oxford.
5. A.K. Rath, A. K. Jagadev, "Data Structure Using C", Scitech Publications.
6. T. H. Coreman, "Introduction to Algorithms", MIT Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	-	3	-	-
CO2	-	-	-	-	-	2	3	2	2	-	-	-
CO3	-	-	1	-	-	-	-	-	2	3	-	-
CO4	-	1	-	-	-	-	-	-	-	-	-	-
CO5	3	-	-	-	-	3	-	-	-	-	-	-

Course Code	YDT2004			
Course Title	Computer Programming in Python			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this practical course, the students will be learning Python programming basics and paradigm. python looping, control statements and string manipulations. Students will be made familiar with the concepts of various modules, packages and python libraries used for various applications (Machine learning, Deep learning etc.).

Course Outcomes:

CO1: Understand and explain the basic principles of Python programming language and object-oriented concepts.
CO2: Define and demonstrate the use of built-in data structures along with the help of condition checking and looping structures.
CO3: Understand and apply various applications of different modules and packages in Python.
CO4: Learn to handle exceptions and files in Python.
CO5: Apply Python programming concepts to develop a computer game for teaching data structures like stacks and queues, enhancing visualization and understanding of abstract concepts through game-based learning.

Contents

Module 1: **[6L]**

Introduction to Python: Python variables, Python basic Operators, Python Data Types, variables, Declaring and using Numeric data types: int, float etc., Basic Input-Output Operations, Basic Operators.

Module 2: **[8L]**

Conditionals and loops: Boolean Values, if, else and else if, Simple for loops in python, for loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else.

Module 3: **[6L]**

Strings: Assigning values in strings, String manipulations, String special operators, String formatting operators, Triple Quotes, Raw String, Unicode String, Build-in-String methods,

Module 4: **[6L]**

Lists: Lists Introduction, accessing values in list, List manipulations, List Operations, Indexing, slicing & matrices, use of tuple data type. string, list and Dictionary, string manipulation methods, programming using string, list and dictionary in-built functions.

Module 5: **[6L]**

Functions: Built –in Functions and methods, Functions, writing functions in Python, returning a result from a function, Pass by value & pass by reference, function arguments & its types, recursive functions.

Module 6: **[4L]**

Python packages: Simple programs using the built-in functions of packages matplotlib, numpy, pandas etc.,

Text Books:

1. Introduction to Python Programming, William Mitchell, Povel Solin, Martin Novak et al., NCLab Public Computing, 2012.
2. Introduction to Python Programming, ©Jacob Fredslund, 2007.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	2	2	0	0	0	2	0	0	3

Course Code	YMT2005			
Course Title	Mathematics II			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	Mathematics I			

Learning Objective:

In this course the students will learn about the basic knowledge of double and triple integration, ordinary differential equation and vector calculus. At the end of the course, the students will be able to solve engineering problems.

Course Outcomes:

CO1: To use mathematical tools to evaluate multiple integrals and vector calculus

CO2: To understand the properties of vector calculus

CO3: To understand the properties to evaluate multiple integrals

CO4: To apply mathematical tools for solving ordinary differential equations

CO5: To understand the higher order differential equations and its applications

Course Content:

Module 1: Vector Calculus [10L]

Scalar point function, vector point function, directional derivatives, unit normal vector, magnitude of directional derivative, gradient of a scalar point function and its properties, solenoidal and irrotational vector, tangent plane and normal line to the surface, divergence and curl of a vector point function and their properties,

Module 2: Multivariable Calculus (Integration): [14L]

Double integration, Change of order of integration in double integrals, Triple integrals, vector line integrals, scalar surface integrals, vector surface integrals, Green's theorem, Gauss divergence theorem and Stokes' theorem.

Module 3: First Order Ordinary Differential Equations: [12L]

Solution of first order and first-degree ODE: Exact ODE, Rules for finding Integrating factors, Linear ODE, Bernoulli's equation, Solution of first order and higher degree ODE: solvable for, solvable for solvable for and Clairaut's equation.

Module 4: Second Order Ordinary Differential Equations: [12L]

Solution of second order ODE with constant coefficients: C.F. & P.I., Method of variation of parameters, Cauchy-Euler equations, Reduction of 2nd order ODE to a pair of first order ODEs, Solution of simultaneous linear ODEs.

Text / Reference Books :

1. E. Kreyszig, “Advanced Engineering Mathematics”, 9th Edition, John Wiley & Sons.
2. B. V. Ramana, “Higher Engineering Mathematics”, Tata McGraw Hill New Delhi.
3. T. Veerarajan, “Engineering Mathematics for First Year”, Tata McGraw-Hill.
4. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers.
5. N. P. Bali and M. Goyal, “A Text Book of Engineering Mathematics”, Laxmi Publications.
6. G. B. Thomas and R. L. Finney, “Calculus and Analytic Geometry”, 9th Edition, Pearson.
7. W. E. Boyce and R. C. DiPrima, “Elementary Differential Equations and Boundary Value Problems”, Wiley India.
8. S. L. Ross, “Differential Equations”, Wiley India.
9. N. Piskunov, “Differential and Integral Calculus”, Vol. I & Vol. II, Mir Publishers.
10. E. A. Coddington, “An Introduction to Ordinary Differential Equations”, Prentice Hall, India.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	-	-	-	-	-	-	-	1
CO2	3	2	2	-	-	-	-	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1
CO5	3	3	2	-	-	-	-	-	-	-	-	1

Course Code	YDT2102			
Course Title	Operating Systems Laboratory			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Data Structures and Algorithms andComputer Organization			

Learning Objective:

In this laboratory course, students will carry out various software assignments on Unix/Linux shell programming and system calls. Additionally, assignments for simulating important OS modules like CPU scheduling, file system, etc., shall be carried out

Course Outcome:

CO1: To learn how to write shell scripts.
CO2: To learn how to use Unix/Linux system calls and to design a shell program.
CO3: To analyze the performance of CPU scheduling algorithms through simulation.
CO4: To learn how to use multi-threaded programming.
CO5: To design and implement one OS module like memory management, file system, etc

Course Content:

Suggestive List of Experiments:

1. Write shell scripts using "bash" shell scripting language for simple system administration tasks, text search and replacement, directory and file manipulation, simple numeric computations, etc.

2. Write programs in C for familiarization with the Unix/Linux system calls fork, exec, wait, exit, dup, pipe, shared memory, etc.

3. Write a command-line interpreter (shell) program using the Unix/Linux system calls with the facilities for: (a) running executable programs, (b) running a program in the background, (c) input and output redirection, (d) command piping.

4. Implementation of various CPU scheduling algorithms in C and compare their performances.

5. Write programs using the "pthread" library with multiple threads and use semaphores for mutual exclusion.

6. Design and implement a Unix-like memory-resident file system using the concept of inodes. OR Implementation of memory management system supporting virtual memory, and analyze the performance.

Text / Reference Books:

1. A. Silberschatz, P. B. Galvin, and G. Gagne, "Operating System Concepts," Wiley Asia.

2. D. M. Dhamdhere, "Operating Systems: A Concept-Based Approach," Tata McGraw-Hill.
3. M. Bach, "Design of the Unix Operating System," Prentice-Hall of India.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	2	3	2	-	-	2	-	-	3
CO2	2	2	1	1	1	1	-	-	-	-	-	3
CO3	1	3	1	2	2	-	-	-	1	-	-	3
CO4	2	1	1	1	1	-	-	-	1	-	-	1
CO5	2	1	1	2	1	-	-	-	-	-	-	3

Course Code	YDT2103			
Course Title	Data Structures and Algorithms Laboratory			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Fundamentals of Programming			

Learning Objective:

In this course, the students will learn about C program-based implementation of different algorithmic approaches by using non-linear and linear data structures to solve problems in different engineering domains.

Course Outcome:

CO1: To choose appropriate data structure as applied to specified problem definition

CO2: To compare operations like searching, insertion, deletion, traversing mechanism on various data structures

CO3: To explain various practical applications of data structures

CO4: To analyze how to store, manipulate and arrange data in an efficient manner

CO5: To demonstrate how to implement various data structures using arrays and linked list

Suggestive List of Experiments:

1. Experiments on arrays **[1 day]**
   Addition and Multiplication of Arrays
   Implementation of Sparse Matrices

2. Experiments on Abstract Data Types **[2 days]**
   Implementation of stack using Array
   Applications of stack – infix to postfix conversion, expression evaluation

3. Experiments on Linked List **[2 days]**
   Implementation of linked lists and its operations -- insertion, deletion and reverse
   Implementation of stacks and queues using linked list.
   Polynomial addition and polynomial multiplication.

4. Experiments on Searching and Sorting **[2 days]**
   Searching: Linear Search, Binary Search
   Sorting: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort and Heap Sort
5. Experiments on Non-linear Data Structures **[2 days]**
   Traversals of binary tree, Binary Search Tree (BST), Threaded binary tree
   Height balanced binary tree – AVL tree (insertion, deletion)
   B- Trees – insertion, deletion

6. Experiments on Hashing **[1 day]**

Implementation of Hash tables and its operations -- searching, inserting, and deleting, handling collisions.

7. Innovative Experiments **[2 days]**
Case study of solving complex problems from various engineering domains using suitable data structures (e.g., mesh analysis in electrical circuits, event-driven simulation, etc.).

Text/Reference Books:

1. C. E. Balagurusamy, "Data Structures using C", McGraw Hill.
2. E. Horowitz, S. Sahni and S. Anderson-freed, "Fundamentals of Data Structures of C", Universities Press.
3. A. K. Sharma, "Data Structures using C", Pearson.
4. R. Thareja, "Data Structures using C", Oxford University Press.

CO-PO mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	1	-	-
CO2	-	2	2	-	2	-	-	-	-	1	-	2
CO3	2	1	1	-	-	-	-	-	-	-	-	-
CO4	3	2	-	2	-	-	-	-	-	-	1	-
CO5	-	-	2	1	2	-	-	-	-	-	1	2

Course Code	YDT2104			
Course Title	Programming Using Python Laboratory			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Programming Practices II			

Learning Objective:

In this course, the students will learn to manipulate data objects, produce graphics, analyze data using common statistical methods and generate reproducible statistical reports with programming in Python.

After the completion of this course, the students will be in a better position to solve the analytical problems of data science using Python.

Course Outcome:

CO1: To be able to solve analytical problems using Python

CO2: To develop competency in Python and Python libraries such as Pandas, Numpy, and Scipy

CO3: To explain and analyze results effectively using visualizations in Python

CO4: To demonstrate how to import, export and manipulate data and produce statistical summaries of continuous and categorical data in Python

CO5: To be able to perform exploratory data analysis using Python

Suggestive List of Experiments:

1. History, Features, setting up path, working with Python, Basic Syntax, Variable and Data Types, Operator. [1 day]
2. Conditional Statements: If, If-else, Nested if-else, Looping, For, While, Nested loops, Control Statements: Break, Continue, Pass. [1 day]
3. String Manipulation: Accessing Strings, Basic Operations, String slices, Function and Methods. Lists: Introduction, accessing list, Operations, Working with lists, Function and Methods. [2 days]
4. Tuple: Introduction, accessing tuples, Operations, Working, Functions, and Methods. Dictionaries: Introduction, accessing values in dictionaries, Working with dictionaries, Properties. [2 days]
5. Functions: Defining a function, Calling a function, Types of functions, Function Arguments, Anonymous functions, Global and local variables. [1 day]
6. Modules: Importing module, Math module, Random module, Packages, Composition, InputOutput Printing on screen, reading data from the keyboard, Opening and closing file, Reading and writing files, Functions. [2 days]

7. Exception and File Handling: Exception, Exception Handling, except clause, Try & finally clause, User-Defined Exceptions. [1 day]

8. Case study on using a computer game for teaching data structures on stacks and queues. The computer game is developed to help students visualize the data structures and data access operations on stacks and queues. This game-based learning is engaging, fun, and, more importantly, abstract concepts in data structures can be visualized and learned through gameplaying. [2 days]

Text / Reference Books:

1. J. Payne, “Beginning Python: Using Python 2.6 and Python 3.1”, Wrox.
2. M. T. Goodrich, R. Tamassia and M. H. Goldwasser, “Data Structures and Algorithms in Python”, John Wiley & Sons.
3. I. Idris, “Python Data Analysis”, Pact Publishing Limited.
4. C. Beeley, "Web Application Development with R Using Shiny", Pact Publishing.
5. M. J. Crawley, “The R Book”, Wiley.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	-	-	-	-	-	-
CO2	2	1	3	2	3	1	-	-	-	-	-	1
CO3	1	1	1	1	1	-	-	-	-	-	-	-
CO4	2	1	2	2	3	-	-	-	-	-	-	-
CO5	1	2	1	1	1	-	-	-	-	-	-	-

Semester 3
Curriculum and Detailed Syllabus

SEMESTER-3							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YDT3001	Computer Networks	3	0	0	3
2		YDT3002	Data Base Management System	3	0	0	3
3		YDT3003	Data Analytics using R	3	0	0	3
4		YDT3004	Artificial Intelligence	3	0	0	3
5		YDT3005	Statistics II	3	1	0	4
B. PRACTICAL							
6		YDT3102	Data Base Management System Lab	0	0	3	1.5
7		YDT3104	Artificial Intelligence Lab using python	0	0	3	1.5
8		YDT3103	Data Analytics Lab with python and R	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)							
9		JSC3502	GROUP DISCUSSION	1	0	0	1
10		JSC3503	SKILL X	0	0	3	1
11		JSC3504	NSS/PHYSICAL ACTIVITIES /MEDITATION YOGA/ PHOTOGRAPHY	0	0	0	1
Total of Theory, Practical and Mandatory Activities/Courses				**16**	**1**	**9**	**20.5**

Course Code	YDT3001			
Course Title	Computer Network			
Category	Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

In this course, the students will learn the fundamental types of computer networks. To demonstrate the TCP/IP & OSI model merits & demerits. To know the role of various protocols in Networking

Course Outcome:

CO1: understand and explore the basics of Computer Networks and Various Protocols

CO2: Understand the World Wide Web concepts

CO3: Students will be in a position to administrate a network and flow of information further

CO4: Student can understand easily the concepts of network security, Mobile

CO5: Apply the basic understanding of computer network in real-world applications.

Course Content:

Module 1: [7L]

Introduction: Network, Uses of Networks, Types of Networks, Reference Models: TCP/IP Model, The OSI Model, Comparison of the OSI and TCP/IP reference model. Architecture of Internet.

Physical Layer: Guided transmission media, Wireless transmission media, Switching

Module 2: [7L]

Data Link Layer - Design issues, Error Detection & Correction, Elementary Data Link Layer Protocols, Sliding window protocols

Multiple Access Protocols - ALOHA, CSMA,CSMA/CD, CSMA/CA, Collision free protocols, Ethernet- Physical Layer, Ethernet Mac Sub layer, Data link layer switching: Use of bridges,

learning bridges, spanning tree bridges, repeaters, hubs, bridges, switches, routers and gateways.

Module 3: [8L]

Network Layer: Network Layer Design issues, store and forward packet switching connection less and connection oriented networks-routing algorithms-optimality principle, shortest path,

flooding, Distance Vector Routing, Count to Infinity Problem, Link State Routing, Path Vector Routing, Hierarchical Routing; Congestion control algorithms, IP addresses, CIDR, Subnetting, SuperNetting, IPv4, Packet Fragmentation, IPv6 Protocol, Transition from IPv4 to IPv6, ARP, RARP

Module 4: **[8L]**

Transport Layer: Services provided to the upper layers elements of transport protocol addressing connection establishment, Connection release, Error Control & Flow Control, Crash Recovery. The Internet Transport Protocols: UDP, Introduction to TCP, The TCP Service Model, The TCP Segment Header, The Connection Establishment, The TCP Connection Release, The TCP Sliding Window, The TCP Congestion Control Algorithm.

Module 5: **[6L]**

Application Layer- Introduction, providing services, Applications layer paradigms:
Client server model, HTTP, E-mail, WWW, TELNET, DNS; RSA algorithm,

Text / Reference Books:

1.An Engineering Approach to Computer Networks - S. Keshav, 2nd Edition, Pearson Education.
2. Understanding communications and Networks, 3rd Edition, W. A. Shay, Cengage Learning. 3. Computer Networking: A Top-Down Approach Featuring the Internet, James F. Kurose, K. W. Ross, 3rd Edition, Pearson Education.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Course Code	YDT3002			
Course Title	Data Basse Management System			
Category	Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

In this course, the students will be able to learn the data models, conceptualize and depict a database system; design system using E-R diagram; learn SQL & relational database design; understand the internal storage structures using different file and indexing techniques; know the concepts of transaction processing, concurrency control techniques and recovery procedure.

Course Outcome:

CO1: To apply the knowledge of E-R diagram for an application

CO2: To explain the creation of the normalized relational database model

CO3: To analyze real world queries to generate reports from it

CO4: To determine whether the transaction satisfies the ACID properties

CO5: To create and maintain the database of an organization

Course Content:

Module 1: Introduction **[3L]**

Concept and overview of DBMS, data models.
Database languages, database administrator, database users, three-schema architecture of DBMS.

Module 2: Entity-Relationship and Relational Database Model **[9L]**

Basic concepts, design issues, mapping constraints, keys, entity-relationship diagram, weak entity sets, extended E-R features, case study on E-R model.
Structure of relational databases, relational algebra, relational calculus, extended relational algebra operations, views, modifications of the database.

Module 3: SQL and Integrity Constraints **[6L]**

Concept of DDL, DML, DCL.
Basic structure, set operations, aggregate functions, null values, domain constraints, referential integrity constraints, assertions, views, nested sub-queries.
Database security application development using SQL, stored procedures and triggers.

Module 4: Relational Database Design **[6L]**

Functional dependency, Different anomalies in designing a Database. Normalization using functional dependencies, decomposition, Boyce-Codd Normal Form, 3NF.
normalization using multi-valued dependencies, 4NF, 5NF, Case Study.

Module 5: Internals of RDBMS **[6L]**

Physical data structures, query optimization: join algorithm, statistics and cost based optimization. Transaction processing, concurrency control and recovery management: transaction model properties, state serializability, lock base protocols; two phase locking, deadlock handling.

Module 6: File Organization & Index Structures **[6L]**

File and record Concept, placing file records on disk, fixed and variable sized records, Ttypes of single-level index (primary, secondary, clustering).
Multilevel indices, dynamic multilevel indices using B-tree and B+ tree.

Text / Reference Books:

1. R. Elmasri and S. B. Navathe, "Fundamentals of Database Systems", Addison Wesley Publishing.
2. C.J. Date, "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
3. J.D. Ullman, "Principles of Database Systems", Galgottia Publication.
4. G. Jim and R. Address, "Transaction Processing : Concepts and Techniques", Morgan Kauffman.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	1	-	-	-	-	-	-	-	-
CO3	3	3	3	1	2	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-

Course Code	YDT3003			
Course Title	Data Analytics using R			
Category	Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

In this course, the students will learn about Data analytics and its application areas.To understand the use of R-software and its fundamental concepts for data analytics. To be able to understand R Programming Decision making, functions, control statements and data structures. To be able to understand data visualization using R programming. To learn statistical methods and models for data analytics.

Course Outcome:

CO1: To understand Data analytics, its types and its applications

CO2: To get knowledge about R studio installation and R programming fundamental concepts like variable, data types, commands

CO3: To apply the basics in R programming in terms of functions, loops, decision

making and data structure.

CO4: To design various experiments based on graphs and charts for data visualization in R programming.

CO5: To apply of statistical computations for data analytics.

Course Content:

Module 1: Introduction to Data Analysis **[5L]**

Overview of Data Analytics, Need of Data Analytics, Nature of Data, Classification of Data: Structured, Semi-Structured, Unstructured, Characteristics of Data, Applications of Data Analytics

Module 2: Introduction to R Programming **[5L]**

Overview of R programming, Features of R, Applications of R, Introduction and Installation of R Studio, Creation and Execution of R File in R Studio, Clear the Console and the Environment in R Studio , Basic Syntax in R Programming , R Commands, Variables and scope of variables, Data Types, Operators, Keywords

Module 3: R Programming Basics **[8L]**

How to take Input from user in R, Output in R using different functions, Decision making statements, Looping statements, Break next, return statements, Switch case, Data Structure in R: Vectors , Lists , Data frames , Matrices, Arrays.

Module 4: Data Visualization using R **[8L]**

Reading and getting data into R (External Data): Using CSV files, XML files, Web Data, JSON files, Databases, Excel files. Working with R Charts and Graphs: Bar Charts, Line Graphs, Scatterplots, Pie Charts, Boxplots, Histograms

Module 5: Statistics with R: **[10L]**

Mean, Median and Mode, Variance and Standard Deviation, Descriptive Analysis, Normal Distribution, Binomial Distribution, Analysis of Variance (ANOVA) Test : One Way & Two Way ANOVA, Regression: Linear and Multiple Linear Regression, Logistic Regression. Time Series Analysis, Survival Analysis.

Text / Reference Books:

1.“R for Everyone”, Jared P Lander, Pearson Education 2017, Latest Edition.
2. “Beginning R: An Introduction to Statistical Programming”-Larry Pace, Latest Edition.
3. “Big Data Fundamentals” Thomas Erl, Wajid Khattak,and Paul Buhler:: Concepts, Dribers and techniques , Pearson, Latest Edition.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Course Code	YDT3004			
Course Title	Artificial Intelligence			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Design and Analysis of Algorithms			

Learning Objective:

In this course, the students will learn the basic concepts, theories and techniques of artificial intelligence and also help students to learn the application of machine learning / AI algorithms in different fields of Computer Engineering.

Course Outcome:

CO1: Explain the basic concept of Artificial Intelligence and its applications.

CO2: Classify and analyze various AI tools and techniques.

CO3: Learn and evaluate various AI algorithms.

CO4: Apply the basic understanding of artificial intelligence in real-world applications.

CO5: Evaluate and assess the performance, effectiveness, and ethical implications of artificial intelligence systems in various real-world applications.

Course Content:

Module 1: Introduction to Artificial Intelligence (AI) [7L]

Overview: foundations, scope, problems, and approaches of AI. Intelligent agents: reactive, deliberative, goal-driven, utility-driven, and learning agents.

Module 2: AI Techniques [7L]

Artificial Intelligence programming techniques, Problem-solving through Search: forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural, stochastic, and evolutionary search algorithms, sample applications.

Module 3: Planning and Representation in AI [8L]

Planning: planning as search, partial order planning, construction and use of planning graphs, Representing and Reasoning with Uncertain Knowledge: probability, connection to logic, independence, Bayes rule, Bayesian networks, probabilistic inference, sample applications.

Module 4: Decision Making [8L]

Decision-Making: basics of utility theory, decision theory, sequential decision problems, elementary game theory, sample applications.

Module 5: Knowledge Acquisition [6L]

Machine Learning and Knowledge Acquisition: learning from memorization, examples, explanation, and exploration. Learning nearest neighbor, naive Bayes, and decision tree classifiers, Q-learning for learning action policies, applications.

Text / Reference Books:

1. S. Russell, P. Norvig, “Artificial intelligence: A Modern Approach”, Prentice Hall.
2. N. J. Nilsson, “Artificial Intelligence: A New Synthesis”, Morgan-Kaufmann, 1998.
3. J. Pearl, “Heuristics: Intelligent Search Strategies for Computer Problem Solving”, Addison-Wesley Publishing Company.
4. B, A. Heule, M.Van Maaren, H.Walsh, “T Handbook of Satisfiability”, IOS Press.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Course Code	YDT3005			
Course Title	Statistics II			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Basic statistics			

Learning Objective

In this course the students will learn about the basic knowledge about the various concepts in statistics. Understand the application of correlation and regression. Understand various tests for data analysis

Course Outcome:

CO1: Understand the basic principles of regression and correlation.

CO2: To explain the methods of estimation that fits the phenomena.

CO3: To explain and demonstrate the testing of hypothesis

CO4: To explain and demonstrate the non-parametric test

CO5: Perform correlation, regression analysis and appropriate statistical tests for real life situation

Course Content:

Module 1: **[8L]**

Simple linear regression & correlation, multiple regression & multiple correlation, Analysis of variance.

Module 2: **[12L]**

Estimation: Concepts of point estimation, Criterion of a good estimator, unbiasedness, sufficiency, consistency and efficiency. Point estimation, criteria for good estimates (un-biasedness, consistency),

Methods of Estimation: Method of moments, method of maximum likelihood estimation, method of minimum Chi-square, basic idea of Bayes estimators.

Module 3: **[8L]**

Nonparametric Tests: Introduction and Concept, Parametric versus non-parametric tests, advantages and disadvantages of non-parametric tests. Test for randomness based on total number of runs, Empirical distribution function, Kolmogrov Smirnov test for one sample, Sign tests- one sample.

Module 4: **[8l]**

Kolmogrov Smirnov two samples test, Spearman's Rank-Correlation test, Wilcoxon signed rank tests, Wilcoxon-Mann- Whitney U test, Kruskal-Wallis test.

Text/Reference Books:

1.Goon A.M., Gupta M.K.: Das Gupta.B. (2005), Fundamentals of Statistics, Vol. I, World Press, Calcutta.

2. Gun, A.M., Gupta, M.K. and Dasgupta, B.: An Outline of Statistical Theory, Vol.II, (4thed.), World Press

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	-	-	-	-	-	-	-	1
CO2	3	2	1	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	2	2	-	-	-	-	-	-	-	-	1
CO5	3	2	2	1	-	-	-	-	-	--	-	1

Course Code	YDT3102			
Course Title	Data Base Management System Laboratory			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Data Structures and Algorithms Laboratory			

Learning Objective:

In this course, the students will able to learn the data models, conceptualize and depict a database system; learn the fundamental concepts of SQL queries; understand the concept of designing a database with the necessary attributes; know the methodology of Accessing, Modifying and Updating data & information from the relational databases; learn database design as well as to design user interface and how to connect with database.

Course Outcome:

CO1: To understand the basic concepts regarding database, SQL queries

CO2: To explain the concepts of PL/SQL

CO3: To differentiate between DBMS and advanced DBMS.

CO4: To analyze database system concepts and apply normalization to the data base

CO5: To apply and create different transaction processing and concurrency control applications

Suggestive List of Experiments:

1.Experiments on fundamentals of data base systems **[2 days]**
Creating a Database
Creating a Table
Specifying Relational Data Types
Specifying Constraints
Creating Indexes

2.Experiments on database Tables and Record handling **[2 days]**
INSERT statement
Use of SELECT and INSERT together
DELETE, UPDATE, TRUNCATE statements
DROP, ALTER statements

3.Experiments on retrieving data from database **[3 days]**
The SELECT statement
Use of the WHERE clause
Use of the Logical Operators in the WHERE clause
Use of IN, BETWEEN, LIKE , ORDER BY, GROUP BY and HAVING Clause
Use of the Aggregate Functions
Combining tables using JOINS Sub-queries

4.Experiments on Miscellaneous Database Management **[1 day]**
Creating Views
Creating Column Aliases
Creating Database Users
Use of GRANT and REVOKE

5.Experiments on PL/SQL **[1 day]**
Use of decision-making statement, different loop structures to solve simple programs (e.g., sum of few numbers, pattern prints, etc.). Inserting values into tables, reading data from a table. Basic working with CURSORS

6.Innovative Experiments **[3 days]**
Case study of handling complex databases (e.g., College Management System, Hospital management System, Library management System, Payroll management System, etc.)

Text / Reference Books:

1. H. F. Korth and A. Silberschatz, "Database System Concepts", McGraw Hill.
2. E. Ramez and S. Navathe, "Fundamentals of Database Systems", Benjamin Cummings Publishing Company.
3. C. J. Date, "Introduction to Database Management", Vol. I, II, III, Addison Wesley.
4. G. Jim and R. Address, "Transaction Processing : Concepts and Techniques", Moragan Kauffman.
5. J.D. Ullman, "Principles of Database Systems", Galgottia Publication.
6. I. Bayross , "SQL, PL/SQL the Programming Language of Oracle", BPB Publications.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Course Code	YDT3103			
Course Title	Data Analytics Laboratory using R			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Data Structures and Algorithms Laboratory			

Learning Objective:

In this course, the students will learn about Data analytics and its application areas.To understand the use of R-software and its fundamental concepts for data analytics. To be able to understand R Programming Decision making, functions, control statements and data structures. To be able to understand data visualization using R programming. To learn statistical methods and models for data analytics.

Course Outcome:

CO1: To understand Data analytics, its types and its applications

CO2: To get knowledge about R studio installation and R programming fundamental concepts like variable, data types, commands

CO3: To apply the basics in R programming in terms of functions, loops, decision

making and data structure.

CO4: To design various experiments based on graphs and charts for data visualization in R programming.

CO5: To apply of statistical computations for data analytics.

Suggestive List of Experiments:

(1)Write R script for some inbuilt functions like :
help(),c(),ls(),rm(),sqrt(),seq(),min(),max(),assign(),print().
(2) Write a R program to take input from the user (name and age) and
display the values. Also print the version of R installation.
(3) Write a program to use R as a calculator.
(4) Write R script to perform arithmetic and logical operations
(5) Write a program to assign value to a variable in difference ways.
(6)Write R script to create an array, passing in a vector of values and a vector of dimensions. Also provide names for each dimension.
(7) Write R script to create a 4 × 4 matrix , 3 × 3 matrix with labels and fill the matrix by rows and 2 × 2 matrix with labels and fill the matrix by columns.
(8) Write R script to create 3 x 3 matrix to perform addition, subtraction, multiplication and division operations.
(9) Write R script to print even numbers from 10 to 30 using all available loops in R.
(10) Write R script to print result as given below using decision making statements:>70 Distinction,>60 First ,>40 pass
(11)Write R script to read and write excel
(12) Write R script to read and write csv file.
(13) Write R script to read and write XML file.

(14) Writ4e R script to read and download Web data file
(15)Write R script to create bar chart(3 different styles preferable).
(16) Write R script to create single and multiple Line graph (3 different styles preferable).
(17) Write R script to create scatter plot.(3 different styles preferable).
(18) Write R script to create pie chart(5 different styles preferable).
(19)Write R script to calculate mean , median and mode of given data.
(20) Write R script for finding probability by using Normal distribution. (21) Write R script for finding probability by using Binomial distribution.
(22) Write R script for Analysis of Variance (ANOVA) Test :One Way & Two Way ANOVA.
(23) Write R script for Linear and Multiple Regression.
(24) Write R script for Logistic Regression
(25) Write R script for Time Series Analysis

Text / Reference Books:

1."Introductory Statistics with R", P Dalgaard, Second edition.

2. "Beginning R-The statistical Programming language", Mark Gardner, John wiley & sons 2012, Latest Edition.

3. "An Introduction to R" , Notes on R: A Programming Environment for Data Analysis and Graphics. W. N. Venables, D.M. Smith and the R Development Core Team. Version3.0.1 (2013-05-16).

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	-
CO2	3	2	2	1	2	-	-	-	-	-	-	-
CO3	1	2	3	-	-	-	-	-	-	-	-	-
CO4	3	1	2	2	1	-	-	-	-	-	-	-
CO5	2	2	3	1	-	-	-	-	-	-	-	-

Course Code	YDT3104			
Course Title	Artificial Intelligence Laboratory			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Design and Analysis of Algorithms			

Learning Objective:
In this course, students will learn the basic principles, techniques, and applications of Artificial Intelligence and Machine Learning for problem-solving, inference, perception, knowledge representation, and puzzles design.

Course Outcomes:

CO1: Explain the working principles of PROLOG/LISP and apply LIST structure of PROLOG.

CO2: Apply reasoning and inference principles to real-world problems and design programs to solve various puzzles.

CO3: Design simple algorithms for data classification in Python/R and test them with benchmark datasets.

CO4: Design simple algorithms for data clustering in Python/R and test them with benchmark datasets.

CO5: Analyze and evaluate algorithms for estimation/prediction using regression.

Course Content:

Suggestive List of Experiments:

In this laboratory, students will be familiarized with PROLOG/LISP language. The experiments are structured into four modules.

1. Module 1 (4 days):

Introduction to PROLOG facts & rules using a simple family tree.
Explanation of how goals are given in PROLOG and simple queries on the family tree.
Formation of recursive definitions and how PROLOG executes goals.
Implementation of Graph Search algorithms like DFS, BFS.
Implementation of well-known puzzles like the 8-queens problem, Towers-of-Hanoi problem, etc.

2. Module 2 (4 days):

Implementation of Classifiers: KNN, Naive Bayes Classifier, Decision Tree, SVM, Perceptron, Multi-Layer Perceptron, Random Forest, etc., on Python/R platform and test them on benchmark datasets. Familiarization with ML Tools: Excel, WEKA, R, Python for classification.

3. **Module 3 (3 days):**

Implementation of data clustering algorithms: K-Means, DBSCAN, Hierarchical (AGNES/DIVISIVE), etc., on Python/R platform and test them on benchmark datasets. Familiarization with ML Tools: Excel, WEKA, R, Python for clustering.

4. Module 4 (1 day):

Implementation of Regression (single and Multiple Variables) linear and non-linear, Logistic regression for prediction tasks.

Text / Reference Books:

1. S. Russell, P. Norvig, "Artificial intelligence: A Modern Approach", Prentice Hall.
2. N. J. Nilsson, "Artificial Intelligence: A New Synthesis", Morgan-Kaufmann, 1998.
3. J. Pearl, "Heuristics: Intelligent Search Strategies for Computer Problem Solving", Addison-Wesley Publishing Company.
4. B, A. Heule, M.Van Maaren, H.Walsh, "T Handbook of Satisfiability", IOS Press.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	1	2	3	2	0	0	3	0	0	3
CO2	2	2	1	1	1	1	0	0	0	0	0	3
CO3	1	3	1	2	2	1	0	0	1	0	0	3
CO4	2	2	2	1	1	1	0	0	1	0	0	3
CO5	2	1	1	1	2	2	0	0	2	0	0	3

Semester 4
Curriculum and Detailed Syllabus

SEMESTER-4							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT4001	Data Visualization	3	0	0	3
2		YDT4002	Machine Learning	3	0	0	3
3		YDT4003	Data Security & Privacy	3	0	0	3
4		YDT4004	Numerical Methods	3	1	0	4
5		YDT4005	Cloud Computing	3	0	0	3
B.PRACTICAL							
6		YDT4101	Data Visualization Lab	0	0	3	1.5
7		YDT4102	Machine Learning Lab using python	0	0	3	1.5
9		YDT4105	Cloud Computing Lab	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES(Non-CGPA)							
10		JSC4502	Soft Skill & Aptitude	1	0	0	0
11		JSC4503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**14**	**0**	**15**	**22**

Course Code	YDT4001			
Course Title	Data Visualization			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Data Structure & Algorithm			

Learning Objective:

To understand the basic concepts of Data science, Data Visualization; ability to apply AI and Data Science in different domain; and do exploratory analysis on a given data.

Course Outcome:

CO1: Use R to carry out basic statistical modelling and analysis

CO2: Explain the significance of exploratory data analysis (EDA) in data science. Apply basic tools (plots, graphs, summary statistics) to carry out EDA

CO3: Apply EDA and the Data Science process in a case study.

CO4: Create effective visualization of given data.

CO5: Describe the Data Science Process and how its components interact and work effectively in teams on data science projects.

Course Content:

Module 1: Introduction **[6L]**

Data science, data analytics, data visualization, machine learning, and Artificial Intelligence. AI in your company, AI and society. Role of Data..

Module 2: Data Science Programming **[11L]**

Introduction to R, R packages, R Markdown, Programming e.g. functions, loops, if/else, comments, Tidy data, Tabular data and data import, Strings and regular expressions.

Module 3: Manipulation of Data **[8L]**

Data Wrangling, Data manipulation dplyr. Plotting- Visualization with ggplot2. Statistical inference using R, What-if analysis, case studies.

Module 4: Application **[11L]**

Exploratory Data Analysis and the Data Science Process, Basic tools (plots, graphs and summary statistics) of EDA. Case studies. Web scraping, Text data and Natural Language Processing. Data Visualization, Data Science and Ethical Issues, Discussions on privacy, security, ethics.

Text/Reference Books:

1. C. O'Neil and R. Schutt, "Doing Data Science, Straight Talk from The Frontline", O'Reilly. 2014. 2. P. Bruce and A. Bruce, "Practical Statistics for Data Scientists", O'Reilly Media, 2017.

3. G. James, D. Witten, T. Hastie, and R. Tibshirani, “An Introduction to Statistical Learning: with Applications in R”, Springer,2013.
4. J. M. Chambers, “Software for Data Analysis: Programming with R (Statistics and Comput- ing)”, Springer.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	**1**	**2**	**2**	**-**	-	-	-	-	-	-	**3**
CO2	**1**	**1**	**2**	**-**	**2**	**-**	-	-	-	-	-	**3**
CO3	**1**	**1**	2	**-**	**2**	**-**	-	-	-	-	**-**	**3**
CO4	**1**	**1**	3	**2**	**1**	**-**	-	-	-	-	**-**	**3**
CO5	**1**	**2**	**2**	**-**	**3**	**2**	-	-	-	-	**-**	**3**

Course Code	YDT4002			
Course Title	Machine Learning			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Probability and Statistics b) Design and Analysis of Algorithms			

Learning Objective:

It covers some of the important regression, classification, clustering, rule-based and probabilistic models and algorithms. The Themes included linear and logistic regression, regularization, decision trees, probabilistic, SVMs and neural networks, clustering and reduction in feature dimensionality.

Course Outcome:

CO1: Understand the fundamental principles and concepts of machine learning.

CO2: Implement and evaluate supervised and unsupervised learning algorithms.

CO3: Apply appropriate machine learning techniques to solve classification, regression, clustering problems.

CO4: Utilize popular machine learning libraries and frameworks such as scikit-learn, TensorFlow, and PyTorch

CO5: Design and execute experiments to analyze the performance of machine learning models.

Course Content:

Module 1: Introduction to Machine Learning [6L]

Introduction, Types of machine learning, Applications of Machine Learning, Perspectives and issues in machine learning, Tools in machine learning, basic types of data in machine learning, exploring structure of data, data preprocessing. Performance metrics - accuracy, precision, recall, sensitivity, specificity, AUC, RoC, Bias Variance decomposition.

Module 2: Probabilistic and Stochastic Models [8L]

Bayesian Learning – Bayes theorem, Concept learning, Maximum likelihood, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, Expectation maximization and Gaussian Mixture Models, Hidden Markov models.

Module 3: Supervised Learning [8L]

Introduction, Regression, Linear regression, Classification: Decision trees, k-Nereast Neighbours, Support Vector Machine, Logistic regression, Naïve Bayes, Random Forest. Artificial Neural Network: Introduction, Perceptrons, multi-layer networks and back propagation.

Module 4: Unsupervised learning: [8L]

Introduction, Supervised vs Unsupervised Cluster Analysis, K-means clustering, Hierarchical clustering. Dimension reduction: Principal Component Analysis, Linear Discriminant Analysis.

Module 5: Modelling, evaluation and Genetic algorithms: [6L]

Building the model, Training a model, evaluating a model, improving a model. Genetic Algorithms – Representing hypothesis, Genetic operators and Fitness function and selection, Simple applications of the Genetic Algorithm.

Text/Reference Books:

1.P. Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge University Press.

2.M. Mohri, A. Rostamizadeh and A. Talwalkar, "Foundations of Machine Learning", MIT Press.

3.K. P. Murphy, "Machine Learning: A Probabilistic Perspective", MIT Press.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	1	2	3	2	0	0	3	-	-	3
CO2	**2**	2	1	1	1	1	-	-	-	-	-	3
CO3	**1**	3	1	2	2	1	-	-	1	-	-	3
CO4	2	2	2	1	1	1	-	-	1	-	-	3
CO5	**2**	1	1	1	**2**	2	-	-	2	-	-	3

Course Code	YDT4003			
Course Title	Data Privacy and Security			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Data Structure & Algorithm			

Learning Objective:

The objective of this course is to create architectural, algorithmic and technological foundations for the maintenance of the privacy of individuals, the confidentiality of organizations, and the protection of sensitive information, despite the requirement that information be released publicly or semi-publicly.

Course Outcome:

CO1: To understand the concepts of privacy in today's environment

CO2: To obtain the understanding of how automation is changing the concepts and expectations concerning privacy and the increasingly interconnected issue of security

CO3: To obtain the knowledge of the role of private regulatory and self-help efforts

CO4: To have an understanding of how emerging issues are affecting society and business, with a concentration on how information security must shape corporate practices

CO5: Comprehend the Information Security and Privacy Compliance Requirements

Course Content:

Module 1: Introduction [8L]

Fundamental Concepts, Definitions, Statistics, Data Privacy Attacks, Data linking and profiling, access control models, role based access control, privacy policies, their specifications, languages and implementation, privacy policy languages, privacy in different domains- medical, financial, etc.

Module 2: Data explosion [12L]

Statistics and Lack of barriers in Collection and Distribution of Person-specific information, Mathematical model for characterizing and comparing real-world data sharing practices and policies and for computing privacy and risk measurements, Demographics and Uniqueness.

Module 3: Survey of Techniques [12L]

Protection models (null-map, k-map, wrong map), Disclosure control, Inferring entity identities, Strength and weaknesses of techniques, entry specific databases.

Module 4: Computation systems for protecting delimited data [8L]

MinGen, Datafly, Mu-Argus, k-Similar, Protecting textual documents: Scrub.

Module 5: Technology, Policy, Privacy and Freedom [8L]

Medical privacy legislation, policies and best practices, Examination of privacy matters specific to the World Wide Web, Protections provided by the Freedom of Information Act or the requirement for search warrants.

Text/Reference Books:

1. B. Raghunathan, The Complete Book of Data Anonymization: From Planning to Implementation,

(2013), Auerbach Pub.
2. L. Sweeney, Computational Disclosure Control: A Primer on Data Privacy Protection, (2002), MIT Computer Science.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**1**	**2**	**-**	**-**	**-**	-	-	-	-	-	-	**1**
CO2	**2**	**2**	**2**	**1**	**2**	**1**	-	-	-	-	-	**1**
CO3	**2**	**2**	2	**1**	**2**	**3**	-	-	-	-	**-**	**1**
CO4	**1**	**2**	3	**1**	**2**	**2**	-	-	-	-	**-**	**1**
CO5	**1**	**2**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**1**

Course Code	YDT4004			
Course Title	Numerical Methods			
Category				
LTP & Credits	L	T	P	Credits
	3	1	0	4
Total Contact Hours	48			
Pre-requisites	10+2 mathematics			

Learning Objective:

The objective of the course is to introduce the fundamental concepts and results in Numerical methods and to develop the student's ability to deal with different problems in real life where numerical methods are used.

Course Outcome:

CO1: Recall the distinctive principles of numerical analysis and the associated error measures.
CO2: Understand the theoretical workings of numerical techniques.
CO3: Apply numerical methods used to obtain approximate solutions to intractable mathematical problems such as interpolation, integration, the solution of linear and nonlinear equations, and
CO4: Understand the theoretical workings of the solution of ordinary differential equations.
CO5: Select appropriate numerical methods to apply to various types of problems in engineering and science

Course Content:

Module 1: Error Analysis and Interpolation [12L]

Numerical errors and their computations, Truncation and rounding errors, Calculus of differences: Forward, Backward, Shift, Average, Central, Differential and Divided difference operators, Relation between the operators, Problems on missing terms Interpolation: Newton's forward and backward interpolation, Lagrange's interpolation, Newton's divided difference, related problems.

Module 2: Numerical Integration [7L]

Numerical Integration: General quadrature formula, Trapezoidal rule, Simpson's $1/3^{rd}$ rule, Expression for corresponding error terms, related problems.

Module 3: Numerical Solution of Linear and Non-linear Equations [8L]

Solutions of Nonlinear Equations: Bisection method, Regula–Falsi method, Method of Iteration, Newton Raphson method, related problems.

Module 4: Numerical Solution of a System of Linear Equations [12L]

Gauss elimination method, Matrix inverse method, Gauss-Jacobi iterative method, Gauss-Seidel iterative method, related problems.

Module 5: Numerical Solution of Differential Equation **[9L]**

Euler's method, Runga-Kutta method order two, Runga-Kutta method of order 4, Predictor-Corrector method, related problems.

Reference Books:

1. S.S.Sastry, "Introductory Methods of Numerical Analysis", PHI.

2. S.A.Mollah, "Numerical Analysis and Computational Procedure", Books & Allied Pvt. Ltd.

3.Jain, Iyenger & Jain, Numerical Methods, New Age International Publishers.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT4005			
Course Title	Cloud Computing			
Category				
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

This course provides an insight into cloud computing Topics covered include- distributed system models, different cloud service models, service-oriented architectures, cloud programming and software environments, resource management.

Course Outcome:

CO1: Articulate the main concepts, key technologies, strengths and limitations of cloud computing.
CO2: Explain the key and enabling technologies that help in the development of cloud.
CO3: Explain the core issues of cloud computing such as resource management and security
CO4: Install and use current cloud technologies.
CO5: Illustrate and choose the appropriate technologies, algorithms and approaches for implementation and use of cloud.

Course Content:

Module 1: Cloud Computing Overview [10L]

Origins of Cloud computing – Cloud components - Essential characteristics – On-demand self-service, Broad network access, Location independent resource pooling, Rapid elasticity, measured service, Comparing cloud providers with traditional IT service providers, Roots of cloud computing

Module 2: Cloud Insights [8L]

Architectural influences – High-performance computing, Utility and Enterprise grid computing, Cloud scenarios – Benefits: scalability, simplicity, vendors, security, Limitations – Sensitive information - Application development- security level of third party - security benefits, Regularity issues: Government policies.

Module 3: Cloud Architecture- Layers and Models [8L]

Layers in cloud architecture, Software as a Service (SaaS), features of SaaS and benefits, Platform as a Service (PaaS), features of PaaS and benefits, Infrastructure as a Service (IaaS), features of IaaS and benefits, Service providers, challenges and risks in cloud adoption.

Cloud deployment model: Public clouds – Private clouds – Community clouds - Hybrid clouds - Advantages of Cloud computing.

Module 4: Cloud Simulators [10L]

CloudSim and GreenCloud: Introduction to Simulator, understanding CloudSim simulator, CloudSim Architecture(User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud.

Introduction to VMWare Simulator: Basics of VMWare, advantages of VMware virtualization, using Vmware workstation, creating virtual machines- understanding virtual machines, create a new virtual machine on local host, cloning virtual machines, virtualize a physical machine, starting and stopping a virtual machine.

Reference Books:

1. Cloud computing a practical approach‖ - Anthony T.Velte , Toby J. Velte Robert Elsenpeter, TATA McGraw- Hill , New Delhi – 2010

2. Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online‖ - Michael Miller - Que 2008

3. Cloud computing for dummies‖- Judith Hurwitz , Robin Bloor , Marcia Kaufman ,Fern Halper, Wiley Publishing, Inc, 2010

4. Cloud Computing (Principles and Paradigms)‖, Edited by Rajkumar Buyya, James Broberg, Andrzej Goscinski, John Wiley & Sons, Inc. 2011

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT4101			
Course Title	Data Visualization Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

To understand the need of different datasets visualization
Can perform descriptive and inferential analysis on data sets
Can create visualization using modern tool
Can develop analytical products
Identify opportunities for application of data visualization in various domains

Course Outcome:

CO1: Design and create data visualizations.
CO2: Conduct exploratory data analysis using visualization.
CO3: Craft visual presentations of data for effective communication.
CO4: Use knowledge of perception and cognition to evaluate visualization design alternatives.
CO5: Use JavaScript with D3.js to develop interactive visualizations for the Web.

Suggestive List of Experiments:

1. Defining data visualization

2. Visualization workflow: describing data visualization workflow, process in practice.

3. Data Representation: chart types: categorical, hierarchical, relational, temporal & spatial.

4. 2-D: bar charts, Clustered bar charts, dot plots, connected dot plots, pictograms, proportional shape charts, bubble charts, radar charts, polar charts, Range chart, Box-and-whisker plots, univariate scatter plots, histograms word cloud, pie chart, waffle chart, stacked bar chart, back-to-back bar chart, treemap and all relevant 2-D charts.

5. 3-D: surfaces, contours, hidden surfaces, pm3d coloring, 3D mapping

6. Multi-dimensional data visualization

7. Manifold visualization

8. Graph data visualization

Text / Reference Books:

1. A. Kirk, “Data Visualization A Handbook for Data Driven Design, Sage Publications, 2016.
2. P. K. Janert, “Gnuplot in Action, Understanding Data with Graphs”, Manning Publications, 2010.
3. E. Siegel, T. H. Davenport, “Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die”, Wiley, 2013

4. A.Cordoba, “Understanding the Predictive Analytics Lifecycle”, Wiley, 2014.
5. J. R. Evans, “Business Analytics – Methods, Models and Decisions”, Pearson 2013.
6. R. N. Prasad, S. Acharya, “Fundamentals of Business Analytics”, Wiley, 2015

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3

Course Code	YDT4102			
Course Title	Machine Learning Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

It covers some of the important regression, classification, clustering, rule-based and probabilistic models and algorithms. The Themes included linear and logistic regression, regularization, decision trees, probabilistic, SVMs and neural networks, clustering and reduction in feature dimensionality.

Course Outcome:

CO1: Understand the Basic operations of Linear Algebra in Machine Learning

CO2: Use various Supervised Learning techniques like Linear Regression and Nonlinear Regression

CO3: Apply Statistical approaches for multiple Learning techniques

CO4: Construct models for Classification

CO5: Build neural network models

Suggestive List of Experiments:

1. Write a Program to perform the following operations on matrices
a) Matrix addition
b) Matrix Subtraction
c) Matrix Multiplication
d) Matrix Inversion
e) Transpose of a Matrix
2. Write a Program to perform the following operations
a) Find the minimum and maximum element of the matrix
b) Find the minimum and maximum element of each row in the matrix
c) Find the minimum and maximum element of each column in the matrix
d) Find trace of the given matrix
e) Find rank of the given matrix
f) Find eigenvalues and eigenvectors of the given matrix.

3. Write a Program to find the mean, median, standard deviation and mode using user defined functions
4. Create a data frame with columns at least 5 observations
a) Retrieve a particular column from the Data Frame
b) Summarize the data frame and observe the statistics of the Data Frame created
c) Observe the mean and standard deviation of the data frame and print the values.
5. Write a program to implement the Linear Regression for a sample training data set stored as

a .CSV file. Compute Mean Square Error by considering few test data sets..

6. Write a program to implement the Non-linear Regression for a sample training data set stored as a .CSV file. Compute Mean Square Error by considering few test data sets.

7. Write a program to implement the Logistic Regression for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier.

8. 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 data sets.

9. Write a program to implement k-Nearest Neighbor algorithm to classify the iris data set. Print both correct and wrong predictions.

10. Write a program to implement Support Vector Machine algorithm to classify the iris data set. Print both correct and wrong predictions.

11. 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.

12. Write a program to demonstrate the working of the decision tree based CART algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

13. Write a program to construct a Regression tree for cost estimation by assuming any numerical dataset.

14. Write a program to calculate the accuracy, precision, and recall for your data set. Assume a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task.

15. Implement a single neural network and test for different logic gates.

16. Build an Artificial Neural Network by implementing the Backpropagation algorithm and test the same using appropriate data sets.

Text / Reference Books:

1. Vijayvargia, Abhishek, Machine Learning with Python: An Approach to Applied Machine Learning, BPB Publications, 1st edition,2018.

2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn and TensorFlow, Oreilly, March 2017.

3. Dr. M Gopal, Applied Machine Learning, 1st Edition, McGraw-Hill,2018

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	1	2	-	-	-	-	-	-	-
CO2	2	1	3	2	3	1	-	-	-	-	-	1
CO3	1	1	1	1	1	-	-	-	-	-	-	-
CO4	2	1	2	2	3	-	-	-	-	-	-	-
CO5	1	2	1	1	1	-	-	-	-	-	-	-

Course Code	YDT4105			
Course Title	Cloud Computing Lab			
Category	Professional			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			

Learning Objective:

This course provides an insight into cloud computing. Topics covered include- distributed system models, different cloud service models, service-oriented architectures, cloud programming and software environments, resource management.

Course Outcome:

CO1: Ability to understand various service delivery models of a cloud computing architecture

CO2: Ability to understand the ways in which the cloud can be programmed and deployed. Understanding cloud service providers

CO3: Understand various models, types and challenges of cloud computing

CO4: Understand the design of cloud native applications, the necessary tools and the

design tradeoffs

CO5: Realize the importance of Cloud Virtualization, Abstraction`s, Enabling Technologies and cloud security

Suggestive List of Experiments:

1. Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs.
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using trystack (Online Openstack Demo Version)
8.Install Hadoop single node cluster and run simple applications like wordcount.

Text/Reference Books:

1. "The Internet of Things: Enabling Technologies, Platforms, and Use Cases", by Pethuru Raj and Anupama C. Raman ,CRC Press.
2. Adrian McEwen, Designing the Internet of Things, Wiley,2013.

3. Tim Mather, Subra Kumaraswamy, ShahedLatif (2010), Cloud Security and Privacy, OREILLY Media.
4. RajkumarBuyya, James Broberg, AndrzejGoscinski(2011),CLOUD COMPUTING Principles and Paradigms, John Wiley & Sons, Inc., Hoboken, New Jersey.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Semester 5
Curriculum and Detailed Syllabus

SEMESTER-5							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A. THEORY							
1		YDT5001	Deep Learning	3	0	0	3
2		YDT5002	Multivariate Data Analysis	3	0	0	3
3		YDT5003	Social and web media analytics	3	0	0	3
4		YDT5004	Time Series Analysis and Forecasting	3	0	0	3
5		YDT5005	Applied Regression Analysis	3	0	0	3
6		**Elective II**		3	0	0	3
		YDT5006	Analytics for Service Industry				
		YDT5007	Business and Financial Analytics				
B. PRACTICAL							
7		YDT5102	Multivariate Data Analysis Lab	0	0	3	1.5
8		YDT5101	Deep Learning Lab using Python	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
			Behavioral an Interpersonal skills	3	0	0	0
		JSC5503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**18**	**0**	**6**	**21**

Course Code	YDT5001			
Course Title	Deep Learning			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Machine Learning			

Course Outcome:

CO1: Make use of deep learning APIs like Keras

CO2: Implement multiple conversions for Analysis

CO3: Apply deep learning techniques for object identification and segmentation

CO4: Implement RNN and CNN for multiple problems

CO5: Implement Autoencoders and GAN.

Course Content:

Module 1: Introduction **[8L]**

Introduction to deep learning, Neural Network Basics, Backpropagation, Feed forward Neural Network, Logistic Regression.

Module 2: Key Concepts **[6L]**

Key concepts on Deep Neural Networks, Shallow Neural Network, Planar data classification with a hidden layer, Building your Deep Neural Network: step by step

Module 3: Optimization **[8L]**

Hyperparameter Tuning, Batch Normalization, Regularization, Gradient Checking.

Generative Adversarial Networks: Practical aspects of deep learning, Generative Adversarial Networks (GAN), Conditional GAN, Super Resolution GAN, Cycle GAN.

Module 4: Deep Reinforcement Learning **[8L]**

Deep Reinforcement Learning, Hyperparameter Tuning, Batch Normalization.

Module 5: Convolutional Neural Network **[6L]**

Foundations of Convolutional Neural Network, Deep Convolutional Models.

Text/Reference Books:

1. I. Goodfellow, Y. Bengio and A. Courville, “Deep Learning”, MIT Press.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3

Course Code	YDT5002			
Course Title	Multivariate Data Analysis			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Basics of Mathematics and Statistics			

Learning Objective:

The main objectives of this course are to:

1. Distinguish between dependence and interdependence techniques
2. Fit the various regression models and predict the results
3. Perform the dimension reduction techniques and interpret the results
4. Discriminate and classify the given objects by using target variable
5. Form the groups by using suitable clustering techniques

Course Outcome:

CO1: Distinguish between dependence and interdependence techniques

CO2: Fit the various regression models and predict the results

CO3: Perform the dimension reduction techniques and interpret the results

CO4: Discriminate and classify the given objects by using target variable

CO5: Form the groups by using suitable clustering techniques

Course Content:

Module 1: Introduction to Multivariate Analysis **[8L]**

Meaning of Multivariate Analysis – Multivariate Analysis in Statistical Terms – Basic concepts: Variate, Measurment Scales, Measurement Error, Multivariate Measurement, Statistical Significance and Statistical Power. Classification of Multivariate Techniques: Dependence and Independence Techniques – Applications of Multivariate Techniques.

Module 2: Multiple Regression Analysis **[8L]**

Concept of Simple and Multiple Regressions – Illustrations. Prediction using Single and Several Independent Variables – Decision Process in Multiple Regression Analysis: Objectives, Research Design, Assumptions, Estimation of Regression Model – Assessing Model Fit – Interpretation of Regression Variate using Regression Coefficients and Assessing Multicollinearity.

Module 3: Factor Analysis **[8L]**

Notion of Principal Components and Factors – Concept of Data Summarization and Data Reduction - Introduction to Principal Component Analysis and Factor Analysis – Illustrations. Decision Process in Factor Analysis: Objectives, Design, Assumptions, Deriving Factors, Interpretation of Factors, Validation of Factors – Illustrations.

Module 4: Discriminant Analysis **[6L]**

Concept of Discriminant Function – Meaning of Discriminant Analysis – Decision Process in Discriminant Analysis: Objectives, Research Design, Assumptions, Estimation of Discriminant Model, Assessing Model Fit, Interpretation.

Module 5: Cluster Analysis **[6L]**

Meaning and Conceptual Development of Cluster Analysis – Decision Process in Cluster Analysis: Objectives, Research Design, Assumptions, Deriving Clusters, Interpretation of Clusters, Validation and Profiling of Clusters – Illustrations – Basic Notion of Hierarchical and Non-hierarchical Clusters

Reference Books:

1. Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2018). Multivariate Data Analysis, Eighth Edition, Pearson.
2. Johnson, R. A., and Wichern, D. W. (2015). Applied Multivariate Statistical Analysis, Sixth Edition, Pearson.
3. Johnson, D. E. (1998). Applied Multivariate Methods for Data Analysts, First Edition, Duxbury Press.

CO-PO Mapping:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1
CO5	3	3	3	-	-	-	-	-	-	-	-	1

Course Code	YDT5003			
Course Title	Social and Web Media Analytics			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Data Science and Data analytics			

Learning Objective:

The aim of this course unit is to showcase the opportunities that exist today to leverage the power of the Web and social media; to develop students' expertise in assessing web marketing initiatives, evaluating web optimisation efforts, and measuring user experience; and to equip students with skills to collect, analyse and derive actionable insights from web click-stream, social media chatter, usability testing and experiments.

Course Outcome:

CO1: Remember the concept of social media analytics and understand its significance and potential impact.

CO2: Understand usability metrics and identify key performance indicators for a given goal, identify data relating to the metrics and key performance indicators.

CO3: Understand web and social media metrics and analyse and interpret the data generated from usability testing, questionnaire surveys, or collected from Web and social media tracking tools.

CO4: Design and conduct usability studies using various data sources and collect data relating to the metrics and key performance indicators.

CO5: Understand and use ready-made web analytics tools (Google Analytics) and a statistical programming language (R) and use its graphical development environment (Deduce) for data exploration and analysis.

Course Content:

Module 1: Introduction to Web and Social Media [6L]

Web and social media (Web sites, web apps, mobile apps and social media), Usability, user experience, customer experience, customer sentiments, web marketing, conversion rates, ROI, brand reputation, competitive advantages, Web analytics and a Web analytics 2.0 framework (clickstream, multiple outcomes analysis, experimentation and testing, voice of customer, competitive intelligence, Insights)

Module 2: Measuring user experience [6L]

Usability metrics (performance metrics, issues-based metrics, self-reported metrics), Planning and performing a usability study (study goals, user goals, metrics and evaluation methods, participants, data collection, data analysis), Typical types of usability studies and their corresponding metrics (comparing alternative designs, comparing with competition, completing a task or transaction, evaluating the impact of subtle changes)

Module 3: Web metrics and web analytics [6L]

PULSE metrics (Page views, Uptime, Latency, Seven-day active users) on business and technical issues; HEART metrics (Happiness, Engagement, Adoption, Retention, and Task success) on user behaviour issues; On-site web analytics, off-site web analytics,the goal-signal-metric process.

Module 4: Social media analytics [13L]

Social media analytics (what and why); Social media KPIs (reach and engagement); Performing social media analytics (business goal, KPIs, data gathering, analysis, measure and feedback)

Module 5: Data analysis language and tools **[5L]**

Ready-made tools for Web and social media analytics (Key Google Analytics metrics, dashboard, social reports); Statistical programming language (R), its graphical development environment (Deducer) for data exploration and analysis, and its social media analysis packages (RGoogleTrends, twitteR); Usability study planning and testing; and data analysis using software tools (Google Analytics, Google Sites, R and Deducer).

Text/Reference Books:

1. A. Kaushik, " Web Analytics 2.0: The Art of Online Accountability and Science of Customer Centricity (Pap/Cdr Ed.)", John Wiley Sons.
2. T. Tullis, B. Albert, "Measuring the User Experience: Collecting, Analyzing, and Presenting Usability Metrics (1st Ed.)", Morgan Kaufmann.
3. J. Sterne, "Social Media Metrics: How to Measure and Optimize Your Marketing Investment (1st Ed.)", John Wiley Sons.
4. B. Clifton, " Advanced Web Metrics with Google Analytics (3rd Ed.)", John Wiley Sons.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	2	**1**	1	2	-	-	**-**	**1**	**-**
CO2	2	2	1	2	**1**	**1**	-	-	-	-	2	**1**
CO3	3	3	3	3	3	1	2	-	-	-	**1**	2
CO4	3	3	2	3	2	2	1	-	-	-	2	3
CO5	3	3	2	3	2	2	1	-	-	-	2	3

Course Code	YDT5004			
Course Title	Time Series Analysis and Forecasting			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Probability and Statistics b) Design and Analysis of Algorithms			

Learning Objective:

Present time series in an informative way, both graphically and with summary statistics, Model time series to analyses the underlying structure(s) in both the time and frequency domai

Course Outcome:

CO1: Forecast the trend pattern exhibited by the given data by using various methods

CO2: Run and interpret time series models and regression models for time series

CO3: Use the Box-Jenkins approach to model and forecast time series data empirically.

CO4: Analyze and estimate the cyclic components using special processes.

CO5: To implement the concept in real life problem

Course Content:

Module 1: Introduction to Trend **[8L]**

Introduction to times series data, application of time series from various fields, Components of a time series, Decomposition of time series. Trend: Estimation of trend by free hand curve method, method of semi averages, fitting a various mathematical curve, and growth curves.

Module 2: Trend and Seasonal Component **[10L]**

Method of moving averages. Detrending. Effect of elimination of trend on other components of the time series. Seasonal Component: Estimation of seasonal component by Method of simple averages, Ratio to Trend, Ratio to moving average and Link relatives.

Module 3: Forecasting **[8L]**

Variate component method: Stationary Time series: Weak stationary, auto correlation function and correlogram of moving average .Forecasting: Exponential smoothing methods, Short term forecasting methods: Brown's discounted regression, Box-Jenkins Method.

Module 4: Cyclic Component **[10L]**

Deseasonalization. Cyclic Component: Harmonic Analysis. Some Special Processes: Moving-average (MA) process and Autoregressive (AR) process of orders one and two, Estimation of the parameters of AR (1) and AR (2) – Yule-Walker equations.

Text/Reference Books:

1. Kendall M.G. (1976): Time Series, Charles Griffin.
2. Chatfield C. (1980): The Analysis of Time Series –An Introduction, Chapman & Hall.

3. Mukhopadhyay P. (2011): Applied Statistics, 2nd ed. Revised reprint, Books and Allied

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	1	2	3	2	0	0	3	-	-	3
CO2	**2**	2	1	1	1	1	-	-	-	-	-	3
CO3	**1**	3	1	2	2	1	-	-	1	-	**-**	3
CO4	2	2	2	1	1	1	-	-	1	-	-	3
CO5	**2**	1	1	1	**2**	2	-	-	2	-	**-**	3

Course Code	YDT5005			
Course Title	Applied Regression Analysis			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Database Management Systems b) Data Science			

Learning Objective:

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

Course Outcome:

CO1: Understand the basics of regression analysis

CO2: Build and fit simple and multiple linear regression models

CO3: Validate the modelling assumptions with formal tests

CO4: Diagnose the model violations

CO5: Model qualitative data

Course Content:

Module 1: Introduction **[5L]**

Regression Analysis - Publicly Available Data Sets - Applications - Steps in Regression Analysis

Module 2: Simple Linear Regression **[8L]**

Introduction - Covariance and Correlation Coefficient - The Simple Linear Regression Model - Parameter Estimation - Tests of Hypotheses - Confidence Intervals - Predictions - Measuring Quality of Fit - Regression Line Through the Origin - Trivial Regression Models

Module 3: Multiple Linear Regression **[7L]**

Introduction - Description of the Data and Model - Supervisor Performance Data - Parameter Estimation - Interpretations of Regression - Centering and Scaling - Properties of the Least Squares Estimators - Multiple Correlation Coefficient - Inference for Individual Regression Coefficients - Tests of Hypotheses in a Linear Model

Module 4: Regression Diagnostics **[8L]**

Detection of Model Violations Introduction - Standard Regression Assumptions - Various Types of Residuals - Graphical Methods - Graphs Before and After Fitting a Model

Module 5: Logistic Regression **[8L]**

Introduction - Modeling Qualitative Data - The Logit Model - Estimating Probability of Bankruptcies - Logistic Regression Diagnostics

Text/Reference Books:

1.Samprit Chatterjee and Ali S. Hadi, Regression Analysis by Example, John Wiley and Sons, 5th Edition , 2013.

2.Samprit Chatterjee and Jeffrey S. Simonoff, Handbook of

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT5006			
Course Title	Analytics for Service Industries			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Objectives

1. Recognize challenges in dealing with data sets in service industry.

2. Identify and apply appropriate algorithms for analyzing the healthcare, Human resource, hospitality and tourism data.

3. Make choices for a model for new machine learning tasks.

Course Outcome:

CO1: Understand and critically apply the concepts and methods of business analytics

CO2: Identify, model and solve decision problems in different settings

CO3: Interpret results/solutions and identify appropriate courses of action for a given managerial situation whether a problem or an opportunity

CO4: Create viable solutions to decision making problems

CO5: Instil a sense of ethical decision-making and a commitment to the long-run welfare of both organisations and the communities they serve

Module 1: Healthcare Analytics **[8 L]**

Introduction to Healthcare Data Analytics- Electronic Health Records– Components of HER Coding Systems- Benefits of EHR- Barrier to Adopting HER Challenges-Phenotyping Algorithms. Biomedical Image Analysis and Signal Analysis- Genomic Data Analysis for Personalized Medicine. Review of Clinical Prediction Models

Module 2 Healthcare Analytics Applications **[7L]**

Applications and Practical Systems for Healthcare– Data Analytics for Pervasive HealthFraud Detection in Healthcare- Data Analytics for Pharmaceutical Discoveries- Clinical Decision Support Systems- Computer- Assisted Medical Image Analysis Systems- Mobile Imaging and Analytics for Biomedical Data.

Module 3 HR Analytics **[7 L]**

Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus

analytical thinking; HRMS/HRIS and data sources; Analytics frameworks like LAMP, HCM:21(r) Model.

Module 4 Performance Analysis **[8 L]**

Predicting employee performance, training requirements, evaluating training and development, Optimizing selection and promotion decisions.

Module 5 Tourism and Hospitality Analytics **[6 L]**

Guest Analytics – Loyalty Analytics – Customer Satisfaction – Dynamic Pricing – optimized disruption management – Fraud detection in payments.

REFERENCE BOOKS

1. Hui Yang and Eva K. Lee, "Healthcare Analytics: From Data to Knowledge to Healthcare Improvement, Wiley, 2016.

2. Fitz-enzJac, Mattox II John (2014), "Predictive Analytics for Human Resources", Wiley, ISBN- 1118940709.

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	**-**	**-**	**-**	-	-	-	-	**-**	-	-
CO2	3	2	**2**	1	**2**	**-**	-	-	-	-	**-**	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	3	1	2	-	-	-	-	-	-	1
CO5	3	3	3	2	2	-	-	-	-	-	-	1

Course Code	YDT5007			
Course Title	Business and Financial Analytics			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Objectives

1. To provide a solid foundation in business.

2. To acquire logical & analytical skills in financial analytics

Course Outcome:

CO1: Interpret and discuss the outputs of given financial models and create their own models.

CO2: Design and create visualisations that clearly communicate financial data insights.

CO3: Gain essential knowledge and hands-on experience in the data analysis process, including data scraping, manipulation, exploratory data analysis.

CO4: Be prepared for more advanced applied financial modelling courses

CO5: Improve leadership, teamwork and critical thinking skills for financial decision making.

UNIT 1 Financial Analytics **[10 L]**

Introduction: Meaning-Importance of Financial Analytics uses-Features-Documents used in Financial Analytics: Balance Sheet, Income Statement, Cash flow statement-Elements of Financial Health: Liquidity, Leverage, Profitability. Financial Securities: Bond and Stock investments - Housing and Euro crisis - Securities Datasets and Visualization - Plotting multiple series

UNIT 2 Forecasting Analytics **[10 L]**

Estimating Demand Curves and Optimize Price, Price Bundling, Non Linear Pricing and Price Skimming, Forecasting, Simple Regression and Correlation Multiple Regression to forecast sales. Modelling Trend and Seasonality Ratio to Moving Average Method, Winter‟s Method **UNIT 3 Business Intelligence & Tableau** **[10 L]**

Definition of BI – A Brief History of BI – The Architecture of BI. The origin and Drivers of BI. Successful BI Implementation – Analytics Overview – Descriptive, Predictive and Perspective Analytics. Business reporting and Visualization – components - A brief history of data visualization – Different types of charts and graphs – The emergence of data

visualization and visual analytics – Performance dashboards – Dashboard design – Best practices in dashboard design – Business performance management – Balanced Scorecards – Six sigma as a performance measurement system.

UNIT 4 Visualizations **[6 L]**

Using Tableau to Summarize Data, Slicing and Dicing Financial Data, Charts to Summarize Marketing Data. Functions to Summarize Data, Pricing Analytics, Risk based pricing, Fraud Detection and Prediction, Recovery Management, Loss Risk Forecasting, Risk Profiling, Portfolio Stress Testing.

TEXTBOOKS

1. Analysis of Economic Data, Gary Koop, (4th Edition), Wiley.

2. Statistics and Data Analysis for Financial Engineering: with R examples; David Ruppert, David S. Matteson, Springers.

CO-PO mapping

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	**-**	**-**	**-**	-	-	-	-	**-**	-	-
CO2	3	2	**2**	1	**2**	**-**	-	-	-	-	**-**	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	3	1	2	-	-	-	-	-	-	1
CO5	3	3	3	2	2	-	-	-	-	-	-	1

Course Code	YDT5101			
Course Title	Deep Learning Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

To understand the need of different datasets visualization
Can perform descriptive and inferential analysis on data sets
Can create visualization using modern tool
Can develop analytical products
Identify opportunities for application of data visualization in various domains

Course Outcome:

At the end of the Course the student shall be able to

CO1: Make use of deep learning APIs like Keras

CO2: Implement multiple conversions for Analysis

CO3: Apply deep learning techniques for object identification and segmentation

CO4: Implement RNN and CNN for multiple problems

CO5: Implement Autoencoders and GAN.

Suggestive List of Experiments:

1. Build a deep neural network model start with linear regression using a single variable.
2. Build a deep neural network model start with linear regression using multiple variables.
3. Write a program to convert speech into text.
4. Write a program to convert text into speech.
5. Write a program to convert video into frames.
6. Write a program for Time-Series Forecasting with the LSTM Model.
7. Build a feed forward neural network for prediction of logic gates.
8. Write a program to implement deep learning Techniques for image segmentation.
9. Write a program for object detection using image labeling tools.
10. Write a program to predict a caption for a sample image using LSTM.
11. Write a program for character recognition using CNN.
12. Write a program to predict a caption for a sample image using CNN.
13. Write a program for character recognition using RNN and compare it with CNN.
14. Write a program to detect Dog image using YOLO Algorithm.
15. Write a program to develop Autoencoders using MNIST Handwritten Digits.
16. Write a program to develop a GAN for Generating MNIST Handwritten Digits.

Text / Reference Books:

1. Navin Kumar Manaswi ,Deep Learning with Applications Using Python Chatbots

and Face, Object, and Speech Recognition With TensorFlow and Keras , Apress,2018.
2. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press,2016.
3. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3

Course Code	YDT5102			
Course Title	Multivariate Data Analysis Lab			
Category	Basic Science			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	Basics of Mathematics and Statistics			

Learning Objective:

The main objectives of this course are to:
1. Distinguish between dependence and interdependence techniques
2. Fit the various regression models and predict the results
3. Perform the dimension reduction techniques and interpret the results
4. Discriminate and classify the given objects by using target variable
5. Form the groups by using suitable clustering techniques

Course Outcome:

CO1: Distinguish between dependence and interdependence techniques

CO2: Fit the various regression models and predict the results

CO3: Perform the dimension reduction techniques and interpret the results

CO4: Discriminate and classify the given objects by using target variable

CO5: Form the groups by using suitable clustering techniques

Problems relating to the following topics using R / Python programming shall form the basis for setting the question paper.
1. Computation of Mean vector and covariance matrix for multivariate data set
2. Generation of multivariate data using multivariate normal distribution
3. Fitting of linear, quadratic, exponential and logistic models
4. Principal Component analysis and factor analysis
5. Linear and quadratic discriminant analysis with classification of two and three groups.
6. Cluster analysis with hierarchical clustering (single linkage, average linkage, Wards method)
and non-hierarchical clustering (k-means)

Reference Books:

1. Hair, J. F., Black, W. C., Babin, B. J., and Anderson, R. E. (2018). Multivariate Data Analysis, Eighth Edition, Pearson.
2. Johnson, R. A., and Wichern, D. W. (2015). Applied Multivariate Statistical Analysis, Sixth Edition, Pearson.
3. Johnson, D. E. (1998). Applied Multivariate Methods for Data Analysts, First Edition, Duxbury Press.

CO-PO Mapping:

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	3	2	-	-	-	-	-	-	-	-	-	1
CO2	3	2	-	-	-	-	-	-	-	-	-	1
CO3	3	2	2	-	-	-	-	-	-	-	-	1
CO4	3	3	2	-	-	-	-	-	-	-	-	1
CO5	3	3	3	-	-	-	-	-	-	-	-	1

Semester 6
Curriculum and Detailed Syllabus

SEMESTER-6							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT6001	Data warehousing and data mining	3	0	0	3
2		YDT6002	Operations Research	3	0	0	3
3		YDT6003	Principle of Management	3	0	0	3
4		YDT6004	HR Analytics	3	0	0	3
		YDT6005	Supply Chain and Logistics Analytics	3	0	0	3
		Elective III					
5		YDT6006	Marketing Analytics	3	0	0	3
		YDT6007	Data Administration & Support				
B.PRACTICAL							
6		YDT6101	Data warehousing and data mining Lab	0	0	3	1.5
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
9			Innovation, Entrepreneurship & IPR	3	0	0	0
10		JSC6503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**18**	**0**	**9**	**19.5**

Course Code	YDT6001			
Course Title	Data Warehousing and Data Mining			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a) Data Structures and Algorithms b) Database Management System			

Learning Objective:

In this course, the students will understand classical models and algorithms in data warehousing and data mining. It enables students to analyze the data, identify the problems, and choose the relevant models and algorithms to apply. This course assesses the strengths and weaknesses of various methods and algorithms and analyze their behavior.

Course Outcomes:

CO1: Understand Data Mining Fundamentals and remember the various issues in Data mining

CO2: Understand the architecture of Data warehousing and its different tools

CO3: Understand the basic of Data mining techniques and its various functionalities

CO4: Understand various issues and challenges of data mining techniques along with various applications, trends in different areas

CO5: Apply Data mining techniques in real life problem

Course Content:

Module 1: Introduction to Data Warehouse and Multi-dimensional Data [6L]

Introduction to Data Warehousing, Data warehouse Architecture and Infrastructure, Data cube and lattice structure. Star, Snowflakes and Fact Constellation models, Components. Building a Data warehouse – Mapping the Data Warehouse to a Multiprocessor Architecture, Reporting and Query tools and Applications, Tool Categories.

Module 2: Online Analytical Processing (OLAP) tools [6L]

Online Analytical Processing (OLAP) vs OLTP, Need –Multidimensional Data Model – OLAP Guidelines - ROLAP vs MOLAP vs HOLAP - Multidimensional versus Multirelational OLAP - Categories of Tools – OLAP Tools and the Internet.

Module 3: Data Mining and Knowledge Discovery Process [6L]

Introduction to Data Mining, Types of data, AI vs ML vs DL - Data Mining Functionalities, Data Mining Systems and Task Primitives - Integration of a Data Mining System with a Data Warehouse -

Data Preprocessing, Data Mining vs. Machine learning, Prediction with Regression - Mining Frequent Patterns, Associations and Correlations - Mining Methods (Apriori Algorithm) - Mining Methods-FP Growth Algorithm.

Module 4: Supervised and Unsupervised learning [13L]

Classification and Prediction - Basic Concepts - Decision Tree Induction - Bayesian Classification - Lazy Learners (KNN Classification) - Classification by Backpropagation - Support Vector Machines - Clustering and Applications and Trends in Data Mining - Categorization of Major Clustering Methods, Types of Data - Partitioning Methods - K-Means Clustering - K-Medoids Clustering - Density-Based Methods->DBSCAN - Hierarchical Methods (Agglomerative approach) - Hierarchical Methods (Divisive approach) - Grid Based Methods - Model-Based Clustering Methods.

Module 5: Data mining and Its Applications [5L]

Clustering High Dimensional Data - Outlier Analysis - Data Warehousing Applications - Data Mining Applications - Machine Learning Applications Towards Research.

Text / Reference Books:

1. J. Han and M. Kamber, “Data Mining Concepts and Techniques (2nd Ed.)”, Elsevier.
2. P. Tan, M. Steinbach and V. Kumar, “Introduction To Data Mining (3rd Ed.)”, PHI / Person Education.
3. D. T. Larose, “Data Mining Methods and Models (1st Ed.)”, Wiley.
4. M. H. Dunham, "Data Mining: Introductory and Advanced Topics (1st Ed.)", Prentice Hall.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	2	1	-	-	-	-	-	-	-
CO2	2	2	1	2	1	-	-	-	-	-	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	-	-	3
CO5	2	3	2	3	1	-	-	-	-	-	-	3

Course Code	YDT6002			
Course Title	Operations Research			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

The main objective of this course is to make the students to gain knowledge about various concepts of Operations Research and to identify and develop operational research models from the verbal description of the real system and train them to apply the operations research tools that are needed to solve optimization problems.

Course Outcomes:

CO1: Define and formulate linear programming problems and evaluate their applications

CO2: To understand concepts and terminology of Linear Programming from

formulation of mathematical models to their optimization using Simplex Method

CO3: To comprehend the concept of a Transportation Model and develop the initial

solution and optimality checking of the solution

CO4: To apply the strategies of game theory and to make better decisions while solving business problems

CO5: Use critical path analysis and programming evaluation and review

techniques for timely project scheduling and completion

Course Content:

Module 1: Introduction to Operations Research [8L]

Introduction to Operations Research – Meaning – Scope – Applications - Limitations.

Linear programming-Mathematical Formulation-Application in management decision making - Graphical Method-Simplex Method.

Module 2: Transportation and Assignment Problems [6L]

Transportation problems: Introduction- Finding Initial Basic Feasible solutions- moving towards optimality (non degenerate only) – Maximization in transportation problem-Unbalanced transportation problem. Assignment problem: Introduction –Hungarian Assignment method – Maximization in Assignment problem – Unbalanced Assignment problem.

Module 3: Game theory [8L]

Concept of Pure and Mixed strategies – solving 2 x 2 matrices with and

without saddle point. Graphical solution - mx2 and 2xn games. Solving games by Dominance Property.

Module 4: Networking **[8L]**

CPM–Principles–Construction of network- Critical path –Forward pass–Backward pass computations–PERT – Time scale analysis - probability of completion of project – types of floats.

Module 5: Sequencing Problem and Replacement Theory **[6L]**

Theory of Replacement – Introduction - Replacement models –Replacement of items that deteriorates gradually (value of money does not change with time)

Text / Reference Books:

1. P. K. Gupta, Man Mohan, Kanti Swarup: "Operations Research", Sultan Chand, 2008
2. J. K. Sharma: Operations Research Theory & Applications, Macmillan India Limited, fifth edition.2013

3. Sundaresan V, Ganapathy K.S, Ganesan K, Resource Management Technique- Lakshmi Publications, 2003

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	2	1	-	-	-	-	-	-	-
CO2	2	2	1	2	1	-	-	-	-	-	-	1
CO3	3	3	3	3	3	-	-	-	-	-	-	2
CO4	3	3	2	3	2	-	-	-	-	-	-	3
CO5	2	3	2	3	1	-	-	-	-	-	-	3

Course Code	YDT6003			
Course Title	Principles of Management			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Database Management Systems b) Data Science			

Learning Objective:

The objective of the course is to provide the student with an understanding of basic management concepts, principles and practices.

Course Outcome:

CO1: Understand the meaning and characteristics of management

CO2: Understand functions of management

CO3: Understand skill of the manager

CO4: Understand scientific management.

CO5: Understand the evolution of management thought.

Course Content:

Module 1: **[9L]**

Nature of Management: Meaning, Definition, it's nature purpose, importance & Functions, Management as Art, Science & Profession- Management as social System Concepts Of management-Administration-Organization. Evolution of Management Thought: Contribution of F.W. Taylor, Henri Fayol, Elton Mayo, Chester Barhard & Peter Drucker to the management thought. Various approaches to management (i.e. Schools of management thought) Indian Management Thought.

Module 2: **[9L]**

Functions of Management (Part-I) Planning - Meaning - Need & Importance, types levels– advantages& limitations, Forecasting - Need & Techniques, Decision making - Types - Process of rational decision making &techniques of decision making, Organizing - Elements of organizing & processes: Types of organizations, Delegation of authority - Need, difficulties in delegation – Decentralization

Module 3: **[10L]**

Functions of Management (Part-II) Staffing - Meaning & Importance, Direction – Nature – Principles, Communication – Types & Importance, Motivation - Importance – theories, Leadership - Meaning - styles, qualities & functions of leaders Controlling Need, Nature, importance, Process & Techniques, Coordination - Need, Importance.

Module 4: **[8L]**

Strategic Management: Definition, Classes of Decisions, Levels of Decision, Strategy, Role of different Strategist, Relevance of Strategic Management and its Benefits, Strategic Management in India.

Text/Reference Books:

1. Horold Koontz and Iteinz Weibrich, Essential of Management, McGraw-Hill International

2. K.Aswathapa, Essential of Business Administration, Himalaya Publishing House

3. L.M.Parasad Principles & practice of management - Sultan Chand & Sons - New Delhi

4. Tripathi, Reddy, Principles of Management, Tata McGraw Hill

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT6004			
Course Title	HR Analytics			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Database Management Systems b) Data Science			

Learning Objective:

The main objectives of this course are to:
Understand the fundamentals of HR analytics
Understand the process of recruitment analysis

Course Outcome:

CO1: Understand the theory, concepts, and business application of human resources research, data, metrics, systems, analyses, and reporting.

CO2: Discuss the role and importance of HR analytics, and the ability to track, store, retrieve, analyse and interpret HR data to support decision making.

CO3: Apply benchmarks/metrics to conduct research and statistical analyses related to Human Resource Management

CO4: Apply appropriate software to record, maintain, retrieve and analyse human resources information (e.g., staffing, skills, performance ratings and compensation information).

CO5: Apply quantitative and qualitative analysis to understand trends and indicators in human resource data; understand and apply various statistical analysis methods.

Course Content:

Module 1: Introduction to HR Analytics [6L]

Evolution of HR Analytics, HR information systems and data sources, HR Metric and HR Analytics, Evolution of HR Analytics; HR Metrics and HR Analytics; Intuition versus analytical thinking; HRMS/HRIS and data sources

Module 2: Diversity Analysis [7L]

Equality, diversity and inclusion, measuring diversity and inclusion, Testing the impact of diversity, Workforce segmentation and search for critical job roles

Module 3: Recruitment and Selection Analytics [7L]

Evaluating Reliability and validity of selection models, finding out selection bias, Predicting the performance and turnover.

Module 4: Performance Analysis [8L]

Predicting employee performance, training requirements, evaluating training and development, Optimizing selection and promotion decisions.

Module 5: Monitoring impact of Interventions [8L]

Tracking impact interventions, Evaluating stress levels and value-change. Formulating evidence-based practices and responsible investment. Evaluation mediation process, moderation, and interaction analysis

Text/Reference Books:

1.Edwards Martin R, Edwards Kirsten (2016),"Predictive HR Analytics: Mastering the HR Metric", Kogan Page Publishers, ISBN-0749473924

2.Fitz-enz Jac (2010), "The new HR analytics: predicting the economic value of your company's human capital investments", AMACOM, ISBN-13: 978-0-8144-1643-3

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT6005			
Course Title	Supply Chain and Logistics Analytics			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Database Management Systems b) Data Science			

Learning Objective:

To provide a strong foundation in supply chain analytics in order to handle complex data bases, build advanced analytical models and deliver effective visualization product and comprehensive reports.

Course Outcome:

CO1: Analyse and model supply chains.
CO2: Enhance supply chain visibility
CO3: Develop data driven rules to manage volatility
CO4: Plan inventory flow of goods and services.
CO5: Forecast demand and to predict and monitor supply and replenishment policies.

Course Content:

Module 1: Introduction [4L]

Basics of Supply Chain Management Supply Chain Management – An Overview Supply Chain
Analysis Types of Supply Chains Advanced Planning

Module 2: Concepts of Advanced Planning Systems [8L]

Structure of Advanced Planning Systems, Strategic Network Planning, Demand Planning, Master Planning, Demand Fulfilment, Transport Planning Coordination, and Integration Collaborative
Planning

Module 3: Implementing Supply Chain Project [8L]

Implementing Advanced Planning Systems, The Definition of a Supply Chain Project, The Implementation Process

Module 4: Logistics Management [8L]

Definition and Evolution -Achievement of competitive advantage through logistics Framework- Role of Logistics Management-Integrated Logistics Management - Model – Flow of process activities

Module 5: Logistics Strategy [8L]

Strategic role of logistics – Definition-role of logistics managers in strategic decisions: Strategy options, Lean Strategy, Agile Strategies & Other strategies: Designing & Implementing logistical strategy.

Text/Reference Books:

1.Stadler Hartmut and Kilger Christoph (2005),"Supply Chain Management and Advanced Planning: Concepts, Models, Software and Case Studies", Third Edition, Springer, ISBN-3- 540-22065-8.

2.Simchi-Levi, David, Chen, Xin, Bramel, Julien (2014), “The Logic of Logistics Theory, Algorithms, and Applications for Logistics Management”, Third Edition, Springer, ISBN- 978-1- 4614-9149-1 **CO-PO Mapping:**

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT6006			
Course Title	MARKETING ANALYTICS			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objectives

1. Recognize challenges in dealing with data sets in marketing.
2. Identify and apply appropriate algorithms for analyzing the social media and web data
3. Make choices for a model for new machine learning tasks.

Course Outcome:

CO1: Critically evaluate the key analytical frameworks and tools used in marketing. Apply key marketing theories, frameworks and tools to solve Marketing problems

CO2: Utilise information of a firm's external and internal marketing environment to identify and prioritise appropriate marketing strategies

CO3: Exercise critical judgement through engagement and reflection with existing marketing literature and new developments in the marketing environment.

CO4: Critically evaluate the marketing function and the role it plays in achieving organisational success both in commercial and non-commercial settings

CO5: Evaluate and act upon the ethical and environmental concerns linked to marketing activities

Module 1: Marketing Analytics **[4L]**

Introduction to marketing research, Research design setup, qualitative research, quantitate research, Concept development, scale development, Exploring Data, Descriptive Statistics. Product analytics- features, attributes, benefits, Price analytics, Promotion analytics, Channel analytics, Multiple Discriminate analysis.

Module 2: Customer Analytics **[4L]**

Customer Analytics, Analyzing customer satisfaction, Prospecting and Targeting the Right Customers, Covariance and Correlation analysis, Developing Customers, Retaining Customers, Customer lifetime value case, Factor analysis. Market Segmentation & Cluster Analysis, Scatterplots & Correlation Analysis, Linear Regression, Model Validation & Assessment, Positioning analytics, Cross tabulation.

Module 3: Social Media Analytics **[8L]**

Social media landscape, Need for SMA; SMA in Small organizations; SMA in large organizations; Application of SMA in different areas Network fundamentals and models: The social networks perspective - nodes, ties and influencers, Social network and web data and methods. Graphs and Matrices- Basic measures for individuals and networks. Information visualization.

Module 4: Facebook Analytics **[12L]**

Introduction, parameters, demographics. Analyzing page audience. Reach and Engagement analysis. Post- performance on FB. Social campaigns. Measuring and Analyzing social campaigns, defining goals and evaluating outcomes, Network Analysis. 9 (LinkedIn, Instagram, YouTube Twitter etc. Google analytics. Introduction. (Websites)

Module 5: Web Analytics and making connections **[8L]**

Link analysis. Random graphs and network evolution. Social contexts: Affiliation and identity. Web analytics tools: Clickstream analysis, A/B testing, online surveys, Web crawling and Indexing

TEXT BOOKS

1. Digital Marketing Analytics: Making Sense of Consumer Data in a Digital World, ChuckHemann& Ken Burbary, Pearson, ISBN 9780789750303

2. Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Eric Siegel, Pearson,

3. Marketing Analytics: Optimize Your Business with Data Science in R, Python, and SQL, Dave Jacobs

4. Matthew Ganis, AvinashKohirkar. Social Media Analytics: Techniques and Insights for Extracting Business Value Out of Social Media. Pearson 2016. 45

5. Jim Sterne. Social Media Metrics: How to Measure and Optimize Your Marketing Investment. Wiley, 2020.

6. Marshall Sponder. Social Media Analytics. McGraw Hill Latest edition.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	2	-	-	1	-	-	-	-	1
CO2	2	3	1	2	-	-	1	-	-	-	-	1
CO3	3	2	2	1	3	-	1	-	-	-	-	2
CO4	3	3	2	3	3	-	1	-	-	-	-	2
CO5	3	3	2	3	3	-	1	-	-	-	-	2

Course Code	YDT6007			
Course Title	Data Administration & Support			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Machine Learning			

Course Outcome:

CO1: Familiarization with Data administrative methods modeling Tools.

CO2: Familiarization with architectural details of data administration.

CO3: Familiarization with several data model as per industry standards.

CO4: Familiarize with data analytics tools, like R, Advance Excel.

CO5: Apply in real life problem

Module 1: Introduction to Data Administration [4L]
Introduction to Data Administration, Reference Model, Purpose, Information Resource Management, Data Administration, Data Modeling Tools Administration, Database Administration, Data Management Integration, Organizational Interfaces.

Module 2: Data Administration Functions [4L]
IRM Architecture Definition, ANSI/SPARC Three Schema Architecture, Example Three Schema Application, Advantages of Three Schema Architecture, Data Administration External Activities, Data Administration Coordinating Activities,Mapping Data Administration Functions to Activities, Mapping Data Administration Activities to Functions, Tool-Oriented Data Administration Functions, Naming policy.

Module 3: Information Modeling [8L]
Purposes of Information Modeling, Modeling Through the System Lifecycle, Entity- Relationship-Attribute Model, Binary Relationship Model, N-ary Relationship Model, Relationships-on-Relationships Model, Attributes on Relationships, Structured Analysis and Design Models, Object-Oriented Model, Data Abstraction, Data Aggregation, Inheritance.

Module 4: Tools for Information Modelling [8L]
Data sources, Tools and methods with Excel, R. Background of Data Dictionary Systems, Features of Successful Data Dictionary Systems, Background of CASE Tools, Features of Successful CASE Tools, Tool Support for Data Administration.

Module 5: Information Resource Dictionary System (IRDS) [12L]

Background of the IRDS Standard, IRDS as a Modeling Tool, IRDS Family of Standards, Schema Extensibility, Command Language, Panel, and Services Interfaces, Export/ Import Facility, IRDS and Three Schema Architecture, Modeling the Three Schema Architecture, IRDS Application of the Three Schema Architecture, Example IRD Schema Extension, Example IRD Metadata Definition, IRDS Coordination of Data Administration, Name Analysis, Central Repository with Interconnected CASE Tools, Information Interchange and Schema Integration, Maintenance of Data Integrity, Reporting Coordination, Reference Elements and the Three Schema Architecture, Tool Requirements for Data Element Specification, IRDS and Reference Data Elements, Role of Data Administration in Configuration Management, Configuration Management and the Three Schema Architecture, Configuration Management and the IRDS, Data protection policy.

Text/Reference Books:

1. Rosen, B. and Law, M. (1989), Guide to Data Administration, Special Publication (NIST SP), National Institute of Standards and Technology, Gaithersburg, MD (Accessed April 25, 2022).
2. Dan E. Kelley. Oceanographic Analysis with R. Springer-Verlag, New York, October 2018. ISBN 978-1-4939-8842-6.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	-	-	1	-	-	-	-	1
CO2	2	3	1	2	-	-	1	-	-	-	-	1
CO3	3	2	2	1	3	-	1	-	-	-	-	2
CO4	3	3	2	3	3	-	1	-	-	-	-	2
CO5	3	2	2	2	3	-	-	-	-	-	-	3

Course Code	YDT6101			
Course Title	Data Warehousing and Data Mining Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites				

Learning Objective:

Data mining is primarily used by the companies with a strong consumer focus. It enables these companies to determine the factors such as price, product positioning, or staff skills, and economic indicators, competition, and customer demographics.

Course Outcome:

CO1: Provide efficient distribution of information and easy access to data

CO2: Create user friendly reporting environment

CO3: Find the unseen pattern in large volume of historical data that helps to manage an organization efficiently

CO4: Understand the concepts of various data mining Techniques

CO5: Understand the concepts of Preprocessing.

Course Content:

List of Experiments12 Hours

1. Exploring Weka mining tool.

2.To study the file formats for the data mining.

3. Demonstration of preprocessing on dataset.

4. To convert ARFF (Attribute-Relation File Format) into text file and vice Versa.

5. To apply the concept of Linear Regression for training the given dataset.

6. Demonstration of Association rule process on dataset using apriori algorithm.

7. Demonstration of classification rule process on dataset using j48 algorithm.

8. Demonstration of classification rule process on dataset using id3 algorithm.

9. Demonstration of classification rule process on dataset using naïve bayes algorithm.

10.Demonstration of clustering rule process on dataset using simple k-means algorithm.

Text / Reference Books:

1. R. Elmasri and S. B. Navathe, “Fundamentals of Database Systems”, Addison Wesley Publishing.
2. C.J. Date, “Introduction to Database Management”, Vol. I, II, III, Addison Wesley.
3. J.D. Ullman, “Principles of Database Systems”, Galgottia Publication.
4. G. Jim and R. Address, “Transaction Processing : Concepts and Techniques”, Morgan Kauffman.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	-	-	-	-	-	-	-	-
CO2	3	3	3	1	-	-	-	-	-	-	-	-
CO3	3	3	3	1	2	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
CO5	3	2	2	2	-	-	-	-	-	-	-	-

SEMESTER-7							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT7001	Values and Ethics in Profession	2	0	0	2
2		YDT7002	Big Data Analytics	3	0	0	3
3		YDT7003	Predictive Analytics	3	0	0	3
4		YDT7004	Digital Marketing	3	0	0	3
5		YDT7005	Business Research Methods	3	0	0	3
B.PRACTICAL							
6		YDT7102	Big Data and Analytics Lab	0	0	3	1.5
7		YDT7103	Predictive Analytics Lab	0	0	3	1.5
8		YDT7201	Mini Project	0	0	3	3
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
9			Constitution of India	3	0	0	0
10		JSC7503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**17**	**0**	**9**	**20**

Course Code	YDT7001			
Course Title	Values and Ethics in Profession			
Category				
LTP & Credits	L	T	P	Credits
	2	0	0	2
Total Contact Hours	24			
Pre-requisites	None			

Learning Objective:

In this course, the students will learn to be awareness on professional ethics and human values.

Course Outcome:

CO1: To explain the core values that shape the ethical behavior of an engineer

CO2: To understand the basic perception of profession, professional ethics, various moral issues and uses of ethical theories

CO3: To analyze various social issues, industrial standards, code of ethics, and role of professional ethics in engineering field

CO4: To explain the responsibilities of an engineer for safety and risk benefit analysis, professional rights and responsibilities of an engineer

CO5: To acquire knowledge about various roles of engineers in variety of global issues and able to apply ethical principles to resolve situations that arise in their professional lives

Course Content:

Module 1: Introduction **[2L]**

Definition of Ethics; Approaches to Ethics: Psychological, Philosophical, Social.

Module 2: . Psycho-social theories of moral development **[4L]**

View of Kohlberg; Morality and Ideology, Culture and Morality, Morality in everyday Context.

Module 3: Ethical Concerns **[4L]**

Work Ethics and Work Values, Business Ethics, Human values in organizations: Values Crisis in contemporary society Nature of values: Value Spectrum of a good life.

Module 4: Ethics of Profession: **[4L]**

Engineering profession: Ethical issues in Engineering practice, Conflicts between business demands and professional ideals. Social and ethical responsibilities of Technologists. Codes of professional ethics. Whistle blowing and beyond, Case studies.

Module 5: Self Development **[4L]**

Character strengths and virtues, Emotional Intelligence, Social intelligence, Positive cognitive states and processes (Self-efficacy, Empathy, Gratitude, Compassion, and Forgiveness).

Module 6: Effects of Technological Growth: **[6L]**

Rapid Technological growth and depletion of resources, Reports of the Club of Rome. Limits of growth: sustainable development Energy Crisis: Renewable Energy Resources, Environmental degradation and pollution. Eco-friendly Technologies. Environmental Regulations, Environmental Ethics. Appropriate Technology, Movement of Schumacher; Problems of man, machine, interaction.

Text / Reference Books:

1.S. H. Unger, "Controlling Technology: Ethics and the Responsible Engineers", John Wiley & Sons.

2.D. Johnson, "Ethical Issues in Engineering", Prentice Hall.

3.A. N. Tripathi, "Human Values in the Engineering Profession", Monograph published by IIM, Calcutta 1996.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	-	-	-	-	1	1	1	1	2	-	-
CO2	-	-	-	-	-	1	1	3	1	2	-	-
CO3	-	-	-	-	-	3	2	3	-	1	-	-
CO4	-	-	-	-	-	3	2	1	-	-	-	-
CO5	-	-	-	-	-	3	2	2	-	1	3	-

Course Code	YDT7002			
Course Title	Big Data Analytics			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Database Management Systems b) Data Science			

Learning Objective:

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

Course Outcome:

CO1: Outline the importance of Big Data Analytics

CO2: Apply statistical techniques for Big data Analytics

CO3: Analyze problems appropriate to mining data streams.

CO4: Apply the knowledge of clustering techniques in data mining

CO5: Apply Hadoop map Reduce programming for handing Big Data.

Course Content:

Module 1: Introduction to Big Data [5L]

Evolution of Big data - Best Practices for Big data Analytics - Big data characteristics - Validating - The Promotion of the Value of Big Data - Big Data Use Cases- Characteristics of Big Data Applications - Perception and Quantification of Value -Understanding Big Data Storage - Evolution Of Analytic Scalability - Analytic Processes and Tools - Analysis vs Reporting - Modern Data Analytic Tools - Statistical Concepts: Sampling Distributions - Re-Sampling - Statistical Inference - Prediction Error.

Module 2: Data Analysis, Clustering And Classification [9L]

Regression Modeling - Multivariate Analysis - Bayesian Modeling - Support Vector and Kernel Methods - Analysis of Time Series: Linear Systems Analysis - Nonlinear Dynamics - Rule Induction. Overview of Clustering - K-means - Use Cases - Overview of the Method-Determining the Number of Clusters - Diagnostics - Reasons to Choose and Cautions .- Classification: Decision Trees - Overview of a Decision Tree - The General Algorithm - Decision Tree Algorithms - Evaluating a Decision Tree - Decision Trees in R - Naïve Bayes - Bayes' Theorem - Naïve Bayes Classifier.

Module 3: Stream Memory [6L]

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.

Module 4: Association And Graph Memory [8L]

Advanced Analytical Theory and Methods: Association Rules - Overview - Apriori Algorithm - Evaluation of Candidate Rules - Applications of Association Rules - Finding Association& finding similarity - Graph Analytics for Big Data: Graph Analytics - The Graph Model - Representation as Triples - Graphs and Network Organization - Choosing Graph Analytics - Graph Analytics Use Cases - Graph Analytics Algorithms and Solution Approaches - Technical Complexity of Analyzing Graphs- Features of a Graph Analytics Platform..

Module 5: Frameworks And Visualization [8L]

MapReduce – Hadoop, Hive, MapR – Sharding – NoSQL Databases - S3 - Hadoop Distributed File Systems – Visualizations - Visual Data Analysis Techniques - Interaction Techniques; Systems and Analytics Applications - Analytics using Statistical packages-Approaches to modeling in Analytics – correlation, regression, decision trees, classification, association Intelligence from unstructured information-Text analytics-Understanding of emerging trends and Technologies-Industry challenges and application of Analytics- Analyzing big data with twitter - Big data for E-Commerce Big data for blogs - Review of Basic Data Analytic Methods using R.

Text/Reference Books:

1. D. Loshin, "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph", 2013.
2. A. Rajaraman and J. D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
3. M. Berthold, D. J. Hand, “Intelligent Data Analysis”, Springer, 2007.
4. B. Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", Wiley Publishers, 2015.
5. K. H. Pries and R. Dunnigan, "Big Data Analytics: A Practical Guide for Managers " CRC Press, 2015

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT7003			
Course Title	Predictive Analytics			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

The course enables students to: 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. To know the use of the binary classifier and numeric predictor nodes to automate model selection. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

Course Outcome:

CO1: Understand the process of formulating business objectives, data selection/collection, preparation

CO2: Understand the process to successfully design, build, evaluate and implement predictive models for a various business application.

CO3: Compare the underlying predictive modeling techniques.

CO4: Select appropriate predictive modeling approaches to identify cases to progress with.

CO5: Apply predictive modeling approaches using a suitable package such as SPSS Modeler

Course Content:

Module 1: **[8L]**

Introduction to Data Mining Introduction, what is Data Mining? Concepts of Datamining, Technologies Used, Data Mining Process, KDD Process Model, CRISP – DM, Mining on various kinds of data, Applications of Data Mining, Challenges of Data Mining.

Module 2: **[10L]**

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.

Module 3: **[10L]**

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.

Module 4: **[8L]**

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.

Text/Reference Books:

1.Eric Siegel, Predictive analytics- the power to predict who will Click, buy, lie, or die, John Wiley & Sons, 2013.

2. Dean Abbott, Applied Predictive Analytics - Principles and Techniques for the Professional Data Analyst, 2014.

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3

Course Code	YDT7004			
Course Title	**DIGITAL MARKETING**			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Learning Objectives

1. Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media
2. Learn and develop, evaluate, and execute a comprehensive digital marketing strategy and plan
3. Learn how to measure digital marketing efforts and calculate ROI
4. Explore the latest digital ad technologies

Course Outcome:

CO1: Define and explain various terminologies associated with Digital Marketing
CO2: Apply the knowledge of Digital marketing concepts
CO3: Construct an appropriate marketing model .
CO4: Analyze role and importance of digital marketing in a rapidly changing business landscape
CO5: Implement the key elements of a digital marketing strategy

Module 1: Introduction to Digital Marketing **[4L]**

Digital marketing, Marketing v/s Sales, comparison between digital and traditional marketing, Benefits of Digital marketing, Digital marketing platforms and Strategies, Defining Marketing Goals, Latest Digital marketing trends, Case studies of Digital Campaigns

Module 2: Search Engine Optimization **[4L]**

Components of Search Engines, SEO Keyword Planning, Meta Tags and Meta Description, Website Content Optimization, Back Link Strategies, Internal and External Links, Optimizing Site Structure Keywords in Blog and Articles, On Page SEO, Off Page SEO, Local SEO, Mobile SEO, Ecommerce SEO, optimizing with Google Algorithms, Using Web Master Tool, Measuring SEO Effectivenes

Module 3: Social Media Marketing **[8L]**

Introduction to social Media Marketing, Benefits of using SMM, Social Media Statistics, Social Media Strategy, Facebook Marketing, Word Press blog creation, Twitter marketing, LinkedIn Marketing, Google plus marketing, Social Media Analytical Tools

Module 4: Search Engine Marketing **[12L]**

Hough transforms and other simple object recognition methods,shape correspondence and shape matching,Principal component analysis,Shape priors for recognition.Image Understanding-Pattern recognition methods-HMM,GMM and EM

Module 5: Application **[8L]**

Google Analytics, Online Reputation Management, E-Mail Marketing, Affiliate Marketing, Social Media Analytics, Ad designing

TEXT BOOKS

1. Ryan Deiss and Russ Hennesberry, “Digital Marketing forDummies",2017
2. Puneet singh bhatia, “Fundamentals of DigitalMarketing”,2017
3.Introduction to Programmatic Advertising ByDominikKosorin,2016
4.Blogging: A Practical Guide to Plan Your Blog: Start Your Profitable Home-Based Business with a Successful Blog by Jo and DaleReardon,2015
5.Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing By IanBrodie,2013
6.Social Media Marketing All-In-One for Dummies By Jan Zimmerman and Deborah Ng,2017

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	2	3	2	-	-	1	-	-	-	-	1
CO2	2	3	1	2	-	-	1	-	-	-	-	1
CO3	3	2	2	1	3	-	1	-	-	-	-	2
CO4	3	3	2	3	3	-	1	-	-	-	-	2
CO5	3	3	2	3	3	-	1	-	-	-	-	2

Course Code	YDT7005			
Course Title	Business Research Methods			
Category	Professional			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	a)Database Management Systems b) Data Science			

Learning Objective:

The primary objective of this course is to develop a research orientation among the scholars and to acquaint them with fundamentals of research methods. Specifically, the course aims at introducing them to the basic concepts used in research and to scientific social research methods and their approach. It includes discussions on sampling techniques, research designs and techniques of analysis

Course Outcome:

CO1: Apply a range of quantitative and / or qualitative research techniques to business and management problems / issues

CO2: Understand and apply research approaches, techniques and strategies in the appropriate manner for managerial decision making

CO3: Demonstrate knowledge and understanding of data analysis and interpretation in relation to the research process

CO4: Students should be able to define the meaning of a variable, and to be able to identify independent, dependent, and mediating variables

CO5: Students should be familiar with good practices in conducting a qualitative interview and observation

Course Content:

Module 1: **[9L]**

Meaning and Importance of Research - Process of Research - Types of Research -Defining Research Problem - Formulation of Hypothesis.

Module 2: **[9L]**

Exploratory Research - Descriptive Research - Causal Research - Sampling and Sampling Design - Sampling Techniques - Sample Size determination Decision Theory, Decision making under Certainty, Risk, Uncertainty, Criteria for Decision Making Pessimism, Regret ,EMV, EOL, Cost and Value of Information, Determination of EVPI

Module 3: **[10L]**

Primary and Secondary Data, Sources of Gathering Information- Respondents, Experiments, Simulation and Panels - Construction of Questionnaire - Editing, Coding and Classification of Data - Tables and Graphic Presentation, Measurement and Scaling Nominal Scale - Ordinal Scale - Interval Scale - Ratio Scale - Guttman Scale - Likert Scale SemanticDifferential.

Module 4: **[8L]**

Mc Nemar, Sign Test - One and Two Samples, Run Test, Wilcoxon Matched Pair Test, Mann Whitney-U Test, Kolmogorov-Smirnov D Test, Kruskal- Wallis Tests.

Module 5: Multi-Variate Analysis - Multiple Regression Analysis - Concepts and Applications of Discriminant Analysis and Factor Analysis, Cluster Analysis for Market Segmentation, Multidimensional Scaling for Brand Positioning, Conjoint Analysis for Product Design. Report Preparation and Presentation.

Text/Reference Books:

1. C.R. Kothari, Research Methodology.
2. O.R. Krishna Swamy, Research Methodology
3. Wilkinson and Bhandarkar, Methodology and techniques of social research
4. Sadhu Sing, research methodology in social sciences
5. V.P. Michael, Research Methodology in Management
6. Willium M.K. Trochim, Research Methods, Bzantra

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	**1**	2	-	-	-	-	-	-	1
CO3	3	2	2	3	2	-	-	-	-	-	-	-
CO4	3	3	2	1	2	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	1

Course Code	YDT7102			
Course Title	Big Data Analytics Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

This course gives an overview of Big Data, i.e. storage, retrieval and processing of big data. In addition, it also focuses on the "technologies", i.e., the tools/algorithms that are available for storage, processing of Big Data. It also helps a student to perform a variety of "analytics" on different data sets and to arrive at positive conclusions.

Course Outcome:

CO1: Outline the importance of Big Data Analytics

CO2: Apply statistical techniques for Big data Analytics

CO3: Analyze problems appropriate to mining data streams.

CO4: Apply the knowledge of clustering techniques in data mining

CO5: Apply Hadoop map Reduce programming for handing Big Data.

Suggestive List of Experiments:

1. Install, configure and run python, numPy and Pandas.
2. Install, configure and run Hadoop and HDFS.
3. Visualize data using basic plotting techniques in Python.
4. Implement NoSQL Database Operations: CRUD operations, Arrays using MongoDB.
5. Implement Functions: Count – Sort – Limit – Skip – Aggregate using MongoDB.
6. Implement word count / frequency programs using MapReduce.
7. Implement a MapReduce program that processes a dataset.
8. Implement clustering techniques using SPARK.
9. Implement an application that stores big data in MongoDB / Pig using Hadoop / R.

Text / Reference Books:

1. Mark Dexter, Louis Landry, "Joomla Programming", 2012 Pearson Education.
2. Seema Acharya and Subhashini C, "Big Data and Analytics", Wiley Publication, 2015.
3. Judith Hurwitz, Alan Nugent, Fern Halper, Marcia Kaufman, "Big data for dummies", Wiley Publication, 2013.
4. Tom White, "Hadoop: The Definitive Guide", O"Rilly Publication, 2015.

5. Chuck Lam, “Hadoop in action”, Dreamtech Press, 2011.
6. Dirk Deroos, Paul C. Zikopoulos, Roman B. Melnyk, Bruce Brown, “Hadoop for dummies”, Wileypublication, 2015.

CO-PO Mapping:

PO-CO Mapping	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12
CO1	2	2	2	2	3	1	-	-	1	1	1	1
CO2	2	2	2	2	3	1	-	-	1	1	1	1
CO3	2	2	2	2	2	1	-	-	1	1	1	1
CO4	2	2	2	2	3	1	-	-	1	1	1	1
CO5	2	2	2	2	3	1	-	-	1	1	1	1

Course Code	YDT7103			
Course Title	Predictive Analytics Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

The course enables students to: 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. To know the use of the binary classifier and numeric predictor nodes to automate model selection. To advice on when and how to use each model. Also learn how to combine two or more models to improve prediction

Course Outcome:

CO1: Understand the process of formulating business objectives, data selection/collection, preparation

CO2: Understand the process to successfully design, build, evaluate and implement predictive models for a various business application.

CO3: Compare the underlying predictive modeling techniques.

CO4: Select appropriate predictive modeling approaches to identify cases to progress with.

CO5: Apply predictive modeling approaches using a suitable package such as SPSS Modeler

Suggestive List of Experiments:

Following experiments to be carried out using Python/SPSS/SAS/R/Power BI

1. Simple Linear regression
2. Multiple Linear regression
3. Logistic Regression
4. CHAID
5. CART
6. ARIMA – stock market data
7. Exponential Smoothing
8. Hierarchical clustering
9. Ward's method of clustering
10. Crowdsource predictive analytics- Netflix data

Text / Reference Books:

1. Eric Siegel, Predictive analytics- the power to predict who will Click, buy, lie, or die, John Wiley & Sons, 2013.

2. Dean Abbott, Applied Predictive Analytics - Principles and Techniques for the Professional Data Analyst, 2014.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3

SEMESTER-8							
Sl. No.	**Type**	**Course No.**	**Course Name**	**L**	**T**	**P**	**Credits**
A.THEORY							
1		YDT8001	Business Analytics	3	0	0	3
2		YDT8002	Natural Language Processing	3	0	0	3
B.PRACTICAL							
3		YDT8102	Natural Language Processing Lab	0	0	3	1.5
4		YDT8201	Project	0	0	24	9
5		YDT8202	Grand Viva	0	0	3	3
C.MANDATORYACTIVITIES/COURSES (NON-CGPA)							
6			Essence of Indian Knowledge Tradition	0	0	3	0
7		JSC8503	SkillX	0	0	0	0
Total of Theory, Practical and Mandatory Activities /Courses				**6**	**2**	**30**	**19.5**

Course Code	YDT8001			
Course Title	Business Analytics			
Category	Humanities			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites				

Course Outcome:

CO1: Understand the various features of Spreadsheets and use them for business analysis

CO2: Understand and describe data and its distributions

CO3: Describe the various forecasting techniques and perform spreadsheet modelling and analysis

CO4: Make decisions by optimizing business problems

CO5: Use Six Sigma for data driven decision making

Course Content:

Module 1: Business Analytics: [7L]

Introduction - Business Analytics: The Science of Data-Driven Decision Making - Descriptive Analytics - Predictive Analytics - Prescriptive Analytics – Techniques - Big Data Analytics – Web and Social Media Analytics - Analytics Capability Building - Challenges in Data-Driven Decision Making and Future.

Module 2: Descriptive Analytics [8L]

Visualization and Exploring data - Descriptive Statistical Measures - Probability Distributions and Data modelling - Sampling and Estimation - Statistical Inference.

Module 3: Predictive Analytics [8L]

Trendlines and Regression analysis - Forecasting Techniques - Data mining - Spreadsheet modelling and Analysis - Monte Carlo Simulation and Risk Analysis

Module 4: Prescriptive Analysis [6L]

Linear Optimization (LO) - Applications of LO – Integer Optimization - Decision Analysis

Module 5: Six Sigma [7L]

Introduction, Origins of Six Sigma, Three-Sigma versus Six-Sigma Process, Cost of Poor Quality, Sigma Score, Industrial Applications of Six Sigma.

Text / Reference Books:

1.U. Dinesh Kumar, Business Analytics: The Science of Data-Driven Decision Making, Wiley, 2nd Edition, 2021. (Unit I,V)

2. R. Evans James, Business Analytics, Pearson, 2nd Edition,2017 (Unit II,III,IV)

CO-PO Mapping:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3	2	-	-	1	-	-	-	-	1
CO2	2	3	1	2	-	-	1	-	-	-	-	1
CO3	3	2	2	1	3	-	1	-	-	-	-	2
CO4	3	3	2	3	3	-	1	-	-	-	-	2
CO5	3	3	2	3	3	-	1	-	-	-	-	2

Course Code	YDT8002			
Course Title	Natural Language Processing			
Category	Professional Elective			
LTP & Credits	L	T	P	Credits
	3	0	0	3
Total Contact Hours	36			
Pre-requisites	Basic understanding of linguistics, syntax and semantics			

Learning Objective:

In this course, the students will learn about the various Natural Language techniques that are essential to understand how to build Language Processing systems. In particular, various security applications shall be discussed as case studies.

The course will be very helpful for the students in strengthening their basic knowledge in Language Processing.

Course Outcome:

CO 1: Understand the theoretical foundations of NLP.
CO 2: Describe N-gram language model.
CO 3: Perform classification tasks using naive Bayes classifiers and logistic regression.
CO 4: Understand vector semantics and embeddings
CO 5: Implement neural language models for any concerned applications.

Course Content:

Module 1: Regular Expressions, Text Normalization, Edit Distance [7L]

Regular Expressions - Words - Corpora - Word Tokenization – Word Normalization, Lemmatization and Stemming – Sentence Segmentation - Minimum Edit Distance.

Module 2: N-gram Language Models [7L]

N-Grams - Evaluating Language Models – Sampling Sentences from a Language Model - Generalization and Zeros - Smoothing. Sequence Labelling for Parts of Speech and Named Entities English Word Classes - Part-of-Speech Tagging - Named Entities and Named Entity Tagging – HMM or Part-of-Speech Tagging - Conditional Random Fields (CRFs).

Module 3: Naive Bayes, Text Classification and Sentiment [7L]

Naive Bayes Classifiers - Training the Naive Bayes Classifier - Optimizing for Sentiment Analysis - Naive Bayes as a Language Model – Evaluation - Test sets and Cross-validation.

Module 4: Vector Semantics and Embeddings [7L]

Lexical Semantics- Vector Semantics- Words and Vectors – Cosine for measuring similarity – TF-IDF – PMI – Applications of TF_IDF and PMI – Word2Vec

Module 5: Neural Networks and Neural Language Models [8L]

Units - The XOR problem- Feed Forward Neural Networks - Feedforward Networks for NLP: Classification - Training Neural Nets - Feedforward Neural Language Modeling - Training the Neural Language Model. NLP Applications Chatbots & Dialogue Systems - Design

Text / Reference Books:

1.Daniel Jurafsky and James H. Martin, Speech and Language Processing - An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition, Prentice Hall, 3rd Edition, 2024.

2. Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly Media, 1st Edition, 2009

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3

Course Code	YDT8102			
Course Title	Natural Language Processing Lab			
Category	Professional Core			
LTP & Credits	L	T	P	Credits
	0	0	3	1.5
Total Contact Hours	36			
Pre-requisites	None			

Learning Objective:

In this course, the students will learn about the various Natural Language techniques that are essential to understand how to build Language Processing systems. In particular, various security applications shall be discussed as case studies.

The course will be very helpful for the students in strengthening their basic knowledge in Language Processing.

Course Outcome:

CO 1: Use the NLTK and spaCy toolkit for NLP Programming.

CO 2: Analyze various corpora for developing programs.

CO 3: Develop various pre-processing techniques for a given corpus.

CO 4: Develop programming logic using NLTK functions.

CO 5: Build applications using various NLP techniques for a given corpus.

Suggestive List of Experiments:

1. Installation and exploring features of NLTK and spaCy tools. Download Word Cloud and few corpora.
2. (i)Write a program to implement word Tokenizer, Sentence and Paragraph Tokenizers.
(ii) Check how many words are there in any corpus. Also check how many distinct words are there?
3. (i) Write a program to implement both user-defined and pre-defined functions to generate
    (a) Uni-grams
    (b) Bi-grams
    (c) Tri-grams
    (d) N-grams

(ii) Write a program to calculate the highest probability of a word (w2) occurring after another word(w1).

4. (i)Write a program to identify the word collocations.
(ii) Write a program to print all words beginning with a given sequence of letters.
(iii) Write a program to print all words longer than four characters.
5. (i) Write a program to identify the mathematical expression in a given sentence.
(ii) Write a program to identify different components of an email address.
6. (i) Write a program to identify all antonyms and synonyms of a word.
(ii) Write a program to find hyponymy, homonymy, polysemy for a given word.

7. (i) Write a program to find all the stop words in any given text.
(ii) Write a function that finds the 50 most frequently occurring words of a text that are not stop words.
8. Write a program to implement various stemming techniques and prepare a chart with the performance of each method.
9. Write a program to implement various lemmatization techniques and prepare a chart with the performance of each method.
10. (i) Write a program to implement Conditional Frequency Distributions(CFD) for any corpus. (ii) Find all the four-letter words in any corpus. With the help of a frequency distribution (FreqDist), show these words in decreasing order of frequency. (iii) Define a conditional frequency distribution over the names corpus that allows you to see which initial letters are more frequent for males versus females.
11. (i) Write a program to implement Part-of-Speech (PoS) tagging for any corpus. (ii) Write a program to identify which word has the greatest number of distinct tags? What are they, and what do they represent? (iii) Write a program to list tags in order of decreasing frequency and what do the 20 most frequent tags represent? (iv) Write a program to identify which tags are nouns most commonly found after? What do these tags represent?
12. Write a program to implement TF-IDF for any corpus.
13. Write a program to implement chunking and chinking for any corpus.
14. (i) Write a program to find all the mis-spelled words in a paragraph. (ii) Write a program to prepare a table with frequency of mis-spelled tags for any given text.
15. Write a program to implement all the NLP Pre-Processing Techniques required to perform further NLP tasks.

Text / Reference Books:

1.D. Jurafsky and J. H. Martin. “Speech and Language Processing”, Pearson Education.

2.A. James, “Natural Language Understanding”, Pearson Education.

3.A. Bharati, R. Sangal and V. Chaitanya, “Natural Language Processing: a Paninian Perspective”, Prentice-Hall of India.

4.T. Siddiqui and U. S. Tiwary, “Natural language processing and Information Retrieval”, OUP.

CO-PO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	**3**	1	2	2	**-**	-	-	-	-	-	-	2
CO2	1	1	2	-	2	-	-	-	-	-	-	3
CO3	**1**	1	2	-	2	-	-	-	-	-	-	3
CO4	**1**	1	3	2	1	-	-	-	-	-	-	3
CO5	**1**	2	2	-	3	2	-	-	-	-	-	3