B.Sc. Data Science

Syllabus

AFFILIATED COLLEGES

Programme Code:28M

2025 – 2026 onwards

BHARATHIAR UNIVERSITY

(A State University, Accredited with "A++" Grade by NAAC, Ranked 21st among Indian Universities by MHRD-NIRF)

Coimbatore - 641 046, Tamil Nadu, India

	B.Sc. Data Science **Curriculum & Syllabus**
Programme Educational Objectives (PEOs)	
The B.Sc. Data Science program describe accomplishments that graduates are expected to attain within five to seven years after graduation.	
PEO1	Our graduates will excel with professional skills, fundamental knowledge, and advanced futuristic technologies to become Data Scientists, Data Analyst, AI Research Scientists, or Entrepreneurs
PEO2	Our graduates will establish their knowledge by adopting Data Science Technologies to solve complex real-world problems with accurate, thoughtful solutions
PEO3	Our graduates will engage in lifelong learning to excel in their profession with social and ethical awareness and responsibility

Programme Specific Outcomes (PSOs)	
After the successful completion of B.Sc. Data Science programme the students are expected to	
PSO1	Ability to design, develop, implement and apply Analytical skills related to Research and Real-world problems
PSO2	Ability to apply tools and techniques to provide successful solutions in the multidisciplinary field
PSO3	Ability to critique the role of information and analytics for a innovative career, research activities and consultancy

Programme Outcomes (POs)	
On successful completion of the B.Sc. Data Science	
PO1	Apply analytical and critical thinking to identify, formulate, analyze, and solve Complex real-world problems in order to reach nuanced authenticated conclusions
PO2	Possess the ability to demonstrate advanced independent critical enquiry, analysis and reflection of modern statistical methodology and computing
PO3	Have a set of flexible and transferable skills for different types of employment, both within the Information Technology sector and beyond, in both global and local organizations
PO4	Develop and implement data analysis strategies base on theoretical principles, ethical considerations, and deep, detailed and broad knowledge of the underlying data and its implications in the context from which the data was taken
PO5	Be critical and creative thinkers, with an aptitude and appreciation for continued self-directed learning in the evolving world of data science, artificial intelligence and social media
PO6	Design and develop research-based solutions for complex problems with specified needs with appropriate ethical consideration for public health, safety, culture, society, and the environment.
PO7	Establish the ability to listen, read, proficiently communicate and articulate nuanced data and information through traditional and digital channels to audiences with diverse perspectives
PO8	Articulate and evaluate appropriate legal and ethical standards pertaining to all forms of communications, network security and human rights.
PO9	Showcase an understanding of the interdisciplinary nature of data, information and community and its influence innovation and progress within the current local or global context
PO10	Be able to initiate and implement constructive change in their communities with their skills in data and information, including various professions and workplaces

BHARATHIAR UNIVERSITY, COIMBATORE-641 046

(For the students admitted from the academic year 2025-2026 onwards)

B.Sc. Data Science (CBCS pattern)

SCHEME OF EXAMINATIONS

Part	Study Components	Course Title	Ins. hrs / week(Theory)	Dur.Hrs.	CIA	End Sem Exam	Total	Credits
					Examinations			
	SEMESTER–I							
I	Language-I		**6**	3	25	75	100	4
II	English-I		**4**	3	25	75	100	4
III	**Core 1:**Computer Fundamentals and Python Programming		**5**	3	25	75	100	4
III	**Core 2:**Database Management System with SQL		**5**	3	25	75	100	4
III	**Core Lab 1:** Python Programming & SQL Lab		**4**	3	20	30	50	2
III	Allied Paper I:Descriptive Statistics		**4**	3	25	75	100	4
IV	Environmental Studies#		**2**	3	-	50	50	2
		Total	**30**		**145**	**455**	**600**	**24**
	SEMESTER–II							
I	Language-II		**6**	3	25	75	100	4
II	English-II		**4**	3	25	25	50	2
III	**Core 3:**Data Analytics		**6**	3	25	75	100	4
III	**Core Lab 2:Advanced Excel lab**		**4**	3	20	30	50	2
III	Core Lab 3:Internet Basics Lab		**4**	3	20	30	50	2
III	Allied Paper II: Mathematical Foundations for Machine Learning		**4**	3	25	75	100	4
IV	Value Education –Human Rights#		**2**	3	-	50	50	2
IV	Naan Muthalvan - Skill Course ***		-	-	25	25	50	2
		Total	**30**		**165**	**385**	**550**	**22**
	SEMESTER–III							
I	Language– III		**6**	3	25	75	100	4
II	English-III		**4**	3	25	75	100	4
III	Core 4:Data Engineering		**3**	3	25	75	100	3
III	Core 5:Artificial Intelligence		**4**	3	25	75	100	3
III	Core 6: Applied Data Structures		**3**	3	25	75	100	2
III	Core Lab 4:ETL Lab		**3**	3	20	30	50	2
III	Allied Paper III: Inferential Statistics		**3**	3	25	75	100	4

IV	Skill based Subject-1:Mini project using Python Programming / Advanced Excel	**3**	3	20	30	50	2
IV	Tamil@/Advanced Tamil#(or)Non-Major Elective–I: Yoga for Human Excellence#/Women's Rights # Constitution of India #	**1**	3	-	50	50	2
IV	Health and Wellness****	-		100	-	100	1
IV	Naan Mudhalvan Skill Course ***	-	-	25	25	50	2
	Total	**30**		**290**	**585**	**900**	**29**
	SEMESTER–IV						
I	Language–IV	**6**	3	25	75	100	4
II	English-IV	**4**	3	25	75	100	4
III	Core 7:R Programming	**4**	3	25	75	100	4
III	Core 8:Machine Learning Techniques	**4**	3	25	75	100	4
III	Core Lab 5:R Programming Lab	**3**	3	20	30	50	2
III	Allied Paper IV: Digital Marketing	**4**	3	25	75	100	4
IV	Skill based Subject- 2:Optimization Techniques	**3**	3	25	25	50	2
IV	Tamil@/Advanced Tamil #(or) Non-major elective-II: General Awareness#	**2**	3	-	50	50	2
IV	Naan Muthalvan – Skill Course ***	**-**	**-**	25	**25**	50	2
	Total	**30**		**195**	**505**	**700**	**28**
	SEMESTER–V						
III	Core 9:Data Visualization	6	3	25	75	100	4
III	Core 10:Deep Learning	6	3	25	75	100	4
III	Core Lab 6: Data Visualization Lab	6	3	20	30	50	2
III	Elective–I	6	3	25	75	100	3
IV	Skill based Subject-3:Social Media Analytics	6	3	25	25	50	2
IV	Naan Muthalvan – Skill Course ***	**-**	**-**	25	**25**	50	2
	Total	**30**		**145**	**305**	**450**	**18**
	SEMESTER–VI						
III	Core 11:Natural Language Processing	6	3	25	75	100	4
III	Core Lab 7:Natural Language Processing Lab	6	3	20	30	50	2
III	Core12: Project Work Lab%%	5	3	25	75	100	4
III	Elective–II:	5	3	25	75	100	3
III	Elective–III:	5	3	25	75	100	3
IV	Skill based Subject-4:Cap stone project using python or R programming ,Data Visualization tools.	3	3	25	25	50	2
V	Extension Activities@	-	-	50		50	2
IV	Naan Muthalvan-***	-	-	25	25	50	2
	Total	**30**		**195**	**380**	**600**	**24**
	Grand Total			**1135**	**2615**	**3800**	**142**

No Continuous Internal Assessment (CIA). Only University Examinations. @ No University Examinations. Only Continuous Internal Assessment (CIA).

➢ #Govt – Non-Autonomous Colleges, $ Aided – Non-Autonomous Colleges, @ Self - Financing Colleges (Non –Autonomous) (For theory : CIA – 12, CEE – 38; For Practical : CIA – 20, CEE – 30).

List of Elective Papers (Colleges can choose any one of the paper as electives)		
Elective – I	A	Marketing Analytics
	B	Data Security and Compliance
	C	Computer Vision
Elective – II	A	Supply Chain and Logistics Analytics
	B	Business and Financial Analytics
	C	Recommender system
Elective - III	A	HR Analytics
	B	Data Mining
	C	Big Data and Cloud Computing

GUIDELINES FOR EVALUATION

 # Govt. - (Non-Autonomous Colleges), $ Aided – (Non-Autonomous Colleges), @ Self-Financing (Non –Autonomous).
Evaluation of the candidates shall be made through internal and. external marks

Paper Type	Total Marks	Internal		External		Overall Passing Minimum for Total Marks (Internal +External)
		Maximum Marks	Passing Minimum for Internal	Maximum Marks	Passing Minimum for External	
Part III: Core/ Allied Theory	100	25	10	75	30	40
Part III: Core Practical Lab	50	20	8	30	12	20
Part III: Capstone Project Work Lab	50	20	8	30	12	20
Part III: Project Work Lab	100	25	10	75	30	40
Part IV: Skilled Based Subject Theory	50	25	10	25	10	20
Part IV: Skill Based Subject Lab	50	20	8	30	12	20
Part IV: Foundation Course Theory	50	-	-	50	20	20
Part IV: Health and Wellness	100	100	40	-	-	40

INTERNAL MARKS BREAK UP

Core, Allied and Skilled Based Subject -Theory

Components	CIA I	CIA II	Model	Attendance	Assignment & Seminar	Total
Marks	5	5	10	2	3	25

Core Lab & Skill Based Subject Lab – Practical

Components	Observation	Record	Model Practical	Total
Program(s)	5	5	10	20

Project

Components	Topic Selection	First and Second Review	Mock Viva Presentation	Report	Total
Capstone Project Work Lab	5	5	5	5	20
Project Work Lab	5	10	5	5	25

Internal Examination Question Paper Pattern

Core, Allied and Skilled Based Subject -Theory   Duration: 2 Hours

Blooms Classification	Knowledge Level	Section	Type	No. of Questions to be answered	Marks
Remember, Understand	K1,K2	A	Objective type, questions, fill in the blanks, true or false, expand the following	All questions	4 X 1 = 4
Understand, Apply	K2,K3	B	Paragraph about 3 pages	All question either or pattern unit wise	5 X 2 = 10
Apply, Analyze	K3,K4	C	Essay type about 5 pages	2 out of 5 questions	2 X 8 = 16
				Total	**30**

UNIVERSITY EXTERNAL MARKS BREAK UP

Core Lab & Skill Based Subject Lab – Practical

Components	Max. Marks	Aim & Algorithm	Typing	Output	Record	Total	Passing Minimum External
Program 1	10	4	4	2	10	30	12
Program 2	10	4	4	2			

Project

Components	Report	Presentation	Viva-voce	Total	Passing Minimum External
Capstone Project Work Lab	15	10	5	30	12
Project Work Lab	40	20	15	75	40

University Examination Question Paper Pattern

Core Paper & Allied Paper (Theory)   Duration: 3 Hours

Blooms Classification	Knowledge Level	Section	Type	No. of Questions to be answered	Marks
Remember, Understand	K1,K2	A	Objective type questions, fill in the blanks, true or false, expand the following	All questions	10 X 1 = 10
Understand, Apply	K2,K3	B	Paragraph about 3 pages	Either or Pattern (Unit Wise)	5 X 5 = 25
Apply, Analyze	K3,K4	C	Essay type about 5 pages	Either or Pattern (Unit Wise)	5 X 8 = 40
				Total	**75**

Skill Based Subject Paper (Theory)   Duration: 3 Hours

Blooms Classification	Knowledge Level	Section	Type	No. of Questions to be answered	Marks
Remember, Understand	K1,K2	A	Objective type questions	All questions	6 X 1 = 6
Understand, Apply	K2,K3	B	Paragraph about 2 pages	Either or Pattern (Unit Wise)	3 X 3 = 9
Apply, Analyze	K3,K4	C	Essay type about 4 pages	2 out of 5 questions (Unit Wise)	2 X 5 = 10
				Total	**25**

Foundation Course Paper (Theory)   Duration: 3 Hours

Section	Type	No. of Questions to be answered	Marks
A	Essay type about 5 pages	5 out of 10 questions	5 X 10 = 50
		Total	**50**

Note

*	No Continuous Internal Assessment (CIA), University Examinations Only.
**	No University Examinations, Continuous Internal Assessment (CIA) Only.
***	Naan Mudhalvan – Skill courses- external marks (CEE) will be assessed by Industry and internal will be offered by respective course teacher.
****	No University Examinations, Continuous Internal Assessment (CIA) Only will be handled by Department of Physical Education (PD)
*****	Summer Internship / Industrial Training during the Summer Vacation in II Year, IV Semester for 30 hours. The capstone project report to be prepared and it should be submitted during viva-voce. (Refer Project Guidelines)

First Semester

Course Code	Computer Fundamentals and Python Programming		L	T	P	C
Core/Elective/ Supportive	Core 1		5	-	-	4
Pre-requisite	Logical Thinking and Problem Solving Skills	Syllabus Version	2025 – 26 onwards			

Course Objectives:
The main objectives of this course are to:
1. **Understand about number systems, algorithms and OOP concepts.**
2. **Understand the basic Python programming constructs and data structures**
3. **Understand how to use files, modules and packages**

Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1.	Apply number systems and OOPs concepts for algorithmic problem solving	K2, K3
2.	Develop simple Python programs in interactive and script mode using control statements	K2, K3
3.	Construct Python programs using functions and strings.	K3
4.	Make use of Python lists ,set, tuples, dictionaries to represent compound data.	K3,K4
5.	Develop python programs to handle exceptions, packages and perform file processing	K3,K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create		

UNIT:1	COMPUTER FUNDAMENTALS, ALGORITHMIC PROBLEM SOLVING AND OOP CONCEPTS	10 Hours
	Introduction to number systems- Algorithms, building blocks of algorithms (statements, control flow, functions), pseudo code, flow chart, algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion).**OOP concepts**: Overview of Object oriented programming approach, Characteristics of object oriented languages-Classes fundamentals: A Simple Class and Object, Accessing members of class, Initialization of class objects:(Constructor, Destructor).	

UNIT:2	BASICS OF PYTHON PROGRAMMING	9 Hours
	Introduction-Python interpreter- interactive and script mode; values and types, operators, expressions, statements, precedence of operators, Multiple assignments, comments.	

UNIT:3	CONTROL STATEMENTS AND FUNCTIONS IN PYTHON	9 Hours
	Conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass;	
	Functions: Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion.	

UNIT:4	DATA STRUCTURES: STRINGS ,LISTS, SETS	10 Hours
	Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions; list processing: list comprehension, searching and sorting, Sets: creating sets, set operations	

UNIT:5	DATA STRUCTURES: TUPLES, DICTIONARIES	10 Hours
	Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries. Files and exception: text files, reading and writing files, format operator, exception handling, modules, packages	
	Total Lecture hours	**48 hours**

Text Book(s)

1.	Ashok Namdev Kamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018
2.	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press , 2013.
3.	Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.

Reference Books

1.	Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
2.	Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
3.	Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1.	www.mhhe.com/kamthane/python
2.	Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff / O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think-python/)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	L	L	L	L
CO2	S	S	S	M	M	L	L	M	L	L
CO3	S	M	M	M	M	L	L	M	L	M
CO4	S	S	S	M	M	L	M	L	L	L
CO5	S	S	S	M	M	L	L	L	L	L

*S-Strong; M-Medium; L-Low

Course Code	Database Management System with SQL		L	T	P	C
Core/Elective/ Supportive	Core 2		5	-	-	4
Pre-requisite	Basic Computer Fundamentals	Syllabus Version	2025 – 26 onwards			

Course Objectives:

The main objectives of this course are to:
1. **Understand the significance and fundamentals of database management systems.**
2. **Understand the Database design and query optimization techniques.**
3. **Understand the database security concepts**

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1.	Describe the fundamental elements of relational database management systems	K1, K2
2.	Design relational schema using database design principles	K2, K3
3.	Explain the concepts of transaction processing, basic database storage structures and access techniques	K2, K3,K4
4.	Apply indexing techniques to access and generate user reports for a database.	K2, K3
5.	Building Web Applications using Python & SQL.	K4,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

UNIT:1	INTRODUCTION TO DATABASE AND RELATIONAL MODEL	10 Hours
	Introduction: Database applications, Purpose of database systems, Views of data, Database Development Life cycle, Architecture of DBMS. Overview of query processing. Relational Databases: Relational model, Database schema, Keys, Formal Relational Query Languages	
UNIT:2	DATABASE DESIGN	10 Hours
	Logical Database Design: Different approaches in Logical design, ER Modeling, ER notations, Steps in ER modeling. Physical database design: Converting ER Model to Relational Database Design, Normalization -Functional Dependency, 1NF,2NF,3NF (optional: multi-valued dependency and 4th Normal form).	
UNIT:3	QUERY OPTIMIZATION, TRANSACTION PROCESSING AND CONCURRENCY CONTROL	9 Hours
	I SQL Standards – Data types – Database Objects- DDL-DML-DCL-TCL-Embedded SQL- Static Vs Dynamic SQL. Query Processing and Optimization – Heuristics and Cost Estimates in Query Optimization. Transactions: Concept and purpose, ACID properties and their necessity. Concurrency Control: lock-based protocols, 2-phase locking, Timestamp based protocols. Deadlock handling	
UNIT:4	STORAGE AND INDEXING	9 Hours
	Storage and File structure: File Organization, RAID. Indexing: Concepts, Clustered and Non-Clustered Indices, B-tree and B+-tree. Basics of Hashing (Static, Dynamic).	
UNIT:5	DATABASE SECURITY	10 Hours
	Data Classification-Threats and risks – Database access Control – Types of Privileges – Statistical Databases. - Distributed Databases-Architecture-Transaction Processing. Data Warehousing and Mining-Classification-Association rules-Clustering-Information Retrieval	
	Total Lecture hours	**48 hours**

Text Book(s)	
1.	Abraham Silberschatz, Henry Korth, and S. Sudarshan, "Database System Concepts", Sixth Edition, McGraw-Hill.2011
2.	R. Elmasri and S. Navathe, "Fundamentals of Database Systems", Sixth Edition,Pearson Education, 2011
3.	Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, 3nd Edition, McGraw Hill, 2003
Reference Books	
1.	Thomas M. Connolly and Carolyn E. Begg, "Database Systems - A Practical Approach to Design, Implementation and Management", Fifth edition, Pearson Education, 2010.
2.	C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Eighth Edition, Pearson Education, 2006.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1.	https://onlinecourses.nptel.ac.in/noc17_cs33/course
2.	http://nptel.ac.in/courses/IIT- MADRAS / Intro_to_Database_Systems_Design

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	L	M	M	M	L
CO2	S	S	S	S	S	L	L	L	M	L
CO3	S	S	S	M	M	L	L	L	M	L
CO4	S	S	S	M	M	L	M	M	M	L
CO5	S	S	S	S	S	L	M	M	M	L

Course Code	Python Programming & SQL Lab	L	T	P	C
Core/Elective/ Supportive	Core Lab 1	-	-	4	2
Pre-requisite	Exposure to basic syntax of any programming language	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. Apply the basic Python programming constructs and data structures.
2. Apply file concepts, create modules and packages
3. Analyze data using Python

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1.	Solve problems using various control statements, functions and strings in Python	K3
2.	Make use of Python lists , set, tuples, dictionaries to represent compound	K4
3.	Describe the fundamental elements of relational database management systems	K1, K2
4.	Design relational schema using database design principles	K2, K3
5.	Explain the concepts of transaction processing, basic database storage structures and access techniques	K2, K3,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

PYTHON PROGRAMMING LAB

EXERCISE 1	Introduction to Python	6

Programs using expressions and input and output statements. Programs using operators, built in functions and conditional statements

EXERCISE 2	Functions	6

Programs using Functions-Programs to find square root, GCD, sum an array of numbers

EXERCISE 3	Data Structures: Strings and Lists	6

Programs performing all string operations - perform operations on lists- Sorting of elements (Selection and insertion sort)

EXERCISE 4	Data Structures: Tuples, Dictionaries, Sets	6

Programs using dictionaries and sets – Tuples

EXERCISE 5	Files, Modules, Packages and Data Analysis	6

SQL LAB

LIST OF EXPERIMENTS	15

1. Creation of a database and writing SQL queries to retrieve information from the database.
2. Creating relational database to set various constraints.
3. Performing Insertion, Deletion, Modifying, Altering, Updating and Viewing records based on conditions.
4. Working on TCL, DCL commands
5. Creating relationship between the databases.

Total Marks : 45

Text Book(s)

1. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015

2. Ashok Namdev Kamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018	

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1. Infosys Foundation Program: Module 2
2. https://onlinecourses.nptel.ac.in/noc17_cs33/course
3. http://www.db-book.com
4. http://nptel.ac.in/courses/IIT- 5. MADRAS/Intro_to_Database_Systems_Design
6. http://www.iitg.ernet.in/awekar/teaching/cs344fall11/
7. www.w3schools.com/sql/

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	L	L	L	L	L
CO2	S	S	M	M	M	L	L	L	L	L
CO3	S	S	M	M	M	L	L	L	L	L
CO4	S	M	M	M	S	M	L	L	L	L
CO5	S	M	M	M	M	M	L	L	L	L

*Strong; M-Medium; L-Low

Course Code	Descriptive Statistics	L	T	P	C
Core/Elective/ Supportive	Allied 1	4	-	-	4
Pre-requisite	Basic level on Mathematical Computation	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:

      Understand the significance and computational aspects of statistical analysis

      Understand the patterns of distribution of data

      Understand the concepts of predictive analytics

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Understand the scope and necessity of Statistics and the representation of data	K1, K2
2	Tabulate and represent the data in diagrams and graphs	K2, K3
3	Apply the formula and calculate descriptive measures of statistics	K2, K3,K4
4	Analyze the nature of data and interpret the measures	K2, K3,K4
5	Analyze the data and predict the future values using regression	K4,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

UNIT:1	Status of Statistics and collection of data	9 hours

Origin, scope, definition, limitations of Statistics. Data- Types- Primary and Secondary Data- Methods of data Collection

UNIT:2	Classification, Tabulation and graphical representation	9 hours

Classification of data, preparation of tables, Diagrammatic representation of data: One dimensional and Two dimensional diagrams – Graphical representation: Line diagram, Frequency polygon, Frequency curve, Histogram

UNIT:3	Measures of Central Tendency and location	10 hours

Measures of Central Tendency: Mean, Median, Mode, Geometric Mean and Harmonic Mean- Properties with Merits and Demerits- Empirical Relation between means. Partition values: Quartiles, Deciles and Percentiles.

UNIT:4	Measures of Dispersion	10 hours

Absolute and Relative Measures Range, Mean deviation, Quartile deviation and Standard deviation – Measures of Skewness - Pearson's and Bowley's Coefficient of Skewness, Coefficient of Skewness based on moments – Kurtosis and its significance

UNIT:5	Measures of Variation, correlation and regression	10 hours
	Measures of Variation : Standard, Mean and Quartile deviations-Co efficient of variation. Simple Correlation - Karl Pearson's Co-efficient of correlation – Rank correlation - Regression lines.	
	Total Lecture hours	**48 hours**

Text Books:

1	Agarwal, B. L. (2021). Basic Statistics, New Age International Private Limited, New Delhi, India
2	Gupta, S.C., and Kappor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons , New Delhi, India

Reference Books

1	Holcomb, Z. C. (2017). Fundamentals of Descriptive Statistics, Routledge, New York, US.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/104/111104120/
2	https://www.iiserpune.ac.in/~bhasbapat/phy221_files/curvefitting.pdf

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	M	S	M	M
CO2	S	S	M	S	S	M	M	S	M	M
CO3	S	S	M	M	S	M	S	S	M	M
CO4	S	S	M	M	S	M	M	S	M	M
CO5	S	S	S	M	S	M	M	S	M	M

*S-Strong; M-Medium; L-Low

Second Semester

Course Code	Data Analytics	L	T	P	C
Core/Elective/ Supportive	Core 3	6	0	0	4
Pre - requisite	Computer Fundamentals	Syllabus version		2025 – 26 onwards	

Course Objectives

The main goal of this course is to help students learn, understand, and practice big data analytics and machine learning approaches, which include the study of modern computing big data technologies and scaling up machine learning techniques focusing on industry applications.

Expected Course Outcomes

1	Ability to select and implement machine learning techniques and computing environment that are suitable for the application.	K1, K2
2	Ability to identify the characteristics of datasets and compare the trivial data and unstructured data	K2, K3
3	Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies	K2, K3
4	Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.	K1, K2
5	Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies	K2, K3

K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6-Create

UNIT I	INTRODUCTION TO DATA ANALYSIS	12

Introduction to Big Data Platform – Challenges of conventional systems – Web data –Evolution of Analytic scalability, analytic processes and tools, Analysis vs reporting – Modern data analytic tools,

UNIT II	DATA ANALYSIS TECHNIQUES	12

Regression modeling, Multivariate analysis, Bayesian modeling, inference and Bayesian networks, Support vector and kernel methods, Analysis of time series: linear systems analysis, nonlinear dynamics – Rule Induction.

UNIT III	LINEAR METHODS FOR REGRESSION AND CLASSIFICATION	12

Overview of supervised learning, Linear regression models and least squares, Multiple regression, Multiple outputs, Subset selection ,

UNIT IV	BASIC ANALYSIS TECHNIQUES	12

Basic analysis techniques, Statistical hypothesis generation and testing, Chi-Square test, t-Test, Analysis of variance, Correlation analysis, Maximum likelihood test, Practice and analysis with R or Python

UNIT V	MODEL ASSESSMENT AND SELECTION	12

Bias, Variance, and model complexity, Bias-variance trade off, Optimism of the training error rate ,Estimate of In-sample prediction error, Effective number of parameters

	Total Lecture Hours	60 Hours

Text Book(s)

1.	Michael Berthold, David J. Hand, Intelligent Data Analysis, Springer, 2007.

Reference Book(s)

1.	Anand Rajaraman and Jeffrey David Ullman, Mining of Massive Datasets,Cambridge University Press, 2012
2.	Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014
3.	Vijay Madisetti and ArshdeepBahga, "Internet of Things (A Hands-on-Approach)", 1st Edition, VPT, 2014.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	L	L	L	L
CO2	S	M	S	S	M	M	M	L	L	L
CO3	S	M	M	M	S	M	L	L	M	L
CO4	M	S	M	M	S	M	L	L	M	L
CO5	M	S	M	M	S	M	L	L	M	L

*S-Strong; M-Medium; L-Low

Course Code	Advanced Excel Lab	L	T	P	C
Core/Elective/ Supportive	Core Lab 2	-	0	4	2
Pre - requisite	Logical reasoning and interest in data handling	Syllabus version		2025 – 26 onwards	

Course Objectives	

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.

Expected Course Outcomes		
1	Develop organized data format using sorting and filtering components	K3, K4
2	Design advanced graphic presentations on stored data	K3,K4
3	Sort, search, and extract knowledge from historical data	K3,K4, K5

K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create

EXERCISE 1	INTRODUCTION TO SPREADSHEETS	9

Introduction to spreadsheets, reading data, manipulating data. Basic spreadsheet operations and functions

EXERCISE 2	DATA CLEANING AND WORKING WITH CONDITIONS USING EXCEL	9

Working with Text: Conditional expression (IF and nested IF), Logical Funcion(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 charts in Excel, Using Ranges Selecting
Ranges, Entering Information Into a Range, Using AutoFill

EXERCISE 3	DATA MANIPULATION USING EXCEL	10

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

EXERCISE 4	DATA ANALYSIS	10

What-if-Analysis- Goal Seek, Data Table, Scenario Manager, Formatting Charts, 3D Graphs,

EXERCISE 5	ADVANCED GRAPHING AND CHARTING	10

Formatting and customizing Pivot tables, Using advanced options of Pivot tables, Pivot charts, Line, Bar and Pie charts, , Scatter plots, Histograms

	Total Practical Hours	48

	Text Book(s)
1	Microsoft Excel 2019 Data Analysis and Business Modeling, Wayne Winston, 2019
	Reference Book(s)
2	https://www.coursera.org/learn/excel-data-analysis#syllabus
3	https://www.coursera.org/learn/analytics-excel#syllabus
4	https://kristujayanti.edu.in/pdf/2018/VAC-Data-Analysis-using-spreadsheet-Syllabus.pdf
5	https://online.rice.edu/courses/excel-data-analysis/
6	https://www.digitalvidya.com/certified-data-analytics-course/
7	https://www.zsem.hr/media/2017/12/Syllabus_Big-Data-Analytics-using-Excel-Business-Intelligence-and-Power-BI-tools_20172018.pdf

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	L	L	L	L
CO2	S	M	M	M	M	S	L	L	L	L
CO3	S	M	L	L	M	S	L	L	L	L

*S-Strong; M-Medium; L-Low

Course code	Internet Basics Lab		L	T	P	C
Core/Elective/ Supportive	Core Lab 3		-	-	4	2
Pre-requisite	Familiarity with Windows OS or any graphical user interface.	Syllabus Version		2025 – 26 onwards		

Course Objectives:

1. Introduce the fundamentals of Internet and the Web functions.
2. Impart knowledge and essential skills necessary to use the internet and its various components.
3. Find, evaluate, and use online information resources.
4. Use Google Apps for education effectively.

Expected Course Outcomes:

1	Apply the predefined procedures to create Gmail account, check and receive messages	K3
2	Apply the predefined procedures to perform various basic operations on internet	K3
3	Utilize various google applications like docs, google classroom, google drive, google forms, google meet and slides	K3

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**– Create

PROGRAM - 1	1
Create an email account in Gmail. Using the account created compose a mail to invite other college students for your college fest, enclose the invitation as attachment and send the mail to at least 50 recipients. Use CC and BCC options accordingly	
PROGRAM - 2	1
Open your inbox in the Gmail account created, check the mail received from your peer from other college inviting you for his college fest, and download the invitation. Reply to the mail with a thank you note for the invite and forward the mail to other friends	
PROGRAM - 3	1
Assume that you are studying in final year of your graduation and are eagerly looking for a job. Visit any job portal and upload your resume.	
PROGRAM - 4	1
Create a meeting using Google calendar and share meeting id to the attendees. Transfer the ownership to the Manager once the meeting id is generated.	
PROGRAM - 5	1
Create a label and upload bulk contacts using import option in Google Contacts	
PROGRAM - 6	2
Create your own Google classroom and invite all your friends through email id. Post study material in Google classroom using Google drive. Create a separate folder for every subject and upload all unit wise E-Content Materials.	
PROGRAM - 7	1
Create and share a folder in Google Drive using „share a link" option and set the permission to access that folder by your friends only.	
PROGRAM - 8	1
Create one-page story in your mother tongue by using voice recognition facility of Google Docs	
PROGRAM - 9	1
Create a registration form for your Department Seminar or Conference using Google Forms.	
PROGRAM - 10	1
Create a question paper with multiple choice types of questions for a subject of your choice, using Google Forms.	
PROGRAM - 11	1

Create a meet using Google Calendar and record the meet using Google Meet. Create a Google slides for a topic and share the same with your friends.		
PROGRAM - 12		1
Create template for a seminar certificate using Google Slides.		
PROGRAM - 13		1
Create a sheet to illustrate simple mathematical calculations using Google Sheets. Create student"s internal mark statement and share the Google sheets via link.		
	Total Lecture hours	14 hours

	Text Book(s)	
1	Ian Lamont, Google Drive & Docs in 30 Minutes, 2nd Edition.	
	Reference Books	
1	Sherry Kinkoph Gunter, My Google Apps, 2014.	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	M	L	L	L	L	L	L	L	M
CO2	S	M	L	L	L	L	L	L	L	L
CO3	S	S	S	L	L	L	L	L	L	L

*S-Strong; M-Medium; L-Low

Course code	21CSEGC06	Mathematical foundations for Machine learning	L	T	P	C
Core/Elective/Supportive		Allied	4	-	0	4
Pre-requisite		Basic Mathematics	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. To understand linear programming methods.
2. To understand Dynamic programming approach.
3. To understand concepts basics concepts of Linear Algebra
4. To understand concepts of vector spaces and matrices
5. To understand the applications of Linear Algebra in Machine Learning

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Solve linear programming techniques to optimization problems arising in all Computer fields	K3
2	Use Dynamic programming approach to real time problems.	K3
3	Understand the basics of Linear Programming constructs	K2
4	Apply vector spaces and their applications in Machine Learning	K3
5	Understand the concepts of matrix, Gaussian Elimination and differential equations and Apply the concepts of Linear Algebra in Machine Learning Algorithms	K2, K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	Linear Programming Problem	10 hours

Introduction to Operations Research: Basics definition - scope – objectives - phases - models - limitations of Operations Research - Linear Programming Problem - Formulation of LPP - Graphical solution of LPP - Simplex Method - Artificial variables - Big-M method - Two-phase method - Degeneracy - Unbound solutions – Duality in Linear Programming Problems – Dual Simplex - Introduction to optimization - gradient descent method - convex optimization.

Unit:2	Dynamic Programming	12 hours

Introduction - Characteristics of dynamic programming – Dynamic programming approach for Priority Management employment smoothening – capital budgeting – Stage Coach/Shortest Path – cargo loading and Reliability problems.

Unit:3	Geometry Linear Equations and Vector Spaces	12 hours
The Geometry of Linear Equations - An Example of Gaussian Elimination- Matrix Notation and Matrix Multiplication - Triangular Factors and Row Exchanges- Inverses and Transposes. Vector Spaces and Subspaces – Solving Ax=0 and Ax=b - Linear Independence, Basis and Dimension- The Four Fundamental Subspaces- Graphs and Networks- Linear Transformations.		
Unit:4	Determinants, Eigenvalues and Eigenvectors	12 hours
Determinants: Introduction- Properties of the Determinant- Formulas for the Determinant – Applications of Determinants. Eigenvalues and Eigenvectors: Introduction- Diagonalization of a Matrix .- Difference Equations and Powers A k- Differential Equations and e At - Complex Matrices- Similarity Transformations – A - Applications of Machine Learning – Use cases.		
Unit:5	Positive Definite Matrices	12 hours
Minima, Maxima, and Saddle Points - Tests for Positive Definiteness - Singular Value Decomposition – Machine Learning Applications – Use cases.		
Unit:6	Contemporary Issues	2 hours
Use Linear and Dynamic programming approach to real time problems. Apply the concepts of Linear Algebra in Machine Learning Algorithms Expert lectures, online seminars – webinars		
	Total Lecture hours	60 hours

Text Book(s)

1	J K Sharma, **"Operations Research Theory &Applications"** 6th Edition, Laxmi Publications, 2017.
2	Gilbert Strang, Linear Algebra and Its Application, 5[th]Edition, Wellesley Cambridge Press, ISBN: 9780980232776, 2017.

Reference Books : EBooks

1	P. K. Gupta and D. S. Hira, **"Operations Research"**, S. Chand & co., 2017
2	David C. Lay, Steven R. Lay, Judi J. McDonald, **"Linear Algebra and Its Applications"** 5th Edition, Pearson Education, 2016.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

	Course Title	Duration	Provider
1.	Operations Research	15 Weeks	Swayam
2.	Linear Algebra	12 Weeks	Swayam

Web link
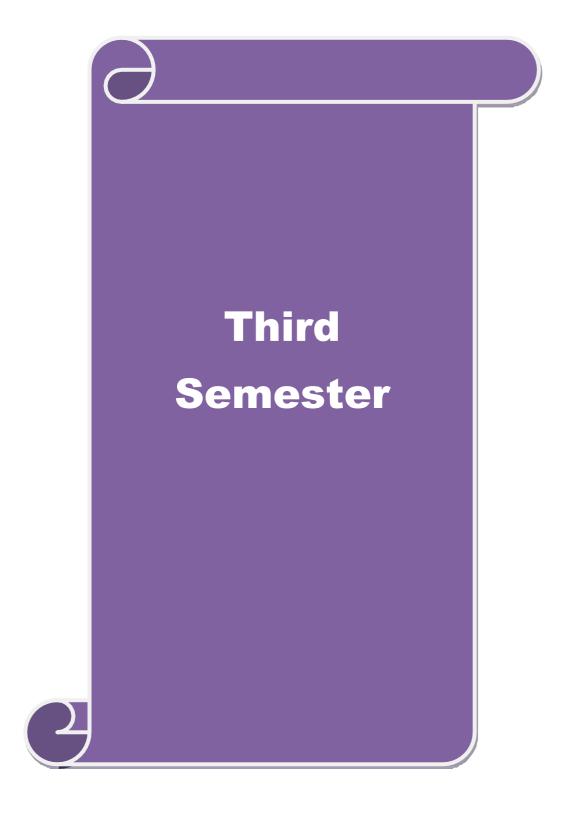
1. https://stemez.com/subjects/science/1HOperationsReseach/1HOperationsReseach.php
2. https://www.khanacademy.org/math/linear-algebra
Course Designed by: Mr. Moorthy , Dr. T. Devi

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	S	M	M	M	S	S	M	S
CO2	S	S	S	S	M	M	S	S	M	S
CO3	M	M	M	S	S	M	M	S	L	S
CO4	S	M	S	S	S	M	S	S	L	S
CO5	M	M	M	S	S	M	M	S	L	S

*S-Strong; M-Medium; L-Low

Third Semester

Course Code	Data Engineering		L	T	P	C
Core/Elective/ Supportive	Core 4		3	-		3
Pre-requisite	Understanding of SQL and database concepts	Syllabus Version		2025 – 26 onwards		

Course Objectives:

The main objectives of this course are to:
1. Identify basic concepts, terminology, theories, models and methods in the field of Data Engineering
2. Apply data transformations such as aggregation and filtering for visualization
3. Identify opportunities for application of data visualization in various domains.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Acquire knowledge on various phases of data engineering	K1, K2
2	Identify necessity of data pre-processing and apply the appropriate procedure	K2, K3
3	Demonstrate data warehouse schema and process of data retrieval for real time applications.	K2, K3,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**–Create

UNIT:1	DATA ENGINEERING INTRODUCTION	8 Hours

KDD Process – Kinds of data can be mined – Kind of patterns can be mined – Technologies used – Kinds of Applications targeted – Issues in data mining - Data Objects and Attribute Types - Data preprocessing overview – Data Cleaning – Data Integration – Data Reduction – Data Transformation and Discretization

UNIT:2	DATA WAREHOUSING	10 Hours

Data warehouse – Basic Concepts –Modeling - Data cube and OLAP – Data warehouse Design and Usage – Implementation - Data Generalization by Attribute Oriented Induction.

UNIT:3	DATA MODELING	10 Hours

Introduction to data modeling-Relational data models-NoSQL data models-Data Pipelines- Data Quality-Production data Pipelines

UNIT:4	DATA PROCESSING	10 Hours

ETL basics –Extraction of Data-Extraction Methods-Transportation of data- Transportation mechanisms-ETL Tools-Loading and Transformation. Data Capture-Data warehouse performance-basic query-advanced query-Schema modeling techniques-Analysis and Reporting-OLAP

UNIT:5	DATA VISUALIZATION	10 Hours

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings.

		Total Lecture hours	48 hours

Text Book(s)		
1	Paul Crickard "Data Engineering with Python" work with massive datasets to design datamodels and automate data pipelines Using python,2020	
2	Jiawei Han, MichelineKamber, Jain Pei "Data Mining: Concepts and Techniques", Third edition, Elsevier, Morgan Kaufmann Publishers, 2012.	
Reference Books		
1	Glenn J. Myatt, Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining, John Wiley Publishers, 2007.	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	M	L	M	M
CO2	S	S	S	S	L	M	L	M	L	M
CO3	S	S	M	M	L	M	S	M	M	M

*S-Strong; M-Medium; L-Low

Course Code	Artificial intelligence	L	T	P	C
Core/Elective/ Supportive	Core 5	4	-	-	3
Pre-requisite	Basic programming knowledge (Python/Java/C++)	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. Understand the fundamentals of artificial intelligence and working of problem-solving agents.
2. Understand the logical agents and knowledge representation using First Order Logic.
3. Understand the concept of uncertainty and building principles of decision-making agents.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Demonstrate fundamentals of artificial intelligence (AI) and problem solving using different search methods	K3
2	Describe about adversarial search and constraint satisfaction problem solving.	K3
3	Develop knowledge about logic representations for making inferences.	K2
4	Demonstrate the decision-making techniques to handle uncertainty.	K2
5	Apply AI principles to develop solutions and applications to solve problems.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit: 1	INTRODUCTION AND PROBLEM SOLVING	8 Hours

Definitions of AI - Intelligent Agents - Problem solving by searching: Problem-solving agents- Example problems – Search for solutions - Uninformed search strategies – Informed search strategies – Heuristic Function – Python AI search implementation.

Unit: 2	ADVERSARIAL SEARCH AND CSP	10 Hours

Adversarial search: Games- Optimal decisions in games – Alpha-beta pruning – Imperfect real time decisions. Constraint Satisfaction Problems (CSP): Defining CSP problems-Constraint Propagation: Inference in CSPs - Backtracking search for CSPs.

Unit: 3	LOGICS AND KNOWLEDGE REPRESENATION	10 Hours

Logical agents: Knowledge-based agents – The Wumpus world. Logic – Propositional logic: A very simple logic-Propositional theorem proving. First order logic: Representation – Syntax and semantics of first order logic – Using first order logic-PROLOG basics. Inference in first order logic: Propositional versus first order inference– Unification and lifting –Forward chaining – Backward chaining – Resolution.

Unit: 4	UNCERTAINITY AND DECISION MAKING	10 Hours

Making Simple Decisions-Combining beliefs and desires under Uncertainty-Utility Theory-Utility Functions-Multi-attribute utility functions- Quantifying uncertainty: Acting under uncertainty - Probability basics – Bayes' Rule and its use. Probabilistic reasoning: Representing knowledge in uncertain domain- The semantics of Bayesian networks - Decision networks- The value of information-Decision theoretic expert systems.	
Unit:5 **AI APPLICATIONS**	**10 Hours**
Future of Artificial Intelligence - Natural Language Processing - Speech Recognition – Robotics – Expert Systems - AI Application Case Studies.	
Total Lecture hours	**48 hours**

Text Book(s)

1	Stuart Russell, Peter Norvig, "Artificial Intelligence – A Modern Approach", 3rd Edition, Pearson Education / Prentice Hall of India, 2015.
2	Elaine Rich, Kevin Knight, Shivashankar.B. Nair, "Artificial Intelligence", Tata Mc Graw Hill, Third Edition , 2009

Reference Books

1	Nils J. Nilsson, "Artificial Intelligence: A new Synthesis", Harcourt Asia Pvt. Ltd., 2000.
2	George F. Luger, "Artificial Intelligence-Structures and Strategies For Complex Problem Solving", Pearson Education / PHI, 2002
3	David L. Poole, Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agents" , Cambridge University Press, 2010.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://aima.cs.berkeley.edu
2	http://nptel.ac.in/courses/106106126/4
3	https://medium.freecodecamp.org/an-introduction-to-q-learning-reinforcement-learning-14ac0b4493cc

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	M	S	M	M	M
CO2	S	S	M	M	M	M	M	M	M	M
CO3	S	S	M	M	M	M	M	M	M	M
CO4	S	S	S	S	S	S	M	M	M	M
CO5	S	S	S	S	S	M	L	M	L	L

*S-Strong; M-Medium; L-Low

Course code	Applied Data Structures	L	T	P	C
Core/Elective/ Supportive	Core 6	3	0	0	2
Pre-requisite	Understanding of control structures (loops, conditionals, functions)	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. Master the implementation of linked data structures such as stack, queues, linked lists, trees etc.
2. To choose the appropriate data structure for a specific application

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Construct and analyze Linked list operations with illustrations	K2,K3
2	Construct and analyze stack operations with illustrations	K2,K3
3	Enhance the knowledge of Queue and Hashing.	K2,K3
4	Demonstrate the concept of trees and its applications	K2,K3
5	Demonstrate the concept of Graph and its applications	K2,K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	LINKED LIST	8 hours

Array list-Review of Pointers- Linked lists –Types- Operations - Creation, Insertion, Deletion, Modification Doubly Linked List operations

Unit:2	STACK	10 hours

Stacks – Operations implemented using arrays and Linked list – Applications of Stack – Balancing Parenthesis – Infix to Postfix Conversion, Postfix Expression Evaluation

Unit:3	QUEUES AND HASHING	10 hours

Queues – Operations on Queues, Circular Queue – Operations, Double ended queue – Priority queue – Hashing- Collision resolution strategies

Unit:4	TREES	10 hours

General Trees Representation – Tree Traversals – Binary Trees- Expression trees – Binary Search Tree operations – B-Trees – B+Trees.

Unit:5	GRAPHS	10 hours

Graphs and their representation: BFS, DFS – Shortest Path Algorithms – Dijikstra's Algorithm – Minimum Spanning Tree – Topological Sorting

		Total Hours : 45

References:
1. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Second Edition, Universities Press, Hyderabad, 2008.
2. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Second edition, Pearson Education Asia, 2007.
3. Jean Paul Tremblay and Paul G. Sorenson, An introduction to data structures with applications 2nd edition, Tata McGraw-Hill, 20014
4. Gilberg and Ferouzan, Data Structures using C, Pearson Education 2004.
5. Robert L. Kruse, Clovis L. Tondo, Bruce P. Leung, 'Data Structures and Program Design in C', PHI, 1996.
6. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, Data Structures &Algorithms, Pearson Education, New Delhi, 2009.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	S	L	L	M
CO2	S	S	S	S	M	S	L	L	L	L
CO3	S	M	M	M	S	S	M	L	L	M
CO4	M	M	M	M	M	M	M	L	L	M
CO5	M	M	M	M	M	M	S	M	L	M

S-Strong; M-Medium; L-Low

Course Code	Inferential Statistics	L	T	P	C
Core/Elective/ Supportive	Allied	4	-	-	4
Pre-requisite	Basics of sampling techniques	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. Gain knowledge on the methods of testing statistical hypothesis.
2. Understand the meaning and applications of tests of significance

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Understand testing of statistical hypothesis	K1, K2
2	Understand the concept of powerful tests based on 't' and 'F' distributions	K2, K3
3	Understand the concept of variability to draw inferences	K2, K3,K4
4	Analyze the test of goodness of fit	K2, K3,K4
5	Understand and apply suitable test for analysis	K4,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	Tests of Hypotheses	8 Hours

Procedure of Testing hypothesis –two types of errors – critical region-Two - tailed and one- tailed tests, measuring the power of a hypothesis test

Unit:2	Estimation	10 Hours

Properties of a good estimator, Tests of significance of attributes-tests for number of successes and proportion of successes

Unit:3	Tests of significance for large samples	10 Hours

Difference between small and large samples-two tailed test for difference between means of two samples, standard deviations

Unit:4	Test of significance for small samples	10 Hours

Assumption of normality-Student's t-distribution-Properties of t-distribution-Application of t-distribution

Unit:5	Sampling Distributions	10 Hours

Chi-square distribution, Fisher's z distribution and F-test

	Total Lecture hours : 48 Hours

	Text Book(s)	
1	Gupta, S.C., and Kapoor, V. K. (2020). Fundamentals of Mathematical Statistics, 12th Edition, Sultan Chand & Sons (Publisher), New Delhi, India	
2	Gupta S.P (2018), Statistical Methods, 45th revised edition, Sultan Chand & Sons, New Delhi	
	Reference Books	
1	Agarwal, B. L. (2006). Basic Statistics, New Age International Private Limited, New Delhi, India	
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/111/104/111104120/	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	M	M	M	M	M
CO2	M	S	M	M	M	M	S	S	M	M
CO3	S	M	S	S	S	M	S	M	S	M
CO4	S	M	M	M	M	M	M	S	S	M
CO5	S	S	M	M	M	M	M	M	M	M

*S-Strong; M-Medium; L-Low

Course Code	ETL Laboratory	L	T	P	C
Core/Elective/ Supportive	**Core Lab 4**	-	-	3	2
Pre-requisite	**Familiarity with Python or any programming language**	**Syllabus Version**		**2025 – 26 onwards**	

Course Objectives:		
The main objectives of this course are to:		
1. To give an understanding of core concepts and technologies of data science.		
2. To give an understanding of data pre-processing techniques		
3. To equip the students to prepare the data for visualization		

Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1	Acquire knowledge on various phases of data engineering	K1, K2
2	Identify necessity of data pre-processing and apply the appropriate procedure	K2, K3
3	Demonstrate data warehouse schema and process of data retrieval for real time applications.	K2, K3,K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create		

1	Data Migration (Informatica)
2	Identification and Retrieval of dataset. (Kaggle/UCI Repository)
3	Statistical Descriptions of Data (R/Python)
4	Pre-processing of datasets using data mining tools.
5	Exploratory Analytics
6	Data Visualization
	Total Practical Hours:48
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://www.udacity.com/course/data-engineer-nanodegree--nd027
2	https://www.datacamp.com/courses/introduction-to-data-engineering
3	https://www.dataquest.io/path/data-engineer/

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	S	M	L	L	M
CO2	M	S	S	S	S	M	M	L	L	L
CO3	M	S	S	M	M	M	L	L	M	M

*S-Strong; M-Medium; L-Low

Course Code	Mini project I using Python Programming / Advanced Excel	L	T	P	C
Core/Elective/ Supportive	Skill based Subject-1	-	-	3	2
Pre-requisite	Students should have a good understanding of Python Programming Advanced Excel	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. To understand and select the task based on their core skills
2. To get the knowledge about analytical skill for solving the selected task
3. To get confidence for implementing the task and solving the real time problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Illustrate a real world problem and identify the list of project requirements	K3
2	Judge the features of the project including forms, databases and reports	K5
3	Design code to meet the input requirements and to achieve the required output	K6
4	Compose a project report incorporating the features of the project	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Aim of the project work

1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied
2. Each student should carry out individually one project work and it may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea focusing on application-oriented concepts
3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

Viva Voce

1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 75 marks at the last day of the practical session.
2. Out of 75 marks, 45 marks for project report and Viva Voce and 30 Marks for Internal Assessment.

Project Work Format

PROJECT WORK
TITLE OF THE DISSERTATION
Bonafide Work Done by STUDENT NAME
REG. NO.
Dissertation submitted in partial fulfillment of the requirements for the award of
< Name of the Degree>
of Bharathiar University, Coimbatore-46.
College Logo

Signature of the Guide   Signature of the HOD

Submitted for the Viva-Voce Examination held on _____

Internal Examiner   External Examiner

Month – Year

Acknowledgement Contents

Synopsis

1. Introduction
    1.1 Organization Profile
    1.2 System Specification
        1.2.1 Hardware Configuration
        1.2.2 Software Specification

2. System Study
    2.1 Existing System
        2.1.1 Drawbacks
    2.2 Proposed System
    2.2.1 Features

3. System Design and Development
    3.1 File Design
    3.2 Input Design
    3.3 Output Design
    3.4 Database Design
    3.5 System Development
        3.5.1 Description of Modules (Detailed explanation about the project work)

4 Software Testing and Implementation Conclusion

Bibliography Appendices
    A. Data Flow Diagram
    B. Table Structure
    C. Sample Coding
    D. Sample Input
    E. Sample Output

Mapping with Programme Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	L	L	L	L	L
CO2	S	S	S	S	S	L	L	L	L	L
CO3	S	S	S	S	S	M	M	L	L	L
CO4	S	S	S	S	S	M	M	L	L	L

*S-Strong; M-Medium; L-Low

Fourth Semester

Course Code	R Programming	L	T	P	C
Core/Elective/ Supportive	Core 7	4	0	0	4
Pre - requisite	Familiarity with computer programming concepts	Syllabus version		2025 – 26 onwards	

Course Objectives					
• To expose the student sot the fundamental concepts of R Programming					

Expected Course Outcomes		
1	Understand the basics in R programming in terms of constructs, control statements, string functions	K2
2	Understand the use of R for Big Data analytics	K2
3	Apply R programming for Text processing	K3
4	Appreciate and apply the R programming from a statistical perspective	K3
K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create		

UNIT I	Introducing to R	12

Introducing to R – R Data Structures – Help Functions in R – Vectors – Scalars – Declarations – Recycling – Common Vector Operations – Using all and any – Vectorized operations – Filtering – Victoriesed if-then else – Vector Element names.

UNIT II	Matrices	12

Creating matrices – Matrix Operations – Applying Functions to Matrix Rows and Columns – Adding and deleting rows and columns - Vector/Matrix Distinction – Avoiding Dimension Reduction – Higher Dimensional arrays – lists – Creating lists – General list operations – Accessing list components and values – applying functions to lists – recursive lists.

UNIT III	Data Frames	12

Creating Data Frames – Matrix-like operations in frames – merging Data frames – Applying functions to Data Frames – Factors and Tables – Factors and levels – Common Functions used with factors – Working with tables – Other factors and table related functions – Control statements – Arithmetic and Boolean operators and values – Default Values for arguments – Returning Boolean Values – Functions are objects – Recursion

UNIT IV	Classes	12

S3 Classes – S4 Classes – Managing your objects – Input/output – accessing keyboard and monitor – reading and writing files – accessing the internet – String Manipulation – Graphics – Creating Graphs– Customizing Graphs – Saving Graphs to files – Creating Three-Dimensional plots .

UNIT V	Modelling in R	12

Interfacing R to other languages – Parallel R – Basic Statistics – Linear Model – Generalized Linear models – Non-linear Models – Time Series and Auto-Correlation – Clustering.

	Total Lecture Hours	60 Hours

Text Book(s)

1	Norman Matloff, ―The Art of R Programming: A Tour of Statistical Software Design‖, No Starch Press, 2011.
2	Jared P. Lander, ―R for Everyone: Advanced Analytics and Graphics‖, Addison-Wesley Data & Analytics Series, 2013.
ReferenceBook(s)	
1	Mark Gardner, ―Beginning R – The Statistical Programming Language‖, Wiley, 2013.
2	Robert Knell, ―Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and programming in R‖, Amazon Digital South Asia Services Inc, 2013. Richard Cotton(2013). Learning R, O'Reilly Media.
3	Garret Grolemund (2014). Hands-on Programming with R. O'Reilly Media, Inc.
4	Roger D.Peng (2018). R Programming for Data Science. Lean Publishing.
	Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)	
1	**https://onlinecourses.swayam2.ac.in/aic20_sp06/preview**	
2	**https://onlinecourses.swayam2.ac.in/arp19_ap79/preview**	
Course Designed by :	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	L	L	L	L
CO2	S	S	M	M	M	S	L	L	L	L
CO3	S	M	M	S	M	M	L	L	L	L
CO4	S	S	M	M	M	S	L	L	L	L

*S-Strong; M-Medium; L-Low

Course code	MACHINE LEARNING TECHNIQUES		L	T	P	C
Core/Elective/ Supportive	Core 8		4	-	-	4
Pre-requisite	Familiarity with data preprocessing and visualization		Syllabus Version		2025 – 26 onwards	

Course Objectives:
The main objectives of this course are to:

1. Understand the significance and basic concepts of machine learning.

2. Understand different forms/methods of learning and its algorithmic perspective.

3. Understand the various applications of machine learning.

Expected Course Outcomes:
On the successful completion of the course, student will be able:

1	Understand the fundamentals and different forms of machine learning.	K2
2	Demonstrate various parametric and semi parametric machine learning techniques.	K2
3	Demonstrate various non- parametric machine learning techniques.	K2
4	Explain about the concepts of computational learning theory and dimensionality reduction	K2
5	Develop applications using appropriate machine learning approaches for real life problems	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	INTRODUCTION AND SUPERVISED LEARNING	12 hours

Introduction to Machine Learning – basic concepts in machine learning – Forms of Learning - Examples of machine learning applications - Supervised Learning: Learning a Class from Examples–Noise–Learning Multiple Classes– Perspectives and Issues in Machine Learning.

Unit:2	PARAMETRIC AND SEMI-PARAMETRIC METHODS	12 hours

Parametric Classification – Regression–Tuning Model Complexity–Model Selection Procedures. Multivariate Methods: Data–Parameter Estimation–Estimation of Missing Values–Multivariate Normal Distribution–Multivariate Classification and Regression - Semi parametric method: Clustering –Expectation–Maximization Algorithm - Self Organizing Feature Map.

Unit:3	NON-PARAMETRIC METHODS	12 hours

Nonparametric Methods: Nonparametric Density Estimation and Classification-Generalization to Multivariate Data–Condensed Nearest Neighbour–Smoothing Models. Decision Trees: Univariate Trees–Pruning–Rule Extraction–Learning Rules–Multivariate Trees.

Unit:4	COMPUTATIONAL LEARNING	12 hours
Computational Learning theory, mistake bound analysis, sample complexity analysis, VC dimension, Occam learning, accuracy and confidence boosting, Dimensionality reduction: Principal component Analysis, feature selection and visualization.		
Unit:5	ML APPLICATIONS AND CASE STUDY	
Automated knowledge acquisition, pattern recognition, program synthesis, text and language processing, internet-based information systems, human computer interaction, semantic web, and bioinformatics.		12 hours
	Total Lecture hours	60 hours

Text Book(s)

1	Ethem Alpaydin, - Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014.
2	Bishop, C. (2006). Pattern Recognition and Machine Learning. Berlin: Springer-Verlag.
3	Tom M. Mitchell, ―Machine Learning, McGraw-Hill Education (India) Private Limited, 2013
4	Stephen Marsland, ―Machine Learning: An Algorithmic Perspective, CRC Press, 2009.

Reference Books

1	Jason Bell, - Machine Learning – Hands on for Developers and Technical professionals, First Edition, Wiley, 2014.
2	Peter Flach, - Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.nptel.ac.in/noc21_cs24/preview	
2	https://www.coursera.org/learn/machine-learning	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	S	L	L	M	L
CO2	S	M	S	M	S	S	M	L	L	L
CO3	S	M	S	S	M	S	L	L	L	L
CO4	S	M	S	M	M	S	L	L	M	M
CO5	S	S	S	M	S	S	L	M	M	L

*S-Strong; M-Medium; L-Low

Course code	R Programming Lab	L	T	P	C
Core/Elective/ Supportive	**Core Lab 5**	**-**	**-**	**3**	**2**
Pre-requisite	**Familiarity with data preprocessing and visualization**	**Syllabus Version**		**2025 – 26 onwards**	

Course Objectives:

The main objectives of this course is to:
- Apply the concepts in descriptive and inferential statistics to solve problems using R Studio

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Understand the basics in R programming in terms of constructs, control statements, string functions	K2
2	Understand the use of R for Big Data analytics	K2
3	Apply R programming for Text processing	K3
4	Appreciate and apply the R programming from a statistical perspective	K3

K1 – Remember; **K2** – Understand; **K3** – Apply; **K4** – Analyze; **K5** – Evaluate; **K6**– Create

List of Programs

List of Programs
1. R Expressions and Data Structures
2. Manipulation of vectors and matrix
3. Operators on Factors in R
4. Data Frames in R
5. Lists and Operators
6. Working with looping statements.
7. Graphs in R
8. 3D plots in R

	Total Lecture hours	**48 hours**

	Text Book(s)	
1	Gareth M. James, Daniela Witten, Trevor Hastie, Robert Tibshirani, An Introduction to Statistical Learning: With Applications in R, 2017
2	Mark Gardner, ―Beginning R – The Statistical Programming Language‖, Wiley, 2013
3	Roger D.Peng (2018). R Programming for Data Science. Lean Publishing
	Reference Books
1	Garret Grolemund (2014). Hands-on Programming with R. O'Reilly Media, Inc.
2	Robert Knell, ―Introductory R: A Beginner's Guide to Data Visualisation, Statistical Analysis and programming in R‖, Amazon Digital South Asia Services Inc, 2013. Richard Cotton (2013). Learning R, O'Reilly Media.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://onlinecourses.swayam2.ac.in/aic20_sp06/preview									
2	https://onlinecourses.swayam2.ac.in/arp19_ap79/preview									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	M	S	L	L	L	L
CO2	M	S	S	M	M	M	M	L	L	L
CO3	S	M	S	M	M	S	M	L	L	L
CO4	S	S	M	M	M	M	M	L	L	L

*S-Strong; M-Medium; L-Low

Course Code	DIGITAL MARKETING	L	T	P	C
Core/Elective/ Supportive	Allied Paper 4	4	-	-	4
Pre-requisite	Basic understanding of marketing principles	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:

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

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Define and explain various terminologies associated with Digital Marketing.	K1, K2
2	Apply the knowledge of Digital marketing concepts.	K2, K3
3	Construct an appropriate marketing model.	K2, K3
4	Analyze role and importance of digital marketing in a rapidly changing business landscape.	K3
5	Implement the key elements of a digital marketing strategy.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	INTRODUCTION TO DIGITAL MARKETING	9 hours

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

Unit:2	SEARCH ENGINE OPTIMIZATION(SEO)	9 hours

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

Unit:3	SOCIAL MEDIA MARKETING (SMM)	10 hours

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

Unit:4	**SEARCH ENGINE MARKETING (SEM)**	10 hours

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

Unit:5	**APPLICATION**	hours

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

	Total Lecture hours	**48 hours**
	Text Book(s)	
1	Ryan Deiss and Russ Hennesberry, "Digital Marketing forDummies",2017	
2	Puneet singh bhatia, "Fundamentals of DigitalMarketing",2017	

References

- Introduction to Programmatic Advertising ByDominikKosorin,2016
- Blogging: A Practical Guide to Plan Your Blog: Start Your Profitable Home-Based Business with a Successful Blog by Jo and DaleReardon,2015
- Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing By IanBrodie,2013
- Social Media Marketing All-In-One for Dummies By Jan Zimmerman and Deborah Ng,2017

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	M	S	M	M
CO2	M	S	S	S	S	L	M	S	M	M
CO3	S	S	M	M	S	L	S	M	M	S
CO4	M	M	S	S	M	M	M	M	M	M
CO5	M	M	M	M	M	M	M	L	L	L

*S-Strong; M-Medium; L-Low

Course code	Optimization Techniques	L	T	P	C
Core/Elective/ Supportive	Skill based Subject-2	3	-	-	2
Pre-requisite	Familiarity with matrices and linear equations	Syllabus Version		2025 – 26 onwards	

Course Objectives:

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.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Define and formulate linear programming problems and evaluate their applications	K1
2	To understand concepts and terminology of Linear Programming from formulation of mathematical models to their optimization using Simplex Method	K1
3	To comprehend the concept of a Transportation Model and develop the initial solution and optimality checking of the solution	K2
4	To apply the strategies of game theory and to make better decisions while solving business problems	K3
5	Use critical path analysis and programming evaluation and review techniques for timely project scheduling and completion.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION TO OPERATION RESEARCH	9 --hours

Introduction to Operations Research – Meaning – Scope – Applications - Limitations.
Linear programming-Mathematical Formulation-Application in management decision making - Graphical Method-Simplex Method.

Unit:2	TRANSPORTATION AND ASSIGNMENT PROBLEMS	9 --hours

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.

Unit:3	GAME THEORY	9--hours
Game theory: 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.

Unit:4	NETWORK ANALYSIS	9 --hours
CPM–Principles–Construction of network- Critical path –Forward pass–Backward pass computations–PERT – Time scale analysis - probability of completion of project – types of floats.

Unit:5	SEQUENCING PROBLEM AND REPLACEMENT THEORY	10 --hours
Theory of Replacement – Introduction - Replacement models –Replacement of items that deteriorates gradually (value of money does not change with time)

Unit:6	CONTEMPORARY ISSUES	02-hours
Expert lectures, online seminars – webinars

Note: Theory and problem shall be distributed as 20% and 80% respectively.

	Total Lecture hours	48 --hours

Text Book(s)

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

Reference Books

1	Kanti Swarup, P.K.Gupta and Man Mohan – Operations Research
2	Sundaresan V, Ganapathy K.S, Ganesan K, Resource Management Technique- Lakshmi Publications, 2003.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://nptel.ac.in/courses/111/105/111105077/
2	https://nptel.ac.in/content/syllabus_pdf/111105077.pdf

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	S	S	M	S
CO2	S	S	S	S	S	S	S	S	S	S
CO3	S	M	M	S	S	S	M	M	S	S
CO4	M	S	M	S	M	M	S	M	S	M
CO5	S	S	S	S	M	S	S	S	S	M

*S-Strong; M-Medium; L-Low

Fifth

Semester

Course Code	Data Visualization	L	T	P	C
Core/Elective/ Supportive	Core 9	6	-	-	4
Pre-requisite	Familiarity with spreadsheets and data analysis	Syllabus Version		2025 – 26 onwards	

Course Objectives:	
The main objectives of this course are to:	
1. Understand the fundamentals of visualization concepts and its importance.	
2. Understand essential design principles to design and develop effective visualizations.	
3. Understand planning and visual analytics through advanced visualization techniques.	

Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1	Understand foundational visualization concepts	K2
2	Demonstrate visualizations principles to enhance data visualization	K2
3	Analyze and apply essential design principles to data exploration and visualization	K3
4	Design appropriate charts, tables, maps and dashboards	K3
5	Effectively create and tell a story based on visualized data	K3
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create		

Unit: 1	**VISUALIZATION FUNDAMENTALS**	10 hours

Introduction to data visualization-Need for data visualization and its definition-Tools for Visualizing Data-Methods of visualizing data-Overview of modern visualization tools - working with various data formats - Basic chart types.

Unit: 2	**DATA VISUALIZATION FOR HUMAN PERCEPTION**	14 hours

The Human Brain and Data Visualization-Cognitive vs Perceptual Design Distinction-Introduction of Effective and Ineffective Visuals-Types of Visualizations and its examples-Practicing Good Ethics in Data Visualization-Ineffective Visuals and improvements-Visual Perception and Cognitive Principles- Strategic Use of Pre-Attentive Attributes - De-Cluttering.

Unit: 3	**DESIGN AND EXPLORATORY ANALYSIS**	14 hours

Introduction-Exploratory and Explanatory Analysis -Identifying Outliers-Constructing a Control Chart-Design For Purpose-Data, Relationships, and Design-Static Versus Interactive Visualizations-Multiple, Connected View, Language, Labelling, and Scales-Visual Lies and Cognitive Bias- Case Study.

Unit: 4	**VISUAL ANALYTICS AND PLANNING**	16 hours

Basics of Visual Analytics -Charts- Colours, Shapes, and Sizes-Dual Line Charts-Bar Charts, Line Graphs, Pie Charts-Scatter Plots, Gantt Charts, Bubble Charts-Histograms, Bullet Charts, Heat Maps and Highlight Tables-Dates-Discrete vs. Continuous Dates-Basics of table calculations-Maps. Introduction to Planning and Preproduction for Visualizations-A Design Checklist-understanding Stakeholders-Prioritizing, Optimizing, and Designing

Unit:5	DASHBOARD AND STORY TELLING	
	Dashboard Design Principles-Hierarchies, Actions, Filters, and Parameters-Creating Dashboards. The Story of the data-The Art of Storytelling (Past, Present, and Future)-Storytelling and the Human Brain-Bringing Data to Life-Emotion Modulators-Framing and Format-False Narratives and Data Storytelling-Preparation of the Story Points – Case Study	18 hours
	Total Lecture hours	**72 hours**
	Text Book(s)	
1	Colin Ware and Kaufman M,, Visual thinking for design‖, Morgan Kaufmann Publishers, 2008	
2	Ben Fry, " Visualizing data", O'Reily,2007	
	Reference Books	
1	Chakrabarti, S, ―Mining the web: Discovering knowledge from hypertext data ―,Morgan Kaufman Publishers, 2003.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.coursera.org/learn/data-visualization-tableau? specialization=data-visualization	
2	Essential Design Principles for Tableau: https://www.coursera.org/learn/dataviz-design?specialization=data-visualization	
3	Visual Analytics with Tableau :https://www.coursera.org/learn/dataviz-visual-analytics?specialization=data-visualization	
4	Creating Dashboards and Storytelling with Tableau: https://www.coursera.org/learn/dataviz- dashboards? specialization=data-visualization	
5	Data Visualization with Tableau Project: https://www.coursera.org/learn/dataviz-project	
6	Data Visualization with Tableau Specialization: https://www.coursera.org/specializations/data-visualization	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	S	M	M	M
CO2	S	M	S	S	M	S	S	M	M	M
CO3	S	S	S	S	M	S	S	M	M	M
CO4	S	S	S	S	M	M	S	M	M	M
CO5	S	S	S	S	S	M	S	S	S	S

*S-Strong; M-Medium; L-Low

Course Code	Deep Learning	L	T	P	C
Core/Elective/ Supportive	Core 10	6	-	-	4
Pre-requisite	Understanding of Machine Learning concepts	Syllabus Version	2025 – 26 onwards		

Course Objectives:		
The main objectives of this course are to:		
1. Understand the fundamentals of neural networks and deep networks		
2. Understand the basics of Tensorflow		
3. Understand about the architectures and applications of Deep Learning		
Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1	Understand the basics of neural networks and deep networks	K2, K3
2	Develop small applications using Tensorflow	K2, K3
3	Understand about the major architectures of Deep Networks	K2
4	Analyze the applications of Deep Learning	K3,K4
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create		

Unit:1	Introduction to Learning	10 hours
Neural Networks – Training Neural networks-Activation functions-Loss functions-Hyperparameters		
Unit:2	**Fundamentals of Deep Networks**	14 hours
Defining Deep Learning-Common architectural principles of Deep Networks- Building blocks of Deep Networks		
Unit:3	**Tensorflow**	14 hours
Tensorflow – Variables – Operations – Placeholders – Sessions – Sharing Variables – Graphs – Visualization		
Unit:4	**Major architectures of Deep Networks**	16 hours
Unsupervised pretrained networks- Convolution Neural Networks- Recurrent neural networks-Recursive neural networks		
Unit:5	**Applications**	18 hours
Large scale Deep Learning–Computer Vision- Speech Recognition – Natural Language Processing(NLP) –Other Applications		
	Total Lecture hours	**72 hours**

	Text Book(s)
1	Josh Patterson & Adam Gibson, Deep Learning- A Practitioner's approach, O'Reilly Media, 2019.
2	Rajiv Chopra, Deep Learning-A practical approach(Using Python), Second Edition, Khanna Publishing, 2020.
3	Charles Dierbach, Introduction to Computer Science using Python: A Computational Problem Solving Focus, Wiley India Edition, 2013.
	Reference Books
1	Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning (Adaptive computation and Machine Learning series), MIT Press, 2017.

| 2 | Nikhil Buduma, Nicholas Locascio, Fundamentals of Deep Learning: Designing Next Generation Machine Intelligence Algorithms, O'Reilly Media, 2017. |
| 3 | Li Deng , Dong Yu, Deep Learning: Methods and Applications, Now Publishers, 2014 |

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

| 1 | https://onlinecourses.swayam2.ac.in/aic20_sp06/preview |
| 2 | https://onlinecourses.swayam2.ac.in/arp19_ap79/preview |

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	L	L	L	L
CO2	S	S	M	M	M	S	L	L	L	L
CO3	S	S	M	M	M	S	L	L	M	L
CO4	S	S	M	M	M	M	M	L	M	L

*S-Strong; M-Medium; L-Low

Course Code	Data Visualization Laboratory	L	T	P	C
Core/Elective/ Supportive	Core Lab 6	0	0	3	2
Pre - requisite	Basic statistics and data handling	Syllabus version		2025 – 26 onwards	

Course Objectives		
1. Understand the fundamentals of data visualization concepts and basic chart types.		
2. Apply essential design principles to design and develop effective visualizations.		

Expected Course Outcomes		
1	Understand concepts and basic charts using data visualization tools and techniques.	K2
2	Analyze and apply essential design principles to data exploration and visualization.	K4
3	Apply appropriate charts, plots, tables, and maps for complex data analysis.	K3

K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create

List of Experiments	60 hours
1. Create a basic visualization using Google Sheets.	
2. Demonstrate proper use of the design principles used: "pop-out" or "pre-attentive" attributes, Gestalt Principles, cognitive load and clutter, and static or interactive format.	
3. Analyze customer's purchases and how much the company is profiting from each customer by create a scatter plot	
4. Create a table showing total sales by product category, broken down by Year and Month -sales spotlight.	
5. Create a dual layer map showing total profit by postal code, colorized by profit ratio, and sized by total sales.	
6 Provided any dataset, create a dashboard consisting of at least 2 KPIs.	
7. Create a story consisting of at least three story points and must explicitly answer the business question(s) in the project .	

Total Practical Hours	72 Hours

Text Book (s)

1	Colin Ware and Kaufman M,, Visual thinking for design‖, Morgan Kaufmann Publishers, 2008.
2	Chakrabarti, S, "Mining the web: Discovering knowledge from hypertext data ", Morgan Kaufman Publishers, 2003.
3	Ben Fry, "Visualizing data", O'Reily, 2007.

ONLINE COURSES AND VIDEO LECTURES:

1	https://www.coursera.org/learn/data-visualization-tableau? specialization=data-visualization
2	Essential Design Principles for Tableau: https://www.coursera.org/learn/dataviz-design?specialization=data-visualization
3	Visual Analytics with Tableau :https://www.coursera.org/learn/dataviz-visual-analytics?specialization=data-visualization
4	Creating Dashboards and Storytelling with Tableau: https://www.coursera.org/learn/dataviz- dashboards?

	specialization=data-visualization
5	Data Visualization with Tableau Project: https://www.coursera.org/learn/dataviz-project
6	Data Visualization with Tableau Specialization: https://www.coursera.org/specializations/data-visualization

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	M	M	S	M	M	S	M	M	M
CO2	S	S	S	S	M	S	S	M	M	M
CO3	S	S	S	S	M	S	S	M	M	M

*S-Strong; M-Medium; L-Low

Course code	Social Media Analytics	L	T	P	C
Core/Elective/ Supportive	Skill based Subject-3:	6	-	-	2
Pre-requisite	Python or R programming (optional for practicals)	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:

- Give an overview of social networks and its importance.
- Understand the social network concepts and various methods of analysis.
- Expose and train on various tools and techniques for analyzing and visualizing social media networks.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Analyze social network data using various software packages.	K1, K2
2	Implement statistical models of social networks to analyze network formation and evolution.	K2, K3
3	Implement the basic concepts and theories of network analysis in the social sciences.	K2, K3
4	Use statistical software to visualize networks and analyze their properties.	K2

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	INTRODUCTION TO SOCIAL NETWORKS AND SNA	10 hours

Connected World – Networks: Actors, Relations and Attributes - Networks as Information Maps - Networks as Conduits – Leaders and Followers – Psychological foundations of social networks – Basic building Blocks– Brief history of Social Network Analysis.

Unit:2	NETWORK CONCEPTS	14 hours

Individual Members of the Network – Sociological Questions about Relationships – Whole Social Networks- Distributions – Multiplexity – Roles and Positions – Network Segmentation – Graph Theory – Notations for Social Network Data

Unit:3	SOCIAL NETWORK ANALYSIS FUNDAMENTALS	14 hours

Points, Lines and Density – Centrality and Centralization – Components, Cores and Cliques – Positions, Roles and Clusters – Dimensions and Displays.

Unit:4	METHODS OF SOCIAL NETWORK ANALYSIS	18 hours

Graphs – Matrices – Relationship Measures – Centrality and Prestiges – Cliques – Structural Equivalence – Visual Displays – Book models – Network Position Measures – Logit Models – Affiliation networks – Lattices- Levels of Analysis

Unit:5	TOOLS AND TECHNOLOGIES

Twitter Analytics – Facebook Analytics – Google+ Analytics – Google+ Ripples – R for Social Network Analysis – Pajek – Network Visualization Tools – Analyzing Social Media Networks with NodeXL.	18 hours
Total Lecture hours	**72 hours**

Text Book(s)

1	Charles Kadushin, "Understanding Social Networks: Theories, Concepts, and Findings", Oxford University Press,USA,2011
2	David Knoke, Song Yang, "Social Network Analysis", 2nd Edition, SAGE Publications,2007

References

Christina Prell, "Social Network Analysis: History, Theory and Methodology", 1st Edition, SAGE Publications Ltd, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	M	M	S	M	M
CO2	M	S	S	S	S	M	M	S	M	M
CO3	M	S	S	S	S	M	M	S	M	M
CO4	M	M	S	S	M	M	M	M	M	M

*S-Strong; M-Medium; L-Low

Sixth Semester

Course code	Natural Language Processing	L	T	P	C
Core/Elective/ Supportive	Core 11	6	-	-	4
Pre-requisite	Probability and Linear Algebra basics	Syllabus Version		2025 – 26 onwards	

Course Objectives:	
The main objectives of this course are to: 1. Understand the significance of NLP tasks 2. Understand about syntax parsing and semantic analysis methods 3. Understand the application domains of NLP	

Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1	Demonstrate an understanding of Natural Language Processing tasks in syntax, semantics, and pragmatics.	K1, K2
2	Demonstrate an understanding of Morphology and Part of Speech Tagging.	K2, K3
3	Show how syntax parsing techniques can be used.	K2, K3,K4
4	Explain the use of semantic analysis methods.	K2, K3
5	Relate a few applications of NLP.	K4,K5
K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create		

Unit:1	Introduction	10 hours
Natural Language Processing tasks in syntax, semantics, and pragmatics – Issues - Applications - The role of machine learning - Probability Basics –Information theory – Collocations -N-gram Language Models - Estimating parameters and smoothing - Evaluating language models.		

Unit:2	Morphology and Part of Speech Tagging	14 hours
Linguistic essentials - Lexical syntax- Morphology and Finite State Transducers - Part of speech Tagging - Rule-Based Part of Speech Tagging - Markov Models - Hidden Markov Models – Transformation based Models - Maximum Entropy Models. Conditional Random Fields		

Unit:3	Syntax Parsing	14 hours
Syntax Parsing - Grammar formalisms and tree banks - Parsing with Context Free Grammars - Features and Unification -Statistical parsing and probabilistic CFGs (PCFGs)-Lexicalized PCFGs.		

Unit:4	Semantic Analysis	16 hours
	Representing Meaning – Semantic Analysis -Lexical semantics –Word-sense disambiguation - Supervised – Dictionary based and Unsupervised Approaches - Compositional semantics- Semantic Role Labeling and Semantic Parsing– Discourse Analysis.	
Unit:5	Applications	18 hours
	Named entity recognition and relation extraction- IE using sequence labeling-Machine Translation (MT) -Basic issues in MT-Statistical translation-word alignment-phrase-based translation – Question Answering	
	Total Lecture hours	**72 hours**

Text Book(s)		
1	Daniel Jurafsky and James H. Martin, "Speech and Language Processing", Second Edition, Prentice Hall, 2008.	
	Reference Books	
1	Holcomb, Z. C. (2017). Fundamentals of Descriptive Statistics, Routledge, New York, US.	
2	Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, First Edition, 2009.	
3	Roland R. Hausser, "Foundations of Computational Linguistics: Human- Computer Communication in Natural Language", Paperback, MIT Press, 2011.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	NLTK – Natural Language Tool Kit - http://www.nltk.org/	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	M	M	L	L	L
CO2	S	S	M	M	M	M	L	L	L	L
CO3	S	S	M	M	M	S	M	L	L	L
CO4	S	S	M	M	M	S	L	L	L	L
CO5	S	S	M	M	M	S	L	L	L	L

*S-Strong; M-Medium; L-Low

Course Code	Natural Language Processing Lab	L	T	P	C
Core/Elective/ Supportive	Core Lab 7	0	0	6	4
Prerequisite	Access to tools like Jupyter Notebook or Google Colab	Syllabus Version		2025 – 26 onwards	

Course Objectives	

- To introduce the fundamental concepts and techniques of natural language processing (NLP)

Expected Course Outcomes		
1	Understand the fundamental concepts and techniques of natural language processing (NLP)	K2
2	Understanding of the models and algorithms in the field of NLP.	K2
3	Demonstrate the computational properties of natural languages and the commonly used algorithms for processing linguistic information.	K2
4	Understanding semantics and pragmatics of languages for processing	K2

K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create

LIST OF PROGRAMS

1. Implementing word similarity

2. Implementing simple problems related to word disambiguation

3. Simple demonstration of part of speech tagging.

4. Lexical analyzer.

5. Semantic Analyzer.

6. Sentiment Analysis**.**

Total Lecture Hours	36 Hours

Text Book(s)	
1	Daniel J and James H. Martin,‖speech and language processing‖ an introduction to natural language processing, computational linguistcs& speech recognition‖prentice hall,2009

Reference Book(s)	
1	Lan H Written and Elbef,MarkA.Hall,‖data mining: practical machine learning tools and techiniques‖,Morgan Kaufmann,2013
	Related Online Contents (MOOC, SWAYAM,NPTEL, Websites etc)	
1	**https://onlinecourses.swayam2.ac.in/aic20_sp06/preview**	
2	**https://onlinecourses.swayam2.ac.in/arp19_ap79/preview**	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	M	S	L	L	L	L
CO2	S	M	S	M	M	S	L	L	L	L
CO3	S	S	M	S	S	M	L	L	L	L
CO4	S	S	S	M	M	M	L	L	L	L

*S-Strong; M-Medium; L-Low

Course Code	Project Work Lab	L	T	P	C
Core/Elective/ Supportive	Core 12	0	0	5	4
Pre-requisite	Students should have the strong knowledge in any one of the programming languages in this course.	Syllabus version		2025 – 26 onwards	

Course Objectives			

- To understand and select the task based on their core skills.
- To get the knowledge about analytical skill for solving the selected task.
- To get confidence for implementing the task and solving the real time problems.
- Express technical and behavioral ideas and thought in oral settings.
- Prepare and conduct oral presentations

Expected Course Outcomes

On the successful completion of the course, student will be able to:

1	Formulate a real world problem and develop its requirements develop a design solution for a set of requirements	K3
2	Test and validate the conformance of the developed prototype against the original requirements of the problem	K5
3	Work as a responsible member and possibly a leader of a team in developing software solutions	K3
4	Express technical ideas, strategies and methodologies in written form. Self-learn new tools, algorithms and techniques that contribute to the software solution of the project	K1-K4
5	Generate alternative solutions, compare them and select the optimum one	K6

K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create

Aim of the project work

1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied.

2. Each student should carry out individually one project work and it may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea focusing on application oriented concepts.

3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

Viva Voce

1. Viva-Voce will be conducted at the end of the year by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 200 marks at the last day of the practical session.

2. Out of 200 marks, 160 marks for project report and 40 marks for Viva Voce.

Project Work Format

<div align="center">

PROJECT WORK

TITLE OF THE DISSERTATION

Bonafide Work Done by

STUDENT NAME

REG. NO.

Dissertation submitted in partial fulfillment of the requirements for the award of
<Name of the Degree>
of Bharathiar University, Coimbatore-46.

College Logo

</div>

Signature of the Guide   Signature of the HOD
Submitted for the Viva-Voce Examination held on _____

Internal Examiner   External Examiner

<div align="center">

Month – Year

</div>

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Contents
Synopsis

3. System Design and Development

       3.1 File Design

       3.2 Input Design

       3.3 Output Design

       3.4 Database Design

       3.5 System Development

             3.5.1 Description of Modules (Detailed explanation about the project work)

4. Testing and Implementation

5. Conclusion Bibliography Appendices

       A. Data Flow Diagram

       B. Table Structure

       C. Sample Coding

       D. Sample Input

       E. Sample Output

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	M	M	M	M
CO2	S	S	S	S	M	S	M	M	M	M
CO3	S	S	S	S	M	M	M	M	M	M
CO4	S	S	S	S	M	M	M	M	M	M
CO5	S	S	S	S	M	M	M	M	M	M

    *S-Strong; M-Medium; L-Low

Course code	Capstone Project using Python or R Programming, Data Visualization Tools	L	T	P	C
Core/Elective/ Supportive	Skill based Subject-4:	-	-	3	2
Pre-requisite	Students should have completed Project I & II Phase – I Strong coding skills in any one programming paper	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:
1. To understand and select the task based on their core skills
2. To get the knowledge about analytical skill for solving the selected task.
3. To get confidence for implementing the task and solving the real time problems.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Select appropriate input, output, form and table design	K3
2	Design code to meet the input requirements and to achieve the required output	K6
3	Compose a project report incorporating the features of the project	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Aim of the project work

1. The aim of the project work is to acquire practical knowledge on the implementation of the programming concepts studied

2. Each student should carry out individually one project work and it may be a work using the software packages that they have learned or the implementation of concepts from the papers studied or implementation of any innovative idea focusing on application oriented concepts

3. The project work should be compulsorily done in the college only under the supervision of the department staff concerned.

Viva Voce

1. Viva-Voce will be conducted at the end of the semester by both Internal (Respective Guides) and External Examiners, after duly verifying the Annexure Report available in the College, for a total of 75 marks at the last day of the practical session.

2. Out of 75 marks, 30 marks for project report and 45 Marks for Viva Voce

Project Work Format

PROJECT WORK
TITLE OF THE DISSERTATION
Bonafide Work Done by STUDENT NAME
REG. NO.
Dissertation submitted in partial fulfillment of the requirements for the award of
< Name of the Degree>
of Bharathiar University, Coimbatore-46.
College Logo

Signature of the Guide   Signature of the HOD

Submitted for the Viva-Voce Examination held on _____

Internal Examiner   External Examiner

Month – Year

Acknowledgement
Contents
Synopsis
1. Introduction
      1.1 Organization Profile
      1.2 System Specification
          1.2.1 Hardware Configuration
          1.2.2 Software Specification
2. System Study
      2.1 Existing System
        2.1.1 Drawbacks
      2.2 Proposed System
        2.2.1 Features
3. System Design and Development
      3.1 File Design
      3.2 Input Design
      3.3 Output Design
      3.4 Database Design
      3.5 System Development
        3.5.1 Description of Modules (Detailed explanation about the project work)
4 Software Testing and Implementation
Conclusion
Bibliography
Appendices
      A. Data Flow Diagram
      B. Table Structure
      C. Sample Coding
      D. Sample Input
      E. Sample Output

Mapping with Programme Outcomes									
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	M	M	M	M
CO2	S	S	S	S	S	S	M	M	M	M
CO3	S	S	S	S	S	M	M	M	M	M

*S-Strong; M-Medium; L-Low

Elective Course

Course code	TITLE OF THE COURSE	L	T	P	C
		-	-	6	3
Elective I	Marketing Analytics				
Pre-requisite	Optimization Techniques	Syllabus Version		2025 – 26 onwards	

Course Objectives:

The main objectives of this course are to:

1. To provide knowledge on elements of market analysis

2. To use marketing analytics to predict outcomes and systematically allocate resources.

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Gain a solid understanding of key marketing concepts and skills	K2 level
2	Identify and demonstrate the dynamic nature of the environment in which marketing decisions are taken and appreciate the implications for marketing analytics strategy determination and implementation.	K3 level
3	Develop the students' skills in applying the analytic perspectives, decision tools, and concepts of marketing to decisions involving. segmentation, targeting and positioning.	K3 level
4	Develop an understanding of the underlying concepts, strategies and the issues involved in the exchange of products and services and control the marketing mix variables in order to achieve organizational goals.	K2-K3 level
5	Develop strong marketing plans and apply the concept of Sales analytics in E commerce sales and metrics	K3 level

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	INTRODUCTION	10 hours

. Marketing Analytics, Models and metrics- Market Insight – Market data sources, sizing, PESTLE trend analysis, and porter five forces analysis – Market segment identification and positioning

Unit:2	COMPETITIVE ANALYSIS AND BUSINESS STRATEGY:	14 hours

. Competitor identification, Intelligence gathering, analysis and strategy- Analytics based strategy selection, with strategic models and metrics, Forecasting, balanced scorecard, and critical success factors.

Unit:3	PRODUCT, SERVICE AND PRICE ANALYTICS:	14 hours

Conjoint analysis model, decision tree model, portfolio resource allocation, Pricing techniques, pricing assessment, pricing for business markets, price discrimination

Unit:4	DISTRIBUTION AND PROMOTION ANALYTICS:	16 hours

Retail location selection, distribution channel evaluation, and multi-channel distribution, Promotion budget estimation and allocation, promotion metrics for traditional media and social media.

Unit:5	SALES ANALYTICS	18 hours

E Commerce sales mode, sales metrics, profitability metrics and support metrics.
Total hours: 60
References:
.1. Stephan Sorger, ―Marketing Analytics – Strategic Models and Metrics‖, Admiral Press, 2013.
2. Mark Jeffery, ―Data Driven Marketing: The 15 Metrics Everyone in Marketing should know‖, Wiley, 2013.
3. Paul W. Farris, Neil T. Bendle, Phillip E. Pfeifer, David J. Reibstein ―Marketing Metrics: The Definitive Guide to Measuring Marketing Performance‖, Pearson FT press, 2012.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	M	M	L	S	M	M	M	M
CO2	S	M	M	M	S	M	L	L	M	L
CO3	M	M	S	M	S	S	M	M	M	M
CO4	S	M	M	S	S	S	L	M	M	L
CO5	S	M	M	L	S	M	M	M	L	L

S-Strong; M-Medium; L-Low

Course code	Data Security and Compliance	L	T	P	C
	Elective I	**6**	**-**	**-**	**3**
Pre-requisite	Basic Information System exposure	**Syllabus Version**	**2025 – 26 onwards**		

Course Objectives:

The main objectives of this course are to:
1. Increase information security and privacy awareness.
2. Manage information system security risk for organizations.
3. Know the security and privacy compliance requirements and standards

Expected Course Outcomes:

On the successful completion of the course, student will be able to:

1	Understand the Security requirements, components, and processes	**K2**
2	Understand the various needs, risks and issues related to Information Security	**K2**
3	To plan information security risk management	**K3**
4	Understand Physical, Operational and Personnel Security	**K2**
5	Comprehend the Information Security and Privacy Compliance Requirements	**K2**

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit:1	Introduction	10 hours

History - What is Information Security? - CIA requirements- security model - Components of an information system - Securing the components - Balancing security and access - The SDLC - Security in SDLC

Unit:2	Needs, Information Threats, Attacks and Issues	14 hours

Need for security - Business needs - Threats – Attacks – Legal - Ethical and professional issues

Unit:3	Risk Management	14 hours

Planning for Security, Risk management: Identifying and assessing risk - Assessing and controlling risk.

Unit:4	Physical, Operational and Personnel Security	106hours

User-Defined Functions: Introduction – Need and Elements of User-Defined Functions- Definition- Return Values and their types - Function Calls – Declarations – Category of

Unit:5	Compliance – Information Security Management Systems	18 hours

Importance of ISMS – Purpose and Objectives, Process Approach, Processes involved in Establishing, Implementing, Operating, Monitoring, Reviewing, Maintaining and Improving ISMS. Scope and Exclusions. ISO 27001, ISO/IEC 27701, GDPR, Data Protection Bill - India

	Total hours: 72

References:

1. Michael E Whitman and Herbert J Mattord, "Principles of Information Security", Sixth Edition, Cengage Learning, 2017
2. Alan Calder, Steve Watkins, "IT Governance: An International Guide to Data Security and ISO27001/ISO27002", Kogan Page; 6th edition, 2015

3. ISO/IEC 27701 PIMS:
   https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3uDwE

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO-10
CO1	M	L	M	M	L	S	L	M	M	L
CO2	M	M	M	M	L	M	M	M	L	M
CO3	M	M	M	M	M	S	L	L	L	M
CO4	S	L	S	M	M	M	M	L	L	M
CO5	S	M	S	M	M	S	L	L	L	M

*S-Strong; M-Medium; L-Low

Course Code	Computer Vision	L	T	P	C
	Elective I	**6**	**-**	**-**	**3**
Pre-requisite	**Basic computer knowledge**	**Syllabus Version**	**2025 – 26 onwards**		

Course Objectives:

The main objectives of this course are to:

1. Identify basic concepts, terminology, theories, models and methods in the field of computer vision
2. To give an understanding of image processing for computer vision
3. Focus on early processing of images and the determination of structure: edges, lines, shapes.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Acquire knowledge on Image retrieval and processing	K1, K2
2	Design and deploy various image formation models	K2, K3
3	Apply the techniques of motion estimation and object recognition.	K2, K3,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	INTRODUCTION	10 hours

Image Processing-Computer Vision-Low Level-Mid Level-High Level-Overview of diverse computer vision applications: Document Image Analysis, Biometrics, Object Recognition, Tracking ,Medical Image Analysis, Content Based Image Retrieval, Video data Processing, Mutimedia, Virtual Reality and Augmented Reality

Unit:2	IMAGE FORMATION MODELS	14 hours

Monocular Imaging System-Camera Model and Camera calibration-Binocular Imaging System, Multiple views geometry, Structure Determination, Shape from Shading-Construction of 3D model from images. Image Processing and Feature Extraction-Image representation, Edge detection

Unit:3	MOTION ESTIMATION	14 hours

Optical Computation, Structure from motion. Shape Representation and Segmentation-Contour based representation, Region based representation, Deformambale curves and surfaces, multiresolution analysis

Unit:4	OBJECT RECOGNITION	16 hours

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

Unit:5	APPLICATIONS	18 hours

Photo album-face detection-Face recognition-Eigen faces-Surveillance-foreground-background separation-particle filters-chamfer matching, tracking-occlusion-combining views from multiple cameras-locating roadway-road makings-identifying road signs-locating pedestrians

		Total Lecture hours	**72**

	Text Book(s)	
1	Computer Vision – A modern approach ,by D.Forsyth and J.Ponce Prentice Hall Robot Vision, by B.K.P.Horn. McGraw-Hill	
2	Introductory Techniques by 3D Computer Vision, by E.Trucco and A.Verri, Publisher: Prentice Hall	
3	R.C.Gonzalez, R.E.Woods. Digital Image Processing. Addison Wesley Longman,Inc.,1992	
4	Richard Szeliski, Computer Vision: Algorithms and Applications.Springer,2010	
	Reference Books	
1	R.H.Ballard, C.M.Brown, Computer Vision, Prentice Hall ,Englewood Cliffs ,1982	
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://nptel.ac.in/courses/106/105/106105216/	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M	S	S	M	S	S	L	L	L	M
CO2	M	S	S	S	S	S	M	L	M	L
CO3	S	S	M	M	S	S	L	M	M	L

*S-Strong; M-Medium; L-Low

Course code	Supply Chain and Logistics Analytics	L	T	P	C
	Elective II	5	-	-	3
Pre-requisite	Introduction to Data Analytics	**Syllabus Version**		**2025 – 26 onwards**	

Course Objectives:		
Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1	Understand of the role and importance of Supply chain management.	K1, K2
2	Understand the concepts of planning systems	K2
3	Understand the concepts of Logistics management	K2,

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit: 1	**Introduction**	12 hours
Basics of Supply Chain Management Supply Chain Management – An Overview Supply Chain Analysis Types of Supply Chains Advanced Planning		
Unit: 2	**Concepts of Advanced Planning Systems**	12 hours
Structure of Advanced Planning Systems, Strategic Network Planning, Demand Planning, Master Planning, Demand Fulfilment, Transport Planning Coordination, and Integration Collaborative Planning		
Unit: 3	**Implementing Supply Chain Project**	12 hours
Implementing Advanced Planning Systems, The Definition of a Supply Chain Project, The Implementation Process		
Unit: 4	**Logistics Management**	12 hours
Definition and Evolution -Achievement of competitive advantage through logistics Framework-Role of Logistics Management-Integrated Logistics Management - Model – Flow of process activities		
Unit: 5	**Logistics Strategy**	12 hours
Strategic role of logistics – Definition-role of logistics managers in strategic decisions: Strategy options, Lean Strategy, Agile Strategies & Other strategies: Designing & Implementing logistical strategy.		
	Total Lecture hours	**60 hours**

	Text Book(s)	
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	Márquez Adolfo Crespo (2010) "Dynamic Modelling for Supply Chain Management: Dealing with Front-end, Back-end and Integration Issues", Springer	

3	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
4	Tang Christopher S, Teo Chung-Piaw and Wei Kwok-Kee (Eds) (2008), "Supply Chain Analysis: A Handbook on the Interaction of Information, System and Optimization", Springer, ISBN-13: 978-0- 387-75239-6

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	M	M	L	L	L	L
CO2	S	S	S	M	M	M	L	L	L	L
CO3	S	S	S	M	M	M	L	L	L	L

*S-Strong; M-Medium; L-Low

Course code	**Business and Financial Analytics**	**L**	**T**	**P**	**C**
	Elective II	**5**	**-**	**-**	**3**
Pre-requisite	**Basic Analytical Tools**	**Syllabus Version**	**2025 – 26 onwards**		

Course Objectives:		
The main objectives of this course are to:		

1. Understand the significance and fundamentals of Business analytics
2. Understand the basic models of analytics.
3. Understand the Financial analytics concepts

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Understand the basics on Business Intelligence.	K1, K2
2	Describe the essentials on Business Analytics models	K2, K3
3	Understand the importance of Business Analytics for Managers	K2, K3,K4
4	Explain the role and importance of Financial Analytics.	K2, K3
5	Understand the role of Business Analyst and Data Science in business	K4,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit: 1	**Business Intelligence (BI)**	12 hours

Business Intelligence - Definitions - Evolution of Business Intelligence and Role of DSS, EIS, MIS and Digital dash boards-Difference between ERP and Business Intelligence-need for BI-BI for past, Present and Future. Business Intelligence Applications-technology solutions and business solutions-Business Intelligence Roles and Responsibilities.

Unit: 2	**Essentials of Business Analytics**	12 hours

Introduction: Decision Making- Business Analytics Definition-Business Analytics meaning - categorization of Analytical methods and models: Descriptive -Predictive -Prescriptive–Big data-Business Analytics in practice: Financial, Human Resource, Marketing, Health care, Supply chain Analytics. Analytics for government and Nonprofits, sports and web Analytics

Unit: 3	**Business Analytics for Managers**	12 hours

Business analytics model: Overview of Business-driven environment & technically oriented environment-types of Reporting and Analytical process-case study.

Unit: 4	**Financial Analytics**	12 hours

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.

Unit:5	**Analysts: Role and Responsibilities**	12 hours

Information and Knowledge-Methodology-Data-Required Competencies for the Analyst- Data Scientist vs. Data Engineer vs. Business Analyst, Career in Business Analytics, , Applications for data science, Data Scientists Roles and Responsibility		
	Total Lecture hours	**60 hours**
Text Book(s)		
1	An Introduction to Business Analytics, Ger Koole, Lulu.com, 2019	
2	Business Analytics for Managers - GEAT H.N.LAURSEN JESPER THORLUND, P.No: 1-16- UnitIII, P.No:93-136-Unit V	
3	Fundamentals of Business Analytics -R N Prasad,. Seema Achavya, Wiley India PVT Ltd, New Delhi, P.No: 87-100, P.No:115-125	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	M	L	L	M	L
CO2	S	S	S	M	S	M	L	L	M	L
CO3	S	S	S	S	M	M	L	L	L	L
CO4	S	S	S	S	M	M	L	L	L	L
CO5	S	S	S	M	M	M	L	L	M	L

*S-Strong; M-Medium; L-Low

Course code	Recommender Systems		L	T	P	C
	Elective II		**5**	**-**	**-**	**3**
Pre-requisite	**Working knowledge of Excel and introductory data analytics tools**		**Syllabus Version**		**2025 – 26 onwards**	

Course Objectives:

The main objectives of this course are to:
1. Understand about different types of recommender systems.
2. Understand the evaluation methods for recommender systems
3. Understand about some of the recent developments in this field

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Understand the basics of Recommender systems	K2
2	Understand about the different types of recommender systems	K2, K3
3	Analyze ways to evaluate Recommender Systems and provide explanations	K3, K4
4	Understand a few applications of Recommender Systems	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**Collaborative recommendation**	12 hours

Introduction to basic concepts behind recommender systems-Recent developments

Collaborative recommendation: User-based and item-based nearest neighbour recommendations – Ratings- Further model-based and preprocessing based approaches- Recent practical approaches and systems

Unit:2	**Content-based and Knowledge-based recommendation**	12 hours

Content-based recommendation: Content representation and content similarity-Similarity-based retrieval.
Knowledge based recommendation: Knowledge representation and reasoning, Constraint based recommenders, Case based recommenders.

Unit:3	**Hybrid recommendation and explanations**	12 hours

Hybrid recommendation : Opportunities for hybridisation-monolithic, parallelized and piplined hybridization designs
Explanations in recommender systems: Explanations in constraint-based, case-based and collaborative filtering recommenders

Unit:4	Evaluating Recommender System and case study	12 hours

General properties of evaluation research- Popular evaluation designs-Evaluation on historical datasets – Alternate evaluation designs Case study- Personalised game recommendation on the mobile internet

Unit:5	Recent developments	12 hours
Online consumer decision making: Context, primacy/recency and further effects - Personality and social psychology R**ecommender systems and the next generation Web:** Trust-aware recommender systems-Folksonomies-Ontological filtering-Extracting semantics from the web		

	Total Lecture hours	**60 hours**

Text Book(s)		
1	Jannach and Zanker, Recommender Systems: An Introduction, Cambridge University Press, 2012.	
2	Aggarwal, Recommender Systems: The Textbook, Springer Publications, 2016.	
	Reference Books	
1	Ricci F., Rokach L., Shapira D., Kantor B.P., Recommender Systems Handbook, Springer(2011), 1st ed.	
2	Manouselis N., Drachsler H., Verbert K., Duval E., Recommender Systems For Learning, Springer (2013), 1st ed.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://www.coursera.org/specializations/recommender-systems	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	L	L	L	L
CO2	S	S	S	S	M	L	L	L	L	L
CO3	S	S	M	M	M	L	L	L	L	L
CO4	S	S	M	M	M	L	L	L	L	L

*Strong-S, Medium-M, Low-L;

Course code	HR Analytics	L	T	P	C
	Elective III	5	-	-	3
Pre-requisite	**Fundamentals of Statistics and Data Visualization**	Syllabus Version		2025 – 26 onwards	

Course Objectives:		
The main objectives of this course are to:		
1. Understand the fundamentals of HR analytics		
2. Understand the process of recruitment analysis		
Expected Course Outcomes:		
On the successful completion of the course, student will be able:		
1	Understand of the role and importance of HR analytics.	K1, K2
2	Explain the strategies to track, store, retrieve, analyse and interpret HR data to support decision making.	K2, K3
3	Apply appropriate software to record, maintain, retrieve and analyse human resources information.	K2, K3,K4
4	Apply quantitative and qualitative analysis to understand trends and indicators in human resource data.	K2, K3
5	Demonstrate how to connect HR results to business results.	K4,K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	Introduction to HR Analytics	12 hours
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		
Unit:2	Diversity Analysis	12 hours
Equality, diversity and inclusion, measuring diversity and inclusion, Testing the impact of diversity, Workforce segmentation and search for critical job roles.		
Unit:3	Recruitment and Selection Analytics	12 hours
Evaluating Reliability and validity of selection models, finding out selection bias, Predicting the performance and turnover.		
Unit:4	Performance Analysis	12 hours
Predicting employee performance, training requirements, evaluating training and development, Optimizing selection and promotion decisions		
Unit:5	Monitoring impact of Interventions:	12 hours
Tracking impact interventions, Evaluating stress levels and value-change. Formulating evidence-based practices and responsible investment. Evaluation mediation process, moderation, and interaction analysis		
	Total Lecture hours	**60 hours**
	Text Book(s)	
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
3	Fitz-enz Jac, Mattox II John (2014), "Predictive Analytics for Human Resources", Wiley, ISBN- 1118940709

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	L	L	L	L	L	L
CO2	S	S	M	M	L	L	L	L	L	L
CO3	S	M	M	M	L	M	L	L	M	L
CO4	M	M	M	M	L	L	L	L	M	L
CO5	M	M	M	M	L	L	L	L	M	L

*S-Strong; M-Medium; L-Low

Course code	Data Mining	L	T	P	C
	Elective III	5	-	-	3
Pre-requisite	Programming (Python or Java preferred)	**Syllabus Version**	**2025 – 26 onwards**		

Course Objectives:		

The main objectives of this course are to:
1. Understand the fundamentals of data mining and significance of data pre-processing.
2. Apply appropriate data mining technique on the large dataset for knowledge discovery.
3. Understand the application of data mining on complex data objects.

Expected Course Outcomes:

On the successful completion of the course, student will be able:

1	Understand data mining primitives and data pre-processing methods.	K2
2	Apply prediction and association rule mining for real life mining applications.	K3
3	Apply appropriate Classification techniques for various problems with high dimensional data using modern tools.	K3
4	Apply appropriate Clustering techniques for various problems with high dimensional data using modern tools.	K3
5	Synthesize various mining techniques and work in teams to develop project on complex data objects.	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Unit:1	**DATA MINING FUNDAMENTALS**	12 hours

Data Mining life cycle - KDD Process – Kinds of data can be mined – Kind of data can be mined – Technologies used –Kinds of Applications targeted – Issues in data mining - Data Objects and Attribute Types - Data Pre-processing overview.

Unit:2	**ASSOCIATION AND CORRELATION**	12 hours

Mining Frequent Patterns - Associations and Correlations – Mining Methods – Apriori – FP Growth - Mining various Kinds of Association Rules – Correlation Analysis – Constraint Based Association Mining.

Unit:3	**CLASSIFICATION**	12 hours

Classification Basic Concepts – Decision Tree Induction – Bayesian Classification – Rule Based Classification –- Support Vector Machine - Lazy Learners – Other classification methods - Model Evaluation and Selection.

Unit:4	**CLUSTERING AND OUTLER ANALYSIS**	12 hours

Cluster Analysis – Partitioning Methods - Hierarchical Methods – Density Based Methods – Grid Based Methods – Evaluation of Clustering - Outlier Analysis – Outlier detection Methods.

Unit:5	**MINING COMPLEX DATA**	

Time Series and Sequence Mining – Mining graphs and networks – Web Mining – Spatial Mining – Text Mining – Multimedia Mining – Data Mining Applications.	12 hours

	Total Lecture hours	**60 hours**

Text Book(s)

1	Jiawei Han, Micheline Kamber, Jain Pei "Data Mining: Concepts and Techniques", Third edition, Elsevier, Morgan Kaufmann Publishers, 2012.

2	Alex Berson and Stephen J. Smith "Data Warehousing, Data Mining & OLAP", Tata McGraw– Hill Edition, Tenth Reprint 2007.	
	Reference Books	
1	K.P. Soman, Shyam Diwakar and V. Ajay "Insight into Data mining Theory and Practice",Easter Economy Edition, Prentice Hall of India, 2006.	
2	Hand.D, Mannila H, Smyth.P, "Principles of Data Mining", MIT press, USA,2001.	
3	Dunham M, "Data Mining: Introductory and Advanced Topics", Prentice Hall, New Delhi, 2002	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1	https://nptel.ac.in/courses/106/105/106105174/	
2	https://www.coursera.org/specializations/data-mining	

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P10
CO1	S	S	M	M	S	M	L	L	L	L
CO2	S	S	S	M	S	S	L	L	L	L
CO3	S	M	S	M	S	S	L	L	L	L
CO4	M	M	M	M	S	S	L	L	L	L
CO5	S	M	S	M	S	S	L	L	L	L

*S-Strong; M-Medium; L-Low

Course Code	Big data and Cloud Computing	L	T	P	C
	Elective III	**5**	**-**	**-**	**3**
Pre - requisite	**Knowledge of Operating Systems and Computer Networks**	**Syllabus version**		**2025 – 26 onwards**	

Course Objectives	
• To provide an overview of an exciting growing field of big data analytics.	
• To introduce the tools required to manage and analyze big data like Hadoop, Map Reduce and other Hadoop Ecosystems.	
• Introduction to cloud computing, cloud architecture, cloud service models, Service Oriented Architectures, security in cloud computing, disaster management in clouds.	

	Expected Course Outcomes	
1	Identify the components of Hadoop Distributed File System for big data processing	**K1, K2**
2	Develop Big Data Solutions using Hadoop Eco System	**K1, K4**
3	Identify the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, Maas, public cloud, private cloud, hybrid cloud, etc	**K1, K3**
4	Provide the appropriate cloud computing solutions and recommendations according to the applications used	**K1, K2**
5	Attempt to generate new ideas and innovations in cloud computing	**K1, K2**

K1 – Remember K2 – Understand K3 – apply K4- Analyze K5 – evaluate K6- Create

UNIT I	Introduction to Big Data	12 Hours

Classification of digital data – Characteristics of data – Challenges – Five Vs- Typical Hadoop environment- Classification of analytics- Data science – Terminologies used in big data environments- Parallel Vs Distributed Environment-Big data applications, Problems when handling large data – General techniques for handling large data – Case study – Steps in big data – Distributing data storage and processing with Frameworks – Case study

UNIT II	INTRODUCTION TO HADOOP ECO SYSTEM	12 Hours

Introduction to Hadoop Eco system- Hadoop core components- Hadoop distributions- HDFS-Common Hadoop Shell commands- Processing data with Hadoop- Name Node- Secondary Name Node, and Data Node - Hadoop Map Reduce paradigm- Map and Reduce tasks, Job, Task trackers - Cluster Setup – SSH & Hadoop Configuration – HDFS Administering –Monitoring & Maintenance.

UNIT III	HADOOP ECOSYSTEM COMPONENTS	12 Hours

Pig: Introduction to PIG, Execution Modes of Pig, Comparison of Pig with Databases, Grunt, Pig Latin, User Defined Functions, Data Processing operators, Hive : Hive Shell, Hive Services, Hive Metastore, HiveQL, Tables, Querying Data and User Defined Functions. Base: HBase Concepts, Clients, Example, Zookeeper - Building applications with Zookeeper, Oozie-Workflows of Oozie

Unit IV	Introduction to Cloud Computing	12 Hours
Defining the Cloud, The Emergence of Cloud Computing, Cloud-Based Services, Grid Computing or Cloud Computing, Components of Cloud Computing, Virtualization, Cloud Computing Deployment Models (Types): Public, Private, Hybrid, Benefits of Using a Cloud Model, Legal Issues in Using Cloud Models, Characteristics of Cloud Computing, Evolution of Cloud Computing, Challenges for the Cloud computing, Grid Computing, Distributed Computing in Grid and Cloud.		

UNIT V	Cloud Service Models	12 Hours
Communication-as-a-Service (CaaS): Advantages of CaaS, Fully Integrated, Enterprise-Class Unified Communications, Infrastructure-as-a-Service (IaaS): Modern On-Demand Computing, Amazon's Elastic Cloud, Amazon EC2 Service Characteristics, Monitoring-as-a-Service (MaaS): Protection Against Internal and External Threats, Platform-as-a-Service (PaaS): The Traditional On-Premises Model, The New Cloud Model, Key Characteristics of PaaS, Software-as-a-Service (SaaS): SaaS Implementation Issues, Key Characteristics of SaaS, Benefits of the SaaS Model, Jericho Cloud Cube Model.		

		Total Lecture hours	60 hours
	Text Book(s)		
1	Seema Acharya, Subhashini Chellappan, " Big Data and Analytics" Wiley, First Edition, 2015		
2	EMC Education Services, "Data Science and Big Data Analytics: Discovering, Analyzing, Visualizing and Presenting Data", Wiley publishers, 2015		
3	David S. Linthicum., "Cloud Computing and SOA Convergence in your Enterprise, a step by step guide" 2009		
4	John W. Rittinghouse , James F. Ransome., "Cloud Computing: Implementation Management and Security, 2009		
5	Dirk Deroos et al., Hadoop for Dummies, Dreamtech Press, 2014		
	Reference Books		
1	Tom White, "HADOOP: The definitive Guide" , O Reilly 2012		
2	Borko Furht, Handbook of Cloud Computing, Armando Escalante (Editors), Springer, 2010		
3	Raj Kumar Buyya, James Broberg, Andrezei M.Goscinski, Cloud Computing: Principles and paradigms, 2011		
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]			
1	https://onlinecourses.nptel.ac.in/noc20_cs92/preview		
2	https://onlinecourses.nptel.ac.in/noc20_cs20/preview		

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	L	M	L	L	M	L
CO2	S	S	S	M	M	S	M	L	M	L
CO3	M	S	M	M	L	S	L	L	L	L
CO4	M	S	M	M	M	M	L	L	L	L
CO5	M	S	M	M	L	M	L	L	L	L

*S-Strong; M-Medium; L-Low