Fergusson College (Autonomous), Pune

Learning Outcomes-Based Curriculum

for 3/4 years B**.** Sc. / B. Sc. (Honors) Programme

as per guidelines of

NEP 2020

for

F. Y. B. Sc. (Data Science)

With effect from Academic Year

2026-2027

Preamble

The B.Sc. (Data Science) is a specifically designed honors course that aims to prepare the students for a bright future in the field of Data science and Data analytics. The Programme will help students gain knowledge and expertise in the field of data science with a strong foundation in mathematics, statistics, data science, and handling data ethically. This programme aims to make students competent in the technical domains and fosters a mindset of continuous learning, adaptability, and leadership and becoming entrepreneurs. The key highlights of the programme include industry-driven comprehensive curriculum, in depth knowledge of core subjects in statistics, mathematics, and data science, experiential Learning on latest technologies by industry experts.

Eligibility

(a) Higher Secondary School Certificate (10+2) Science Stream or its equivalent examination

(b) Three-Year Diploma Course after S.S.C. (10th standard) of Board of Technical Education

Syllabi under NEP 2020 to be implemented from Academic Year 2025-26

Programme Outcomes for B. Sc. Programme	
PO1	**Disciplinary Knowledge:** Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.
PO2	**Critical Thinking and Problem solving:** Exhibit the skills of analysis, inference, interpretation and problem solving by observing the situation closely and design the solutions.
PO3	**Social competence:** Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibits thoughts and ideas effectively in writing and orally.
PO4	**Research-related skills and Scientific temper:** Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.
PO5	**Trans-disciplinary knowledge:** Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem.

PO6	**Personal and professional competence:** Performing dependently and collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	**Effective Citizenship and Ethics:** Demonstrate empathetic social concern and equity centered national development and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	**Environment and Sustainability:** Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	**Self-directed and Life-long learning:** Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Program Specific Outcomes (PSOs) **Upon completion of this programme the student will be able to**	
PSO1	**Academic Competence:** (i) A comprehensive understanding of the mathematical and statistical principles underlying data science along with core data science concepts. (ii) Recommend computing solutions to solve the problems in different domains
PSO2	**Personal and Professional Competence:** (i) Apply the fundamental knowledge for professional development as well as to acquire new skills in the domain of data science. (ii) Develop strong problem solving, analytical reasoning and decision-making abilities.
PSO3	**Research Competence:** (i) Apply appropriate research methodologies, including data collection, experimental design, and statistical analysis, to address research questions in data science. (ii) conduct independent data-driven investigations, demonstrating the ability to critically evaluate existing research, synthesize information, and generate novel insights and integrate Computer Science, Electronics, Mathematical and Statistical knowledge to explore different domains data for experimental and research purpose
PSO4	**Entrepreneurial and Social Competence:** (i) Identify and evaluate potential business opportunities by leveraging data analysis and market research techniques, demonstrating the ability to translate data insights into viable entrepreneurial ventures. (ii) Effectively collaborate with diverse teams and communicate complex data insights to both technical and non-technical audiences, demonstrating leadership skills and the ability to build consensus for data-driven initiatives.

F.Y. B. Sc. Data Science Program Structure

F.Y. B.Sc. Data Science NEP 2020										
Sem	Paper	Paper Code	Paper Title	Credits		Teaching Scheme Hrs/week		Examination Scheme and Marks		
				TH	PR	TH	PR	CE	ESE	Total
I	DSC	CSD1001	Applied Python Programming	2	-	2	-	20	30	50
		CSD1111	Data Science - Practical I	-	2	-	4	20	30	50
	Minor	CSD1011	Discrete Mathematics	2	-	2	-	20	30	50
		CSD1121	Mathematics Practical - I	-	2	-	4	20	30	50
	Minor	CSD1021	Fundamentals of Statistics	2	-	2	-	20	30	50
		CSD1131	Statistics Practical - I	-	2	-	4	20	30	50
	OE	CSC1021	IT Literacy	2	-	2		20	30	50
	SEC	CSD1141	Fundamentals of Data Analysis	-	2	-	4	20	30	50
	AEC	AEC-1001	AEC	2	-	2	-	20	30	50
	VEC	VEC-1001	VEC	2	-	2	-	20	30	50
	CC	CC-1011	NSS	2	-	2	-	20	30	50
		CC-1021	NCC							
		CC-1031	Sports							
		CC-1041	Cultural							
		CC-1051	Yoga							
		CC – 1061	SOEC - I							
		CC – 1071	SAATHI - I							
Total				**14**	**8**	**14**	**16**			**550**
II	DSC	CSD1002	Relational Databases	2	-	2	-	20	30	50
		CSD1112	Data Science - Practical II	-	2	-	4	20	30	50
	Minor	CSD1012	Graph Theory	2	-	2	-	20	30	50
		CSD1122	Mathematics Practical -II	-	2	-	4	20	30	50
	Minor	CSD1022	Advanced Statistics	2	-	2	-	20	30	50
		CSD1132	Statistics Practical - II	-	2	-	4	20	30	50
	OE	CSC -1022	Handling Data with Excel	2	-	2	-	20	30	50
	SEC	CSD1242	Data Engineering	-	2	-	4	20	30	50

	AEC	AEC1002	AEC	2	-	2	-	20	30	50
	VEC	CSD1002	VEC	2	-	2	-	20	30	50
	CC	CC-1012	NSS	2	-	2	-	20	30	50
		CC-1022	NCC							
		CC-1032	Sports							
		CC-1042	Cultural							
		CC-1052	Yoga							
		CC – 1062	SOEC - I							
		CC – 1072	SAATHI - I							
Total				14	8	14	16			550

**** DSC- Discipline Specific Course, OE – Open Elective, SEC- Skill Enhancement Course , VEC - Vocational Education Course***

Teaching and Evaluation (Only for FORMAL education courses)

Course Credits	No. of Hours per Semester Theory/Practical	No. of Hours per Week Theory/Practical	Maximum Marks	CE 40 %	ESE 60%
1	**15 / 30**	**1 / 2**	**25**	**10**	**15**
2	**30 / 60**	**2 / 4**	**50**	**20**	**30**
3	**45 / 90**	**3 / 6**	**75**	**30**	**45**
4	**60 / 120**	**4 / 8**	**100**	**40**	**60**

CSD1001	Paper Title - Applied Python Programming Major-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Understand the basics of problem solving techniques and fundamentals of programming.	1
CO2	Develop Python programs using fundamental concepts such as data types, variables, control structures, loops, and functions.	2
CO3	Use various data structures to gain suitable knowledge about their implementation	3
CO4	Compare various file formats and perform read/write operations.	4
CO5	Evaluate patterns, compile expressions, and write scripts to extract data.	5
CO6	Write an application to solve real life problems by applying Object-Oriented principles.	6

Paper Code: **Paper Title: Applied Python Programming (Major- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
1	**Basics of Python Programming** 1.1 Introduction to problem solving - Algorithms, flowcharts, pseudocodes 1.2 Data types, variables, control structure, loops 1.3 Functions 1.4 Data Structures- List, Tuple, Set, Dictionary	**8**
2	**Object Oriented Programming** 2.1 Concept of class, object and instances 2.2 Constructors and destructors 2.3 Inheritance, overlapping and overloading operators, Programming using Oops support	**10**
3	**Python File Operation** 3.1 Reading different types of file- text, csv, excel, JSON 3.2 Understanding Read/Write Functions 3.3 Manipulating file pointer using seek. 3.4 Programming using file operations	**8**
4	**Regular Expression** 4.1 Powerful pattern matching and searching 4.2 Password, email, URL validation using regular expression 4. 4.3 Pattern finding programs using regular expression	**4**

Learning Resources- References

Sr. No.	References
1.	Learning Python, O'Reilly publication
2.	Programming Python, O'Reilly publication

CSD1111	**Paper Title -Data Science - Practical I** **Major-Practical**	
	Number of Credits: 02 **No. of Hours:60**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Understand the basics of problem solving techniques and fundamentals of programming .	1
CO2	Develop Python programs using fundamental concepts such as data types, variables, control structures, loops, and functions.	2
CO3	Use various data structures to gain suitable knowledge about their implementation	3
CO4	Compare various file formats and perform read/write operations.	4
CO5	Evaluate patterns, compile expressions, and write scripts to extract data.	5
CO6	Write an application to solve real life problems by applying Object- Oriented principles.	6

Paper Code: Data Science - Practical I

(Major- Practical)

Unit No.	**Title of Unit Contents**
1	Control structures, Loops
2	Data Structures in Python
3	Functions, Modules and Packages
4	Class and Objects
5	Inheritance
6	File Handling
7	Regular Expression
8	Case study- I
9	Case Study -II
10	Student Activity

CSD1011	**Paper Title –Discrete Mathematics (Minor)Theory**	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		**Bloom's cognitive level**
CO1	Describe the fundamentals of logic and operands.	**1**
CO2	Discuss concepts of relation and functions .	**2**
CO3	Apply the counting principle on real life situations.	**3**
CO4	Explain different methods of mathematical proofs by using logical reasoning	**4**
CO5	Determine the solutions of recurrence relations.	**5**
CO6	Integrate basic concepts of logic, Recurrence and counting principles.	**6**

Paper code: CSD1011 Paper Title: Discrete Mathematics (Minor- Theory)

Unit No.	**Title of Unit and Contents**	**No. of hours**
I	**Statements and Logic** 1.1 Statements 1.2 Statements with quantifiers 1.3 Compound Statements 1.4 Implications 1.5 Proofs in Mathematics	5
II	**Sets, Relations and Functions** 2.1 Sets, Operations on Sets, Power Set, Cartesian product of Sets,Graphical representation of sets 2.2 Relations, types of Relations. 2.3 Equivalence relations. 2.4 Partition of a set and equivalence classes. 2.5 Digraphs of relations, matrix representation and	10
	composition of Relations. 2.6 Transitive closure and Warshall's Algorithm. 2.7 Types of functions (Injective, surjective, Bijective). Composition of functions, Inverse function.	
III	**Counting Principles** 3.1 Cardinality of a finite set. 3.2 The Sum Rule, the Product Rule, the Inclusion-Exclusion Principle. 3.3 Statement of Pigeonhole Principle, Its Applications.	5

IV	**Recurrence Relation** 4.1 Introduction to Recurrence Relations, Formation. 4.2 Linear Recurrence Relations with constant coefficients. 4.3 Homogeneous Solutions. 4.4 Particular Solutions. 4.5 Total Solutions. 4.6 Solution to recurrence relation using generating functions.	10

Learning Resources- References

Sr. No.	References
1.	Kenneth Rosen, 'Discrete Mathematics and its applications', Seventh Edition by Tata McGraw Hill.
2.	Kolman, Busby, Ross, Rehman, 'Discrete Mathematical Structures', Sixth edition, by Prentice Hall
3.	C. L. Liu, 'Elements of Discrete Mathematics', Fourth edition, by Tata McGraw Hill

CSD1121	**Paper code: Paper Title: CSD1121Mathemats Practical- I (Minor- Practical)**	
	Number of Credits: 02 **No. of Hours:60**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Understand basic matrix operations using python.	
CO2	Discuss counting techniques such as permutations, combinations, and the pigeonhole principle.	
CO3	Discuss set operations, Venn diagrams, and Cartesian products for problem-solving.	
CO4	Apply propositional and predicate logic for mathematical reasoning.	
CO5	Evaluate solution of recurrence relations using characteristic equations and generating functions.	
CO6	Apply concepts of Discrete mathematics in various fields.	

Unit No.	Title of Unit and Contents
1	Logic- I
2	Logic- II
3	Relations- I
4	Relations - II
5	Counting Principles
6	Recurrence Relation- I
7	Recurrence relation - II
8	Introduction to Python-I
9	Introduction to Python - II
10	Problem solving in Python.

CSD1021	**Paper Title – Fundamentals of Statistics (Minor)Theory**	
	Number of Credits: 02 **No. of Hours:30**	
	Course Outcomes (COs) **On completion of the course, the students will be able to:**	**Bloom's cognitive level**
CO1	Describe basic features of the data.	1
CO2	Help make informed judgments based on a pattern of data observed previously.	2
CO3	Find chance of an event based on prior knowledge of conditions that might be related to the event.	3
CO4	Provide brief summary about the sample using different graphs.	4
CO5	Enhance the computational techniques related to probability.	5
CO6	Develop analytical thinking by using the ability to see a problem or solution from different points of view.	6

Unit No.	**Title of Unit and Contents**	**No. of hours**
I	**Measures of central tendency and dispersion:** 1. Measures of Central tendency: Mean, Mode, Median. Examples where each one of these is most appropriate. 1.2 Graphical Presentation of frequency distribution – histogram, stem and leaf chart, less than and more than type ogive curves 1.3 Partition values: Quartiles, Box-Plot. Variance, Standard Deviation, Coefficient of Variation. (Section 1.1 to 1.3 should be covered for raw data, ungrouped frequency distribution and exclusive type grouped frequency distribution)	**8**
II	**Measures of Skewness and Kurtosis** 2.1 Concept of symmetric frequency distribution, skewness, positive and negative skewness 2.2 Measures of Skewness-Pearson's measure, Bowley's measure (β_1, γ_1) 2.3 Kurtosis of a frequency distribution, measure of kurtosis (β_2, γ_2) based upon moments, type of kurtosis: leptokurtic, platykurtic and mesokurtic 2.4 Numerical problems related to real life situations.	**5**

III	**Basic Theory of Probability:** 3.1Counting Principles , Permutation ,Combination, Deterministic and non-deterministic models. 3.2 Random Experiment, Sample Spaces (finite and countably infinite) 3.3 Events: types of events, Operations on events. 3.4 Probability - classical definition, probability models, axioms of probability, probability of an event. 3.5Theorems of probability (without proof) i) $0 \leq P(A) \leq 1$ ii) $P(A) + P(A') = 1$ iii) $P(A) \leq P(B)$ when $A \subset B$ iv) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ 3.6 Numerical problems related to real life situations.	**5**
IV	**Advanced Theory of Probability** 4.1Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B)=P(A).P(B\|A)$ 4.2 Bayes' theorem (without proof) 4.3 Concept of Posterior probability, problems on posterior probability. 4.4 Definition of sensitivity of a procedure, specificity of a procedure. Application of Bayes' theorem to design a procedure for false positive and false negative. 4.5 Concept and definition of independence of two events. 4.6 Numerical problems related to real life situations.	**12**

Learning Resources- References

Sr. No.	Contents
1	Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
2	Fundamentals of Applied Statistics (4th Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 2014.
3	Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.
4	A First course in Probability 6^{th} Edition, Ross, Pearson Publication, 2006.
5	Fundamentals of Mathematical Statistics (12^{th} Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 2014.

CSD1131	**Paper Title – Fundamentals of Statistics** **(Minor)Theory** **Statistics Practical - I**	
	Number of Credits: 02 **No. of Hours:60**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Identify the methods and procedures of summarizing information by using summary statistics such as measures of central tendency, dispersion, skewness kurtosis using R	
CO2	Articulate the data, its types and summarize information in the data using different measures.	
CO3	Explain sample space for a certain random experiment and identify events and their types.	
CO4	Illustrate different real-life situations to find probability of different types of events, the theorems of probability.	
CO5	Analyze different concepts of statistics using R software.	
CO6	Create different frequency distributions for real life data	

Practical No.	**Title of the Practical**
1	Diagrammatic Representation
2	Introduction to R
3	Graphical methods using R
4	Measure of Central Tendency and Dispersion
5	Measure of Central Tendency and Dispersion using R
6	Measures of skewness and kurtosis
7	Measures of skewness and kurtosis using R
8	Basic probability theory
9	Conditional probability and Independence
10	Applications of Multiplication and Bayes' theorem

CSD1141	**Paper Code -Fundamentals of Data Analysis** **Skill Enhancement Course Practical**	
	Number of Credits: 02 **No. of Hours:60**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Relate the landscape of data analysis and visualization	1
CO2	Demonstrate data with pivot charts and Excel Charts	2
CO3	Apply Excel tools and formulas to transform and structure your data	3
CO4	Analyze a dataset using native Excel tools	4
CO5	Create pivot tables to slice and dice your data	5
CO6	Discuss an Excel Analysis for the given data	6

Paper Code -Fundamentals of Data Analysis

Skill Enhancement Course

Unit No.	Title of Unit and Contents	No. of hours
1	**Introduction to Data Analysis** What is data analysis? Importance of Excel. Basic excel functions- Min(), max(), avg(), count(), sum(), cell reference. Autofill, AutoSum etc. Data formatting.	4
2	**Analyze Data using Excel** Introduction to Macros Sorting , Filtering Conditional Formatting Conditional Login- if, switch	4
3	**Data Transformation** Text to Columns Removing Duplicate Values String Functions for Text Values Working with Date Values Looking Up Data - VLOOKUP() Using HLOOKUP() with VLOOKUP() Looking Up Data - INDEX() & MATCH()	**7**
4	**Dynamic Arrays** Introduction to Dynamic arrays Dynamic Array Formulas Dynamic Array Functions Combining Dynamic Arrays & Excel Functions XLOOKUP()	5

5	**Pivot Tables** Creating, modifying, formatting, grouping. PivotTable Analyze Options Power Pivot Activating the Excel PowerPivot AddIn, Creating Data Models with PowerPivot	6
6	**Visualizing Data in Excel** Creating Basic Charts in Excel Advanced Excel Visualization Techniques Customizing & Formatting Excel Charts Selection of Right Graph for right data	4

Learning Resources- References

Sr. No.	References
1.	https://www.datacamp.com/courses/data-analysis-in-excel
2.	https://www.geeksforgeeks.org/data-analysis-in-excel/
3.	https://corporatefinanceinstitute.com/course/excel-data-analysis/

CSD1002	Paper Title: Relational Databases Major-Theory	
	Number of Credits: 02 No. of Hours:30	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Describe basic concepts of SQL	1
CO2	Distinguish between use of SQL for data science and SQL as a common database management system	2
CO3	Apply the basic and advanced concepts of SQL language to solve the queries in the databases.	3
CO4	Analyse the data using SQL statements	4

Paper Code: **Paper Title: CSD1002 Relational Databases (Major- Theory)**

Unit No.	Title of Unit and Contents	No. of hours
1	**Introduction to Relational Database Management System** ● Introduction to Databases and its types ● Structure of relational databases ● Design of E-R model ● Types of Constraints ● Entity Relationship Diagrams	06
2	**Basics of SQL** ● Overview of SQL query language ● Basic structure of SQL queries ● SQL Data Definition using CRUD ● Working with aggregate Functions ● Working with queries in SQL	08
3	**Intermediate SQL Operations** ● Join Operations - Join conditions, Outer joins, Join types and conditions ● Views- View definition, using views in SQL queries	08
4	**Advanced SQL Operations** ● Set Operations ● Stored procedures and functions	08

Learning Resources- References

Sr. No.	References
1.	Abraham Silberschatz, Henry F. Korth, S. Sudarashan, Database System Concepts, McGraw-Hill International Edition, Sixth Edition
2.	Elmasri, Navathe, Fundamentals of Database Systems, Pearson Education, Third Education

CSD1112	Paper Title – Data Science Practical - II Major-Practical	
	Number of Credits: 02 No. of Hours:60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Discuss basic SQL schema design	1
CO2	Design basic queries in SQL	2
CO3	Write the queries to use SQL for data analysis using views.	3
CO4	Design queries using user defined functions	4

Unit No.	Title of Unit and Contents
1	Basic Database schema creation
2	Working with basic queries in SQL
3	Working with advanced queries in SQL
4	Creation of views for the databases in SQL
5	Working with stored functions

Learning Resources- References

Sr. No.	References
1	Abraham Silberschatz, Henry F. Korth, S. Sudarashan, Database System Concepts, McGraw-Hill International Edition, Sixth Edition
2	Elmasri, Navathe, Fundamentals of Database Systems, Pearson Education, Third Education

CSD1012	**Paper Title - Graph Theory** **Minor-Theory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Understand the basic concepts of graph theory, including graphs, vertices, edges, and degrees.	1
CO2	Demonstrate problem-solving skills by using graph theory to solve practical problems.	2
CO3	Discuss and apply graph isomorphism and subgraph concepts.	3
CO4	Analyze and apply graph representations, including adjacency matrices and edge incidence matrices.	4
CO5	Evaluate properties of graphs, including Eulerian and Hamiltonian paths/cycles, using different algorithms.	5
CO6	Apply various graph algorithms, such as Dijkstra's algorithm, Kruskal's algorithm.	6

Paper code: Paper Title: CSD1012Graph Theory

(Minor- Theory)

Sr No.	Unit and Contents	No. of Hours
I.	**Introduction to Graphs and Operations on Graphs** 1.1 Definition and examples of graph, degree of a vertex, Hand shaking lemma and it's corollaries. 1.2 **Types** of graphs. 1.3 **Isomorphism** of graphs. 1.4 **Adjacency** and Incidence Matrix of a Graph. 1.5 Vertex induced subgraph, Edge induced subgraph, Vertex deleted subgraph, Edge deleted subgraph. 1.6 Union of two graphs, Intersection of two graphs, Ring Sum of two graphs, Fusion of vertices. 1.7 Complement of a graph.	4
II	**Connected Graphs** 2.1 Walk, Trail, Path, Cycle: Definitions and elementary properties. 2.2 Connected Graphs: definition and properties. 2.3 Distance between two vertices, eccentricity, centre, radius and diameter of a graph. 2.4 Isthmus, Cut vertex: Definition and properties. 2.5 Cutset, edge connectivity, vertex connectivity. 2.6 Weighted Graph and Dijkstra's Algorithm	8

III.	**Eulerian and Hamiltonian Graphs** 3.1 Seven Bridge Problem, Eulerian Graph: Definition and Examples. 3.2 Fleury's Algorithm. 3.3 Hamiltonian Graph : Definition and Examples.	3
IV.	**Trees** 4.1 Definition, Properties of trees. 4.2 Centre of a tree. 4.3 Binary Tree : Definition and properties. 4.4 Tree Traversal : BFS, DFS. 4.5 Spanning Tree: Definition, Properties. 4.6. Fundamental Cycle, Fundamental Cutset. 4.6 Shortest Spanning Tree, Kruskal's Algorithm.	8
V.	**Directed Graphs** 5.1 Definition, Examples, Elementary Terminologies and properties. 5.2 Special Types of Digraphs.	7
	5.3 Connectedness of digraphs. 5.4 Network and Flows: definition and examples. 5.5 Ford Fulkerson's Algorithm	

Learning Resources- References

Sr. No.	References
1.	Graph Theory with applications to Engineering and Computer Science', D Narsingh, Prentice Hall publication.
2.	'A first look at Graph Theory', John Clark, Derek Allen Holton, Allied Publikashers Ltd.

	Paper code: Paper Title: CSD1122 Mathematics Practical- II (Minor- Practical)	
Number of Credits: 02 No. of Hours:60		
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Understand the basic concepts of graph theory, including graphs, vertices, edges, and degrees.	
CO2	Demonstrate problem-solving skills by using graph theory to solve practical problems.	
CO3	Discuss and apply graph isomorphism and subgraph concepts.	
CO4	Analyze and apply graph representations, including adjacency matrices and edge incidence matrices.	
CO5	Determine solution of different problems using various graph algorithms, such as Dijkstra's algorithm, Kruskal's algorithm.	
CO6	Apply Python Programming for Mathematical Computation.	

Unit No.	Title of Unit and Contents
1	Graphs
2	Operations on graphs
3	Connected graphs
4	Trees
5	Directed graphs
6	Eulerian and Hamiltonian graphs
7	Python programming- I
8	Python programming- II
9	Python programming- III
10	Case study

CSD1022	**Paper Title - Advanced Statistics** **MinorTheory**	
	Number of Credits: 02 **No. of Hours:30**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		**Bloom's cognitive level**
CO1	Define various discrete probability distributions and outline the properties of cumulative distribution functions.	1
CO2	Distinguish between multiple and partial correlation.	2
CO3	Demonstrate multiple regression model.	3
CO4	Compare different data sets and conclude the best fit.	4
CO5	Measure partial regression coefficient, multiple and partial correlation coefficient for tri-variate data.	5
CO6	Build predictive models for the data.	6

Unit No.	**Title of Unit and Contents**	**No. of hours**
I	**Correlation and Linear Regression** 1.1 Bivariate data, Scatter diagram. 1.2 Correlation, Positive Correlation, Negative correlation, Zero Correlation 1.3 Karl Pearson's coefficient of correlation (r), limits of r (-1 ≤r ≤1),interpretation of r, Coefficient of determination (r 2) 1.4 Meaning of regression, difference between correlation and regression. 1.5 Concept and equation of the regression line of Y on X. 1.6 Concept of residual plot and mean residual sum of squares. 1.7 Numerical Problems.	6
II	**Non-Linear Regression**. 2.1Second degree curve 2.2 Growth curve models of the type i) Y = ae bX ii) Y = ab X iii) Y = aX b 2.3 Logistic model Y = k / (1+e a+bx) 2.4 Numerical problems related to real life situations.	5
III	**Multiple and Partial Correlation and Regression (for tri-variate data)** 3.1 Yule's notation and concept of multiple regression, Fitting of multiple regression plane 3.2 Partial regression coefficient, interpretation 3.3 Multiple correlation coefficient, concept, definition, computation and interpretation 3.4 Partial correlation coefficient, concept, definition, computation and interpretation 3.5 Numerical Problems	6

IV	**Discrete Random variable** 4.1 Definition of random variable and discrete random variable, probability mass function, distribution function and its properties 4.2 Definition of mathematical expectation and variance 4.3Theorems on expectation 4.4 Determination of median and mode using p.m.f. 4.5 Numerical problems related to real life situations.	5
V	**Standard Discrete Probability Distributions** 5.1Discrete Uniform Distribution: definition, mean, variance 5.2 Bernoulli Distribution: definition, mean, variance, additive property 5.3 Binomial Distribution: definition, mean, variance, additive property 5.4 Geometric Distribution (p.m.f $p(x) = pq\ x$, x = 0,1,2.....): definition, mean, variance 5.5 Poisson Distribution: definition, mean, variance, mode, additive property 5.6 limiting case of B (n, p), Illustration of real-life situations 5.7 Numerical problems related to real life situations.	8

Semester II		
CSD1132	**Statistics Practical - II**	
	Number of Credits: 02 **No. of Hours:60**	
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall the concepts of tri-variate data, multiple and partial correlation coefficient, partial regression coefficient and its interpretation.	
CO2	Discuss various applications of statistical measures using R software.	
CO3	Execute the computational techniques using R software.	
CO4	Analyze different concepts of statistics using R software.	
CO5	Validate the fundamental knowledge and represent using R software.	
CO6	Write a program using R to build different regression models for the given data and estimate the error.	

Unit No.	Title of Unit and Contents
1	Correlation and Regression, verification using R
2	Fitting of Second degree and Exponential curves, verification using R.
3	Multiple Regression
4	Multiple Regression using R
5	Discrete Probability theory
6	Applications of Binomial, Poisson and Geometric distribution.
7	Computation of probabilities using R
8	Fitting of Binomial and Poisson distribution
9	Fitting of Binomial and Poisson distribution using R
10	Random sampling from discrete probability distributions using R Exponential distribution and Normal distribution. Numerical problems related to real life situations.

Learning Resources- References

Sr. No.	Contents
1	Fundamentals of Mathematical Statistics (12th Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 2014
2	Statistical Methods, G.W. Snedecor, W.G. Cochran, John Wiley & sons, 1989.
3	Fundamentals of Applied Statistics (4th Edition), Gupta and Kapoor, S. Chand and Sons, New Delhi, 2014.
4	Modern Elementary Statistics, Freund J.E., Pearson Publication, 2005.
5	A First course in Probability 6th Edition, Ross, Pearson Publication, 2006.
6	First course in Probability and Statistics, Rao, VLS Prakash, New Age international Publishers, New Delhi, 2008.

CSD-1242	Paper Title – Data Engineering Skill Enhancement Course- Practical	
	Number of Credits: 02 No. of Hours:60	
Course Outcomes (COs) On completion of the course, the students will be able to:		Bloom's cognitive level
CO1	Outline different terms and concepts in Data science	1
CO2	Explain the importance of different steps in data processing to get the desired result.	2
CO3	Implement different models and concepts in Data Science	3
CO4	Analyze different visualizations to display the result.	4

Paper Code CSD – 1242: Paper Title: Data Engineering

Unit No.	Title of Unit and Contents
1	**Introduction** Sources of Data Data Types – structured vs unstructured data Data Preparation
2	**Feature Engineering** Introduction to feature engineering libraries Types of features: numerical, categorical, text, time series. The curse of dimensionality
3	**Handling Different types of** **features** Scaling and normalization Transformation Encoding techniques
4	**Feature Selection and Dimensionality Reduction** Filter methods - correlation, chi-squared Wrapper methods - recursive feature elimination Principal component analysis- PCA
5	**Story telling – A Case Study Approach** Visualize preliminary data
	Data story telling using visualization tools

Learning Resources- References

Sr. No.	Contents
1	https://learndataengineering.com/
2	https://www.deeplearning.ai/courses/data-engineering/