

*Progressive Education Society's*  
Modern College of Arts, Science &  
Commerce, (Autonomous)  
Ganeshkhind, Pune 411016

**Program Code: BSC DS10**  
**Bachelor of Science (Data Science)**  
**(Under Faculty of Science &**  
**Technology)**

**A.Y: 2024 – 2025**

Opposite to University of Pune, Pashan Road 411016  
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**Name of Program: Bachelor of Science (Data Science) with**  
**Actuarial Analysis/ML and AI**

*Introduction:*

B.Sc. (Data Science) is a Four Year Full Time Graduate Program. It is an interdisciplinary field that combines statistics, mathematics, computer science, and domain expertise which is a career-focused program designed to equip students with latest technologies and various programming skills and become proficient in the Data Analytics field.

### *Program Structure:*

- The Program is a Four Year (Eight semesters) Full Time Degree Program.
- The Program shall be based on a credit system comprising 176 credits.

### *Objectives:*

- 1) To expose and provide a strong foundation to the students in the upcoming era of Data Science and Artificial Intelligence
- 2) The programme aims at providing a rigorous training in fundamental concepts of Statistics, Mathematics, & Computers Science which creates a strong knowledge base in Data Science domain.
- 3) To provide a complete understanding of the subject by introducing projects from the Second semester on the relevant subject.
- 4) Focus on blending theory with practical and industry application to enhance understanding and learning.
- 5) Focus on the overall development of the students to help gain knowledge and skillsets required for further studies after completion of the course.

### *Eligibility Criteria:*

- Candidate must have passed 10 + 2 or equivalent examination from a recognized board with Mathematics/ Mathematics & Statistics as compulsory subject with minimum 50% aggregate marks in any stream (Science/Commerce/Arts with Mathematics/ Mathematics & Statistics).
- Three Years Diploma Course, after S.S.C. (10th standard) of Board of Technical Education conducted by Government of Maharashtra or its equivalent.
- English Language Proficiency.
- Intake: 80 Seats

### **Medium of Instruction: English**

### **Instructions for Teachers for Internal Evaluation for 20 Marks and 40 Marks:**

The purpose of internal evaluation is to assess the depth of knowledge, understanding and awareness. For this purpose, a teacher is expected to use different evaluation methods in order to have rational and objective assessment of the learners and available resources.

### **External Examination:**

There will be a written Examination of 30 marks in 2 hrs. duration and 60 marks of 3 hrs. for every course at the end of each Semester only for major and minor subjects.

*Award of Class:*

Letter Grade	Grade Point
O (outstanding)	10
A+ (Excellent)	9
A (Very good)	8
B+ (Good)	7
B (Above average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

Question Paper Pattern:CIE

<b>Max. Marks: 20 (Credit:02, Duration: 50 Min.)</b>				
<b>Question No.</b>	<b>Question</b>	<b>No. of sub questions</b>	<b>Marks to each sub question</b>	<b>Total Question Marks</b>
1	Multiple Choice Questions 5	5	1	5
2	Define any 5	6	1	5
3	Attempt any two of the following	3	2	4
4	Attempt any two of the following	3	3	6
<b>Total Marks:</b>				<b>20</b>

<b>Max. Marks: 40 (Credit 4, Duration: 1hr:30 Min.)</b>				
<b>Question No.</b>	<b>Question</b>	<b>No. of sub questions</b>	<b>Marks to each sub question</b>	<b>Total Question Marks</b>
1	Multiple Choice Questions 5	5	1	5
2	Define any 5	6	1	5
3	Attempt any two of the following	3	2	4
4	Attempt any two of the following	3	3	6
<b>Total Marks:</b>				<b>20</b>

For 2 credits CIE 20 Marks for internal Examination and 20 Marks for CBCS activity (Open book test, Seminars, Online Test, Surprise Test, Preparation of Models, Group Discussions etc.) average of 40 marks will be considered.

Question Paper Pattern: ESE

<b>Max. Marks: 60 (Credit:04, Duration: 3 Hrs.)</b>					
<b>Question No.</b>	<b>Question</b>		<b>No. of sub questions</b>	<b>Marks to each sub question</b>	<b>Total Question Marks</b>
1	Attempt All		10	1	10
2	Attempt any 5		7	2	10
3	Attempt any 5		7	3	15
4	Attempt any 3		5	5	15
5	Attempt any 2		4	5	10
<b>Total Marks:</b>					<b>60</b>

<b>Max. Marks: 30 (Credit 2, Duration: 2 Hrs.)</b>					
<b>Question No.</b>	<b>Question</b>		<b>No. of sub questions</b>	<b>Marks to each sub question</b>	<b>Total Question Marks</b>
1	Attempt All		5	1	5
2	Attempt any 5		7	2	10
3	Attempt any 2		4	5	10
4	Attempt any 1		2	5	5
<b>Total Marks:</b>					<b>30</b>

Major: Data Science minor: Actuarial Science

## B.Sc. Data Science Curriculum & Syllabus

### Programme Specific Outcomes (PSOs)

***After the successful completion of B.Sc. Data Science program the students are expected to***

<b>PSO1</b>	Apply foundations of Mathematics, Statistics and Computer Science in Solving real world problems.
<b>PSO2</b>	Design, develop, implement, and apply Analytical skills related to Research, consultancy, and multidisciplinary domains.
<b>PSO3</b>	Equip with requisite theoretical and practical skills to enable them to pursue multidisciplinary courses at postgraduate level and to obtain placement opportunities.
<b>PSO4</b>	To develop the speed and accuracy levels of analysis and drawing inferences.

### Programme Outcomes (POs)

***On successful completion of the B.Sc. Data Science students will be able to***

<b>PO1</b>	Gain fundamental knowledge and ability to expertise in Data Science and analytics.
<b>PO2</b>	Utilize the features and new updates of Excel, Python, R, Tableau and Power BI to enhance analytical reasoning.
<b>PO3</b>	Establish the ability to listen, read, proficiently communicate, and articulate data and information through traditional and digital channels to audiences with diverse perspectives.
<b>PO4</b>	Apply critical thinking by understanding financial mathematics, time series analysis, real analysis, artificial intelligence, deep learning, data security that are applied in actuarial science and cloud computing.
<b>PO5</b>	Acquire appropriate knowledge base in domain specific areas leading to the pursue of an advanced level of study.
<b>PO6</b>	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.
<b>PO7</b>	Inculcate professional effective communication skills, teamwork, multidisciplinary approach and an ability to relate issues to broader social context.

F.Y.BSc (Data Science) for A. Y. 2025-20256							
Semester -I							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	PR	CIE	ESE	Total
Major Mandatory (4)+(4)+(4)	24DSC11101	Fundamentals of C Programming	2	-	20	30	50
	24DSC11102	Practical based on C Programming	-	2	20	30	50
	24DSC11103	Fundamentals of Mathematics	2	-	20	30	50
	24DSC11104	Practical based on Mathematics	-	2	20	30	50
	24DSC11105	Basics of Descriptive Statistics	2	-	20	30	50
	24DSC11106	Practical based on Descriptive Statistics	-	2	20	30	50
OE (2)	24COB11301(C)	OE (A.Y. 2024-2025) OE (A.Y. 2025-2026) Fundamentals of Marketing (From Commerce Basket) (But can be decided on Workload)	2	-	20	30	50
SEC(2)	24DSC11401/ 24DSC11407	Data Science with EXCEL	-	2	20	30	50
AEC(2)	24ENG11506	Developing Communicative Competence	2	-	20	30	50
VEC(2)	24VEC11501	Entrepreneurship Essentials- I	2	-	20	30	50
IKS(1)	24IKS11501	Foundation Course in Indian Knowledge System	2	-	20	30	50
		Total	16	6	220	330	550

F.Y.BSc (Data Science) Semester -II							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	PR	CIE	ESE	Total
Major Mandatory (4)+(4)+(4)	24DSC12101	Introduction to Data Science	2	-	20	30	50
	24DSC12102	Practical based on Data Science	-	2	20	30	50
	24DSC12103	Introduction to Graph Theory	2	-	20	30	50
	24DSC12104	Practical based on Graph Theory	-	2	20	30	50
	24DSC12105	Discrete & Continuous Probability Distributions	2	-	20	30	50
	24DSC12106	Practical based on DCPD	-	2	20	30	50
OE3(2)	24HIS12303	OE (A.Y. 2025-2026) History of Science and Technology	-	2	20	30	50
SEC(2)	24DSC12401/ 24DSC12407	R Programming	-	2	20	30	50
AEC(2)	24ENG12506	Mastering English for Professional Purposes)	2	-	20	30	50
VEC(2)	24VEC12507/ 24VEC12502	Entrepreneurship Essentials-II	2	-	20	30	50
CC(2)	24NSS12601/ 24NCC12601/ 24RED12601/ 24DRM12601/ 24ANM12601/ 24CUL12601/ 24SPO12601/ 24YOG12601	NSS/ NCC/ Red Cross/ Theatre & Drama/ Animation/ Culinary Arts/ Sports Physical Education/ Yoga	-	2	20	30	50
		Total	10	12	220	330	550

S. Y. BSc (Data Science) Semester -III							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	PR	CI E	ES E	Total
Major Mandatory (4T) + (2P)	24DSC23101	Introduction to Python Programming	2	-	20	30	50
	24DSC23102	Testing of Hypothesis	2	-	20	30	50
	24DSC23103	Practical on Python & Testing of Hypothesis	-	2	20	30	50
Major Specific IKS	24DSC23104	Timeline of Computing	2	-	20	30	50
Minor 2T+2P	24DSC23205	A Course in Linear Algebra	2	-	20	30	50
	24DSC23206	A Course in Linear Algebra Practical	-	2	20	30	50
OE(2)	24SOC23305	Sociology of Human Resource	2	-	20	30	50
VSEC(2)	24DSC23407	Multivariate Analysis	2	-	20	30	50
AEC(2)	24HIN23501	Hindi Bhasha Shikshan	2	-	20	30	50
CC (2)	24NSS12601/ 24NCC12601/ 24RED12601/ 24DRM12601/ 24ANM12601/ 24SPO12601/ 24YOG12601	NSS/ NCC/ Red Cross/ Theatre & Drama/ Animation/ Sports Physical Education/ Yoga	2	-	20	30	50
FP(2)	24DSC23608	Field Project	-	2	20	30	50
		Total	16	6	220	330	550

S. Y. BSc (Data Science) Semester -IV							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	PR	CIE	ESE	Total
Major Mandatory (4T) =(2T+2T)  +2P	24DSC24101	Advanced Python Programming	2	-	20	30	50
	24DSC24102	Regression Analysis	2	-	20	30	50
	24DSC24103	Practical on Calculus & Regression Analysis	-	2	20	30	50
Minor (4) 2T+2P	24DSC24204	Actuarial Statistics	2	-	20	30	50
	24DSC24205	Practical on Actuarial Statistics	-	2	20	30	50
OE3(2)	24COB24305(B)	Introduction to Stock Market	2	-	20	30	50
VSEC(2)	24DSC24406	Advanced Python Programming Practical	2	-	20	30	50
SEC(2)	24DSC24407	Calculus	2	-	20	30	50
AEC(2)	24HIN24501	Vaikalpik Hindi	2	-	20	30	50
CEP(2)	24DSC24608	Community Engagement and Services	-	2	20	30	50
CC (2)	24NSS12601/ 24NCC12601/ 24RED12601/ 24DRM12601/ 24SPO12601/ 24YOG12601	NSS/ NCC/ Red Cross/ Theatre & Drama/ Sports Physical Education/ Yoga	2	-	20	30	50
		Total	16	6	220	330	550

T. Y. BSc (Data Science) Semester -V							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	P R	CIE	ESE	Total
Major Mandatory (8T) +(4P)	24DSC35101	Basics of Machine Learning	4	-	40	60	100
	24DSC35102	Sampling Methods	2	-	20	30	50
	24DSC35103	Database Management System	2	-	20	30	50
	24DSC35104	Practical on Machine Learning	-	2	20	30	50
	24DSC35105	Practical Based on Sampling Methods	-	2	20	30	50
Elective 2T + 2P	24DSC35106	Artificial Intelligence	2	-	20	30	50
	24DSC35107	Practical based on AI & DBMS	-	2	20	30	50
Minor	24DSC35208	Mathematical Techniques for Optimization	2	-	20	30	50
VSEC(2)	24DSC35409	Advanced EXCEL	-	2	20	30	50
FP(2)	24DSC35610	Field Project	-	2	20	30	50
		<b>Total</b>	<b>12</b>	<b>10</b>	<b>220</b>	<b>330</b>	<b>550</b>

T. Y. BSc (Data Science) Semester -VI							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	PR	CIE	ESE	Total
Major Mandatory (8T) + (4P)	24DSC36101	Generative AI	2	-	40	60	100
	24DSC36102	Data Science & Privacy	2	-	20	30	50
	24DSC36103	BigData	2	-	20	30	50
	24DSC36104	Statistical Inference using Non Parametric Tests	2	-	20	30	50
	24DSC36105	Generative AI Practical	-	2	20	30	50
	24DSC36106	Tableau	-	2	20	30	50
Elective 2T + 2P	24DSC36107	Data Structure & Analysis	2	-	20	30	50
	24DSC36109	Practical based on Data Structure		2	20	30	50
VSEC(2)	24DSC36610	MATLAB Practical	-	2	20	30	50
OJT(2)	24DSC36611	OJT	-	4	40	60	100
		Total	12	10	220	330	550



*First  
Semester*

<b>Semester- I</b>			
<b>Course Type: Major Mandatory Paper 1(Theory)</b>			
<b>Course Code: 24DSC11101 Course Title: - Fundamentals of C Programming</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>● Problem solving Skills</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>● To introduce the foundations of computing, programming and problem- solving using computers.</li> <li>● To develop the ability to devise algorithms &amp; flowcharts for arithmetic and logical problems. test, debug and execute programs.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Explore algorithmic approaches to problem solving.		B1,B2
CO2	Develop modular programs using control structures and arrays in 'C'		B3,B4
CO3	Solve simple computational problems using modular design and basic features of the structured programming 'C' language.		B5, B6
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Problem Solving</b> <ul style="list-style-type: none"> <li>● Introduction to problem solving using computers.</li> <li>● Algorithms-definition, characteristics, examples, advantages and limitations.</li> <li>● Flowcharts - definition, notations, examples, advantages and limitations, Comparison with algorithms.</li> <li>● program Types of languages</li> <li>● Compilation process (compilers, interpreters), linking and loading, syntax and semantic errors, testing of a program</li> </ul>	2	CO1
<b>2</b>	<b>C Fundamentals</b> <ul style="list-style-type: none"> <li>● History of 'C' language.</li> <li>● Application areas.</li> <li>● Structure of a 'C' program.</li> <li>● Function as building blocks.</li> <li>● 'C' tokens</li> <li>● Character set, Keywords, Identifiers</li> <li>● Variables, Constants (character, integer, float, string, escape sequences, constant).</li> </ul>	2	CO1

	<ul style="list-style-type: none"> <li>• Data Types (Built-in and user defined data types).</li> <li>• Operators, Expressions, types of operators, Operator precedence and Order of evaluation.</li> <li>• Character, String, Formatted input and output</li> </ul>		
3	<b>Control Structures</b> <ul style="list-style-type: none"> <li>• Decision making structures- if ,if-else, switch and conditional operator.</li> <li>• Loop control structures: while, do while, for.</li> <li>• Use of break and continue.</li> <li>• Nested structures.</li> <li>• Unconditional branching (goto statement).</li> </ul>	5	CO2
4	<b>Functions</b> <ul style="list-style-type: none"> <li>• Standard library functions.</li> <li>• User defined functions: declaration, definition, function call, parameter passing (call by value), return statement.</li> <li>• Recursive functions.</li> <li>• Scope of variables</li> </ul>	5	CO2,C03
5	<b>Arrays</b> <ul style="list-style-type: none"> <li>• Concept of array.</li> <li>• Types of Arrays – One, Two and Multidimensional array.</li> <li>• Array Operations - declaration, initialization, accessing array elements.</li> <li>• Passing arrays to function.</li> <li>• Array applications - Finding maximum and minimum, Counting occurrences, Linear search,</li> <li>• Matrix operations (trace of matrix, addition, transpose, multiplication, symmetric, upper/ lower triangular matrix)</li> </ul>	5	CO2,C03
6	<b>Pointers</b> <ul style="list-style-type: none"> <li>• Introduction to Pointers.</li> <li>• Declaration, definition, initialization, dereferencing.</li> <li>• Pointer arithmetic.</li> <li>• Relationship between Arrays &amp; Pointers- Pointer to array, Array of pointers.</li> <li>• Functions and pointers- Passing pointer to function, Returning pointer from function</li> </ul>	5	CO2,C03
7	<b>Strings</b> <ul style="list-style-type: none"> <li>• String Literals, string variables, declaration, definition, initialization.</li> <li>• Syntax and use of predefined string functions</li> <li>• Array of strings.</li> <li>• Strings and Pointers</li> <li>• Command line arguments.</li> </ul>	3	CO2,C03
8	<b>Structures</b>	3	CO2,C03

	<ul style="list-style-type: none"> <li>● Concept of structure, definition and initialization, use of typedef.</li> <li>● Accessing structure members.</li> <li>● Arrays of Structures</li> <li>● Structures and functions- Passing each member of structure as a separate argument, Passing structure by value / address.</li> <li>● Pointers and structures.</li> </ul>		
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<b>Text Books</b>
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| 1. Problem Solving Using Computer and 'C' Programming, Parijat Publication |
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<b>Reference Books</b>
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|---|
| 1. Problem Solving and Programming Concept, Maureen Sprankle, 7 <sup>th</sup> Edition, Pearson Publication.                           |
| 2. A Structured Programming Approach Using C, Behrouz A. Forouzan, Richard F. Gilberg, Cengage Learning India                         |
| 3. The 'C' programming language, Brian Kernighan, Dennis Ritchie, PHI 6. Programming in C ,A Practical Approach, Ajay Mittal, Pearson |

<b>Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)</b>
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| 1. <a href="http://riptutorial.com/Download/c-language.pdf">riptutorial.com/Download/c-language.pdf</a>   |
| 2. <a href="http://Lec-1c.pdf(iitkgp.ac.in)">Lec-1c.pdf (iitkgp.ac.in)</a>  |
| <b>Online Courses:</b>  |
| 1. <a href="http://Introduction to Programming in C - Course (nptel.ac.in)">Introduction to Programming in C - Course (nptel.ac.in)</a>   |
| 2. <a href="http://Free C (programming language) Tutorial - Introduction To The C Language   Udemy">Free C (programming language) Tutorial - Introduction To The C Language   Udemy</a>   |
| 3. <a href="http://Top Free Programming Fundamentals Courses &amp; Tutorials Online - Updated [February 2024] (udemy.com)">Top Free Programming Fundamentals Courses &amp; Tutorials Online - Updated [February 2024] (udemy.com)</a> |

CO-PO MAPPING							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	M	L	--	--	--	--
CO 2	M	S	M	S	--	S	--
CO 3	S	--	--	L	M	S	--
<b>S: Strong, M: Medium, L: Low, -- NA</b>							

<b>Semester- I</b>			
<b>Course Type: Major Mandatory Paper 2 (Practical)</b>			
<b>Course Code: 24DSC11102 Course Title: - Practical Based on C Programming</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Practicals:</b> 10	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Problem Solving Skills</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To understand the program development life cycle.</li> <li>• Solve simple computational problems using modular design and basic features of the 'C' language</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Devise pseudocodes and flowchart for computational problems.	B6,B3,B1	
C02	Write, debug, and execute simple programs in 'C'	B2,B3,B4,B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>
1	Simple Programmes for calculation of area of circle, roots of quadratic equation, calculation of mean,median,mode	2	C01, C02
2	Programmes on decision making (if,if else,switch)	4	C01

3	Programmes on loop control structures	5	C02
4	Programmes on User defined Function and Library functions	5	C01
5	Programs on Arrays (1-D and 2-D)	4	C02
6	Programmes on Pointer	4	C02
7	Programmes on Strings	3	C01, C02
8	Programmes on Structure and Unions	3	C01,C02

CO-PO MAPPING							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	--	--	S	M	S	--
CO 2	S	--	L	S	S	M	--

**S: Strong , M: Medium , L: Low, -- NA**

Semester- I			
Course Type: Major Paper 3 (Theory)			
Course Code: 24DSC11103 Course Title: - Fundamentals of Mathematics			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>Mathematics at HSC level</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>Learn concepts of mathematical logic for analyzing propositions and proving theorems.</li> <li>Use sets for solving applied problems and use the properties of set operations algebraically.</li> <li>Work with relations and investigate their properties.</li> <li>Investigate functions as relations and their properties.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	be equipped with fundamental principles and mathematical tools which will help them in further studies of computer science.		B1,B2
CO2	be able to model, solve and interpret the practical real-life problem.		B3,B2
CO3	do Logical thinking and the learning ability of students will be enhanced.		B2,B4
CO4	learn counting skills which are essential for the study of probability distributions.		B1,B2

C05	achieve the skills essential to become a good programmer and data scientist.	B4,B3	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Introduction to fundamentals</b> <ul style="list-style-type: none"> <li>● Sets and Subsets</li> <li>● Operations on sets</li> <li>● Sequences</li> <li>● Integers.</li> <li>● Divisibility relation and properties.</li> <li>● G.C.D. and L.C.M</li> <li>● Modular arithmetic and its application to cryptology</li> </ul>	7	C01
2	<b>Logic</b> <ul style="list-style-type: none"> <li>● Propositions and Logical Operations</li> <li>● Conditional Statements</li> <li>● Methods of proof.</li> </ul>	5	C01,C03
3	<b>Counting</b> <ul style="list-style-type: none"> <li>● Permutations</li> <li>● Combinations</li> <li>● Pigeonhole Principle</li> </ul>	5	C04, C05
4	<b>Relations and Functions</b> <ul style="list-style-type: none"> <li>● Products Sets and Partitions</li> <li>● Relations and Digraphs</li> <li>● Paths in Relations and Digraphs</li> <li>● Properties of Relations</li> <li>● Equivalence Relations</li> <li>● Data Structures for Relations and Digraphs</li> <li>● Operations on Relations</li> <li>● Transitive Closure and Warshall's Algorithm</li> </ul>	10	C04, C05
5	<b>Recurrence Relations</b> <ul style="list-style-type: none"> <li>● Introduction and Examples of homogeneous and Nonhomogeneous Recurrence Relation.</li> </ul>	3	C01,C02

#### Reference Books

1.	Discrete Mathematics and Its Applications with Combinatorics and Graph Theory, Kenneth H Rosen
2.	Discrete Mathematical Structures, , Kolman , Busby , Ross; Sixth Edition.

#### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1	<a href="#">Fundamentals of Mathematics   Download book PDF (freebookcentre.net)</a>
2	<a href="#">lecture3.dvi (stonybrook.edu)</a>
3	<a href="#">Master the Fundamentals of Math Training Course   Udemy</a>

<b>CO-PO MAPPING</b>							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	--	S	S	M	M	L
CO 2	S	--	M	M	M	L	S
CO 3	S	-	M	S	S	L	--
CO 4	S	--	S	S	M	L	--
CO 5	S	--	L	S	S	M	--
<b>S: Strong , M: Medium , L: Low, -- NA</b>							

<b>Semester- I</b>			
<b>Course Type: Major Paper 4(Practical)</b>			
<b>Course Code: 24DSC11104 Course Title: - Practical based on Mathematics</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Practicals:</b> 10	<b>Examination Scheme:</b> CIE: 10 Marks ESE: 15 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Problem Solving Skills in mathematics</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To understand the basic concepts of sets, counting principles and relations and functions</li> </ul>			
<b>Expected Course Outcomes:</b>			

<b>On the successful completion of the course, student will be able to:</b>			
C01	Solve problems based on sets and integers, and modular arithmetic's and logic	B6,B3,B1	
C02	Solve Counting principles and relations and functions and homogeneous and non-homogeneous relations	B2,B3,B4,B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>
1	Sets and integers	1	C01
2	Modular arithmetic and application to cryptography	1	C01
3	Logic-I	1	C01
4	Logic-II	1	C01
5	Counting Principles-I	1	C02
6	Counting Principles-II	1	C02
7	Relations and Functions	1	C02
8	Operations on relations and transitive closure	1	C02
9	Homogeneous recurrence relation	1	C02
10	Non-homogeneous recurrence relation	1	C02

<b>Semester- I</b>			
<b>Course Type: Major Paper 5 (Theory)</b>			
<b>Course Code: 24DSC11105 Course Title: - Basics of Descriptive Statistics</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No of Lectures: 30</b>	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>Basic concepts like mean, median, mode which they have learned in school and Junior college.</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>Students will be able to understand the concept of population and sample.</li> </ul>			

- Students will be able to prepare a survey design and implement it in the proper manner.

**Expected Course Outcomes:**

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

C01	Understand the concept of population and sample, various statistical measures such as measures of central tendency, dispersion, skewness and kurtosis.	B2, B3
C02	Apply all the above-mentioned topics in real life.	B2, B4
C03	Evaluate and define the correlation and regression analysis for the data.	B4,B3
C04	Create a survey design and to collect data with proper insights in the data.	B1

**B1** - Remember; **B2** - Understand; **B3** - Apply; **B4** - Analyze; **B5** - Evaluate; **B6** - Create

UNIT	Contents	No of Lectures	CO targeted
1	<p><b>Introduction to Statistics</b></p> <ul style="list-style-type: none"> <li>• Meaning of Statistics as a Science,</li> <li>• Importance of Statistics.</li> <li>• Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social Sciences, Management sciences, Agriculture, Insurance, Information technology, Education and Psychology.</li> </ul>	2	CO1
2	<p><b>Population and Sample</b></p> <ul style="list-style-type: none"> <li>• Types of characteristics and their scale:</li> <li>• Attributes: Nominal scale, ordinal scale,</li> <li>• Variables: discrete and continuous variables, interval scale, ratio scale,</li> <li>• Types of data: Primary data, Secondary data, Cross-sectional data, time series data, directional data.</li> <li>• Notion of a statistical population and sample:</li> <li>• Finite population, infinite population, homogeneous population and heterogeneous population.</li> <li>• Random sample. Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRSWOR) stratified random sampling, systematic sampling</li> </ul>	2	CO1
3	<p><b>Summary Statistics</b></p> <ul style="list-style-type: none"> <li>• Presentation of Data, Interpretation of Data from table and graph, Data validation</li> <li>• Frequency Classification: Raw data and its classification, ungrouped frequency distribution, Sturges' rule, grouped frequency distribution, inclusive and exclusive methods of classification, Open end classes, and relative frequency distribution, cumulative frequency distribution. Histogram and cumulative frequency curves.</li> <li>• Measures of Central Tendency: Concept of central tendency, Statistical averages, characteristics of a good statistical average.</li> <li>• Arithmetic Mean (A.M.): Definition, effect of change of origin and scale, combined mean of a number of groups, merits and demerits, trimmed arithmetic mean. Geometric Mean (G.M.): Definition, formula, merits and demerits. Harmonic Mean (H.M.): Definition. Formula, merits and</li> </ul>	10	CO2

	<p>demerits. Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box Plot, Situations where one kind of average is preferable to others.</p> <ul style="list-style-type: none"> <li>Measures of Dispersion: Concept of dispersion, characteristics of good measure of dispersion. Range, Semi-Range, Semi-interquartile range (Quartile deviation): Definition, merits and demerits. Variance and standard deviation: Definition, merits and demerits, effect of change of origin and scale, coefficient of variation</li> <li>Concept of symmetry/skewness, positive skewness, negative skewness, Bowley's coefficient of skewness and statement of its range, interpretation using Box plot. Karl Pearson's coefficient of skewness.</li> </ul>		
4	<p><b>Correlation</b></p> <ul style="list-style-type: none"> <li>Bivariate data, Scatter diagram and interpretation, correlogram.</li> <li>Concept of correlation between two variables, positive correlation, negative correlation, no correlation.</li> <li>Covariance between two variables (m11): Definition, computation, effect of change of origin and scale.</li> <li>Karl Pearson's coefficient of correlation (r): Definition, computation for ungrouped data and interpretation. Properties: (i) <math>-1 \leq r \leq 1</math> (with proof), (ii) Effect of change of origin and scale (with proof).</li> <li>Spearman's rank correlation coefficient: Definition, derivation of formula, computation and interpretation (without ties). In case of ties, compute Karl Pearson's correlation coefficient between ranks. (Spearman's rank correlation coefficient formula with correction for ties not expected.)</li> </ul>	5	C03
5	<p><b>Fitting of Line (Regression Line)</b></p> <ul style="list-style-type: none"> <li>Concept of dependent and independent variables. Identification of response and predictor variables and relation between them.</li> <li>Meaning of regression, connection between correlation and regression,</li> <li>Simple linear regression model: <math>Y = a + bX + \epsilon</math>. Fitting of line <math>Y = a + bX</math>. Estimation of 'a' and 'b' using least square method and interpretation of 'b' as regression coefficient. Explained and unexplained variation, coefficient of determination, standard error of an estimate of line of regression, relation between regression coefficients and correlation coefficient. Residual plots and its interpretation.</li> <li>Curve fitting: Second degree, parabola and exponential curve</li> </ul>	11	C03 C04

### Reference Books

1. Programmed Statistics, Agarwal B. L., Second Edition, New Age International Publishers, New Delhi.(2003)
2. Fundamentals of Mathematical Statistics, Gupta, S. C. and Kapoor,V. K.,Eighth Edition, Sultan Chand and Sons Publishers, New Delhi (1983)
3. Probability and Statistics for Engineers and Scientists, Raymond Myers and Ronald E. Walpole, Pearson Education (2007)
4. Statistical Methods, Snedecor G. W. and Cochran W. G, Eighth Ed. East-West Press. (1989)

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1	<a href="#">Introduction to Statistics - Open Textbook Library (umn.edu)</a>
2	<a href="#">Statistics/Data Analysis with SPSS: Descriptive Statistics   Udemy</a>
3	<a href="#">04. Probability and Statistics Autor Michael J. Evans and Jeffrey S. Rosenthal.pdf (dropbox.com)</a>

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	M	M	S	M	S	L	-
CO 2	L	S	M	S	M	M	-
CO 3	M	L	L	S	M	L	-
CO 4	L	M	S	-	S	L	-

**S: Strong , M: Medium , L: Low, -- NA**

<b>Semester- I</b>			
<b>Course Type: Major Paper 6(Practical)</b>			
<b>Course Code: 24DSC11106 Course Title: - Practical based on Descriptive Statistics</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 15</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>● Problem Solving Skills</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>● To understand the program development life cycle.</li> <li>● Solve simple computational problems using modular design and basic features of the 'C' language</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Devise data representation methods.	B6,B3,B1	
C02	Measures of central tendency, calculation of correlation coefficient , second degree regression and association study	B2,B3,B4,B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>
1	Diagrammatic representation of data	1	C01
2	Graphical representation of data	1	C01
3	Tabular representation of data	1	C01
4	Sampling Methods	1	C02
5,6	Measures of central tendency and dispersion of data	2	C02
7,8	Calculation of Raw and central moments	2	C02
9,10	Measures of skewness and kurtosis	2	C02
11,12	Representation of bivariate data using scatter diagram and calculation of correlation coefficient	2	C02
13,14	Fitting of line, second degree regression	2	C02
15	Study of association between 2 attributes	1	C02

Semester- I Course Type: SEC( Practical) Course Code: 24DSC11401 Course Title: - Data Science with EXCEL			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>		<b>No. of Practicals : 30</b>
<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>			
<b>Prerequisites:</b> Student should have basic knowledge of: <ul style="list-style-type: none"> <li>• Problem solving Skills</li> </ul>			
The main objectives of this course are to: <ul style="list-style-type: none"> <li>• Learn Microsoft excel for the purpose of data science</li> </ul>			
<b>Expected Course Outcome</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Successfully apply excel functions to database		B1,B2
CO2	Use various data filtering methods in excel		B3,B4
CO3	Use various charts on excel		B5, B6
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Practicals	CO targeted
1	Introduction: Creating workbook, Importing data from delimited text file, Renaming the worksheet, changing the worksheet order	1	CO1
2	Basic Data Manipulation in Excel Simple functions like sum, min,max, percentileexe, percentileinc,	1	CO1
3	Creating Pivot Charts and Tables	2	CO1
4	Inserting text boxes, shapes, images, and modification Formatting text using upper, lower, proper, right, left,mid,concatenate function Countif, countifs, sumif, sumifs, averageif, averageifs Conditional formatting and filtering	2	CO1
5	Logical operations using if function, AND, OR ,VLookup and Hlookup Data	2	CO1
6	Creating and Modifying simple macros Managing workbook by protecting, Encrypting with password Creating the dashboard	2	CO1
7	Introduction to the Data filtering capabilities of Excel, the construction of Pivot Tables to organize data and Introduction to charts in Excel.	2	CO2
8	Constructing various Line, Bar and Pie charts. Using the Pivot chart features of Excel. Understanding and constructing Histograms and Scatter Plots.	3	CO3

<b>Semester- I</b>			
<b>Course Type: AEC(Theory)</b>			
<b>Course Code: 24ENG11506 Course Title: - Developing Communicative Competence</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>● English Language.</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>● Enhance reading comprehension and listening proficiency through skimming, scanning, comprehension, and note-taking techniques.</li> <li>● Foster critical thinking skills by engaging with diverse texts and audio materials.</li> <li>● Develop versatile reading and listening abilities applicable across various contexts and subjects.</li> <li>● Master foundational writing skills, including paragraph writing and generation of ideas.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Learnt to read and understand texts in English	B2,B3	
CO2	Mastered the skill of listening and responding to communication in English	B4	
CO3	Learnt to speak English in different situations	B1	
CO4	Learnt to write letters, memos, notices, agenda and minutes in English	B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
1	<b>Reading Skills</b> <ul style="list-style-type: none"> <li>● Skimming and scanning</li> <li>● Reading comprehension</li> <li>● Loud Reading</li> <li>● Reading and making notes</li> </ul> <b>Listening Skills</b> <ul style="list-style-type: none"> <li>● Active and passive listening</li> <li>● Listening comprehension</li> <li>● Listening and responding</li> <li>● Listening and taking notes</li> </ul>	15	CO1 CO2 CO3
2	<b>Writing Skills</b> <ul style="list-style-type: none"> <li>● Paragraph writing</li> <li>● Expansion of ideas</li> <li>● Summarizing and Paraphrasing</li> </ul> <b>Forms of Writing</b> <ul style="list-style-type: none"> <li>● Letter writing</li> <li>● Writing notice, agenda and minutes</li> <li>● Drafting an Email</li> <li>● Writing for Digital Platforms</li> </ul>	15	CO4

### Reference Books

1. Aspirations: English for Career. Board of Editors. Orient BlackSwan
2. Business Communication, Sinha, K.K. Taxmann Publications Pvt. Ltd. New Delhi, March 2012.
3. Erica Williams. 2008. Presentations in English. Macmillan
4. Gupta Kounal. 2020. Content Writing Handbook. Henry Harvin
5. Horizons: English in Multivalent Contexts. Board of Editors, Savitribai Phule Pune University. Orient BlackSwan Publications, 2020.

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	M	--	S	--	--	--	S
CO 2	L	--	S	--	--	--	S

**S: Strong, M: Medium, L: Low, -- NA**

<b>Semester- I</b> <b>Course Type: VEC (Theory)</b> <b>Course Code: 24VEC11501</b> <b>Course Title: - Environmental Sustainability: Principles and Values</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Environment</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• The goal of studying this course is to provide students with the understanding and skills they require to evaluate and deal with the many environmental issues that face the global community today. This will promote sustainable solutions and responsible stewardship for the benefit of present and future generations.</li> <li>• To get a thorough understanding of the morals, ethics and guiding principles of environmental sustainability.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Analyze the principles and values underlying environmental sustainability		B4
C02	Evaluate the ethical dimensions of environmental issues and decision-making.		B5
C03	Identify global environmental challenges and propose solutions for sustainable development		B2
C04	Engage in informed discussions on sustainability-related policies, practices, and advocacy efforts		B1,B3
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
1	<b>Introduction to Environmental Sustainability</b> <ul style="list-style-type: none"> <li>• Definitions, Scope and importance of concepts of sustainability &amp; sustainable Development</li> <li>• Historical perspectives on environmental movements(discuss Chipko, Appiko movement and narmada bachao)and sustainability initiatives</li> <li>• Overview of the United Nations SDGs and their relevance to environmental sustainability</li> <li>• Case studies and examples of SDG implementation at local and international levels</li> </ul>	5L	C01

2	<b>Principles of Environmental Sustainability</b> <ul style="list-style-type: none"> <li>Ecological principles: Concept of ecosystem and ecosystem services, Biodiversity: concept and conservation strategies</li> <li>Economic principles: concept of circular economy and green growth</li> <li>Value and ethics in environment sustainability: anthropocentrism, biocentrism, and ecocentrism</li> </ul>	5L	C02,C03
3	<ul style="list-style-type: none"> <li><b>Global Environmental Challenges</b> Climate change and global warming: what is climate change?, concept of global warming and greenhouse gases</li> <li>Biodiversity loss and habitat degradation: discuss impact of deforestation, urbanization, and agricultural expansion on biodiversity. Highlighting threats to endangered species and the importance of conservation efforts. Discuss on convention on biological diversity (CBS) and Environment Protection Act (1986)</li> <li>Pollution and resource depletion: concept of pollution and discuss practices to minimize various types of pollution</li> <li>Adaptation and Resilience: Discuss developing strategies to cope with the impacts of climate change such as extreme weather events, sea-level rise, and disruptions to ecosystems.</li> </ul>	6L	C03
4	<b>Practices, Solutions, policy and governance for sustainability</b> <ul style="list-style-type: none"> <li>Concept of Renewable and Non-renewable energy sources, introduction to use of alternate energy sources (Solar, Geothermal, wind, hydro) with respect to growing energy needs, Renewable energy technologies and energy efficiency measures &amp; case studies (Solar energy in India)</li> <li>Sustainable agriculture: concept and importance of organic farming, agroforestry, urban farming, and soil conservation practices.</li> <li>Circular Economy: Concept of waste reduction (types and management of waste, examples of recycling innovations, product life extension and concept of upcycling.</li> <li>Behavioral Changes: Discuss educational campaigns, public awareness initiatives, and sustainable lifestyle choices.</li> <li>Environmental Regulations: Explore laws and policies on emissions control, waste management, and natural resource conservation</li> <li>International Agreements: Highlight global agreements like the Paris Agreement, Kyoto Protocol, and their impact on sustainability goals</li> </ul>	11L	C04
5	<b>Discovering our Local Environment:</b> <ul style="list-style-type: none"> <li>Visit to a local area to document environmental assets (river / forest / flora / fauna) or to a local polluted site or to study simple ecosystems in nearby areas.</li> <li>Submission of report</li> </ul>	3L	C01,C02

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	-	S	M	M	L	-
CO 2	S	-	S	S	M	L	-

CO 3	S	-	S	S	M	M	-
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Semester- I			
Course Type: VEC 1(Theory)			
Course Code: 24VEC11501 Course Title: - Environment Sustainability Principles & Values			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> <li>Human values</li> </ul>			
The main objectives of this course are to:			
<ul style="list-style-type: none"> <li>This course on “Mulya Pravah” creates a new paradigm towards a just and equitable world for all. It draws upon the innate space of universal values. It develops the capacity of individuals to look within themselves to source their inner potential and universal values to ensure that their actions enable justice and equity for all.</li> </ul>			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Understand the ethos of the Indian value system.		B2,B1
CO2	Know the importance of mental wellbeing and stress management techniques.		B2
CO3	Examine values significant for eco friendly behavior		B5
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Sessions	CO targeted
1	<b>Introduction to Indian Ethos</b> <ul style="list-style-type: none"> <li>Meaning of ethos and cultural essence of India</li> <li>Integrating the two methodologies: interiorization process for self-exploration, and exterior scientific pursuit for the prosperity of world</li> <li>The Law of Karma and Nishkama Karma (The Law of action and selfless action)</li> </ul>	6	CO1
2	<b>Integrated Personality and Well-being</b> <ul style="list-style-type: none"> <li>The three gunas (qualities of sattva—purity and harmony, rajas —activity and passion, tamas —darkness and chaos), the four antah-karanas (inner instruments), and panch kosha (five sheaths).</li> </ul>	10	CO2

	<ul style="list-style-type: none"> <li>Stress management: meditated personality and agitated personality.</li> <li>Oneness, non-duality, and equanimity</li> <li>Physical, mental, social, and spiritual well-being</li> </ul>		
3	<p><b>Environmental Values</b></p> <p><b>Introduction to Environment and ecosystem</b></p> <ul style="list-style-type: none"> <li>Introduction and Components in environment,</li> <li>Objectives of Environment Education,</li> <li>Importance and scope of Environmental studies,</li> <li>Structure, scale and functions of ecosystem,</li> <li>Type of ecosystem,</li> <li>Important ecological concept – food chain, food web, ecological pyramid</li> </ul> <p><b>Understanding Biodiversity Conservation</b></p> <ul style="list-style-type: none"> <li>What is biodiversity?</li> <li>Need to conserve biodiversity.</li> <li>Types of conservation</li> </ul> <p><b>Living with sustainability</b></p> <ul style="list-style-type: none"> <li>Definition of sustainability and three pillars of sustainability</li> <li>What is energy and water conservation?</li> <li>Best Ways to save energy and water</li> <li>Concept of reduce, reuse and recycle,</li> <li>Overall benefits of sustainable living</li> </ul>	14	C03

<b>CO-PO MAPPING</b>							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	M	--	--	--	--	S	L
CO 2	M	--	--	--	--	M	L
CO 3	M	--	--	--	--	M	L
<b>S: Strong, M: Medium, L: Low, -- NA</b>							

<b>Semester- I</b>			
<b>Course Type: IKS (Theory)</b>			
<b>Course Code: IKS11501 Course Title: - Introduction to Indian Knowledge System</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Languages Proficiency English, Hindi &amp; Marathi</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To familiarize students with the Heritage of ancient and eternal Indian Knowledge System.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Enumerate contribution of Indian Mathematicians		B1,B2
CO2	Explain the ideas behind astronomical phenomenon, books, and institutes of astronomy		B1
CO3	Describe different traditions of Indian Economic thoughts and organization		B3
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Introduction to Indian Ethos</b> <ul style="list-style-type: none"> <li>• Bharatavarsha Uniqueness of Indian culture</li> <li>• Rationale behind starting this course.</li> <li>• Glory of Bharata</li> <li>• Structures of Learning Centres</li> </ul>	8	CO1

	<ul style="list-style-type: none"> <li>University education: introduction to scholars produced by Indian Education System</li> <li>Splendid geographical isolation of India and the uniqueness of Indian culture</li> </ul>		
2	<p><b>Mathematics in India-</b> Introduction to contribution of Indian Mathematicians</p> <ul style="list-style-type: none"> <li>Aryabhata: Place Value System, Zero, Trigonometry, Algebra, Approximation of Pi</li> <li>Brahmagupta: Zero, Positive and Negative integers, Cyclic Quadrilateral, Approximation of Pi</li> <li>Varahmihira : Magic square</li> <li>Madhava : Algebra, Calculus</li> <li>Srinivas Ramanujan: Ramanujan Number, Circle Method, Mock Theta Function, Theta Function</li> <li>D R Kaprekar : Three digit Kaprekar's constant</li> <li>Shakuntaladevi: Speedy computation and calculations</li> <li>Subhash Khot: Computational Complexity</li> </ul>	8	CO1
3	<p><b>Indian Astronomy</b></p> <ul style="list-style-type: none"> <li>Ancient records of the observation of the motion of celestial bodies in the Vedic corpus</li> <li>Eclipses: Lunar and Solar</li> <li>Astronomical Institutes in India</li> <li>Observatories</li> <li>Astronomical Instruments</li> </ul>	8	CO2
4	<p><b>Indian Economy</b> -Indian conception of flourishing Economy</p> <ul style="list-style-type: none"> <li>Basic Chronology</li> <li>Peculiar features of Indian Economic Idea</li> <li>Indus Valley Civilisation</li> <li>Economic Thoughts in Vedas</li> <li>Buddhist Economics</li> <li>Economics of Mahavir</li> <li>Kautilya</li> <li>Thiruvalluvar</li> </ul>	6	CO3

### Reference Books

- Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010
- D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010\
- Astāngahrdaya, Vol. I, Sūtrasthāna and Śārīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991
- Dharampal, Some Aspects of Earlier Indian Society and Polity and Their Relevance Today, New Quest Publications, Pune, 1987
- Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Dharampal Classics Series, Rashtrottana Sahitya, Bengaluru, 2021. University Grants Commission 15

6. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrottana Sahitya, Bengaluru, 2021
7. J. K. Bajaj and M. D. Srinivas, Indian Economy and Polity in Eighteenth century Chengalpattu, in J. K. Bajaj ed., Indian Economy and Polity, Centre for Policy Studies, Chennai, 1995, pp. 63-84
8. J. K. Bajaj and M. D. Srinivas, Annam Bahu Kurvita Recollecting the Indian Discipline of Growing and Sharing Food in Plenty, Centre for Policy Studies, Chennai, 1996
9. J. K. Bajaj and M. D. Srinivas, Timeless India Resurgent India, Centre for Policy Studies, Chennai, 2001
10. M. D. Srinivas, The methodology of Indian sciences as expounded in the disciplines of Nyāya, Vyākaraṇa, Ganita and Jyotisa, in K. Gopinath and Shailaja D. Sharma (eds.), The Computation Meme: Explorations in Indic Computational Thinking, Indian Institute of Science, Bengaluru, 2022 (in press)

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1. [Certificate Course on "Introduction to Indian Knowledge Systems" - NARMADA COLLEGE OF MANAGEMENT \(ncmbharuch.ac.in\)](http://ncmbharuch.ac.in)
2. [Courses | Bhishma School of Indian Knowledge Systems \(bhishmaiks.org\)](http://bhishmaiks.org)
3. [Indian Knowledge System\(IKS\): Concepts and Applications in Engineering - Course \(swayam2.ac.in\)](http://swayam2.ac.in)

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	–	S	M	M	L	–
CO 2	S	–	S	S	M	L	–
CO 3	S	–	S	S	M	M	–

**S: Strong , M: Medium , L: Low, -- NA**

*Second*

<b>Semester- II</b>			
<b>Course Type: Major Mandatory Paper 1 (Theory)</b>			
<b>Course Code: 24DSC12101 Course Title: - Introduction to Data Science</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>● Knowledge of Computers</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>● Understanding the Role of Data Science in Business.</li> <li>● Understanding the basic concept of Data Collection and Data Pre-Processing Data Collection Strategies.</li> <li>● To understand the basic concept of Exploratory Data Analytics Descriptive Statistics.</li> <li>● To understand the application of business analysis.</li> </ul>			

<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Understand and apply the basics of business analysis and Data Science Knowledge <b>Understand the basic concepts in Data Science</b>	B2, B3	
CO2	Identify data management and handling and Data Science Project Life Cycle. <b>learn different methods of data collection and preprocessing.</b>	B1, B4	
CO3	Recognize and evaluate the data mining concept and its techniques. <b>understand visualization techniques using R</b>	B5, B1	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Data Science</b> <ul style="list-style-type: none"> <li>• What is Data Science?</li> <li>• Historical Overview of data analysis,</li> <li>• Data Scientist vs. Data Engineer</li> <li>• Business Analyst</li> <li>• Why Data Science?</li> <li>• Evolution of Data Science</li> <li>• Data Science Roles</li> <li>• Stages in a Data Science Project</li> <li>• Applications of Data Science in various fields</li> <li>• Security Issues</li> </ul>	6	CO1
<b>2</b>	<b>Data Collection and Data Pre-Processing Data Collection Strategies</b> <ul style="list-style-type: none"> <li>• Data Collection &amp; its methods</li> <li>• Data Management</li> <li>• Big Data Management</li> <li>• Organization/sources of data</li> <li>• Importance of data quality</li> <li>• Dealing with missing or incomplete data</li> <li>• Data Pre- Processing Overview</li> <li>• Data Cleaning</li> <li>• Data Integration and Transformation</li> <li>• Data Reduction –Data Discretization</li> </ul>	8	CO2
<b>3</b>	<b>Data Classification &amp; Data Science Project Life Cycle</b> <ul style="list-style-type: none"> <li>• Business Requirement</li> <li>• Data Acquisition</li> <li>• Data Preparation</li> <li>• Hypothesis and Modelling, Evaluation and</li> <li>• Interpretation, Deployment</li> </ul>	5	CO2
<b>4</b>	<b>Exploratory Data Analytics &amp; Descriptive Statistics</b> <ul style="list-style-type: none"> <li>• Mean</li> <li>• Standard Deviation</li> </ul>	4	CO3

	<ul style="list-style-type: none"> <li>• Skewness, and Kurtosis</li> <li>• Hypothesis Testing( One sample, Two sample and Chi square test) and Linear Regression in R</li> </ul>		
5	Statistics & Visualization using R <ul style="list-style-type: none"> <li>• Mean, median and mode</li> <li>• Minimum and maximum value</li> <li>• Percentiles</li> <li>• Variance and Standard Deviation</li> <li>• Covariance and Correlation</li> <li>• Probability distributions</li> <li>• Types of R – Charts- R Plot,R Line</li> <li>• R Scatter Plot,Bar Plot or Bar Chart,</li> <li>• Pie Diagram or Pie Chart,Histogram</li> <li>• Scatter Plot,Box Plot</li> </ul>	7	CO3

### Reference Books

1. "Fundamentals of Mathematical Statistics" Gupta, S.C., and Kapoor, V.K. Sultan & Chand & Sons, New Delhi, 11th Ed, 2002
2. "The elements of Statistical Learning" Hastie, Trevor, et al Springer, 2009
3. Data Science for Business "Foster Provost and Tom Fawcett

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1. "[https://onlinecourses.swayam2.ac.in/imb24\\_mg31/preview](https://onlinecourses.swayam2.ac.in/imb24_mg31/preview)"
2. "[https://onlinecourses.nptel.ac.in/noc24\\_cs54/preview](https://onlinecourses.nptel.ac.in/noc24_cs54/preview)"
3. [mrcet.com/downloads/digital\\_notes/CSE/II Year/DS/Introduction to Datascience \[R20DS501\].pdf](http://mrcet.com/downloads/digital_notes/CSE/II Year/DS/Introduction to Datascience [R20DS501].pdf)
4. <https://rafalab.dfci.harvard.edu/dsbook/>
5. [Introduction-to-Data-Science-A-Beginners-guide.pdf \(databasetown.com\)](http://Introduction-to-Data-Science-A-Beginners-guide.pdf)

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	M	S	L	--	--	--
CO 2	M	M	S	M	M	L	--
CO 3	L	L	M	L	S	M	--

**S: Strong, M: Medium, L: Low, -- NA**

<b>Semester- I</b>			
<b>Course Type: Major Mandatory Paper 2 (Practical)</b>			
<b>Course Code: 24DSC12102 Course Title: - Practical Based on Data Science</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Practicals:</b> 10	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Problem Solving Skills</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To understand the concepts of Data Science</li> <li>• To apply Data Science Techniques</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Devise various data science techniques.		B6,B3,B1
CO2	Apply various data science techniques		B2,B3,B4,B5
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>
1	Data Collection	2	CO1, CO2
2	Data Preprocessing	4	CO1, CO2
3	Simple Hypothesis Testing	5	CO1, CO2
4	Mean, standard Deviation	5	CO1, CO2
5	Box Plot	4	CO1, CO2
6	Model Evaluation using Visualization	4	CO1, CO2

<b>CO-PO MAPPING</b>							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	--	--	S	M	S	--
CO 2	S	--	L	S	S	M	--
<b>S: Strong , M: Medium , L: Low, -- NA</b>							

Semester- II			
Course Type: Major Paper 3 (Theory)			
Course Code: 24DSC12103 Course Title:- Graph Theory and Calculus			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> <li>• Knowledge of Computers</li> </ul>			
The main objectives of this course are to:			
<ul style="list-style-type: none"> <li>• Understand and explore the basics of graph theory.</li> <li>• To apply graph theory-based tools in solving practical problems</li> <li>• To improve the analyzing skills.</li> <li>• To enhance the creative talent to convert the verbal information into mathematical form</li> </ul>			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
C01	Understand and apply the core theorems and algorithms, generating examples as needed.		B2,B3
C02	Learn conversion of real-life problems into mathematical models which enhance their problem solving and decision-making abilities.		B3,B6
C03	Learn one variable and multivariable differential calculus		B4
C04	Demonstrate algorithms used in interdisciplinary areas.		B3
C05	Evaluate or synthesize any real-world applications using graph theory and derivatives.		B3,B5
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Graphs</b> <ul style="list-style-type: none"> <li>• Definition</li> <li>• Basic terminologies</li> <li>• Types of Graphs</li> <li>• Matrix Representation</li> <li>• Subgraphs</li> <li>• Operations on Graphs</li> <li>• Isomorphism</li> </ul>	8	C01
2	<b>Connected Graphs and Trees</b> <ul style="list-style-type: none"> <li>• Walks, Paths, Circuits</li> <li>• Connected Graphs and disconnected graphs and components.</li> <li>• Isthmus and cut sets</li> <li>• Definition, Properties of tree</li> <li>• Center and radius</li> <li>• binary trees</li> <li>• Spanning Tree</li> </ul>	12	C02, C05, C04

	<ul style="list-style-type: none"> <li>• Kruskal's algorithm for spanning trees in weighted graph.</li> <li>• Tree traversal: Pre order, post order and inorder.</li> </ul>		
3	<b>One Variable Calculus</b> <ul style="list-style-type: none"> <li>• Limit continuity and derivative of one variable function</li> <li>• application to find maxima minima</li> </ul>	5	CO3, CO5

### Reference Books

1. Graph Theory with applications to Engineering and Computer Science Narsingh Deo Prentice Hall
2. A First Look at Graph Theory, John Clark, Derek Allan Holton, Allied publishers LTD
3. Calculus: Gilbert Strang, Wellesley Cambridge Press

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1. [Graph Theory - Course \(nptel.ac.in\)](http://nptel.ac.in)
2. [Graph Theory | Udemey](https://www.udemy.com/)
3. [eskc.ac.in/wp-content/uploads/2018/12/A-Textbook-of-Graph-Theory-R.-Balakrishnan-K.-Ranganathan.pdf](http://eskc.ac.in/wp-content/uploads/2018/12/A-Textbook-of-Graph-Theory-R.-Balakrishnan-K.-Ranganathan.pdf)
4. [Introduction to GRAPH THEORY \(sultanchandandsons.com\)](http://sultanchandandsons.com)

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	L	M	M	M	M	--
CO 2	M	L	S	s	L	S	--
CO3	M	M	L	M	S	M	--
CO4	L	L	L	M	L	S	--
CO5	S	L	L	L	--	S	--

<b>Semester- II</b>			
<b>Course Type: Major Paper 4 (Practical)</b>			
<b>Course Code: DSC12103 Course Title: - Practical Based on Graph Theory</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No of Practicals: 10</b>	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Basic Mathematics</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• Understand and explore the basics of graph theory.</li> <li>• To apply graph theory-based tools in solving practical problems</li> <li>• To improve the analyzing skills.</li> <li>• To enhance the creative talent to convert the verbal information into mathematical form</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Enhance problem solving skills in interdisciplinary fields.		B2,B5
C02	Strengthen theoretical concepts by solving maximum no. of problems.		B1,B2
C03	Learn how to apply mathematical concepts to practical and real-life problems.		B2
C04	Students learn how to apply mathematical concepts to practical and real life problems.		B3
C05	Interdisciplinary approach is developed.		B2,B3
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>
1	Graphs Introduction (ASK RAGINI)	1	C01
2	Types of graphs and isomorphism	1	C02
3	Operations on Graphs	1	C03
4	Connected graphs	1	C04
5	Euler and Hamiltonian Graphs	1	C05

6	Dijkstra's algorithm	1	
7	Trees- Basic properties	1	
8	Spanning tree	1	
9	Tree traversal algorithm	1	
10	Planar graphs and coloring of graphs	1	

<b>Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)</b>
1. <a href="http://athena.nitc.ac.in/summerschool/Files/West.pdf">athena.nitc.ac.in/summerschool/Files/West.pdf</a>

CO-PO MAPPING							
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	M	--	M	--	S	M
CO 2	M	L	--	S	--	M	M
CO3	S	M	--	M	--	L	M
CO4	S	L	--	L	--	L	M
CO5	S	L	--	L	--	M	L

Semester- II			
Course Type: Major Mandatory Paper 5 (Theory)			
Course Code: 24DSC12105 Course Title: - Discrete & Continuous Probability Distributions			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of: <ul style="list-style-type: none"> <li>Sums of finite and infinite series and sequences.</li> <li>Integration and derivative calculations</li> </ul>			
The main objectives of this course are to: <ul style="list-style-type: none"> <li>To get knowledge about the discrete valued variables and the different discrete probability distributions</li> <li>To know about continuous data and different continuous probability distributions</li> </ul>			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Apply these distributions to the real-life data and model the real-life situations.		B3
CO2	Compute probabilities of real-life events based on probability distributions.		B5
CO3	Observe and study the real-life data with respect to probability distributions.		B5
<b>B1</b> - Remember; <b>B2</b> - Understand; <b>B3</b> - Apply; <b>B4</b> - Analyze; <b>B5</b> - Evaluate; <b>B6</b> - Create			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Discrete probability distributions I</b> <ul style="list-style-type: none"> <li>Degenerate distribution, Mean and Variance</li> <li>Discrete Uniform Distribution, Mean and Variance</li> <li>Discrete Bernoulli Distribution, Mean and Variance</li> <li>Discrete Binomial Distribution, Mean and Variance</li> </ul>	7	CO1

	<ul style="list-style-type: none"> <li>Real life examples of Uniform, Bernoulli, Binomial distributions</li> </ul>		
2	<b>Discrete probability distributions-II</b> <ul style="list-style-type: none"> <li>Poisson distribution, Mean and Variance</li> <li>Geometric distribution, Mean and Variance, Memory less Property</li> <li>Negative Binomial distribution, Mean and Variance</li> <li>Hypergeometric distribution, Mean and Variance</li> <li>Real life examples of Poisson, Geometric, Negative Binomial distribution,</li> <li>Hypergeometric distribution</li> </ul>	8	CO2
3	<b>Some Continuous distributions</b> <ul style="list-style-type: none"> <li>Continuous r. v., Definition of probability density function (p.d.f.) of continuous r. v. Cumulative distribution function (c.d.f.) of continuous r.v. and their properties.</li> <li>Uniform Distribution: statement of p.d.f., mean, variance, nature of probability curve. Theorem (without proof): The distribution function of any continuous r.v. follows <math>U(0, 1)</math> distribution</li> <li>Exponential Distribution: statement of p.d.f. of the form <math>f(x) = (1/\theta) e^{-x/\theta}</math>, mean, variance, nature of probability curve, lack of memory property.(with proof)</li> <li>Normal Distribution: statement of p.d.f., identification of parameters, nature of probability density curve, standard normal distribution, symmetry, additive property, linear property, computations of probabilities using normal probability table, normal approximation to binomial and Poisson distribution, central limit theorem (statement only ), Normal probability plot. Numerical problems related to real life situations.</li> <li>Chi Square, <math>t</math>, and F Distribution: pdf, mean, variance, examples</li> </ul>	15	CO 1,CO3

### Reference Books

1. "Mathematical Statistics", Parimal Mukhopadhyay Book and Allied Publication 1996
2. Fundamentals of Mathematical Statistics, Gupta, S. C. and Kapoor, V. K., Eighth Edition, Sultan Chand and Sons Publishers, New Delhi (1983)
3. Probability and Statistics for Engineers and Scientists, Raymond Myers and Ronald E. Walpole, Pearson Education (2007)
4. Statistical Methods, Snedecor G. W. and Cochran W. G., Eighth Ed. East- West Press.(1989)
5. An introduction to Probability and Statistics, V.K.Rohatgi, Wiley Series.
6. Programmed Statistics, Agarwal B. L., Second Edition, New Age International Publishers, New Delhi.(2003)

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	M	M	S	M	S	L	-

CO 2	L	S	M	S	M	M	-
CO 3	M	L	L	S	M	L	-
<b>S: Strong , M: Medium , L: Low, -- NA</b>							

<b>Semester- II</b>			
<b>Course Type: Major Mandatory Paper 6 (Practical)</b>			
<b>Course Code: 24DSC12106 Course Title: - Practical Based on DCPD</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No of Practicals: 10</b>	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Basic Statistics</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• Understand and explore the basics of discrete and continuous probability distributions.</li> <li>• To improve the analyzing skills.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Enhance problem solving skills in interdisciplinary fields.		B2,B5
C02	Strengthen theoretical concepts by solving maximum no. of problems.		B1,B2
C03	Learn how to apply Statistical concepts to practical and real-life problems.		B2
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>
1	Basic probability calculations	1	C01

2	Practical based on Bayes' theorem	1	CO2 CO3
3	Application of Binomial probabilities and fitting of Binomial distribution	1	
4	Application of Poisson probabilities and fitting of Poisson distribution	1	
5	Application of Geometric probabilities and fitting of Geometric distribution	1	
6	Application of negative binomial probabilities and fitting of negative binomial distribution	1	
7	Understanding the above four distribution using probability graphs	1	
8	Finding probabilities of uniform distribution and fitting of uniform distribution	1	
9	Finding probabilities of exponential distribution and fitting of exponential distribution	1	
10	Simulation	1	

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1. [Continuous Probability Distributions - A Beginner's Guide with Examples \(intellipaat.com\)](http://intellipaat.com)

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	M	--	M	--	S	M
CO 2	M	L	--	S	--	M	M
CO3	S	M	--	M	--	L	M
CO4	S	L	--	L	--	L	M
CO5	S	L	--	L	--	M	L

### Semester- II

#### Course Type: AEC(Theory)

**Course Code: 24ENG12506 Course Title: - Mastering English for Professional Purposes**

<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
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**Prerequisites: Student should have basic knowledge of:**

- Basic English Language
- Basics of Communication and Soft Skills

**The main objectives of this course are to:**

- Develop proficiency in communication skills such as introducing oneself, asking for information, and making requests.
- Foster interactive communication abilities through activities focusing on agreeing, disagreeing, and partly agreeing in various contexts.
- Cultivate competence in professional communication for settings like job interviews, telephonic conversations, and virtual meetings.

**Expected Course Outcomes:**

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

CO1	learnt to identify and distinguish correct English sounds.	B1,B3
CO2	Developed fluency and clarity of speech	B3,B2,

CO3	Learnt to speak English in different situations.	B3	
CO4	Understood the use of Phonetics to improve their pronunciation.	B4.B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Speaking Skills</b> <ul style="list-style-type: none"> <li>● Introducing Yourself and Others</li> <li>● Asking for directions and information</li> <li>● Seeking permission, Giving and Declining Permission</li> <li>● Requesting and Demanding</li> <li>● Offering Suggestions</li> <li>● Agreeing, Partly Agreeing and Disagreeing</li> </ul>	15	CO1,CO2,CO3
2	<b>Professional English</b> <ul style="list-style-type: none"> <li>● Use of English in Professional Context</li> <li>● Negotiating Skills</li> <li>● Interview Skills</li> <li>● Telephonic Conversation in English</li> <li>● English for Virtual Meeting</li> <li>● English for Marketing</li> </ul>	15	CO4

### Reference Books (ASK JITENDRA SIR)

1. Aspirations: English for Career. Board of Editors. Orient BlackSwan
2. Essentials of Corporate Communications, Cees B. M. Van Riel and Charles J. Fombrun, Routledge Taylor & Francis Group, London.
3. Corporate Communication: A Guide to Theory and Practice, Joep P. Cornelissen, Sage Publication, Los Angeles.
4. The Handbook of Corporate Communication and Public Relations, Sandra Oliver
5. Effective Corporate Communication, Hargie, Tourish, and Wilson

### Reference Books

1. <https://nptel.ac.in/courses/1091040301>
2. [Effective Business Communication - Course \(swayam2.ac.in\)](https://www.swayam2.ac.in/)
3. [asue.am/upload/files/asue/Essentials-of-Corporate-Communication-PDFDrive.com-.pdf?fbclid=IwAR0k6kDqnBdf6u67EVeE-zAXIjCOIc0AFDOFWw9U7eWtHpKHQLxEUUCejE](https://asue.am/upload/files/asue/Essentials-of-Corporate-Communication-PDFDrive.com-.pdf?fbclid=IwAR0k6kDqnBdf6u67EVeE-zAXIjCOIc0AFDOFWw9U7eWtHpKHQLxEUUCejE)
4. [Handbook of Corporate Communication and Public Relations: Pure and Applied \(armpr.org\)](https://www.armpr.org/)

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	L	--	S	S	--	L	S
CO 2	M	--	S	M	--	--	S
CO 3	L	--	S	S	--	--	S
<b>S: Strong , M: Medium , L: Low, -- NA</b>							

<b>Semester- II</b>			
<b>Course Code: 24VEC12507 Course Title: - Democracy &amp; Constitutional Values</b>			
<b>Course Type: VEC(Theory)</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Constitutional Values</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To introduce the students meaning of democracy, Elections and decentralization (Governance)</li> <li>• To help them understand various approaches to the study of democracy and constitutional values.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			

C01	<ul style="list-style-type: none"> <li>Understand the comprehensive concept of Democracy and its facets.</li> </ul>	B1,B2	
C02	<ul style="list-style-type: none"> <li>Understand the importance of voting and participation in the political process.</li> </ul>	B2,B3	
C03	<ul style="list-style-type: none"> <li>Analyze socio-economic reality around them</li> </ul>	B4,B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Democracy: Foundation and Dimensions</b> <ul style="list-style-type: none"> <li>Constitution of India : Preamble, Rights, Duties Dimensions of Democracy- Social, Economic, and Political Module</li> </ul>	10	C01
2	<b>Elections</b> <ul style="list-style-type: none"> <li>Elections in India, Election Commission National Voters' Day</li> </ul>	10	C02
3	<b>Decentralized Governance</b> <ul style="list-style-type: none"> <li>Democratic Decentralization</li> <li>73rd and 74th amendments</li> </ul>	10	C03

### Reference Books

- Banerjee-Dube, I. (2014). A history of modern India. Cambridge University Press.
- Base, D. D. (1982). Introduction to the Constitution of India. Delhi: Prentice Hall of India.
- Bhargava, R. (2008). Political theory: An introduction. Chennai: Pearson Education India

### CO-PO MAPPING

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	--	--	L	--	--	S	S
CO 2	--	--	M	--	--	M	S
CO 3	--	--	S	--	--	S	S

**S: Strong , M: Medium , L: Low, -- NA**

**Course Title: - General IKS**

**Course Type: IKS (Theory)**

**Course Code: IKS12501**

**Semester- I**

<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 1</b>	<b>No. of Lectures:</b> 15	<b>Examination Scheme:</b> CIE: 10 Marks ESE: 15 Marks
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**Prerequisites: Student should have basic knowledge of:**

- Languages Proficiency English, Hindi & Marathi

**The main objectives of this course are to:**

- To familiarize students with the Heritage of ancient and eternal Indian Knowledge System.

**Expected Course Outcomes:**

<b>On the successful completion of the course, student will be able to:</b>			
CO1	Explain the ideas behind astronomical phenomenon, books, and institutes of astronomy	B1	
CO2	Describe different traditions of Indian Economic thoughts and organization	B3	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Indian Astronomy</b> <ul style="list-style-type: none"> <li>● Ancient records of the observation of the motion of celestial bodies in the Vedic corpus</li> <li>● Eclipses: Lunar and Solar</li> <li>● Astronomical Institutes in India</li> <li>● Observatories</li> <li>● Astronomical Instruments</li> </ul>	8	CO1
<b>2</b>	<b>Indian Economy</b> -Indian conception of flourishing Economy <ul style="list-style-type: none"> <li>● Basic Chronology</li> <li>● Peculiar features of Indian Economic Idea</li> <li>● Indus Valley Civilisation</li> <li>● Economic Thoughts in Vedas</li> <li>● Buddhist Economics</li> <li>● Economics of Mahavir</li> <li>● Kautilya</li> <li>● Thiruvalluvar</li> </ul>	8	CO2

<b>Reference Books</b>	
11.	Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010
12.	D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010\
13.	Astāngahrdaya, Vol. I, Sūtrasthāna and Śarīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991
14.	Dharampal, Some Aspects of Earlier Indian Society and Polity and Their Relevance Today, New Quest Publications, Pune, 1987
15.	Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Dharampal Classics Series, Rashtrottana Sahitya, Bengaluru, 2021. University Grants Commission 15
16.	Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrottana Sahitya, Bengaluru, 2021
17.	J. K. Bajaj and M. D. Srinivas, Indian Economy and Polity in Eighteenth century Chengalpattu, in J. K. Bajaj ed., Indian Economy and Polity, Centre for Policy Studies, Chennai, 1995, pp. 63-84
18.	J. K. Bajaj and M. D. Srinivas, Annam Bahu Kurvita Recollecting the Indian Discipline of Growing and Sharing Food in Plenty, Centre for Policy Studies, Chennai, 1996
19.	J. K. Bajaj and M. D. Srinivas, Timeless India Resurgent India, Centre for Policy Studies, Chennai, 2001
20.	M. D. Srinivas, The methodology of Indian sciences as expounded in the disciplines of Nyāya, Vyākaraṇa, Ganita and Jyotisa, in K. Gopinath and Shailaja D. Sharma (eds.), The Computation Meme: Explorations in Indic Computational Thinking, Indian Institute of Science, Bengaluru, 2022 (in press)

**Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)**

1. [Certificate Course on "Introduction to Indian Knowledge Systems" - NARMADA COLLEGE OF MANAGEMENT \(ncmbharuch.ac.in\)](http://ncmbharuch.ac.in)
2. [Courses | Bhishma School of Indian Knowledge Systems \(bhishmaiks.org\)](http://bhishmaiks.org)
3. [Indian Knowledge System\(IKS\): Concepts and Applications in Engineering - Course \(swayam2.ac.in\)](http://swayam2.ac.in)

**CO-PO MAPPING**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7
CO 1	S	-	S	M	M	L	-
CO 2	S	-	S	S	M	L	-
CO 3	S	-	S	S	M	M	-

**S: Strong , M: Medium , L: Low, -- NA**

**Semester- II****Course Type: SEC(Practical)****Course Code: 24DSC12401 Course Title: - R Programming**

<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 15</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
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**Prerequisites:** Student should have basic knowledge of:

- Problem solving Skills

**The main objectives of this course are to:**

- To cover data reading and its manipulation using R, which is widely used for data analysis
- To cover different control structures and design of user-defined functions. Loading, installing and building packages are covered.

**Expected Course Outcomes:**

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

<b>CO1</b>	Develop an R script and execute it	B1,B2
<b>CO2</b>	Install, load and deploy the required packages, and build new packages for sharing and reusability	B3,B4
<b>CO3</b>	Visualize and summarize the data and use simple statistical summaries	B5, B6

**B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create**

<b>UNIT</b>	<b>Contents</b>	<b>No of Practicals</b>	<b>CO targeted</b>
1	<b>Introduction</b> <ul style="list-style-type: none"> <li>• R interpreter, Introduction to major R data structures like vectors, matrices,</li> <li>• Arrays, list and data frames, Control Structures, vectorized if and multiple selection, functions.</li> </ul>	2	CO1
2	<b>Installing, loading and using packages</b> <ul style="list-style-type: none"> <li>• Read/write data from/in files, extracting data from web-sites, Clean data, Transform data by sorting, adding/removing new/existing columns,centring, scaling and normalizing the data values, converting types of values, using string in-built functions, Statisticalanalysis of data for summarizing and understanding data</li> </ul>	2	CO2
3	<b>Data manipulation with R</b> <ul style="list-style-type: none"> <li>• List Management</li> <li>• Data Transformation</li> <li>• Merging Data Frames</li> <li>• Outlier Detection</li> <li>• Combining multiple vectors</li> </ul>	3	CO1,CO2
4	<b>Data Visualization</b> Visualizing data using scatter plot, line plot, bar chart, histogram and box plot, time series plot	3	CO3
5	<b>Common Statistical summaries</b> <ul style="list-style-type: none"> <li>• Single sample summaries</li> <li>• The t-test</li> <li>• Linear regression</li> </ul>	5	CO3

### Reference Books

1. [The Book of R \(itu.edu.tr\)](http://itu.edu.tr)
2. [2 Introduction | R for Data Science \(had.co.nz\)](http://had.co.nz)
3. [Hands-On Programming with R \(rstudio-education.github.io\)](http://rstudio-education.github.io)

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1. [Entering Data: Entering Data | Saylor Academy](https://www.saylor.org/books/saylor-org/books/entering-data/)

## List of Practicals

1. Practical on Entering Data  
How to Manually Enter Raw Data in R?  
Enter data as a vector  
Enter data as a data frame  
Enter data as a matrix
2. Programmes on Loading packages
3. Programmes on Data types, strings, factors, vectors, arrays, matrices
4. Programs on lists, frames
5. Programmes on Data Visualization-Different charts, plots, graphs, histograms, scatter plots
6. Programmes on t-test and linear regression

Assessment Methods:

- ESE: Practical examination including slip solving, Oral
- CIE: Regular practical attendance, Practical programmes solving

<b>Semester- III</b>			
<b>Course Type: Major Mandatory Paper 1(Theory)</b>			
<b>Course Code: 24DSC23101 Course Title: - Introduction to Python Programming</b>			
<b>Teaching Scheme:</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>

<b>2 Hours / Week</b>			
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Familiarity with simple programming ideas like variables and loops</li> <li>• Basic understanding of math concepts like arithmetic and sets.</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• Build a strong foundation in Python programming and its basic concepts.</li> <li>• Gain the ability to manipulate data using Python's lists, dictionaries, sets, and tuples.</li> <li>• Explore real-world applications, including regular expressions and functional programming tools.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Learn and understand Python basics, data types, and control structures.	B1,B2	
CO2	understand and apply Master lists, tuples, dictionaries, sets, and string manipulation.	B3,B4	
CO3	Develop functions, handle files, and work with modules.	B5, B6	
CO4	Implement exception handling, recursion, and regular expressions.	B3,B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>An Introduction to Python.</b> <ul style="list-style-type: none"> <li>• The Python Programming Language, History, features, Applications, Installing Python, Running Simple Python program</li> <li>• Standard data types - basic, none, Boolean (true &amp; False), numbers, Variables, Constants, Python identifiers and reserved words, Lines and indentation, multi-line statements and Comments, Input/output with print and input ,functions Declaration, Operations on Data such as assignment, arithmetic, relational, logical and bitwise operations, dry run, Simple Input and output etc.</li> </ul>	4	CO1
<b>2</b>	<b>Control Statement.</b> <ul style="list-style-type: none"> <li>• <b>Sequence Control</b> – Precedence of operators, Type conversion. <b>Conditional Statements:</b> if, if-else, nested if-else,</li> <li>• <b>Looping-</b> for, while, nested loops, loop control statements (break, continue, pass)</li> </ul>	3	CO1

	<ul style="list-style-type: none"> <li>• <b>Strings:</b> declaration, manipulation, special operations, escape <ul style="list-style-type: none"> <li>○ character, string formatting operator, Raw String, Unicode strings, Built-in String methods.</li> </ul> </li> </ul>		
3	<p><b>List, tuples and dictionaries, Sets.</b></p> <ul style="list-style-type: none"> <li>• <b>Python Lists:</b> Concept, creating and accessing elements, updating &amp; deleting lists, traversing a List, reverse Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods.</li> <li>• <b>Tuples:</b> Tuples, Accessing values in Tuples, Tuple Assignment, Tuples as return values, Variable-length argument tuples, and Basic tuples operations, Concatenation, Repetition, in Operator, Iteration, Built-in tuple functions, indexing, slicing and matrices.</li> <li>• <b>Dictionaries:</b> Creating a Dictionary, Accessing Values in a dictionary, Updating Dictionary, Deleting Elements from Dictionary, Properties of Dictionary keys, Operations in Dictionary, Built-In Dictionary Functions, Built-in Dictionary Methods.</li> <li>• <b>Sets:</b> Definition, transaction of set(Adding, Union, intersection), working with sets.</li> </ul>	6	CO2
4	<p><b>Functions</b></p> <ul style="list-style-type: none"> <li>• <b>Functions:</b> Definitions and Uses, Function Calls, Type Conversion Functions, Math Functions, Adding New Functions, Flow of Execution, Parameters and Arguments, Variables and Parameters, Stack Diagrams, Void Functions, Anonymous functions Importing with from, Return Values, Boolean Functions, More Recursion, Functional programming tools - filter(), map(), and reduce(), recursion, lambda forms.</li> </ul>	7	CO3

5	<p><b>Modules, working with Files, Exception Handling.</b></p> <ul style="list-style-type: none"> <li>• <b>Modules:</b> Importing module, Creating &amp; exploring modules, Math module, Random module, Time module.</li> <li>• <b>Packages:</b> Importing package, creating package, examples.</li> <li>• <b>Working with files:</b> Creating files and Operations on files (open, close, read, write), File object attributes, file positions, Listing Files in a Directory, Testing File Types, Removing files and directories, copying and renaming files, splitting pathnames, creating and moving directories.</li> <li>• <b>Regular Expression-</b> Concept of regular expression, various types of regular expressions, using match function.</li> <li>• <b>Exception Handling:</b> Built-in Exceptions, Handling Exceptions, Exception with Arguments, User-defined Exceptions.</li> </ul>	10	CO4
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#### Text Books

- Python Programming, Nirali Publication - ISBN: 978-93-54511-95-0
- Python Programming, Vision Publication- ISBN: 978-93-90646-58-6

#### Reference Books

1. An Introduction to Computer Science using Python 3 by Jason Montojo, Jennifer Campbell, Paul Gries, The pragmatic bookshelf-2013.
2. James Payne, "Beginning Python: Using Python and Python 3.1,Wrox Publication.
3. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication Learning with Python ", Green Tea Press, 2002
4. Introduction to Problem Solving with Python by E-balguruswamy, TMH publication 2016
5. Beginning Programming with Python for Dummies Paperback – 2015 by John Paul Mueller
6. Object-oriented Programming in Python, Michael H. Goldwasser, David Letscher, Pearson Prentice Hall-2008.

#### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

##### Online Courses

- Python Programming for Beginners to Intermediate: [www.udemy.com/course/python-programming-for-beginners-to-intermediate/](http://www.udemy.com/course/python-programming-for-beginners-to-intermediate/)

- Complete Python 3 Programming Bootcamp:  
<https://www.udemy.com/course/complete-python-programming-course-beginner-to-advanced/?couponCode=BFCPSALE24>

<b>Semester- III</b> <b>Course Type: (Theory)</b> <b>Course Code: 24DSC23102 Course Title: - Testing of Hypothesis</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Inferential statistics <ul style="list-style-type: none"> <li>● Probability and sampling distributions</li> <li>● Sampling Methods</li> </ul> </li> </ul>			
<b>The main objectives of this course are to:</b> To study how hypothesis ensures the entire research process remains scientific and reliable			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Differentiate between type I and type II error with respect to their measures		B2,B5
CO2	Understand tests for means, proportions based on normal distribution,		B2
CO3	Apply tests for means,proportions based on t distribution,		B4,B5
CO4	Handle situations where non- parametric tests are applicable		B1,B6
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to the testing</b> <ul style="list-style-type: none"> <li>● Statistic and Parameter.</li> <li>● Sampling distribution, standard error of a statistic with illustrations. Statistical Inference:</li> <li>● Examples of statistics, parameters and sampling distribution.</li> <li>● Introduction to the problem of Estimation and testing of hypotheses.</li> <li>● Estimator and estimate. Unbiased estimator (definition and simple illustrations only) (proof on the basis of population of 4 observations and using sampling method SRSWOR ,SRSWR )</li> <li>● Point and interval estimation.</li> </ul>	<b>6</b>	CO1

2	<p><b>Tests of Significance:</b></p> <ul style="list-style-type: none"> <li>• Statistical hypothesis, null and alternative hypothesis, simple and composite hypothesis, one sided and two sided alternative hypothesis, critical region and acceptance region type I error ,type II error, level of significance.</li> <li>• Tests of hypotheses using <ul style="list-style-type: none"> <li>○ Critical region approach</li> <li>○ Confidence interval approach.</li> </ul> </li> <li>• Tests for population means (large sample / approximate tests): <ul style="list-style-type: none"> <li>○ single population(two sided, variance known)</li> <li>○ two populations( two sided, variance known)</li> <li>○ Construction of two sided confidence interval for <math>\mu</math> and <math>\mu_1 - \mu_2</math></li> </ul> </li> <li>• Tests for population means (small sample / exact test): <ul style="list-style-type: none"> <li>○ t test for single population mean( two sided, variance known)</li> <li>○ t test for two populations( two sided, variance unknown)</li> <li>○ Paired t test</li> </ul> </li> </ul> <p>Chi square test</p> <ul style="list-style-type: none"> <li>○ Single population variance</li> <li>○ Independence of attributes</li> <li>○ Goodness of fit</li> </ul> <ul style="list-style-type: none"> <li>• F test for Tests for population variance (small sample / approximate tests): <ul style="list-style-type: none"> <li>○ Two population variances</li> <li>○ One way ANOVA</li> </ul> </li> <li>• Tests for population proportions: <ul style="list-style-type: none"> <li>○ Single population( two sided, one sided test)</li> <li>○ Two population( two sided, one sided test)</li> <li>○ Construction of two sided confidence interval for <math>P</math> and <math>P_1 - P_2</math></li> </ul> </li> </ul>	18	C02, C03
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<b>3</b>	<p><b>Non-parametric Tests</b></p> <ul style="list-style-type: none"> <li>● Concept of non-parametric tests. Distinguish between parametric and nonparametric Tests.</li> <li>● Concept of distribution free statistics.</li> <li>● One tailed and test procedure of <ul style="list-style-type: none"> <li>○ Sign test</li> <li>○ Wilcoxon signed rank test for single population</li> <li>○ Run test, one sample and two samples problems</li> </ul> </li> </ul>	<b>6</b>	C04
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<b>Books</b>
<ul style="list-style-type: none"> <li>● Statistical Theory, B.W. Lindgren (1993), 4th Edition, CRC Press London</li> <li>● Applied Nonparametric Statistics, Daniel, W.W. (2000), Duxbury Press Boston</li> <li>● Modern Mathematical Statistics, Dudewecz, E.J. and Mishra, S.N. (1988), John Wiley and Sons, Inc.</li> <li>● Non parametric Statistical Inference, Gibbons J.D. and Chakraborti, S. (2010), CRC Press, London</li> <li>● Introduction to Statistical Theory, Hoel, P.G. Port, S. and Stone, C. (1972), Houghton Mifflin Company (International) Dolphin Edition</li> <li>● Introduction to Mathematical Statistics, Hogg, R.V. McKean, J. and Craig A.T. (2012), 7th Edition, Pearson</li> <li>● An Introduction to Probability Theory and Statistics, Kendall, M. and Stuart, A. (1943), Wiley, New York</li> <li>● An Introduction of Probability Theory and Its Applications, Feller W. (1968), Vol. I, 3<sup>rd</sup> Edn. Wiley,</li> </ul>

<b>Semester- III</b> <b>Course Type: Major Mandatory Paper 3(Practical)</b> <b>Course Code: 24DSC23103 Course Title: -Practical Python &amp; Testing of Hypothesis</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 10</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>• Knowledge of different types of distributions</li> <li>• Concepts required for testing</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• Introduce the students the important techniques of testing of the general statement regarding the population</li> <li>• To understand the fundamental concepts of databases.</li> <li>• To understand user requirements and frame it in a data model.</li> <li>• To understand creations, manipulation and querying of data in databases.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Apply various tests in an appropriate situations	B1,B2	
C02	Handle situations where non- parametric tests are applicable	B3,B4	
C03	Learn to write simple Python programs and use Python IDEs.	B5,B1	
C04	Work with strings, functions, and perform operations on lists, tuples, sets, and dictionaries.	B6,B2,B4	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Practicals	CO targeted
1	Computation of type I and type II error	1	C01
2	Large sample test (one and two samples)	1	C01
3	Test based on t distribution (mean test ,Paired t test)	1	C01
4	Chi square test for single population variance, independence of attributes and goodness of fit test.	1	C01
5	Test based on F distribution	1	C01
6	ANOVA test	1	C01
7	Non parametric test	2	C02
8	Python basics and IDE, Simple Python Program	2	C03,C04
9	Strings and Functions.	2	C04
10	List, Tuple, Sets and Dictionary.	2	C03
11	File Handling and Date-Time.	2	C03,C04
12	Exception Handling and Regular Expression.	2	C03,C04

<b>Semester- III</b>			
<b>Course Type: Major Mandatory Paper 4(Theory) ( Major Specific IKS)</b>			
<b>Course Code: 24DSC23104 Course Title: -Timeline of Computing</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• General computing systems and Modern technology</li> <li>• Arithmetic skills and number systems</li> <li>• Key inventions and scientific inventors</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• Understand the evolution of computing from early tools to modern technologies.</li> <li>• Analyze the contributions of key inventors, devices, and innovations in computing history.</li> <li>• Recognize the impact of technological milestones on society and industries.</li> <li>• Connect historical advancements to modern computing trends and future developments.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	To understand the history of computing and the era of computing.	B1,B2	
C02	To learn the foundations of modern computing.	B3,B4	
C03	To understand computing in the 21st century.	B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Pre-Computing Era</b> <ul style="list-style-type: none"> <li>• Introduction to Computing Concepts</li> <li>• Definition of computing</li> <li>• Early calculation tools: Abacus, Slide Rule</li> <li>• Historical Milestones in Pre-Computing</li> <li>• Mechanical calculators: Pascaline, Leibniz Wheel</li> <li>• Charles Babbage’s Difference and Analytical Engines</li> <li>• Contributions of Ada Lovelace</li> </ul>	4	C01
<b>2</b>	<b>Foundations of Modern Computing</b> <ul style="list-style-type: none"> <li>• Evolution of Programming :</li> </ul>	8	C02

	<ul style="list-style-type: none"> <li>• Early programming languages (Fortran, COBOL, Lisp)</li> <li>• Machine language and assembly</li> <li>• Turing’s concept of a universal machine</li> <li>• Birth of Electronic Computing</li> <li>• First generation of computers: ENIAC, UNIVAC</li> <li>• Vacuum tube technology</li> <li>• Alan Turing’s contributions to cryptography</li> <li>• Transition to Transistors and Integrated Circuits:</li> <li>• Second and third-generation computers</li> <li>• Rise of IBM and mainframes</li> <li>• Impact of Moore's Law</li> </ul>		
3	<p><b>Personal Computing Revolution</b></p> <ul style="list-style-type: none"> <li>• Development of Microprocessors:</li> <li>• Intel 4004 and subsequent chips</li> <li>• Evolution of processors in personal computers</li> <li>• Birth of the PC Era:</li> <li>• Role of companies like Apple, IBM, and Microsoft</li> <li>• Rise of graphical user interfaces (GUIs)</li> <li>• Early operating systems (DOS, Windows, MacOS)</li> <li>• Networking and the Internet:</li> <li>• ARPANET and the rise of networking</li> <li>• Birth of the World Wide Web (Tim Berners-Lee)</li> <li>• Impact of email and early web browsers</li> </ul>	8	C03
4	<p><b>Computing in the 21st Century</b></p> <ul style="list-style-type: none"> <li>• Mobile Computing and Devices:</li> <li>• Evolution of mobile phones to smartphones</li> <li>• Impact of operating systems like iOS and Android</li> </ul>	10	C03

	<ul style="list-style-type: none"> <li>• Cloud Computing and Big Data:</li> <li>• Introduction to cloud platforms (AWS, Azure)</li> <li>• Role of big data in computing</li> <li>• AI, Machine Learning, and Quantum Computing:</li> <li>• Basics of artificial intelligence and machine learning</li> <li>• Introduction to quantum computing and its potential</li> <li>• Blockchain and Decentralized Systems:</li> <li>• Basics of blockchain technology</li> <li>• Applications in finance, healthcare, and beyond</li> </ul>		
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#### Reference Books

- Computer: A History of the Information Machine by Martin Campbell-Kelly and William Aspray
- <https://books.google.co.in/books?id=0MZVDgAAQBAJ&lpg=PA1&pg=PT27#v=onepage&q&f=false>

#### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

- <https://fortran-lang.org/>
- <https://unacademy.com/content/bank-exam/study-material/computer-knowledge/notes-on-lisp/>
- <https://www.ibm.com/topics/cobol>
- <https://ieeexplore.ieee.org/abstract/document/6369705>

**Course Title: -Course in Linear Algebra**  
**Course Type: Minor (Theory)**  
**Course Code: 24DSC23201**  
**Semester- III**

<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits:</b> 2	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
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**Prerequisites: Student should have basic knowledge of:**

- Basic Mathematics Skills

**The main objectives of this course are to:**

- To understand the basic arithmetic operations on vectors and matrices, including determinants, using technology where appropriate.
- To solve systems of linear equations, using technology to facilitate row reduction.
- To understand the basic terminology of linear algebra in Euclidean spaces, including linear independence, spanning, basis, rank, nullity, subspace, and linear transformation.
- To understand, find the eigenvalues and eigenvectors of a matrix or a linear transformation, and using them to diagonalize a matrix.

**Expected Course Outcomes:**

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

C01	Solve systems of linear equations using methods by Gaussian elimination.	B1,B2
C02	Demonstrate understanding of the concepts of vector space, linear independence and basis	B3,B4
C03	Determine eigenvalues and eigenvectors and solve eigenvalue problems.	B5, B6

**B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create**

UNIT	Contents	No of Lectures	CO targeted
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1	<b>System of Linear Equations and Matrices</b> <ul style="list-style-type: none"> <li>• Matrices and Matrix operations</li> <li>• Introduction to system of linear equations</li> <li>• Gaussian Elimination method</li> <li>• Determinants by cofactor expansion method</li> <li>• Determinant by row reduction method</li> </ul>	09	C01
2	<b>General Vector space</b> <ul style="list-style-type: none"> <li>• Real vector spaces</li> <li>• Subspaces</li> <li>• Linear Independence</li> <li>• Basis and Dimension</li> <li>• Row space, column space, null space, rank and nullity</li> </ul>	11	C01, C02
3	<b>Eigen values and Eigen vectors</b> <ul style="list-style-type: none"> <li>• Eigen values and Eigen vectors</li> <li>• Diagonalization</li> </ul>	5	C03
4	<b>Linear Transformation</b> <ul style="list-style-type: none"> <li>• Linear Transformation : Definition and examples</li> <li>• Kernel and range</li> <li>• Matrix of a Linear Transformation</li> </ul>	5	

#### Text Books

Elementary Linear Algebra by Howard Anton, Chris Rorres.(Seventh Edition) John Wiley & Sons, Inc.

#### Reference Books

K. Hoffman and R. Kunze, Linear Algebra, 2nd edition(2014), Prentice Hall of India, New Delhi

#### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

- <https://textbooks.math.gatech.edu/ila/>
- [032199888X.pdf](#)
- <https://ia801400.us.archive.org/9/items/linear-algebra-by-strang-4-th-edition/linear%20algebra%20by%20strang%204%20th%20edition.pdf>
- <https://math.mit.edu/~gs/linearalgebra/ila6/ILA6website01.pdf>

#### Online Courses:

- [https://onlinecourses.nptel.ac.in/noc24\\_ma69/preview](https://onlinecourses.nptel.ac.in/noc24_ma69/preview)
- [Top Linear Algebra Courses Online - Updated \[November 2024\]](#)

<b>Semester- III</b>			
<b>Course Type: Minor (Practical)</b>			
<b>Course Code: 24DSC23202 Course Title: - Course in Linear Algebra Practical</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 10</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• <b>Basic Mathematical Skills</b></li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To understand the basic arithmetic operations on vectors and matrices, including determinants, using technology where appropriate.</li> <li>• To solve systems of linear equations, using software to facilitate row reduction.</li> </ul>			

- To understand the basic terminology of linear algebra in Euclidean spaces, including linear independence, spanning, basis.
- To abstract notions of vector space and inner product space.
- To understand, find the eigenvalues and eigenvectors of a matrix and using them to diagonalize a matrix.

**Expected Course Outcomes:**

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

C01	Solve systems of linear equations using Python Software.	B1,B2
C02	Demonstrate understanding of the concepts of vector space.	B3,B4
C03	Determine eigen values and eigenvectors and solve eigenvalue problems.	B5, B6

**B1** - Remember; **B2** - Understand; **B3** - Apply; **B4** - Analyze; **B5** - Evaluate; **B6** - Create

UNIT	Contents	No of sessions	CO targeted
1	Problem Solving on System of Linear Equation (Written+software)	4	C01
2	Problem Solving on Vector Spaces (Written+software)	4	C02
3	Problem Solving on Eigenvalues and Eigenvectors (Written+software)	4	C03
4	Problem Solving on Linear Transformation(written)	3	C03

**Text Books**

Howard Anton, Chris Rorres, Elementary Linear Algebra, Application Version, Ninth Edition, Wiley, 11th edition.

**Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)**

**Online Courses:**

- <https://home.csulb.edu/~woollett/mbe4solve.pdf>
- <https://home.csulb.edu/~woollett/mbe5matrix.pdf>
- <https://maxima.st/maxima tutorial.pdf>
- [linear algebra practical using maxima software pdf - Search](#)

<b>Semester- III</b> <b>Course Type: VSEC (Theory)</b> <b>Course Code: 24DSC23401 Course Title: - Multivariate Analysis</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>• Matrix Algebra</li> <li>• Discrete and continuous probability distributions</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• tabulate the large scale data</li> <li>• find the type of relationships between several variables simultaneously.</li> </ul>			
<b>Expected Course Outcomes:</b>			

<b>On the successful completion of the course, student will be able to:</b>			
CO1	understand and arrange the multi-dimensional data.	B2	
CO2	apply various exploratory data analysis tools to analyze the multivariate data	B3	
CO3	find insights from the analyzed data	B4	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
1	<p><b>Discrete Bivariate Probability Distributions</b></p> <ul style="list-style-type: none"> <li>• Joint and marginal Probability mass function (p.m.f.) of (X,Y), conditional p.m.f. of <math>X Y=y</math> and <math>Y X=x</math>.</li> <li>• Computation of mean and variance, Computation of conditional mean and conditional variance.</li> <li>• Simple numerical problems and real life examples</li> </ul>	4	CO1 & CO3
2	<p><b>Continuous Bivariate Probability Distributions</b></p> <ul style="list-style-type: none"> <li>• Joint and marginal p.d.f. of (X,Y), conditional p.d.f. of <math>X Y=y</math> and <math>Y X=x</math>.</li> <li>• Computation of mean and variance, Computation of conditional mean and conditional variance.</li> <li>• Simple numerical problems and real life examples</li> </ul>	4	CO1 & CO3
3	<p><b>Multinomial distribution</b></p> <ul style="list-style-type: none"> <li>• Description of multinomial random variable and its joint p. m. f., means and variance-covariance matrix</li> <li>• univariate marginal distribution, distribution of <math>X_i + X_j</math>, conditional distribution of <math>X_i</math> given <math>X_i + X_j = r</math></li> <li>• Simple numerical problems and real life examples</li> </ul>	4	CO1 & CO3
4	<p><b>Bivariate Normal Distribution</b></p> <ul style="list-style-type: none"> <li>• Probability density function of bivariate normal random variable (X,Y), identification of parameters, marginal and conditional distributions</li> <li>• Regression of Y on X and of X on Y, independence and uncorrelatedness</li> </ul>	5	CO1 & CO3

	<ul style="list-style-type: none"> <li>• Simple numerical problems and real life examples</li> </ul>		
5	<b>Multivariate Normal distribution</b> <ul style="list-style-type: none"> <li>• Exploratory multivariate Data Analysis using Sample mean vector, Dispersion Matrix, Correlation Matrix.</li> <li>• Linear transformation and its mean and variance</li> <li>• Simple numerical problems and real life examples</li> </ul>	5	C01 & C03
6	<b>Principal Component Analysis (PCA)</b> <ul style="list-style-type: none"> <li>• Principal component Analysis (by using covariance and correlation method, standardized method)</li> </ul>	4	C02
7	<b>Multivariate ANOVA (MANOVA)</b>	4	C02

### Reference Book

- Introduction to Multivariate Analysis, Anderson, T. W. (1984) John Wiley
- Symmetric Multivariate and Related Distributions, Fang, K., Kotz, S., Ng K. W. (1990), Chapman and Hall
- Applied Multivariate Statistical Analysis, Härdle, W. K. & Simar, L. (2012), Springer, New York
- Multivariate Statistics: Exercises and Solutions, Härdle, W. K., Hlávka, Z. (2007), Springer, New York
- Applied Multivariate Statistical Analysis, Johnson R.A. & Wichern, D.W. (1988), Prentice Hall Inc.
- Continuous Multivariate Distributions, Volume 1, Models and Applications, Kotz, S., Balakrishnan N. and Johnson N. L. (2000), John Wiley & Sons
- Multivariate Analysis, Kshirsagar, A. M. (1983), Marcel Dekker
- Directional Statistics, Mardia, K. V. and Jupp, P.E. (2000), John Wiley & Sons
- Multivariate Statistical Methods, Morrison, D.F. (1990), McGraw Hill Co.

**Semester- III**  
**Course Type: FP (Practical)**  
**Course Code: 24DSC23601 Course Title: - Field Project**

<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 10</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Technologies Like Google Form, Microsoft form.</li> <li>• Select Topic from Day Today's Problem from the Surrounding And Take Survey about the corresponding topic.</li> <li>• Data analysis libraries, and data visualization tools.</li> <li>• Data cleaning and preprocessing.</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To get knowledge of data collection and preparation.</li> <li>• To understand data exploration and descriptive analysis.</li> <li>• To learn how to design data using visualization tools.</li> <li>• To get knowledge of data reporting and presentation.</li> <li>• To learn how to implement and deploy the model.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	To discover valuable insights and make informed decisions, solve problems, or optimize processes.	B1,B2	
CO2	To make the data more understandable and accessible using visual representations of data, such as charts, graphs, and dashboards.	B3,B4	
CO3	To generate reports by communicating the results to stakeholders, management, or clients.	B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Content</b>	<b>CO targeted</b>	
1	Selection of Topic	CO1,CO2, CO3	
2	Problem Definition (Explanation about Selected Topic)		
3	Methodology(which Methods You have Used To Take Survey eg. Google Forms, real time Survey )		
4	Data Collection (Screenshot Of Google Form.)		
5	Explanation of All Questions included in Google Form (why you ask this Question)		
6	Data Analysis/Report (Screenshot of Excel Data, Pie Charts and Graphs) Description about Analysis (Description about what you have analyze for Survey)		
7	Conclusion		
8	References		



*Fourth  
Semester*

Semester- IV			
Course Type: Major Mandatory Paper 1(Theory)			
Course Code: 24DSC24101 Course Title: - Advanced Python Programming			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• <b>Basic concepts of python like data types, control statements and function calls</b></li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• Master Python basics, including collections, object-oriented programming (OOP) concepts and apply them to create reusable and modular code.</li> <li>• Handle exceptions and errors, work with files and perform input/output (I/O) operations,</li> <li>• Develop graphical user interfaces (GUI) using various widgets and events.</li> <li>• Learn data analysis and handle databases.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Develop object-oriented Python code, encapsulating data and behavior in classes and objects.	B1,B2	
CO2	Handle exceptions and errors gracefully to ensure smooth program execution and perform input/output (I/O) operations.	B3,B4	
CO3	Perform data analysis and establish connection between database and python program	B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
1	<b>Object-oriented programming concepts</b> <ul style="list-style-type: none"> <li>• Class and object</li> <li>• Access modifiers</li> <li>• Abstraction and encapsulation</li> <li>• Inheritance</li> <li>• Polymorphism</li> <li>• Types of Constructors</li> <li>• Operator overloading, Method overloading</li> <li>• Method overriding</li> </ul>	4	CO1
2	<b>Exception handling</b> <ul style="list-style-type: none"> <li>• Simple exceptions</li> <li>• Multiple exceptions</li> <li>• Using else and finally</li> <li>• Raise an exception</li> <li>• Assert statement</li> </ul>	3	CO2
3	<b>I/O streams and buffers</b> <ul style="list-style-type: none"> <li>• Access modes</li> <li>• Exceptions in file</li> </ul>	3	CO2

	<ul style="list-style-type: none"> <li>• Writing to files and Reading from file</li> <li>• File operations: seek() and tell() methods, readline() and readlines() methods, Renaming and deleting files.</li> </ul>		
4	<b>GUI in Python</b> <ul style="list-style-type: none"> <li>• Components and events</li> <li>• Widgets, Attributes for widgets, Label widget, Button widget, Image button, Entry widget, Combo box widget, Check button widget, Radio button widget, Canvas widget, Frame widget, Message box widget, Message widget, Menu widget, Methods, Menu button, Implementation</li> <li>• GUI example</li> </ul>	7	C03
5	<b>Data Analysis</b> <ul style="list-style-type: none"> <li>• Introduction to Pandas</li> <li>• Pandas data structures</li> <li>• Series and DataFrame Data wrangling using pandas</li> <li>• Loading a dataset into a dataframe</li> <li>• Selecting Columns from a dataframe</li> <li>• Selecting Rows from a dataframe</li> <li>• Adding new data in a dataframe</li> <li>• Deleting data from a dataframe</li> </ul>	7	C03
6	<b>Database Programming using Python</b> <ul style="list-style-type: none"> <li>• Connecting to a database (sqlite) using Python</li> <li>• Sending DML and DDL queries</li> <li>• processing the result from a Python Program</li> </ul>	6	C03

### Reference Books

Python Cookbook, 3rd Edition by David Beazley and Brian K. Jones

Python for Data Analysis by Wes McKinney

Python GUI Programming Cookbook by Burkhard A. Meier

### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

#### Online Courses:

- **100-days-of-code The Complete Python Pro Bootcamp**  
<https://www.udemy.com/course/100-days-of-code/?couponCode=24T3MT120924>
- **Python 3 Programming: Beginners to pro Masterclass**  
<https://www.udemy.com/course/python-3-beginner-to-pro/?couponCode=24T3MT120924>

<b>Semester- IV</b> <b>Course Type: Major (Theory)</b> <b>Course Code: 24DSC24102 Course Title: - Regression Analysis</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>• Basics of descriptive statistics.</li> <li>• Prior information about matrices.</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• Learn how the dependent and independent variables are interrelated with each other.</li> <li>• Make reliable predictions about the dependent variable.</li> <li>• Examine the validity and robustness of the regression model</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
C01	Recall the concept of fitting of simple regression models.	B1	
C02	Understand the necessity of building multiple linear regression and logistic regression models and analyze it.	B2,B4	
C03	Compare residual diagnostics and apply corrective measures.	B4,B5	
C04	Determine tests of hypothesis of model parameters, AIC and BIC criteria.	B5	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>

1	<p><b>Simple Linear Regression model</b></p> <ul style="list-style-type: none"> <li>• Review of simple linear regression model :  <math>Y = \beta_0 + \beta_1 X + \epsilon</math>,</li> <li>• where <math>\epsilon</math> is continuous random variable with <math>E(\epsilon) = 0</math>,</li> <li>• <math>V(\epsilon) = \sigma^2</math>. Assumptions of simple linear regression.</li> <li>• Estimation of <math>\beta_0</math> and <math>\beta_1</math>, by the method of least squares.</li> <li>• Properties of estimators of <math>\beta_0</math>, and <math>\beta_1</math>.</li> <li>• Estimation of <math>\sigma^2</math>.</li> <li>• Tests of hypothesis of <math>\beta_1</math>.</li> <li>• Interval estimation in a simple linear regression model.</li> <li>• Coefficient of determination.</li> <li>• Interpretation of three plots produced by lm command in R</li> </ul>	6	CO1,CO4
2	<p><b>Multiple Linear Regression Model</b></p> <ul style="list-style-type: none"> <li>• Review of multiple linear regression model</li> <li>• <math>Y = \beta_0 + \beta_1 X_1 + \dots + \beta_p X_p + \epsilon</math>, where <math>\epsilon</math> is a continuous</li> <li>• random variable with <math>E(\epsilon) = 0</math>, <math>V(\epsilon) = \sigma^2</math>. Assumptions of multiple linear regression.</li> <li>• Estimation of regression parameters <math>\beta_0</math>, <math>\beta_1</math>, ... and <math>\beta_p</math> by the method of least squares, obtaining normal equations, solutions of normal equations.</li> <li>• Test for significance of regressors, tests of hypothesis of regression parameters.</li> <li>• Interval estimation in regression model.</li> <li>• Interpretation of three plots produced by lm command in R.</li> </ul>	6	CO2,CO4
3	<p><b>Regression Diagnostics and model Building Strategies</b></p> <ul style="list-style-type: none"> <li>• Residual Analysis: Residual and its scaling, Residual plots, partial regression and partial residual plots</li> <li>• Diagnostic checks and correction: graphical techniques, tests for normality (Shapiro test), uncorrelatedness, homoscedasticity; Criteria for model adequacy: <math>R^2</math>, adjusted <math>R^2</math>, Mallow's <math>C_p</math> etc.</li> <li>• Outlier, leverage points, influential points, PRESS statistic, Cook's D statistic.</li> <li>• Multicollinearity: consequences, tools for detection and remedies.</li> </ul>	12	CO3,CO4

4	<b>Logistic Regression Model</b> <ul style="list-style-type: none"> <li>• Binary response variable</li> <li>• Logit transformation</li> <li>• Estimation of parameters</li> <li>• Interpretation of parameters</li> <li>• Tests of hypotheses of model parameters, model deviance,</li> <li>• Test based on likelihood ratios(LR). AIC and BIC criteria for model selection.</li> <li>• Interpretation of output produced by glm command in R.</li> <li>• Introduction to Multiple logistic regression</li> </ul>	6	CO2 and CO4
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**Books Recommended:**

<b>Reference Books</b>			
Applied Regression analysis, Draper, N. R. and Smith, H. (1998), (John Wiley) Third Edition.			
Introduction to Linear Regression, Montgomery, D. C., Peck, E. A. and Vining, G.G. (2003), Wiley			
Applied Linear Statistical Models, Neter, J., W., Kutner, M. H.; Nachtsheim, C.J. and Wasserman, W. (1996), fourth edition, Irwin USA			
Regression Analysis by Example, Chatterjee S. and Hadi A.S. (2012), 5th Edition, Wiley.			
Logistic Regression, Kleinbaum G. and Klein M. (2011), Third Edition			
<b>Semester- IV</b>			
<b>Course Type: Major Mandatory Paper 1 (Theory)</b>			
<b>Course Code: 24DSC24103 Course Title: - Practical on Calculus &amp; Regression Analysis</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits:</b> 2	<b>No. of Lectures:</b> 30	<b>Examination Scheme:</b> CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Regression analysis</li> <li>• R software</li> </ul>			
<b>The main objectives of this course are to:</b>			
To introduce the student to the most commonly used statistical technique for model building and forecasting .			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Recall the concept of fitting of simple, multiple and logistics regression model	B1, B2	
CO2	Compare residual diagnostics and apply corrective measures	B3, B4	
CO3	will learn basic concepts of calculus	B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6 - Create</b>			
UNIT	Contents	No of Practicals	CO targeted
1	Simple linear regression analysis by using R software	1	CO1

2	Multiple linear regression analysis by using R software	1	C01
3	Simple logistic regression	1	C01
4	Multiple logistic regression	1	C01
5	Detection of outliers	1	C02
6	Regression diagnosis by using R software	1	C02
7	Model Building Strategies using R software	1	C02
8	Transformation and weighting to correct model inadequacies.	1	C02
9	Limits	1	C03
10	Continuity	1	
11	Differentiability , L' Hospital's Rule	1	
12	Successive Differentiation	1	
13,14	Application of derivative	2	
15	Miscellaneous	1	

### Text Books

Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.

<b>Semester- IV</b> <b>Course Type: Major Mandatory Paper 1(Theory)</b> <b>Course Code: 24DSC24201 Course Title: - Actuarial Statistics</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>• Probability</li> <li>• Survival Models</li> <li>• Basic Mathematics</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• To use statistical and analytical skills to solve business problems</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>C01</b>	Recall the concepts of financial mathematics and probability theory, Construct life tables for different age groups of people.	<b>B1,B2</b>	
<b>C02</b>	Computing premiums, interest rates and other financial indices	<b>B3,B4</b>	
<b>C03</b>	Compare statistical distributions of life length random variables on the basis of survival curves and the force of mortality curves.	<b>B5, B6</b>	

<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Actuarial Science</b> <ul style="list-style-type: none"> <li>• Insurance companies as business organizations.</li> <li>• Role of insurance business in Economy.</li> <li>• Concept of risk and their type</li> <li>• Introduction of terms: premium, policy, policyholder.</li> <li>• Role of Statistics in insurance business.</li> <li>• Roles of actuaries in insurance and finance</li> </ul>	<b>2</b>	<b>CO1</b>
<b>2</b>	<b>Survival Distribution and Life Tables</b> <ul style="list-style-type: none"> <li>• Time- until death random variable, its distribution function and survival function in actuarial notation.</li> <li>• Force of mortality. Curtate future life random variable, its probability mass function and survival function in actuarial notation.</li> <li>• Construction of life table using random survivorship approach</li> </ul>	<b>9</b>	<b>CO1</b>
<b>3</b>	<b>Models for Life Insurance</b> <ul style="list-style-type: none"> <li>• Introduction of simple and compound interest rate policy</li> <li>• Different types of Interest rates. Insurance payable at the end of the year death, present value random variable, actuarial present value.</li> <li>• Derivation of actuarial present value for n-year term life insurance, whole life insurance and n-year endowment insurance</li> </ul>	<b>9</b>	<b>CO1, CO3</b>
<b>4</b>	<b>Annuities</b> <ul style="list-style-type: none"> <li>• Annuities – certain, annuity due, annuity immediate</li> <li>• Discrete life annuities: n-year temporary life annuity due and a whole life annuity due, present value random variables of the payment, and their actuarial present values.</li> <li>• Interrelations between life annuity due and immediate cases.</li> </ul>	<b>5</b>	<b>CO2,CO3</b>
<b>5</b>	<b>Benefit Premiums</b>	<b>5</b>	<b>CO2</b>

	<ul style="list-style-type: none"> <li>• Concept of a loss random variable. Computation of fully discrete premium for n-year term life insurance, whole life insurance and endowment insurance.</li> <li>• Principle to calculate premiums: Equivalence principle, Percentile principle, Exponential principle.</li> </ul>		
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Text Books
Actuarial Statistics , Pravin R Waldhe , Nirali Prakashan

Reference Books
Actuarial Mathematics, Bowers N.L. Jr., H.S. Gerber, J.C. Hickman, D.A. Jones, C.J. Nesbitt, (1997), Society of Actuaries, U.S.
Actuarial Statistics, Deshmukh, S. R. (2009), Universities Press, Hyderabad

Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)
Online <a href="https://www.mooc-list.com/course/actuarial-science-financial-math-actuarial-part-1-edx">https://www.mooc-list.com/course/actuarial-science-financial-math-actuarial-part-1-edx</a>

Semester- IV				
Course Type: Major Mandatory Paper 1 (Theory)				
Course Code: 24DSC24202 Course Title: - Practical on Actuarial Statistics				
Teaching Scheme: 2 Hours / Week	No. of Credits: 2		No. of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b>				
<ul style="list-style-type: none"> <li>• Probability and probability model</li> <li>• Survival functions</li> <li>• Finance</li> </ul>				
<b>The main objectives of this course are to:</b>				
To learn statistical methods, like probability theory and statistical modelling and analysis, and applies these to real world problems to forecast the likelihood of certain events.				
<b>Expected Course Outcomes:</b>				
<b>On the successful completion of the course, student will be able to:</b>				

<b>C01</b>	Recall the concepts of financial mathematics and probability theory, Construct life tables for different age groups of people.	<b>B1,B2</b>	
<b>C02</b>	Computing premiums, interest rates and other financial indices	<b>B3,B4</b>	
<b>C03</b>	Compare statistical distributions of life length random variables on the basis of survival curves and the force of mortality curves.	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Practicals</b>	<b>CO targeted</b>
1	Calculation of effective rate of interest, rate of discount, force of interest and discounted value.	2	C01
2	Force of mortality for various distributions and its graphs	2	C01
3	Construction of life table	2	C01,C02
4	Computation of Present value, accumulated value	2	C02
5	Calculation of actuarial present values for n-year term life insurance, whole life insurance and n-year endowment insurance	2	C02,C03
6	Calculation of actuarial present values for n-year temporary life annuity due and a whole life annuity due	2	C02,C03
7	Calculation of fully discrete premium for n-year term life insurance, whole life insurance and endowment insurance.	2	C02,C03
8	Case study on actuarial data	2	C01,C02,C03

<b>Text Books</b>
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Actuarial Statistics , Pravin R Waldhe , Nirali Prakashan
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<b>Reference Books</b>
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Actuarial Mathematics,Bowers N.L. Jr., H.S.Gerber, J.C. Hickman, D.A.Jones, C.J.Nesbitt, (1997).,Society of Actuaries, U.S.
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Actuarial Statistics,Deshmukh, S. R. (2009),Universities Press,Hyderabad
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<b>Semester- IV</b> <b>Course Type: Major Mandatory Paper 1(Theory)</b> <b>Course Code: 24DSC24401 Course Title: - Calculus</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Sets, Functions and its properties			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• Understand and explore the basics of calculus.</li> <li>• To apply theorems in solving practical problems.</li> <li>• To develop strong foundation for professional growth and lifelong learning in Mathematics.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Students will learn one variable differential calculus	<b>B1,B2</b>	

<b>CO2</b>	Students will be able to demonstrate algorithms used in interdisciplinary areas.	<b>B3,B4</b>	
<b>CO3</b>	Students will be able to evaluate or synthesize any real-world applications using derivatives.	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Limits, Continuity and Differentiability of one variable function</b> <ul style="list-style-type: none"> <li>• Limits</li> <li>• Continuity and Properties of continuous functions defined on [a, b] (Without proof) and examples.</li> <li>• Differentiability , L' Hospital's Rule (without proof)</li> </ul>	15	B1,B2
<b>2</b>	<b>Successive Differentiation</b> <ul style="list-style-type: none"> <li>• The nth derivatives of standard functions.</li> <li>• Leibnitz's Theorem (with proof).</li> </ul>	5	B3,B4
<b>3</b>	<b>Taylor's and Maclaurin's Theorems</b> <ul style="list-style-type: none"> <li>• Taylor's and Maclaurin's Theorems without proof).</li> <li>• Taylor's and Maclaurin's Series.</li> </ul>	5	B5, B6
<b>4</b>	<b>Application of derivative</b> <ul style="list-style-type: none"> <li>• Finding Maxima and minima of one variable and two variable functions</li> </ul>	5	B5, B6

<b>Text Books</b>
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Calculus: Gilbert Strang , Wellesley Cambridge Press
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<b>Reference Books</b>
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Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
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<b>Semester- IV</b>			
<b>Course Type: CEP</b>			
<b>Course Code: 24DSC24601 Course Title: - Community Engagement and Services</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Course Objectives:</b>			
After successfully completing this course, students will be able to :			
<ul style="list-style-type: none"> <li>• Build partnerships with community leaders, organizations, and residents to co-create solutions that address identified issues.</li> <li>• Learn about the different ways to work with communities and why community engagement is important</li> </ul>			
<b>UNIT</b>	<b>List of Activities</b>		
<b>1</b>	River Cleaning Activity(Clean areas near by River)		
<b>2</b>	Orphanage Engagement:(Host storytelling, sports days, or art workshops for children in orphanages.)		
<b>3</b>	Computer Literacy Camp in Rural by Areas		
<b>4</b>	Cyber Security Awareness (Aware People about cyber crime and teach people how to avoid )		
<b>5</b>	Blood Donation Camp (Collaborate with local hospitals or Red Cross to organize drives.)		
<b>6</b>	Tree Plantation (Collaborate with local authorities to plant trees in urban and rural areas)		
<b>7</b>	Recycling Programs (Start campaigns to teach proper waste segregation and recycling)		
<b>8</b>	Clean-Up Drives (Start campaigns to teach proper waste segregation and recycling.)		
<b>9</b>	Women's Empowerment: Offer skill training workshops (tailoring, baking, coding) for women to become self-reliant.		
<b>10</b>	Food Distribution: Cook and distribute meals to homeless people or struggling families.		



*Fifth  
Semester*

**Semester- V**  
**Course Type: Major Mandatory Paper 1(Theory)**  
**Course Code: Course Title: -**

<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
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**Prerequisites: Student should have basic knowledge of:**

**The main objectives of this course are to:**

- Knowledge of HTML, CSS , JS, HTTP
- Basic concepts of web applications and technology like Cookies, Sessions, HTTP Protocols, Caching, Redirects
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**Expected Course Outcomes:**

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

<b>CO1</b>	<b>B1,B2</b>
<b>CO2</b>	<b>B3,B4</b>
<b>CO3</b>	<b>B5, B6</b>

**B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create**

<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	•		
<b>2</b>	•		
<b>3</b>	•		
<b>4</b>	•		

<b>Semester- V</b> <b>Course Type: Major Mandatory Paper 1(Theory)</b> <b>Course Code: 24DSC35101 Course Title: - Basics of Machine Learning</b>			
<b>Teaching Scheme: 4 Hours / Week</b>	<b>No. of Credits: 4</b>	<b>No. of Lectures: 60</b>	<b>Examination Scheme: CIE: 40 Marks ESE: 60 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Students should know basic: <ul style="list-style-type: none"> <li>• Python programming</li> <li>• Statistics and Probability</li> <li>• Linear Algebra</li> <li>• Data handling and visualization</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• To introduce the basic concepts and ideas of Machine Learning.</li> <li>• To understand how machines learn from data.</li> <li>• To learn simple algorithms for prediction and classification.</li> <li>• To apply ML techniques on real-world datasets.</li> <li>• To build and test simple ML models using Python.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Understand the meaning and types of Machine Learning.	<b>B1,B2</b>	
<b>CO2</b>	Apply common ML algorithms for solving data problems.	<b>B3,B4</b>	
<b>CO3</b>	Build, test, and improve simple ML models.	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Machine Learning</b> <ul style="list-style-type: none"> <li>• Definition of Machine Learning</li> <li>• Types of Machine Learning: Supervised, Unsupervised, Reinforcement</li> <li>• Steps in building an ML model</li> </ul>	8	CO1

	<ul style="list-style-type: none"> <li>Real-life examples and applications of ML</li> </ul>		
2	<b>Preparing Data for Machine Learning</b> <ul style="list-style-type: none"> <li>Understanding datasets</li> <li>Data cleaning (handling missing data and outliers)</li> <li>Encoding categorical data</li> <li>Feature scaling (normalization and standardization)</li> <li>Splitting data into training and testing sets</li> </ul>	8	CO1,CO2
3	<b>Regression Algorithms</b> <p>Definition of regression</p> <ul style="list-style-type: none"> <li>Linear regression (Simple and Multiple)</li> <li>Polynomial Regression</li> <li>Regularization (Ridge and Lasso)</li> <li>Evaluating regression models (MAE, MSE, RMSE, <math>R^2</math>)</li> </ul>	10	CO2
4	<b>Classification Algorithms</b> <ul style="list-style-type: none"> <li>What is classification?</li> <li>Logistic Regression</li> <li>Decision Trees</li> <li>K-Nearest Neighbors (KNN)</li> <li>Naïve Bayes Classifier</li> <li>Random Forest</li> <li>Evaluating classifiers (Confusion Matrix, Accuracy, Precision, Recall, F1-score)</li> </ul>	12	CO2
5	<b>Unsupervised Learning</b> <ul style="list-style-type: none"> <li>What is unsupervised learning?</li> <li>Clustering: K-Means, Hierarchical</li> <li>Dimensionality reduction: PCA</li> <li>Association Rules (Apriori Algorithm)</li> </ul>	10	CO3
6	<b>Model Evaluation and Optimization</b> <ul style="list-style-type: none"> <li>Training, Validation, and Testing</li> <li>Cross-validation</li> <li>Overfitting and Underfitting</li> <li>Introduction to Ensemble Models (Bagging, Boosting)</li> <li>Model saving and deployment basics</li> </ul>	12	CO4

**Reference Books**

- 1.Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow.
- 2.Pattern Recognition and Machine Learning

**Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)**

- 1.[https://onlinecourses.nptel.ac.in/noc24\\_cs50/preview](https://onlinecourses.nptel.ac.in/noc24_cs50/preview)
- 2.[https://onlinecourses.nptel.ac.in/noc24\\_cs67/preview](https://onlinecourses.nptel.ac.in/noc24_cs67/preview)

Semester- V			
Course Type: Major Mandatory Paper 1(Theory)			
Course Code:24DSC35102 Course Title: - Sampling Methods			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• understand different sampling methods</li> <li>• understand role of sample surveys in data collection</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	understand different sampling methods	<b>B1,B2</b>	
<b>CO2</b>	apply different sampling methods to real life problems	<b>B3,B4</b>	
<b>CO3</b>	design a survey questionnaire and arranging survey	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
<b>1</b>	Role of Sample Surveys in Research Methodology: <ul style="list-style-type: none"> <li>• Objectives of a sample survey.</li> <li>• Designing a questionnaire, characteristics of a good questionnaire</li> <li>• Planning, execution and analysis of a sample survey, practical problems at each of these stages.</li> <li>• Sampling and non-sampling errors with illustrations.</li> </ul>	3	CO1 CO2 CO3
<b>2</b>	Simple Random Sampling <ul style="list-style-type: none"> <li>• Concept of distinguishable elementary units, sampling units, sampling frame, random sample,</li> </ul>	8	CO1 CO2

	<ul style="list-style-type: none"> <li>• Requisites of a good sample, Simple random sampling from finite population of size (N), i) with replacement (SRSWR) ii) without replacement (SRSWOR),</li> <li>• Definitions of population mean, population variance and population total parameters, inclusion probabilities.</li> <li>• Sample mean as an estimator of population mean, derivation of expectation and standard error of sample mean and population total, confidence interval for population mean, population total, standard error under SRSWR and SRSWOR</li> <li>• Sampling for proportion as an application of a simple random sampling with <math>X_i</math> as zero or one.</li> <li>• Sample proportion (<math>p</math>) as an estimator of population proportion (<math>P</math>) of units possessing a certain attribute, derivation of expectation and standard error of (<math>p</math>), <math>Np</math> as an estimator of total number of units in the population possessing a certain attribute, derivation of expectation and standard error of <math>Np</math>.</li> <li>• Estimator of above standard error both in case of SRSWR and SRSWOR.</li> </ul>		
3	<p>Unit 3: Stratified Random Sampling</p> <ul style="list-style-type: none"> <li>• Stratification, basis of stratification, real life situation where stratification can be used. Stratified random sampling as a sample drawn from individual strata using SRSWOR in each stratum</li> <li>• standard error of <math>N\hat{t}</math> as an estimator of population total, derivation of expectation and standard error of <math>N\hat{t}</math>,</li> <li>• Problem of allocation, Proportional allocation, Neyman's allocation, derivation of the expressions for the standard errors of the above estimators when these allocations are used.</li> <li>• Gain in precision due to stratification, comparison amongst SRSWOR, Stratification with proportional allocation and stratification with Neyman's Allocation.</li> </ul>	9	

	<ul style="list-style-type: none"> <li>• Cost and variance analysis in stratified random sampling, minimization of variance for fixed cost, minimization of cost for fixed variance, optimum allocation, Neyman's allocation as a particular case of optimum allocation in cost and variance analysis.</li> </ul>		
4	<p>Systematic Sampling (Population size divisible by sample size)</p> <ul style="list-style-type: none"> <li>• Real life situations where systematic sampling is appropriate. Techniques of drawing a sample</li> <li>• using systematic sampling</li> <li>• Estimation of the population mean and population total, standard error of these estimators.</li> <li>• Comparison of systematic sampling with SRSWOR.</li> <li>• Comparison of systematic sampling with SRSWOR and stratified sampling in the presence of linear trend</li> <li>•</li> </ul>	8	
5	<p>Determination of Sample Size</p> <ul style="list-style-type: none"> <li>• Determination of the sample size for estimating population mean, population total and population</li> <li>• proportion for the given: <ul style="list-style-type: none"> <li>i) Margin of error and confidence coefficient.</li> <li>ii) Coefficient of variation of the estimator and confidence coefficient</li> </ul> </li> </ul>	2	

#### Reference Books

1. Cochran, W.G.(2007):Sampling Techniques , Third Edition, Wiley India Pvt. Ltd., New Delhi.
2. Sukhatme, P.V., Sukhatme, B. V.(1984): Sampling theory of Surveys with Applications, Indian Society of Agricultural Statistics, New Delhi.
3. Singh, D. and Chaudhary, F. S. (1986): Theory and Analysis of Sample Survey Designs, Wiley Eastern Ltd., New Delhi.
4. Murthy, M. N. (1977): Sampling Theory and Methods, Statistical Publishing Society, Kolkata.

<b>Semester- V</b>			
<b>Course Type: Major Mandatory Paper 2(Theory)</b>			
<b>Course Code: 24DSC35103 Course Title: - DBMS</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Basic Knowledge of understanding data, simple programming concepts, and logical thinking			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• The main objective of a DBMS course is to teach students how to efficiently store, manage, retrieve, and protect data using database systems.</li> <li>• It helps students understand how databases support real-world applications in an organized and reliable way.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	To understand basic concepts of database systems and DBMS.	<b>B1,B2</b>	
<b>CO2</b>	To create, manage, and query databases using SQL.	<b>B3,B4</b>	
<b>CO3</b>	To understand database design concepts and ensure data integrity and security.	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to DBMS</b> <ul style="list-style-type: none"> <li>• Introduction</li> <li>• File system Vs DBMS</li> <li>• Levels of abstraction &amp; data independence</li> </ul>	03	<b>CO1</b>

	<ul style="list-style-type: none"> <li>• Structure of DBMS (Roles of DBMS Users)</li> <li>• Users of DBMS Advantages of DBMS</li> </ul>		
<b>2</b>	<b>Conceptual Design</b> <ul style="list-style-type: none"> <li>• Overview of DB design process</li> <li>• Introduction to data models (E-R model, Relational model, Network model, Hierarchical model)</li> <li>• Conceptual design using ER data model (entities, attributes, entity sets, relations, relationship sets)</li> <li>• Constraints (Key constraints, Integrity constraints, referential integrity, unique constraint, Null/Not Null constraint, Domain, Check constraint, Mapping constraints)</li> <li>• Extended features – Specialization, Aggregation, Generalization</li> <li>• Pictorial representation of ER(symbols)</li> <li>• Structure of Relational Databases (concepts of a table)</li> <li>• DBMS Versus RDBMS</li> <li>• Case Studies on ER model</li> </ul>		<b>CO2</b>
<b>3</b>	<b>SQL</b> <ul style="list-style-type: none"> <li>• Introduction to query languages</li> <li>• Basic structure</li> <li>• DDL Commands</li> <li>• DML Commands.</li> <li>• Forms of a basic SQL query (Expression and strings in SQL)</li> <li>• Set operations</li> <li>• Aggregate Operators and functions</li> <li>• Date and String functions</li> <li>• Null values</li> <li>• Nested Subqueries</li> <li>• SQL mechanisms for joining relations (inner joins, outer joins and their types)</li> <li>• Views</li> <li>• Examples on SQL (case studies)</li> </ul>		<b>CO1,CO2</b>
<b>4</b>	<b>Relational Database Design</b> <ul style="list-style-type: none"> <li>• . Introduction to Relational-Database Design (undesirable properties of a RDB design)</li> <li>• Functional Dependency(Basic concepts, F+, Closure of an</li> </ul>		<b>CO3</b>

	Attribute set, Armstrong's axioms) <ul style="list-style-type: none"> <li>● Concept of Decomposition</li> <li>● Desirable Properties of Decomposition ( Lossless join, Lossy join, Dependency Preservation)</li> <li>● Concept of normalization, Normal Forms (1NF,2NF and 3NF), Examples</li> <li>● Keys Concept with Examples : Candidate Keys and Super Keys, Algorithm to find the super keys / primary key for a relation</li> </ul>		
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#### Reference Books

1. Database Management Systems by Ragu Ramakrishnan and Johannes Gehrke
2. An Introduction to Database Systems by C.J. Date
3. Database Systems: The Complete Book by Ullman

#### Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)

1. [https://onlinecourses.nptel.ac.in/noc22\\_cs91/preview](https://onlinecourses.nptel.ac.in/noc22_cs91/preview)
2. [https://onlinecourses.nptel.ac.in/noc26\\_cs72/preview](https://onlinecourses.nptel.ac.in/noc26_cs72/preview)

<b>Semester- V</b>			
<b>Course Type: Major Mandatory (Practical)</b>			
<b>Course Code: 24DSC35104 Course Title: -Practical on Machine Learning</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 10</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>● Python programming</li> <li>● Statistics and Probability</li> <li>● Linear Algebra basics</li> <li>● Data handling and visualization</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>● To introduce students to practical aspects of data preparation and ML implementation.</li> <li>● To give hands-on exposure to simple regression, classification, and clustering models.</li> <li>● To understand model evaluation and basic optimization concepts.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<ul style="list-style-type: none"> <li>● Handle and preprocess datasets for machine learning tasks.</li> <li>● Apply basic regression, classification, and clustering algorithms.</li> <li>● Evaluate and save simple machine learning models using Python.</li> </ul>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Handle and preprocess datasets for ML tasks	B1,B2	
CO2	Apply basic regression and classification algorithms.	B3,B4	
CO3	Implement clustering and evaluate ML models.	B5,B1	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Practicals</b>	<b>CO targeted</b>
1	<b>Data Handling and Imputation</b> Load datasets using Python libraries, handle missing values, remove duplicates, treat outliers, and encode categorical data using appropriate techniques.	1	CO1

2	<b>Feature Scaling and Data Splitting</b> Apply feature scaling methods such as normalization and standardization, and split the dataset into training and testing sets.	1	C01
3	<b>Data Visualization and Understanding</b> Explore the dataset using summary statistics and create visualizations using Matplotlib and Seaborn to understand data distributions and relationships.	1	C01
4	<b>Simple Linear Regression</b> Implement a simple linear regression model to predict continuous outcomes and evaluate its performance using MAE, MSE, RMSE, and $R^2$ metrics.	1	C02
5	<b>Multiple Linear Regression</b> Build and evaluate a multiple linear regression model using multiple features to predict outcomes and compare model accuracy with simple regression.	1	C02
6	<b>Logistic Regression for Classification</b> Implement logistic regression for binary classification tasks (e.g., Titanic dataset) and evaluate the model using a confusion matrix, accuracy, precision, and recall.	1	C02
7	<b>Decision Tree Classifier</b> Develop and visualize a decision tree classifier model, and evaluate it using classification metrics such as precision, recall, and F1-score.	1	C02
8	<b>K-Nearest Neighbors (KNN) Classifier</b> Implement the KNN classification algorithm, experiment with different values of $k$ , and evaluate model performance using accuracy and confusion matrix.	1	C02
9	<b>K-Means Clustering</b> Apply the K-Means clustering algorithm to group similar data	1	C03

	points, determine the optimal number of clusters using the Elbow method, and visualize the results.		
10	<p><b>Model Evaluation and Cross-Validation</b></p> <p>Perform model evaluation using cross-validation techniques, understand the concepts of overfitting and underfitting, and demonstrate model saving and loading using the <code>joblib</code> library.</p>	1	C03



<b>Semester- V</b> <b>Course Title: - Practical on Sampling Methods</b> <b>Course Type: Major Mandatory( Practical)</b> <b>Course Code: 24DSC35105</b>			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Practicals : 10</b>	<b>Examination Scheme:</b> <b>CIE: 20 Marks</b> <b>ESE: 30 Marks</b>
<b>Prerequisites:</b> Student should have basic knowledge of- <ul style="list-style-type: none"> <li>• Basic Microsoft Excel operations (workbook/sheet management, basic formulas, simple charts)</li> <li>• Basic R software commands</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• form advanced Excel skills useful for data analysis using sampling methods.</li> <li>• use R software to generate random samples using different sampling schemes to imitate the real-world data tasks.</li> </ul>			
<b>Expected Course Outcome</b>			
On the successful completion of the course, student will be able to:			
CO1	Apply advanced Excel functions and R codes to solve complex data problems.	B3,B4	
CO2	Choose a sample of suitable size from large datasets	B3,B4	
CO3	Design a model using appropriate sampling method	B5, B6	
CO4	create and analyze sample survey design	B4, B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Practicals</b>	<b>CO targeted</b>
1	<b>Simple random sampling (estimation of population mean, population total with standard errors), i) with replacement, ii) without replacement. Confidence interval for population mean and population total.</b>	2	CO1
2	Simple Random Sampling for Proportions (estimation of population proportion, population total with standard errors), confidence interval or population proportion and population total.	2	CO1
3	Stratified Random Sampling: Proportional and Neyman allocation, comparison with SRSWOR.	2	CO1
4	Determination of sample size for variables and attributes.	1	CO2,CO3
5	Design and analyze the primary data using any sampling method	3	CO4

Semester- VI			
Course Type: Elective Paper (Theory)			
Course Code: 24DSC36107 Course Title: - Artificial Intelligence			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
<p><b>Prerequisites: Student should have basic knowledge of:</b> Students should know basic:</p> <ul style="list-style-type: none"> <li>• Programming fundamentals (Python preferred)</li> <li>• Basic mathematics (algebra, functions)</li> <li>• Basic statistics and probability</li> <li>• Logic and problem-solving skills</li> </ul>			
<p><b>The main objectives of this course are to:</b></p> <ul style="list-style-type: none"> <li>• Introduce fundamental concepts and applications of Artificial Intelligence</li> <li>• Explain the structure, behavior, and types of intelligent agents</li> <li>• Develop understanding of classical search techniques used in AI</li> <li>• Provide foundational knowledge of Neural Networks and Deep Learning concepts</li> <li>• Enable students to analyze simple AI models and their applications in Data Science</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>C01</b>	Explain the basic concepts, history, and applications of Artificial Intelligence.	<b>B1,B2</b>	
<b>C02</b>	Describe the structure, types, and behavior of Intelligent Agents.	<b>B2,B3</b>	
<b>C03</b>	Apply uninformed and informed search techniques to solve simple AI problems.	<b>B3, B4</b>	
<b>C04</b>	Understand and analyze the basics of neural networks and deep learning architectures	<b>B2, B4</b>	
<b>C05</b>	Demonstrate the practical relevance of AI techniques in real-world data science applications.	<b>B4, B5</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>

1	<b>Introduction to Artificial Intelligence</b> <ul style="list-style-type: none"> <li>● Definition and Scope of AI</li> <li>● History &amp; Evolution of AI</li> <li>● Applications of AI in Data Science</li> <li>● Turing Test &amp; Rationality</li> <li>● Foundations of AI (Maths, Logic, Probability)</li> <li>● AI Techniques: Search, Logic, Learning</li> </ul>	2	CO1
2	<b>Intelligent Agents and Environments</b> <ul style="list-style-type: none"> <li>● Structure of agents,</li> <li>● PEAS representation</li> <li>● Agent types</li> <li>● Simple Reflex Agent, Model-Based Reflex Agent, Goal-based, Utility-based</li> <li>● Learning Agent Components</li> <li>● Critic, Learning Element, Performance Element, Problem Generator</li> <li>● Environment classification</li> <li>● Fully/Partially Observable, Deterministic/Stochastic, Static/Dynamic, Discrete/Continuous</li> </ul>	6	CO1,CO2
3	<b>Problem Solving Methods</b> <ul style="list-style-type: none"> <li>● Problem solving Methods</li> <li>● Search Strategies</li> <li>● UninformedSearch DFS,BFS,DLS,IDDFS,Bidirectional Search,UniformCost Search.</li> <li>● InformedSearch- BestFirstSearch,A*,Problem Reduction and And-Or graphs(AO*) AND-OR graph,</li> <li>● Constraint Satisfaction Problems, Mean End Analysis.</li> <li>● Local Search algorithms and Optimization Problems –</li> <li>● Hill Climbing</li> </ul>	10	CO3
4	<b>Neural Networks &amp; Deep Learning</b> <ul style="list-style-type: none"> <li>● Neural Network Basics</li> <li>● Biological Neuron vs Artificial Neuron</li> <li>● Perceptron Model</li> <li>● Activation Functions (ReLU, Sigmoid, Tanh)</li> </ul>	12	CO4

	<ul style="list-style-type: none"> <li>● Learning Concepts</li> <li>● Feed-Forward Networks</li> <li>● Loss Functions</li> <li>● Backpropagation (Concept only)</li> <li>● Deep Learning Overview</li> <li>● Introduction to Deep Neural Networks</li> <li>● Convolutional Neural Networks (CNN) – concept</li> <li>● Recurrent Neural Networks (RNN) – concept</li> <li>● Applications: Image Recognition, NLP, Recommendation Systems</li> </ul>		
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### Text Books

1. Artificial Intelligence: A Modern Approach – Stuart Russell & Peter Norvig, Pearson.
2. Artificial Intelligence – Elaine Rich & Kevin Knight, McGraw-Hill.
3. Introduction to Artificial Intelligence – Wolfgang Ertel, Springer.

### Reference Books

4. Artificial Intelligence – George F. Luger, Pearson Education.
5. Neural Networks and Deep Learning – Charu C. Aggarwal, Springer.
6. Machine Learning – Tom M. Mitchell, McGraw-Hill.
7. Deep Learning – Ian Goodfellow, Yoshua Bengio, Aaron Courville, MIT Press.

<b>Semester- VI</b>			
<b>Course Type: Major Mandatory Paper 2(Practical)</b>			
<b>Course Code: 24DSC35107 Course Title: - Practical Based on AI &amp; DBMS</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
Basic Knowledge of understanding data, simple programming concepts, and logical thinking			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• The main objective of a DBMS course is to teach students how to efficiently store, manage, retrieve, and protect data using database systems.</li> <li>• It helps students understand how databases support real-world applications in an organized and reliable way.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	To create and manage database tables using SQL commands.	<b>B1,B2</b>	
<b>CO2</b>	To design database structure using ER model and convert it into tables.	<b>B3,B4</b>	
<b>CO3</b>	To perform data operations and queries for retrieving and modifying data.	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	Creation of Tables		<b>CO1</b>
<b>2</b>	Entity Relationship Model: Case Study		<b>CO2</b>
<b>3</b>	Create tables using constraints		<b>CO3</b>
<b>4</b>	Data Definition Queries (Create,Alter,Drop)		<b>CO3</b>
<b>5</b>	Simple queries & Aggregate queries		<b>CO3</b>
<b>6</b>	Implement Breadth-First Search (BFS) – graph traversal		
<b>7</b>	Implement Depth-First Search (DFS) – recursive and iterative		

<b>8</b>	Implement Uniform Cost Search (UCS) – cost-based path search		
<b>9</b>	Implement A* Search Algorithm – with heuristic		
<b>10</b>	8-Puzzle Problem – using A* algorithm		



Semester- V Course Title: - Advanced EXCEL Course Type: VSEC( Practical) Course Code: 24DSC35409			
<b>Teaching Scheme:</b> 2 Hours / Week	<b>No. of Credits: 2</b>	<b>No. of Practicals : 10</b>	<b>Examination Scheme:</b> <b>CIE: 20 Marks</b> <b>ESE: 30 Marks</b>
<b>Prerequisites:</b> Student should have basic knowledge of- <ul style="list-style-type: none"> <li>• Basic Microsoft Excel operations (workbook/sheet management, basic formulas, simple charts)</li> <li>• Familiarity with data types (numbers, text, dates) and basic data cleaning</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• Build advanced Excel skills useful for data analysis and reporting.</li> <li>• Teach automation, advanced functions, and modeling techniques to speed up real-world data tasks.</li> <li>• Provide practical experience with dashboards, Power Query, Power Pivot (Data Model), and VBA macros.</li> </ul>			
<b>Expected Course Outcome</b>			
On the successful completion of the course, student will be able to:			
CO1	Apply advanced Excel functions and formulas to solve complex data problems.	B3,B4	
CO2	Clean, transform and model large datasets using Power Query and Data Model.	B3,B4	
CO3	Design interactive dashboards and visualizations using Pivot Charts, slicers and form controls.	B5, B6	
CO4	Automate repetitive analytical tasks using macros and VBA	B3, B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Practicals	CO targeted
1	<b>Advanced Formula Concepts:</b> -Array formulas and dynamic arrays (FILTER, UNIQUE, SORT, and SEQUENCE). - LET and LAMBDA functions (create reusable formulas). - Advanced use of INDEX-MATCH and XLOOKUP - Error handling (IFERROR, IFNA) and defensive formulas	1	CO1
2	<b>Text, Date &amp; Numeric Advanced Functions:</b> - Advanced TEXT functions (TEXTJOIN, CONCAT, TEXT formats). - Date/time intelligence (EOMONTH, NETWORKDAYS, and YEARFRAC). - Numeric engineering: ROUND variants, MOD, INT.	1	CO1

3	<b>Conditional &amp; Statistical Functions:</b> - Advanced conditional aggregation (SUMIFS, COUNTIFS, and AVERAGEIFS) combined with FILTER and dynamic arrays. - Conditional logic: IFS, SWITCH, nested AND/OR patterns. - Statistical functions useful for analysis: PERCENTILE.INC, RANK.EQ, CORREL, SMALL/LARGE.	1	C01,C02
4	<b>Power Query (Get &amp; Transform):</b> - Importing data from CSV, Excel, web, and databases. - Query Editor: split/merge columns, pivot/un-pivot, fill, replace, and remove duplicates, data type detection. - Parameters, query folding.	1	C02
5	<b>Power Pivot &amp; Data Modeling (DAX basics):</b> - Data Model: relationships. - Calculated columns vs measures. - Basic DAX: CALCULATE, SUMX, FILTER, RELATED, time-intelligence functions (TOTALYTD, SAMEPERIODLASTYEAR).	1	C02,C03
6	<b>Advanced Pivot Tables &amp; Pivot Charts:</b> - Grouping, calculated fields/measures - Multiple consolidation ranges, using Data Model. - Pivot Chart best practices and linking with slicers/timeline.	1	C03
7	<b>Dashboard Design &amp; Visualization:</b> - Interactive components: slicers, timelines, form controls (combo boxes, option buttons). - Best practices in dashboard layout, story-telling with data. - Advanced charts: combo charts, waterfall, gauge, dynamic labels, conditional formatting in charts.	1	C03
8	<b>What-if Analysis &amp; Modeling:</b> - Scenario Manager, Goal Seek, Data - Solver basics for optimization problems (linear simple examples).	1	C03,C01
9	<b>Macros &amp; Introduction to VBA:</b> - Recording macros vs writing VBA: editing recorded code. - Workbook/worksheet events, basic procedures and functions, message/input boxes.	1	C04
10	<b>Advanced Integration &amp; Collaboration:</b> - Connecting Excel with Power BI / exporting Data Model, sharing queries. - Data validation, protection, worksheet auditing (trace precedents/dependents), version control techniques (file naming, change logs)	1	C02,C04

### **Reference Books**

Microsoft Excel 365 Bible — John Walkenbach / Michael Alexander / Richard Kusleika

Excel 365 Formulas and Functions — Michael Alexander & Richard Kusleika

Power Query for Power BI and Excel — Chris Webb

Power Pivot and Power BI — Rob Collie & Avi Singh

Semester- V Course Title: - Mathematical Techniques for Optimization Course Type: Minor Course Code: 24DSC35208			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Lectures :30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites:</b> Student should have basic knowledge of- <ul style="list-style-type: none"> <li>• Functions and equations, Plotting of Graphs, Solving the systems of linear equations</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• This course develops the ideas underlying the Simplex method for Linear programming problem, as an important branch of operations research. The course covers Linear programming with applications to Transportation and Assignment problem. Such problems arise in manufacturing resource planning and financial sectors.</li> <li>• This course develops the ideas underlying the Simplex method for Linear programming problem, as an important branch of operations research. The course covers Linear programming with applications to Transportation and Assignment problem. Such problems arise in manufacturing resource planning and financial sectors.</li> </ul>			
<b>Expected Course Outcome</b>			
On the successful completion of the course, student will be able to:			
CO1	Analyze and solve linear programming models of real-life situations.	B1,B2	
CO2	The graphical solution of LPP with only two variables, and illustrate the concept of convex set and extreme points. The theory of the simplex method is developed.	B3,B4	
CO3	The relationships between the primal and dual problems and their solutions with applications to transportation, assignment and two-person zero-sum game problem	B5, B6	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Practicals	CO targeted
1	<b>Modeling with Linear Programming</b>  1.1 Two variable LP Model  1.2 Solution of LP Model by Graphical Method	8	CO1

	<p>1.3 Selected LP Model Applications</p> <p>1.4 Graphical Sensitivity analysis.</p>		
2	<p><b>The Simplex Method and Duality</b></p> <p>2.1 LP Model in equation form</p> <p>2.2 Transition from graphical to algebraic solutions</p> <p>2.3 The Simplex method.</p> <p>2.4 Definition of the dual problem</p> <p>2.5 Primal dual relationship</p>	12	C01
3	<p><b>Transportation Model</b></p> <p>3.1 Definition of the Transportation model</p> <p>3.2 The Transportation algorithm.</p>	10	C01
4	<p><b>The Assignment Model</b></p> <p>4.1 The Hungarian method</p>	6	C02,C03

<b>Reference Books</b>	
<p>Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.</p> <p>Unit 1: Chapter-2: 2.1,2.2,2.3(2.3.4, 2.3.5).</p> <p>Unit 2:Chapter-3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 (3.6.1), Chapter-4: 4.2, 4.3</p> <p>Unit 3:Chapter -5: 5.1,5.3 (5.3.1, 5.3.2, 5.3.3), Unit 4:Chapter-5: 5.4(5.4.1).</p>	



*Sixth  
Semester*

Semester- VI			
Course Type: Major Mandatory Paper 1(Theory)			
Course Code: Course Title: - Generative AI			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Lectures: 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
<b>Prerequisites: Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>● Artificial Intelligence</li> <li>● Data Structures</li> <li>● Searching tEchniques</li> <li>● Procedural and object oriented programming languages</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>● To build conceptual understanding of what Generative AI is and how it differs from traditional AI.</li> <li>● To understand key model architectures used in Generative AI.</li> <li>● To make students capable of interacting with and controlling generative AI outputs</li> <li>● To understand real-world applications along with ethical and legal implications.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	understand the scope, purpose, and fundamental concepts of Generative AI.	<b>B1,B2</b>	
<b>CO2</b>	understand key model architectures used in Generative AI.	<b>B3,B4</b>	
<b>CO3</b>	differentiate between VAE, GAN, and Transformer-based generative models	<b>B5, B6</b>	
<b>CO4</b>	understand both the power and responsibility that comes with Generative AI		
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted
<b>1</b>	<b>Foundations of Generative AI</b> <ul style="list-style-type: none"> <li>● Introduction to Generative Artificial Intelligence</li> <li>● Difference between Discriminative AI and Generative AI</li> <li>● Overview of generative tasks: <ul style="list-style-type: none"> <li>○ Text generation</li> <li>○ Image synthesis</li> <li>○ Audio and music generation</li> <li>○ Code generation</li> </ul> </li> </ul>		

	<ul style="list-style-type: none"> <li>● Basics of probability and data distribution</li> <li>● Concept of latent space and sampling</li> <li>● Evolution of generative models</li> <li>● Applications of Generative AI in: <ul style="list-style-type: none"> <li>○ Healthcare</li> <li>○ Design &amp; Art</li> <li>○ Education</li> <li>○ Gaming</li> <li>○ Content creation</li> </ul> </li> </ul>		
<b>2</b>	<p><b>Generative Model Architectures</b></p> <ol style="list-style-type: none"> <li>1. Autoencoders &amp; Variational Autoencoders (VAE) <ul style="list-style-type: none"> <li>○ Working principle</li> <li>○ Encoder–Decoder architecture</li> <li>○ Reconstruction loss and KL divergence</li> </ul> </li> <li>2. Generative Adversarial Networks (GANs) <ul style="list-style-type: none"> <li>○ Generator vs Discriminator</li> <li>○ Minimax game concept</li> <li>○ Types of GANs (DCGAN, StyleGAN – overview only)</li> <li>○ Training challenges: Mode collapse, instability</li> </ul> </li> <li>3. Transformer Models for Generation <ul style="list-style-type: none"> <li>○ Concept of attention mechanism</li> <li>○ Self-attention &amp; positional encoding</li> <li>○ Introduction to Large Language Models (LLMs)</li> <li>○ GPT, BERT, Diffusion models (overview)</li> </ul> </li> </ol>		
<b>3</b>	<p><b>Prompt Engineering</b></p> <ul style="list-style-type: none"> <li>● What is prompting?</li> <li>● Zero-shot, One-shot and Few-shot prompting</li> <li>● Prompt structure (role, context, task, constraints, format)</li> <li>● Chain-of-Thought prompting</li> <li>● Image prompting techniques (style, lighting, composition, mood)</li> <li>● Hands-on introduction to: <ul style="list-style-type: none"> <li>○ ChatGPT (Text/Code generation)</li> <li>○ DALL·E / Midjourney / Stable Diffusion (Image generation – concept)</li> </ul> </li> </ul>		

	<ul style="list-style-type: none"> <li>○ Runway / Synthesia (Video – concept)</li> <li>○ MusicLM (Audio – concept)</li> <li>● GenAI for coding: GitHub Copilot (overview)</li> </ul>		
4	<p><b>Applications, Ethics &amp; Future of Generative AI</b></p> <p>Generative AI in:</p> <ul style="list-style-type: none"> <li>○ Design &amp; Art</li> <li>○ Healthcare (medical images, drug discovery)</li> <li>○ Education (personalized content)</li> <li>○ Business (content, advertising, reports)</li> <li>○ Gaming &amp; Virtual Worlds</li> <li>● Deepfakes and misinformation</li> <li>● Bias in generated outputs</li> <li>● Data privacy issues</li> <li>● Copyright and intellectual property</li> <li>● Responsible AI &amp; safe usage guidelines</li> <li>● Human-in-the-loop systems</li> <li>● Career opportunities in Generative AI</li> <li>● Future trends in AGI &amp; multimodal AI</li> </ul>		

<b>Semester- VI</b> <b>Course Type: Major Mandatory Paper 2(Theory)</b> <b>Course Code:24DSC36102 Course Title: - Data Science &amp; Privacy</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Students should know basic: <ul style="list-style-type: none"> <li>● Python programming</li> <li>● Basic SQL</li> <li>● Data types and file formats</li> <li>● Awareness of digital security and common cyber risks</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>● Introduce the foundational concepts of Data Science &amp; Data Privacy</li> <li>● Explain types of data and privacy risks in digital systems</li> <li>● Build understanding of ethical issues and responsible data science</li> <li>● Provide knowledge of database security, SQL injection, and privacy risks</li> <li>● Develop awareness of privacy practices in ML and data-driven environments</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Explain the foundational concepts of Data Science, Data Types, and Data Privacy.	<b>B1,B2</b>	
<b>CO2</b>	Identify and describe ethical issues, responsible data science principles, and real-life privacy problems.	<b>B2,B3</b>	
<b>CO3</b>	Analyze database privacy challenges, SQL injection attacks, and apply basic preventive techniques.	<b>B2, B3</b>	
<b>CO4</b>	Evaluate privacy in database management and propose safe data-handling practices for data science workflows.	<b>B3,B4</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
UNIT	Contents	No of Lectures	CO targeted

1	<b>Introduction to Data Science &amp; Privacy</b> <ul style="list-style-type: none"> <li>● What is Data Science?</li> <li>● Types of Data (Structured, Unstructured, Semi-structured)</li> <li>● What is Data Privacy?</li> <li>● Importance of Privacy in the Data Science ecosystem</li> <li>● Personal Data vs Sensitive Personal Data</li> <li>● Data Life Cycle &amp; Privacy Concerns</li> <li>● Basics of Data Governance</li> </ul>	2	C01
2	<b>SQL Injection &amp; Database Attacks</b> <ul style="list-style-type: none"> <li>● What is SQL injection</li> <li>● How attackers exploit databases</li> <li>● Preventing SQL injection (prepared statements, validation)</li> <li>● Other attacks: Privilege escalation, Insider attacks, Malware and ransomware</li> </ul>	6	C02
3	<b>Privacy in Database Management</b> <ul style="list-style-type: none"> <li>● Minimizing sensitive data</li> <li>● Data retention &amp; deletion policies</li> <li>● Anonymization inside databases</li> <li>● Protecting databases used for ML model training</li> <li>● Preventing data leakage from DB queries</li> </ul>	10	C03
4	<b>Ethics &amp; Responsible Data Science</b> <ul style="list-style-type: none"> <li>● Ethical principles in data science</li> <li>● Fairness, Accountability, Transparency (FAT)</li> <li>● Bias in data collection and algorithms</li> <li>● Ethical issues in AI &amp; ML</li> <li>● Responsible AI guidelines</li> <li>● Real-life ethical case studies (simple examples)</li> </ul>	12	C04

<b>Text Books</b>
<ol style="list-style-type: none"><li>1. Data Privacy and Security- S. Raghavan, Wiley</li><li>2. Introduction to Data Science- Jeffrey Stanton, Syracuse University</li><li>3. Database Systems Concepts – Silberschatz, Korth &amp; Sudarshan (DB security chapters)</li></ol>



<b>Reference Books</b>
<ol style="list-style-type: none"><li>1. Ethics of Artificial Intelligence and Big Data- Alessandro Mantelero, Springer</li><li>2. Privacy and Data Protection – Mike Chapple, Pearson</li><li>3. Fundamentals of Database Security- David Kim, G. Solomon</li><li>4. Web Security for Developers: SQL Injection &amp; Security Basics- Malcolm McDonald</li></ol>

<b>Semester- VI</b> <b>Course Type: Major Mandatory Paper 3(Theory)</b> <b>Course Code:24DSC36103 Course Title: - Big Data</b>			
<b>Teaching Scheme:</b> <b>2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme:</b> <b>CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Students should know basic: <ul style="list-style-type: none"> <li>● Python programming</li> <li>● Basic SQL</li> <li>● Data types and file formats</li> <li>● Basics of databases</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>● Introduce the concept, need, and applications of Big Data</li> <li>● Explain Hadoop ecosystem and its components</li> <li>● Provide basic exposure to real-world big data use cases</li> <li>● Provide foundation of Spark for big data analytics</li> <li>● Develop understanding of Hadoop architecture and ecosystem tools</li> </ul>			
<b>Expected Course Outcomes:</b> <b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Explain the characteristics, challenges, and applications of Big Data.	<b>B1,B2</b>	
<b>CO2</b>	Identify different types of Big Data analytics and their use in Data Science.	<b>B2,B3</b>	
<b>CO3</b>	Describe the Hadoop ecosystem and its core components..	<b>B2, B3</b>	
<b>CO4</b>	Understand and analyze the MapReduce processing framework.	<b>B2, B4,B4</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Big Data</b> <ul style="list-style-type: none"> <li>● Definition &amp; Characteristics of Big Data (5 V's: Volume, Velocity, Variety, Veracity, Value)</li> <li>● Traditional Data vs Big Data</li> <li>● Big Data Challenges</li> <li>● Big Data Architecture</li> <li>● Real-life Applications: Banking, Healthcare, Social Media</li> <li>● Big Data Lifecycle</li> <li>● Introduction to Data Lakes &amp; Data Warehouses</li> </ul>	<b>2</b>	<b>CO1</b>

2	<b>Big Data Analytics</b> <ul style="list-style-type: none"> <li>● What is Big Data Analytics?</li> <li>● Types of Analytics: Descriptive, Diagnostic, Predictive, Prescriptive</li> <li>● Tools used in Big Data Analytics</li> <li>● Data Preprocessing for Big Data</li> <li>● Data Visualization (overview)</li> <li>● Introduction to ML for Big Data</li> </ul>	6	C02
3	<b>Hadoop Ecosystem</b> <ul style="list-style-type: none"> <li>● What is Hadoop?</li> <li>● Need for Hadoop in Big Data</li> <li>● HDFS Architecture: Namenode, Datanode</li> <li>● File storage (Blocks, Replication)</li> <li>● Hadoop Components: <ul style="list-style-type: none"> <li>● MapReduce</li> <li>● YARN</li> <li>● HDFS</li> </ul> </li> <li>● Introduction to Hadoop Tools: Hive, Pig, Sqoop, Flume</li> <li>● Advantages &amp; Limitations of Hadoop</li> </ul>	10	C03
4	<b>MapReduce Framework</b> <ul style="list-style-type: none"> <li>● Concept of Distributed Processing</li> <li>● Map Function &amp; Reduce Function</li> <li>● MapReduce Data Flow</li> <li>● WordCount Example (Concept only)</li> <li>● Combiner &amp; Partitioner Overview</li> <li>● Advantages of MapReduce</li> <li>● Use Cases of MapReduce</li> </ul>	12	C04

### Text Books

1. Big Data: Principles and Paradigms – Rajkumar Buyya, Rodrigo N. Calheiros, Amir Vahid Dastjerdi, Morgan Kaufmann.
2. Big Data Analytics – Seema Acharya & Subhasini Chellappan, Wiley.
3. Hadoop: The Definitive Guide – Tom White, O'Reilly Media

### Reference Books

1. **Big Data Fundamentals: Concepts, Drivers & Techniques** – Thomas Erl, Wajid Khattak, Paul Buhler, Pearson.
2. **Big Data and Hadoop** – V.K. Jain, Khanna Publishing.
3. **Hadoop in Practice** – Alex Holmes, Manning Publications.
4. **Big Data Science & Analytics: A Hands-On Approach** – Arshdeep Bahga & Vijay Madisetti, VPT.

### Semester- VI

**Course Title: - Statistical Inference using Non- Parametric Tests**

Course Type: Major Mandatory Paper 1 (Theory) Course Code: 24DSC36104			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Basic statistics (descriptive stats, probability, hypothesis testing), knowledge of Excel/SPSS/R/Python			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• Understand the concept and need for non-parametric tests.</li> <li>• Learn different types of non-parametric tests and their applications.</li> <li>• Apply non-parametric methods to real datasets using software tools.</li> <li>• Interpret and report results correctly in a data-driven context.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Understand the concept and need for non-parametric tests, ranking, ties, zero difference, and types of non-parametric tests		<b>B2,B3</b>
<b>CO2</b>	Apply one- sample two- sample non-parametric tests to real datasets using software tools.		<b>B2,B4</b>
<b>CO3</b>	Apply two- sample non-parametric tests to real datasets using software tools.		<b>B2,B4</b>
<b>CO4</b>	Evaluate and interpret results from non-parametric tests for >2 samples and categorical data		<b>B4,B5</b>
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Non-Parametric Tests</b> <ul style="list-style-type: none"> <li>- <b>Meaning and Importance of Non-Parametric Tests:</b> <ul style="list-style-type: none"> <li>• Definition parameter</li> <li>• Situations where parameters are not possible</li> <li>• Importance in real-world data analysis where assumptions of parametric tests fail</li> <li>• Comparison with parametric tests (advantages and limitations)</li> </ul> </li> <li>- <b>Scope of Non-Parametric Tests:</b> <ul style="list-style-type: none"> <li>• Applicable in the fields of: Data Science, Social sciences, Economics, Medical sciences, Biological sciences, Management, Agriculture, Education, Psychology, Insurance, IT</li> </ul> </li> </ul>	6	CO1

	<ul style="list-style-type: none"> <li>- <b>Basic Concepts:</b> <ul style="list-style-type: none"> <li>• Ranking, ties, and zero differences in data</li> <li>• Types of non-parametric tests: one-sample, two-sample, more than two samples, categorical/association tests</li> <li>• Effect size and interpretation</li> </ul> </li> </ul>		
2	<p><b>One-Sample Non-Parametric Tests</b></p> <ul style="list-style-type: none"> <li>- <b>Run Test:</b> <ul style="list-style-type: none"> <li>• Definition of randomness</li> <li>• Purpose and assumption</li> <li>• Stepwise procedure for calculation and interpretation</li> </ul> </li> <li>- <b>Shapiro Test:</b> <ul style="list-style-type: none"> <li>• Purpose and assumption</li> <li>• Stepwise procedure for calculation and interpretation</li> </ul> </li> <li>- <b>Sign Test:</b> <ul style="list-style-type: none"> <li>• Definition, purpose, and assumptions</li> <li>• Hypothesis testing using the median</li> <li>• Stepwise procedure for calculation and interpretation</li> </ul> </li> <li>- <b>Wilcoxon Signed-Rank Test:</b> <ul style="list-style-type: none"> <li>• Concept and assumptions (symmetry of differences)</li> <li>• Stepwise calculation, handling ties</li> <li>• Comparison with Sign Test</li> </ul> </li> <li>- <b>Kolmogorov-Smirnov One-Sample Test:</b> <ul style="list-style-type: none"> <li>• Concept: comparing sample distribution to a theoretical distribution</li> <li>• Applications in normality testing</li> </ul> </li> <li>- <b>Real-Life Applications</b> <ul style="list-style-type: none"> <li>• Application of Run Test, Sign Test, Wilcoxon Signed-Rank Test, Kolmogorov–Smirnov Test, and Shapiro Test</li> </ul> </li> </ul>	8	CO2
3	<p><b>Two-Sample Non-Parametric Tests</b></p> <ul style="list-style-type: none"> <li>- <b>Mann-Whitney U Test / Wilcoxon Rank-Sum Test</b> <ul style="list-style-type: none"> <li>• Definition and purpose</li> </ul> </li> </ul>	8	CO3

	<ul style="list-style-type: none"> <li>• Stepwise calculation for independent samples</li> <li>• Interpretation of U statistic and p-value</li> </ul> <p>- <b>Wilcoxon Signed-Rank Test (Paired Samples)</b></p> <ul style="list-style-type: none"> <li>• Application for related/paired data</li> <li>• Stepwise calculation and interpretation</li> </ul> <p>- <b>Kolmogorov-Smirnov Two-Sample Test</b></p> <ul style="list-style-type: none"> <li>• Comparison of distributions for two samples</li> </ul> <p>- <b>Real-Life Applications:</b></p> <ul style="list-style-type: none"> <li>• Applications of Mann-Whitney U Test, Wilcoxon Signed-Rank Test (Paired), and Kolmogorov-Smirnov Two-Sample Test</li> </ul>		
4	<p><b>Non-Parametric Tests for More than Two Samples &amp; Categorical Data</b></p> <p>- <b>Kruskal-Wallis H Test</b></p> <ul style="list-style-type: none"> <li>• Definition, purpose, and assumptions</li> <li>• Stepwise calculation for &gt;2 independent groups</li> <li>• Interpretation and post-hoc analysis</li> </ul> <p>- <b>Friedman Test</b></p> <ul style="list-style-type: none"> <li>• For repeated measures / related samples</li> <li>• Stepwise calculation and interpretation</li> </ul> <p>- <b>Chi-Square Tests</b></p> <ul style="list-style-type: none"> <li>• Chi-Square Test for Independence: contingency tables, expected frequencies, interpretation</li> <li>• Chi-Square Goodness-of-Fit: compare observed vs expected frequencies</li> <li>• Fisher's Exact Test for small or repeated categorical data</li> </ul> <p>- <b>Real-Life Applications:</b></p> <ul style="list-style-type: none"> <li>• Applications of Kruskal-Wallis Test, Friedman Test, Chi-Square Test (Independence and Goodness-of-Fit), and Fisher's Exact Test</li> </ul>	8	CO4

### **Text Books**

1. "Nonparametric Statistical Methods" — Myles Hollander, Douglas A. Wolfe, Eric Chicken
2. "Nonparametric Statistics for the Behavioral Sciences" — Sidney Siegel & N. John Castellan
3. "Practical Nonparametric Statistics" — W.J. Conover
4. "Fundamentals of Biostatistics" — Bernard Rosner

### **Reference Books**

1. "Statistical Methods" — S.P. Gupta & V. Gupta
2. "Introduction to Mathematical Statistics" — Hogg, McKean & Craig
3. "Statistics for Management" — Levin & Rubin
4. "Biostatistics: A Foundation for Analysis in the Health Sciences" — Wayne W. Daniel & Chad L. Cross

### **Semester- VI**

**Course Type: Major Mandatory Paper 1(Theory)**

**Course Code: Course Title: - Practical on Generative AI**

<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>CIE: 20 ESE:30</b>
<b>Prerequisites: Student should have basic knowledge of:</b>			
<ul style="list-style-type: none"> <li>Basic Python, basic understanding of Machine Learning concepts (optional but recommended)</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>To build conceptual understanding of what Generative AI is and how it differs from traditional AI.</li> <li>To understand key model architectures used in Generative AI.</li> <li>To make students capable of interacting with and controlling generative AI outputs</li> <li>To understand real-world applications along with ethical and legal implications.</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	understand the scope, purpose, and fundamental concepts of Generative AI.		
<b>CO2</b>	understand key model architectures used in Generative AI.		
<b>CO3</b>	differentiate between VAE, GAN, and Transformer-based generative models		
<b>CO4</b>	understand both the power and responsibility that comes with Generative AI		
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>		
<b>1</b>	<b>Introduction to Generative AI Tools</b> <ul style="list-style-type: none"> <li>Explore ChatGPT / Gemini / Copilot / Claude (any one)</li> <li>Identify differences between: <ul style="list-style-type: none"> <li>Generative AI</li> <li>Search engines</li> <li>Rule-based systems</li> </ul> </li> <li>Task: Generate 3 outputs: story, poem, explanation</li> </ul>		
<b>2</b>	Discriminative vs Generative Models <ul style="list-style-type: none"> <li>Use a simple dataset (e.g., handwritten digits – MNIST concept only)</li> <li>Compare: <ul style="list-style-type: none"> <li>Classification task → Discriminative</li> <li>Generation task → Generative</li> </ul> </li> <li>Observation report writing</li> </ul>	10	CO1

<b>3</b>	<p>Simple Random Text Generator (Python)</p> <pre>import random words = ["AI","Machine","Generate","Future", Data","Network"] for _ in range(10): print(random.choice(words), end="&amp;quot; &amp;quot;)</pre> <p>Page No 36</p> <p>Outcome: Concept of random sampling Creation of chatbot</p>	5	CO2
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<b>Semester- VI</b> <b>Course Type: Major Mandatory (Practical)</b> <b>Course Code: 24DSC36106 Course Title: -Practical on Tableau</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Practicals: 10</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> <ul style="list-style-type: none"> <li>Basic knowledge of data handling, statistics, and spreadsheet tools (Excel or CSV data).</li> </ul>			
<b>The main objectives of this course are</b> <ul style="list-style-type: none"> <li>To introduce the principles and techniques of data visualization.</li> <li>To provide hands-on experience with Tableau for visual analytics.</li> <li>To enable students to design and publish interactive dashboards.</li> </ul>			
<b>Expected Course Outcomes:</b> <ul style="list-style-type: none"> <li>Import, clean, and manage data in Tableau.</li> <li>Create and customize different types of visualizations.</li> <li>Design interactive dashboards and data stories for analysis and presentation.</li> </ul>			
<b>On the successful completion of the course, student will be able to:</b>			
CO1	Understand and prepare data for visualization in Tableau.	B1,B2	
CO2	Apply Tableau tools to create and analyze different types of visualizations and dashboards.	B3,B4	

C03	Evaluate and present data insights effectively using interactive dashboards and storytelling features.	B5,B1	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Practicals</b>	<b>CO targeted</b>
1	Introduction to Tableau Interface & Data Connection	1	C01
2	Data Cleaning and Preparation	1	C01
3	Basic Charts – Bar, Line, Pie, and Tree Maps	1	C02
4	Scatter Plots and Trend Lines	1	C02
5	Maps and Geographic Visualization	1	C02
6	Calculated Fields and Parameters	1	C02
7	Advanced Charts	1	C02
8	Dashboards and Interactivity	1	C03
9	Storytelling with Data	1	C03
10	Mini Project on Tableau Dashboard	1	C03

**Semester- VI**  
**Course Type: Elective 1(Theory)**  
**Course Code: 24DSC35106 Course Title: - Data Structures**

<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Students should know basic: <ul style="list-style-type: none"> <li>• Basic Programming Knowledge (preferably in C or Python)</li> <li>• Fundamentals of Computer Science</li> <li>• Basic understanding of sets, logic, relation and functions</li> </ul>			
<b>The main objectives of this course are to:</b> <ul style="list-style-type: none"> <li>• Understand the fundamentals of data structures and algorithmic problem solving</li> <li>• Analyze the time and space complexity of algorithms</li> <li>• Apply appropriate data structures for real-world problems</li> <li>• Strengthen the foundation for advanced computing topics like Machine Learning,</li> <li>• Database Systems</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Learn and understand various asymptotic notations	<b>B1,B2</b>	
<b>CO2</b>	Understand and implement various sorting and searching algorithms	<b>B3</b>	
<b>CO3</b>	Implement linear data structures like linked lists, stacks, and queues using static and dynamic memory management	<b>B4</b>	
<b>CO4</b>	Implement non linear data structure line binary trees and binary search trees, and graphs	<b>B5,B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	<b>Introduction to Algorithms &amp; Complexity Analysis</b> <ol style="list-style-type: none"> <li>4. Algorithm Introduction</li> <li>5. Pseudocode conventions</li> <li>6. Asymptotic notation: Big-O, <math>\Omega</math>, <math>\Theta</math></li> <li>7. Best, Worst, and Average case analysis</li> <li>8. Time and space complexity examples</li> <li>9. Recursion Vs Iteration</li> </ol> <b>Sorting and Searching Algorithms</b> <ol style="list-style-type: none"> <li>10. Linear search, Binary search</li> <li>11. Sorting algorithms: <ul style="list-style-type: none"> <li>□ Bubble sort, Selection sort</li> <li>□ Insertion sort, Merge sort, Quick sort</li> </ul> </li> <li>1. Performance analysis</li> </ol>	2	CO1,CO2

<b>2</b>	<b>Stacks and Queues</b> <ul style="list-style-type: none"> <li>● Stack: array and linked list implementation</li> <li>● Applications: Expression evaluation (postfix), parenthesis matching</li> <li>● Queue and its types: Simple, Circular, Deque, Priority Queue (basic)</li> <li>● Applications of queue in scheduling, buffering</li> </ul>	6	CO3
<b>3</b>	<b>Linked Lists</b> <ul style="list-style-type: none"> <li>● Singly, doubly, and circular linked lists</li> <li>● Operations: insert, delete, traverse</li> <li>● Application: Polynomial representation, reverse a list</li> <li>● Comparison with arrays</li> </ul>	10	CO3
<b>4</b>	<b>Trees</b> <ul style="list-style-type: none"> <li>● Binary Trees, Binary Search Trees (BST)</li> <li>● Tree traversals: inorder, preorder, postorder (recursive &amp; iterative)</li> <li>● BST operations: insert, delete, search</li> <li>● Height, depth, and size of a tree</li> <li>● Graphs and its representation techniques</li> <li>● BFS and DFS</li> <li>● Applications: Expression trees, directory structure, Dijkstra's algorithm</li> </ul>	8	CO4

#### Reference Books

1. Classic Data Structures-D. Samanta, Prentice Hall India Pvt. Ltd.
2. Fundamentals of Data Structures in C- Ellis Horowitz, SartajSahni,Susan Anderson Freed, 2nd Edition, Universities Press.
3. Data Structures using C and C++-YedidyahLangsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Pearson Education
4. Data Structures: A Pseudo code approach with C, Richard Gilberg ,Behrouz A. Forouzan, Cengage Learning.
5. Introduction to Data Structures in C-Ashok Kamthane, Pearson Education
6. Algorithms and Data Structures, Niklaus Wirth, Pearson Education

<b>Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)</b>
1. <a href="https://onlinecourses.swayam2.ac.in/cec21_cs02/preview">https://onlinecourses.swayam2.ac.in/cec21_cs02/preview</a>

<b>Semester- VI</b>			
<b>Course Type: Elective 1(Practical)</b>			
<b>Course Code: 24DSC35107 Course Title: - Practical based on Data Structure</b>			
<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Sessions: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
<b>Prerequisites: Student should have basic knowledge of:</b> Students should know basic:			
<ul style="list-style-type: none"> <li>• Basic Programming Knowledge of C, Python, SQL</li> </ul>			
<b>The main objectives of this course are to:</b>			
<ul style="list-style-type: none"> <li>• Understand and Apply appropriate data structures for real-world problems</li> </ul>			
<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Implement various sorting and searching techniques	<b>B1,B2</b>	
<b>CO2</b>	Understand dynamic memory allocation and linear data structures	<b>B3</b>	
<b>CO3</b>	Understand dynamic memory allocation and Non linear data structures	<b>B4</b>	
<b>CO4</b>	create and manage database tables using SQL commands, design database structure using ER model and convert it into tables, perform data operations and queries for retrieving and modifying data.	<b>B5,B6</b>	
<b>UNIT</b>	<b>Contents</b>	<b>No of Sessions</b>	<b>CO targeted</b>

1	<p>Assignment1: Searching Algorithms Implementation of searching algorithms to search an element using: Linear Search, Sentinel Search, Binary Search (with time complexity)</p> <p>Assignment 2: Sorting Algorithms - I Implementation of sorting algorithms: Bubble Sort, Insertion Sort, Selection Sort, Merge Sort</p>	1	CO1
2	<p>Assignment 3: Singly Linked List 1. Dynamic implementation of Singly Linked List to perform following operations: Create, Insert, Delete, Traverse, Doubly Linked List 1. Dynamic implementation of Doubly Linked List to perform following operations: Create, Insert, Delete, Traverse</p>	1	CO2
3	<p>Assignment 4: Stack 1. Static and Dynamic implementation of Stack to perform following operations: Init, Push, Pop, Peek, Isempty, Isfull , Applications of Stack 1. Implementation of an algorithm that reverses string of characters using stack and checks whether a string is a palindrome.</p>	1	CO2
4	<p>Assignment 5: Linear Queue 1. Static and Dynamic implementation of linear Queue to perform following operations: Init, enqueue, dequeue Peek, IsEmpty, IsFull.</p>	1	CO3
5	<p>Assignment 6: Binary Search Tree and Traversals 1. Implement Binary Search Tree (BST) to perform following operations on BST Create, Recursive Traversals - Inorder, Preorder, Postorder 2. Perform following operations: insert, delete Assignment 7: Graph implementation 1. Implement Graph as adjacency matrix and adjacency list 2. Calculate indegree and outdegree of vertices 3. Graph traversals: BFS and DFS.</p>	1	CO3

**Semester- VI**  
**Course Type: VSEC(2)(PRACTICAL)**  
**Course Code: 24DSC36610 Course Title: - MATLAB Practical**

<b>Teaching Scheme: 2 Hours / Week</b>	<b>No. of Credits: 2</b>	<b>No. of Lectures: 30</b>	<b>Examination Scheme: CIE: 20 Marks ESE: 30 Marks</b>
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**Prerequisites: Student should have basic knowledge of:**

**The main objectives of this course are to:**

- Introduce the MATLAB environment and tools
- Develop problem-solving skills using MATLAB
- Apply numerical and visualization techniques
- Perform data analysis using MATLAB programming

<b>Expected Course Outcomes:</b>			
<b>On the successful completion of the course, student will be able to:</b>			
<b>CO1</b>	Understand MATLAB environment, syntax, and basic operations.	<b>B1,B2</b>	
<b>CO2</b>	Apply MATLAB for solving mathematical and engineering problems.	<b>B3,B4</b>	
<b>CO3</b>	Analyze data, visualize results, and develop MATLAB-based solutions.	<b>B5, B6</b>	
<b>B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create</b>			
<b>UNIT</b>	<b>Contents</b>	<b>No of Lectures</b>	<b>CO targeted</b>
<b>1</b>	Introduction to MATLAB Environment	5	CO1
<b>2</b>	Vectors and Matrices	6	CO1,CO2
<b>3</b>	Programming in MATLAB	7	CO2
<b>4</b>	Plotting and Visualization	6	CO2,CO3
<b>5</b>	File Handling and Numerical Methods Using MATLAB	6	CO3