

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



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

A.Y: 2024 – 2025

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Name of Program: Bachelor of Science (Data Science) with Actuarial Analysis

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

Max. Marks: 20 (Credit:02, Duration: 50 Min.)				
Question No.	Question	No. of sub questions	Marks to each sub question	Total Question Marks
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
Total Marks:				20

Max. Marks: 20 (Credit 4, Duration: 50Min.)				
Question No.	Question	No. of sub questions	Marks to each sub question	Total Question Marks
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
Total Marks:				20

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

Max. Marks: 60 (Credit:04, Duration: 3 Hrs.)					
Question No.	Question		No. of sub questions	Marks to each sub question	Total Question Marks
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
Total Marks:					60

Max. Marks: 30 (Credit 2, Duration: 2 Hrs.)					
Question No.	Question		No. of sub questions	Marks to each sub question	Total Question Marks
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
Total Marks:					30

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

PSO1	Apply foundations of Mathematics, Statistics and Computer Science in Solving real world problems.
PSO2	Design, develop, implement, and apply Analytical skills related to Research, consultancy, and multidisciplinary domains.
PSO3	Equip with requisite theoretical and practical skills to enable them to pursue multidisciplinary courses at postgraduate level and to obtain placement opportunities.
PSO4	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

PO1	Gain fundamental knowledge and ability to expertise in Data Science and analytics.
PO2	Utilize the features and new updates of Excel, Python, R, Tableau and Power BI to enhance analytical reasoning.
PO3	Establish the ability to listen, read, proficiently communicate, and articulate data and information through traditional and digital channels to audiences with diverse perspectives.
PO4	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.
PO5	Acquire appropriate knowledge base in domain specific areas leading to the pursue of an advanced level of study.
PO6	Design and develop research-based solutions for complex problems with specified needs with appropriate ethical consideration for public health, safety, culture, society, and the environment.
PO7	Inculcate professional effective communication skills, teamwork, multidisciplinary approach and an ability to relate issues to broader social context.

F.Y.BSc (Data Science) 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
OE1(2)		OE (From Arts, Basket)	2	-	20	30	50
SEC(2)	24DSC11401	Data Science with EXCEL	-	2	20	30	50
AEC(2)	24ENG11506	Developing Communicative Competence	2	-	20	30	50
VEC(2)	24VEC11501	Value Education Course	2	-	20	30	50
IKS(1)	IKS11501	General IKS	2	-	20	30	50
		Total	16	6	220	330	550

CIE :- Continuous Internal Examination, ESE :- End Semester Examination

F.Y.BSc (Data Science) Semester -II							
Course Type	Course Code	Course Title	Credits		Evaluation		
			TH	PR	CIE	ES E	Tota 1
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)		OE (From Commerce Basket)	-	2	20	30	50
SEC(2)	24DSC12401	R Programming	-	2	20	30	50
AEC(2)	24ENG12506	Mastering English for Professional Purposes)	2	-	20	30	50
VEC(2)	24VEC12507	Democracy & Constitutional values	2	-	20	30	50
CC(2)	24NSS12601/ 24NCC12601/ 24RED12601/ 24DRM12601/ 24ANM12601/ 24JWD12601/ 24CUL12601/ 24SPO12601/ 24YOG12601	NSS/ NCC/ Red Cross/ Theatre & Drama/ Animation/ Jewellery Design/ Culinary Arts/ Sports Physical Education/ Yoga	-	2	20	30	50
		Total	10	12	220	330	550



*First
Semester*

Course Title: - Fundamentals of C Programming
Course Type: Major Mandatory Paper 1(Theory)
Course Code: 24DSC11101
Semester- I

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

- Problem solving Skills

The main objectives of this course are to:

- To introduce the foundations of computing, programming and problem- solving using computers.
- To develop the ability to devise algorithms & flowcharts for arithmetic and logical problems. test, debug and execute programs.

Expected Course Outcomes:

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

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

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

UNIT	Contents	No of Lectures	CO targeted
1	Introduction to Problem Solving <ul style="list-style-type: none"> ● Introduction to problem solving using computers. ● Algorithms-definition, characteristics, examples, advantages and limitations. ● Flowcharts - definition, notations, examples, advantages and limitations, Comparison with algorithms. ● program Types of languages ● Compilation process (compilers, interpreters), linking and loading, syntax and semantic errors, testing of a program 	2	CO1
2	C Fundamentals <ul style="list-style-type: none"> ● History of 'C' language. ● Application areas. ● Structure of a 'C' program. ● Function as building blocks. ● 'C' tokens 	2	CO1

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

	<ul style="list-style-type: none"> • Command line arguments. 		
8	<p>Structures</p> <ul style="list-style-type: none"> • Concept of structure, definition and initialization, use of typedef. • Accessing structure members. • Arrays of Structures • Structures and functions- Passing each member of structure as a separate argument, Passing structure by value / address. • Pointers and structures. 	3	CO2,C03

Text Books

1. Problem Solving Using Computer and 'C' Programming, Parijat Publication

Reference Books

1. Problem Solving and Programming Concept, Maureen Sprankle, 7th 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

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

1. riptutorial.com/Download/c-language.pdf
2. [Lec-1c.pdf \(iitkgp.ac.in\)](http://Lec-1c.pdf(iitkgp.ac.in))

Online Courses:

1. [Introduction to Programming in C - Course \(nptel.ac.in\)](http://Introduction to Programming in C - Course (nptel.ac.in))
2. [Free C \(programming language\) Tutorial - Introduction To The C Language | Udemy](http://Free C (programming language) Tutorial - Introduction To The C Language | Udemy)
3. [Top Free Programming Fundamentals Courses & Tutorials Online - Updated \[February 2024\] \(udemy.com\)](http://Top Free Programming Fundamentals Courses & Tutorials Online - Updated [February 2024] (udemy.com))

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	--

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

Course Title: - Practical Based on C Programming
Course Type: Major Mandatory Paper 2 (Practical)
Course Code: 24DSC11102
Semester- I

Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Practicals: 10	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> • Problem Solving Skills 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> • To understand the program development life cycle. • Solve simple computational problems using modular design and basic features of the 'C' language 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
C01	Devise pseudocodes and flowchart for computational problems.	B6,B3,B1	
C02	Write, debug, and execute simple programs in 'C'	B2,B3,B4,B5	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Sessions	CO targeted

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

Course Title: - Fundamentals of Mathematics Course Type: Major Paper 3 (Theory) Course Code: 24DSC11103 Semester- I			
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"> Mathematics at HSC level 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> Learn concepts of mathematical logic for analyzing propositions and proving theorems. Use sets for solving applied problems and use the properties of set operations algebraically. Work with relations and investigate their properties. Investigate functions as relations and their properties. 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
C01	be equipped with fundamental principles and mathematical tools which will help them in further studies of computer science.		B1,B2
C02	be able to model, solve and interpret the practical real-life problem.		B3,B2
C03	do Logical thinking and the learning ability of students will be enhanced.		B2,B4
C04	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	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Introduction to fundamentals <ul style="list-style-type: none"> • Sets and Subsets • Operations on sets • Sequences • Integers. • Divisibility relation and properties. • G.C.D. and L.C.M • Modular arithmetic and its application to cryptology 	7	C01
2	Logic <ul style="list-style-type: none"> • Propositions and Logical Operations • Conditional Statements • Methods of proof. 	5	C01,C03
3	Counting <ul style="list-style-type: none"> • Permutations • Combinations • Pigeonhole Principle 	5	C04, C05
4	Relations and Functions <ul style="list-style-type: none"> • Products Sets and Partitions • Relations and Digraphs • Paths in Relations and Digraphs • Properties of Relations • Equivalence Relations • Data Structures for Relations and Digraphs • Operations on Relations • Transitive Closure and Warshall's Algorithm 	10	C04, C05
5	Recurrence Relations <ul style="list-style-type: none"> • Introduction and Examples of homogeneous and Nonhomogeneous Recurrence Relation. 	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	Fundamentals of Mathematics Download book PDF (freebookcentre.net)
2	lecture3.dvi (stonybrook.edu)
3	Master the Fundamentals of Math Training Course Udemy

CO-PO MAPPING							
	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	--
S: Strong , M: Medium , L: Low, -- NA							

Course Title: - Practical based on Mathematics
Course Type: Major Paper 4(Practical)
Course Code: 24DSC11104
Semester- I

Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Practicals: 10	Examination Scheme: CIE: 10 Marks ESE: 15 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> • Problem Solving Skills in mathematics 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> • To understand the basic concepts of sets, counting principles and relations and functions 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Solve problems based on sets and integers, and modular arithmetic's and logic	B6,B3,B1	
CO2	Solve Counting principles and relations and functions and homogeneous and non-homogeneous relations	B2,B3,B4,B5	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Sessions	CO targeted
1	Sets and integers	1	CO1
2	Modular arithmetic and application to cryptography	1	CO1
3	Logic-I	1	CO1
4	Logic-II	1	CO1
5	Counting Principles-I	1	CO2
6	Counting Principles-II	1	CO2
7	Relations and Functions	1	CO2
8	Operations on relations and transitive closure	1	CO2
9	Homogeneous recurrence relation	1	CO2
10	Non-homogeneous recurrence relation	1	CO2

Course Title: - Basics of Descriptive Statistics
Course Type: Major Paper 5 (Theory)

Course Code: 24DSC11105			
Semester- I			
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"> Basic concepts like mean, median, mode which they have learned in school and Junior college. 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> Students will be able to understand the concept of population and sample. 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:			
CO1	Understand the concept of population and sample, various statistical measures such as measures of central tendency, dispersion, skewness and kurtosis.		B2, B3
CO2	Apply all the above-mentioned topics in real life.		B2, B4
CO3	Evaluate and define the correlation and regression analysis for the data.		B4,B3
CO4	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	Introduction to Statistics <ul style="list-style-type: none"> Meaning of Statistics as a Science, Importance of Statistics. Scope of Statistics: In the field of Industry, Biological sciences, Medical sciences, Economics, Social Sciences, Management sciences, Agriculture, Insurance, Information technology, Education and Psychology. 	2	CO1
2	Population and Sample <ul style="list-style-type: none"> Types of characteristics and their scale: Attributes: Nominal scale, ordinal scale, Variables: discrete and continuous variables, interval scale, ratio scale, Types of data: Primary data, Secondary data, Cross-sectional data, time series data, directional data. Notion of a statistical population and sample: Finite population, infinite population, homogeneous population and heterogeneous population. Random sample. Methods of sampling (Description only): Simple random sampling with and without replacement (SRSWR and SRSWOR) stratified random sampling, systematic sampling 	2	CO1
3	Summary Statistics <ul style="list-style-type: none"> Presentation of Data, Interpretation of Data from table and graph, Data validation 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 	10	CO2

	<p>distribution, cumulative frequency distribution. Histogram and cumulative frequency curves.</p> <ul style="list-style-type: none"> Measures of Central Tendency: Concept of central tendency, Statistical averages, characteristics of a good statistical average. 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 demerits. Partition Values: Quartiles, Deciles and Percentiles (for ungrouped and grouped data), Box Plot, Situations where one kind of average is preferable to others. 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 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. 		
4	<p>Correlation</p> <ul style="list-style-type: none"> Bivariate data, Scatter diagram and interpretation, correlogram. Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Covariance between two variables (m11): Definition, computation, effect of change of origin and scale. Karl Pearson's coefficient of correlation (r): Definition, computation for ungrouped data and interpretation. Properties: (i) $-1 \leq r \leq 1$ (with proof), (ii) Effect of change of origin and scale (with proof). 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.) 	5	C03
5	<p>Fitting of Line (Regression Line)</p> <ul style="list-style-type: none"> Concept of dependent and independent variables. Identification of response and predictor variables and relation between them. Meaning of regression, connection between correlation and regression, Simple linear regression model: $Y = a + bX + \epsilon$. Fitting of line $Y = a + bX$. 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. 	11	C03 C04

	<ul style="list-style-type: none"> • Curve fitting: Second degree, parabola and exponential curve 		
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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	Introduction to Statistics - Open Textbook Library (umn.edu)
2	Statistics/Data Analysis with SPSS: Descriptive Statistics Udemy
3	04. Probability and Statistics Autor Michael J. Evans and Jeffrey S. Rosenthal.pdf (dropbox.com)

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							

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

Course Title: - Data Science with EXCEL Course Type: SEC(Practical) Course Code: 24DSC11401 Semester- I			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Practicals : 30	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> ● Problem solving Skills 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> ● Learn Microsoft excel for the purpose of data science 			
Expected Course Outcome			
On the successful completion of the course, student will be able to:			
C01	Successfully apply excel functions to database	B1,B2	
C02	Use various data filtering methods in excel	B3,B4	

C03 Use various charts on excel		B5, B6	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
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	C01
2	Basic Data Manipulation in Excel Simple functions like sum, min,max, percentileexe, percentileinc,	1	C01
3	Creating Pivot Charts and Tables	2	C01
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	C01
5	Logical operations using if function, AND, OR ,VLookup and Hlookup Data	2	C01
6	Creating and Modifying simple macros Managing workbook by protecting, Encrypting with password Creating the dashboard	2	C01
7	Introduction to the Data filtering capabilities of Excel, the construction of Pivot Tables to organize data and Introduction to charts in Excel.	2	C02
8	Constructing various Line, Bar and Pie charts. Using the Pivot chart features of Excel. Understanding and constructing Histograms and Scatter Plots.	3	C03

Course Title: - Developing Communicative Competence (Theory) Course Type: AEC Course Code: 24ENG11506 Semester- I			
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"> English Language. 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> Enhance reading comprehension and listening proficiency through skimming, scanning, comprehension, and note-taking techniques. Foster critical thinking skills by engaging with diverse texts and audio materials. Develop versatile reading and listening abilities applicable across various contexts and subjects. Master foundational writing skills, including paragraph writing and generation of ideas. 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
C01	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	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Reading Skills <ul style="list-style-type: none"> • Skimming and scanning • Reading comprehension • Loud Reading • Reading and making notes 	15	C01 C02 C03
	Listening Skills <ul style="list-style-type: none"> • Active and passive listening • Listening comprehension • Listening and responding • Listening and taking notes 		
2	Writing Skills <ul style="list-style-type: none"> • Paragraph writing • Expansion of ideas • Summarizing and Paraphrasing 	15	C04
	Forms of Writing <ul style="list-style-type: none"> • Letter writing • Writing notice, agenda and minutes • Drafting an Email • Writing for Digital Platforms 		

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

Course Title: - Environmental Sustainability: Principles and Values Course Type: VEC Course Code: 24VEEC11501 Semester- I			
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"> • . 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> • 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. • To get a thorough understanding of the morals, ethics and guiding principles of environmental sustainability. 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
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
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted

1	<p>Introduction to Environmental Sustainability</p> <ul style="list-style-type: none"> ● Definitions, Scope and importance of concepts of sustainability & sustainable Development ● Historical perspectives on environmental movements (discuss Chipko, Appiko movement and Narmada Bachao) and sustainability initiatives ● Overview of the United Nations SDGs and their relevance to environmental sustainability ● Case studies and examples of SDG implementation at local and international levels 	5L	
2	<p>Principles of Environmental Sustainability</p> <ul style="list-style-type: none"> ● Ecological principles: Concept of ecosystem and ecosystem services, Biodiversity: concept and conservation strategies ● Economic principles: concept of circular economy and green growth ● Value and ethics in environment sustainability: anthropocentrism, biocentrism, and ecocentrism 	5L	
3	<ul style="list-style-type: none"> ● Global Environmental Challenges Climate change and global warming: what is climate change?, concept of global warming and greenhouse gases ● 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 (CBD) and Environment Protection Act (1986) ● Pollution and resource depletion: concept of pollution and discuss practices to minimize various types of pollution ● 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. 	6L	

4	<p>Practices, Solutions, policy and governance for sustainability</p> <ul style="list-style-type: none"> ● 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 & case studies (Solar energy in India) ● Sustainable agriculture: concept and importance of organic farming, agroforestry, urban farming, and soil conservation practices. ● Circular Economy: Concept of waste reduction (types and management of waste, examples of recycling innovations, product life extension and concept of upcycling. ● Behavioral Changes: Discuss educational campaigns, public awareness initiatives, and sustainable lifestyle choices. ● Environmental Regulations: Explore laws and policies on emissions control, waste management, and natural resource conservation ● International Agreements: Highlight global agreements like the Paris Agreement, Kyoto Protocol, and their impact on sustainability goals 	11L	
5	<p>Discovering our Local Environment:</p> <ul style="list-style-type: none"> ● 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. ● Submission of report 	3L	

	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	-

<p>Course Title: - Value Education Course (Theory) Course Type: VEC 1 Course Code: 24VEC11501 Semester- I</p>			
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"> ● Human values 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> ● 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. 			
Expected Course Outcomes:			

On the successful completion of the course, student will be able to:			
C01	Understand the ethos of the Indian value system.		B2,B1
C02	Know the importance of mental wellbeing and stress management techniques.		B2
C03	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	Introduction to Indian Ethos <ul style="list-style-type: none"> • Meaning of ethos and cultural essence of India • Integrating the two methodologies: interiorization process for self-exploration, and exterior scientific pursuit for the prosperity of world • The Law of Karma and Nishkama Karma (The Law of action and selfless action) 	6	C01
2	Integrated Personality and Well-being <ul style="list-style-type: none"> • 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). • Stress management: meditated personality and agitated personality. • Oneness, non-duality, and equanimity • Physical, mental, social, and spiritual well-being 	10	C02
3	Environmental Values Introduction to Environment and ecosystem <ul style="list-style-type: none"> • Introduction and Components in environment, • Objectives of Environment Education, • Importance and scope of Environmental studies, • Structure, scale and functions of ecosystem, • Type of ecosystem, • Important ecological concept – food chain, food web, ecological pyramid Understanding Biodiversity Conservation <ul style="list-style-type: none"> • What is biodiversity? • Need to conserve biodiversity. • Types of conservation Living with sustainability <ul style="list-style-type: none"> • Definition of sustainability and three pillars of sustainability • What is energy and water conservation? • Best Ways to save energy and water • Concept of reduce, reuse and recycle, • Overall benefits of sustainable living 	14	C03

CO-PO MAPPING

	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

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

Course Title: - General IKS Course Type: IKS (Theory) Course Code: IKS11501 Semester- I			
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"> Languages Proficiency English, Hindi & Marathi 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> To familiarize students with the Heritage of ancient and eternal Indian Knowledge System. 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
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
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Introduction to Indian Ethos <ul style="list-style-type: none"> Bharatavarsha Uniqueness of Indian culture Rationale behind starting this course. Glory of Bharata Structures of Learning Centres University education: introduction to scholars produced by Indian Education System Splendid geographical isolation of India and the uniqueness of Indian culture 	8	CO1
2	Mathematics in India- Introduction to contribution of Indian Mathematicians <ul style="list-style-type: none"> Aryabhata: Place Value System, Zero, Trigonometry, Algebra, Approximation of Pi Brahmagupta: Zero, Positive and Negative integers, Cyclic Quadrilateral, Approximation of Pi Varahmihira : Magic square Madhava : Algebra, Calculus Srinivas Ramanujan: Ramanujan Number, Circle Method, Mock Theta Function, Theta Function D R Kaprekar : Three digit Kaprekar's constant 	8	CO1

	<ul style="list-style-type: none"> • Shakuntaladevi: Speedy computation and calculations • Subhash Khot: Computational Complexity 		
3	Indian Astronomy <ul style="list-style-type: none"> • Ancient records of the observation of the motion of celestial bodies in the Vedic corpus • Eclipses: Lunar and Solar • Astronomical Institutes in India • Observatories • Astronomical Instruments 	8	CO2
4	Indian Economy -Indian conception of flourishing Economy <ul style="list-style-type: none"> • Basic Chronology • Peculiar features of Indian Economic Idea • Indus Valley Civilisation • Economic Thoughts in Vedas • Buddhist Economics • Economics of Mahavir • Kautilya • Thiruvalluvar 	6	CO3

Reference Books

1. Baladev Upadhyaya, Samskrta Śāstrom ka Itihās, Chowkhambha, Varanasi, 2010
2. D. M. Bose, S. N. Sen and B. V. Subbarayappa, Eds., A Concise History of Science in India, 2nd Ed., Universities Press, Hyderabad, 2010\
3. Astāngahrdaya, Vol. I, Sūtrasthāna and Śārīrasthāna, Translated by K. R. Srikantha Murthy, Vol. I, Krishnadas Academy, Varanasi, 1991
4. Dharampal, Some Aspects of Earlier Indian Society and Polity and Their Relevance Today, New Quest Publications, Pune, 1987
5. Dharampal, Indian Science and Technology in the Eighteenth Century: Some Contemporary European Accounts, Dharampal Classics Series, Rashtrathana Sahitya, Bengaluru, 2021. University Grants Commission 15
6. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrathana 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 \(ncmbharuch.ac.in\)](https://www.ncmbharuch.ac.in/)

2. [Courses | Bhishma School of Indian Knowledge Systems \(bhishmaiks.org\)](http://Bhishma School of Indian Knowledge Systems (bhishmaiks.org))
3. [Indian Knowledge System\(IKS\): Concepts and Applications in Engineering - Course \(swayam2.ac.in\)](http://Indian Knowledge System(IKS): Concepts and Applications in Engineering - Course (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 Semester

Course Title: - Introduction to Data Science
Course Type: Major Mandatory Paper 1 (Theory)
Course Code: 24DSC12101
Semester- II

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

- Knowledge of Computers

The main objectives of this course are to:

- Understanding the Role of Data Science in Business.
- Understanding the basic concept of Data Collection and Data Pre-Processing Data Collection Strategies.
- To understand the basic concept of Exploratory Data Analytics Descriptive Statistics.
- To understand the application of business analysis.

Expected Course Outcomes:

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

CO1	Understand and apply the basics of business analysis and Data Science Knowledge	B2, B3
CO2	Identify data management and handling and Data Science Project Life Cycle.	B1, B4
CO3	Recognize and evaluate the data mining concept and its techniques.	B5, B1

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

UNIT	Contents	No of Lectures	CO targeted
1	Introduction to Data Science <ul style="list-style-type: none"> • What is Data Science? • Historical Overview of data analysis, • Data Scientist vs. Data Engineer • Business Analyst • Why Data Science? • Evolution of Data Science • Data Science Roles • Stages in a Data Science Project • Applications of Data Science in various fields • Security Issues 	6	CO1
2	Data Collection and Data Pre-Processing Data Collection Strategies <ul style="list-style-type: none"> • Data Collection • Data Management • Big Data Management • Organization/sources of data • Importance of data quality 	8	CO2

	<ul style="list-style-type: none"> Dealing with missing or incomplete data Data Pre- Processing Overview Data Cleaning Data Integration and Transformation Data Reduction –Data Discretization 		
3	Data Classification & Data Science Project Life Cycle <ul style="list-style-type: none"> Business Requirement Data Acquisition Data Preparation Hypothesis and Modelling, Evaluation and Interpretation, Deployment 	5	CO2
4	Exploratory Data Analytics & Descriptive Statistics <ul style="list-style-type: none"> Mean Standard Deviation Skewness, and Kurtosis Box Plots – Pivot Table – Heat Map – Correlation 	4	CO3
5	Model Development and Model Evaluation <ul style="list-style-type: none"> Model Evaluation using Visualization Residual Plot – Distribution Plot Polynomial Regression, and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making Out-of-Sample Evaluation Metrics – Cross Validation – Overfitting – Under Fitting and Model Selection – Prediction by using Ridge, Regression, Testing Multiple Parameters by using Grid Search 	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"
2. "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

Course Title: - Practical Based on Data Science
Course Type: Major Mandatory Paper 2 (Practical)
Course Code: 24DSC12102
Semester- I

Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Practicals: 10	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
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Prerequisites: Student should have basic knowledge of:

- Problem Solving Skills

The main objectives of this course are to:

- To understand the concepts of Data Science
- To apply Data Science Techniques

Expected Course Outcomes:

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

CO1	Devise various data science techniques.	B6,B3,B1
CO2	Apply various data science techniques	B2,B3,B4,B5

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

UNIT	Contents	No of Sessions	CO targeted
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

CO-PO MAPPING

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

Course Title:- Graph Theory and Calculus Course Type: Major Paper 3 (Theory) Course Code: 24DSC12103 Semester- II			
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"> Knowledge of Computers 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> Understand and explore the basics of graph theory. To apply graph theory-based tools in solving practical problems To improve the analyzing skills. To enhance the creative talent to convert the verbal information into mathematical form 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Students will understand and apply the core theorems and algorithms, generating examples as needed.		B2,B3
CO2	Students will learn conversion of real-life problems into mathematical models which enhance their problem solving and decision making abilities.		B3,B6
CO3	Students will learn one variable and multivariable differential calculus		B4
CO4	Students will be able to demonstrate algorithms used in interdisciplinary areas.		B3
CO5	Students will be able to 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	Graphs <ul style="list-style-type: none"> Definition Basic terminologies 	8	CO1

	<ul style="list-style-type: none"> Types of Graphs Matrix Representation Subgraphs Operations on Graphs Isomorphism 		
2	Connected Graphs and Trees <ul style="list-style-type: none"> Walks, Paths, Circuits Connected Graphs and disconnected graphs and components. Isthmus and cut sets Definition, Properties of tree Center and radius binary trees Spanning Tree Kruskal's algorithm for spanning trees in weighted graph. Tree traversal: Pre order, post order and inorder. 	12	CO2, CO5, CO4
3	One Variable Calculus <ul style="list-style-type: none"> Limit continuity and derivative of one variable function application to find maxima minima Taylor series 	5	CO3, CO5
4	Multivariable Calculus <ul style="list-style-type: none"> Function of several variable, Limit and continuity partial derivatives, chain rule Extreme values 	5	CO2, CO3

Reference Books

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

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

- [Graph Theory - Course \(nptel.ac.in\)](http://nptel.ac.in)
- [Graph Theory | Udemy](https://www.udemy.com/)
- eskc.ac.in/wp-content/uploads/2018/12/A-Textbook-of-Graph-Theory-R.-Balakrishnan-K.-Ranganathan.pdf
- [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	--

Course Title: - Practical Based on Graph Theory Course Type: Major Paper 4 (Practical) Course Code: DSC12103 Semester- II			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No of Practicals: 10	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> Basic Mathematics 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> Understand and explore the basics of graph theory. To apply graph theory-based tools in solving practical problems To improve the analyzing skills. To enhance the creative talent to convert the verbal information into mathematical form 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Enhance problem solving skills in interdisciplinary fields.		B2,B5
CO2	Strengthen theoretical concepts by solving maximum no. of problems.		B1,B2
CO3	Learn how to apply mathematical concepts to practical and real-life problems.		B2
CO4	Students learn how to apply mathematical concepts to practical and real life problems.		B3
CO5	Interdisciplinary approach is developed.		B2,B3
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Sessions	CO targeted
1	Graphs Introduction	1	CO1 CO2 CO3 CO4 CO5
2	Types of graphs and isomorphism	1	
3	Operations on Graphs	1	
4	Connected graphs	1	
5	Euler and Hamiltonian Graphs	1	
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	

Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)
1. athena.nitc.ac.in/summerschool/Files/West.pdf

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

C05	S	L	--	L	--	M	L
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Course Title: - Discrete & Continuous Probability Distributions Course Type: Major Mandatory Paper 5 (Theory) Course Code: 24DSC12105 Semester- II			
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"> Sums of finite and infinite series and sequences. Integration and derivative calculations 			
The main objectives of this course are to: <ul style="list-style-type: none"> To get knowledge about the discrete valued variables and the different discrete probability distributions To know about continuous data and different continuous probability distributions 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
C01	Apply these distributions to the real-life data and model the real-life situations.	B3	
C02	Compute probabilities of real-life events based on probability distributions.	B5	
C03	Observe and study the real-life data with respect to probability distributions.	B5	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Discrete probability distributions I <ul style="list-style-type: none"> Degenerate distribution, Mean and Variance Discrete Uniform Distribution, Mean and Variance Discrete Bernoulli Distribution, Mean and Variance Discrete Binomial Distribution, Mean and Variance Real life examples of Uniform, Bernoulli, Binomial distributions 	7	C01
2	Discrete probability distributions-II <ul style="list-style-type: none"> Poisson distribution, Mean and Variance Geometric distribution, Mean and Variance, Memory less Property Negative Binomial distribution, Mean and Variance Hypergeometric distribution, Mean and Variance Real life examples of Poisson, Geometric, Negative Binomial distribution, Hypergeometric distribution 	8	C02
3	Some Continuous distributions <ul style="list-style-type: none"> 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. 	15	C0 1,C03

	<ul style="list-style-type: none"> • 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 U(0, 1) distribution • Exponential Distribution: statement of p.d.f. of the form $f(x) = (1/\theta) e^{-x/\theta}$, mean, variance, nature of probability curve, lack of memory property.(with proof) • 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. • Chi Square ,t, and F Distribution: pdf, mean, variance, examples 		
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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	-
S: Strong , M: Medium , L: Low, -- NA							

Course Title: - Practical Based on DCPD Course Type: Major Mandatory Paper 6 (Practical) Course Code: 24DSC12106 Semester- II			
Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No of Practicals: 10	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
Prerequisites: Student should have basic knowledge of:			

<ul style="list-style-type: none"> Basic Statistics 																																			
The main objectives of this course are to: <ul style="list-style-type: none"> Understand and explore the basics of discrete and continuous probability distributions. To improve the analyzing skills. 																																			
Expected Course Outcomes:																																			
On the successful completion of the course, student will be able to:																																			
<table border="1"> <tr> <td>CO1</td> <td>Enhance problem solving skills in interdisciplinary fields.</td> <td>B2,B5</td> </tr> <tr> <td>CO2</td> <td>Strengthen theoretical concepts by solving maximum no. of problems.</td> <td>B1,B2</td> </tr> <tr> <td>CO3</td> <td>Learn how to apply Statistical concepts to practical and real-life problems.</td> <td>B2</td> </tr> </table>	CO1	Enhance problem solving skills in interdisciplinary fields.	B2,B5	CO2	Strengthen theoretical concepts by solving maximum no. of problems.	B1,B2	CO3	Learn how to apply Statistical concepts to practical and real-life problems.	B2																										
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10	Simulation	1																																	

Related Online Content (MOOCS, SWAYAM, NPTEL, WEBSITES etc.)
1. Continuous Probability Distributions - A Beginner's Guide with Examples (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

Course Title: - Mastering English for Professional Purposes (Theory) Course Type: AEC Course Code: 24ENG12506 Semester- II			
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"> • Basic English Language • Basics of Communication and Soft Skills 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> • 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
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Speaking Skills <ul style="list-style-type: none"> • Introducing Yourself and Others • Asking for directions and information • Seeking permission, Giving and Declining Permission • Requesting and Demanding • Offering Suggestions • Agreeing, Partly Agreeing and Disagreeing 	15	CO1,CO2,CO3
2	Professional English <ul style="list-style-type: none"> • Use of English in Professional Context • Negotiating Skills • Interview Skills • Telephonic Conversation in English • English for Virtual Meeting • English for Marketing 	15	CO4

Reference Books	
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)

3. 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 \(armpr.org\)](http://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
S: Strong , M: Medium , L: Low, -- NA							

Course Title: - Democracy & Constitutional Values (Theory)			
Course Type: VEC			
Course Code: 24VEC12507			
Semester- II			
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"> Constitutional Values 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> To introduce the students meaning of democracy, Elections and decentralization (Governance) To help them understand various approaches to the study of democracy and constitutional values. 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Understand the comprehensive concept of Democracy and its facets.	B1,B2	
CO2	Understand the importance of voting and participation in the political process.	B2,B3	
CO3	Analyze socio-economic reality around them	B4,B5	
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Democracy: Foundation and Dimensions <ul style="list-style-type: none"> Constitution of India : Preamble, Rights, Duties Dimensions of Democracy- Social, Economic, and Political Module 	10	CO1
2	Elections <ul style="list-style-type: none"> Elections in India, Election Commission National Voters' Day 	10	CO2
3	Decentralized Governance <ul style="list-style-type: none"> Democratic Decentralization 73rd and 74th amendments 	10	CO3

Reference Books	
1. Banerjee-Dube, I. (2014). A history of modern India. Cambridge University Press. 2. Base, D. D. (1982). Introduction to the Constitution of India. Delhi: Prentice Hall of India. 3. 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			
Teaching Scheme: 2 Hours / Week	No. of Credits: 1	No. of Lectures: 15	Examination Scheme: CIE: 10 Marks ESE: 15 Marks
Prerequisites: Student should have basic knowledge of:			
<ul style="list-style-type: none"> • Languages Proficiency English, Hindi & Marathi 			
The main objectives of this course are to:			
<ul style="list-style-type: none"> • To familiarize students with the Heritage of ancient and eternal Indian Knowledge System. 			
Expected Course Outcomes:			
On the successful completion of the course, student will be able to:			
CO1	Explain the ideas behind astronomical phenomenon, books, and institutes of astronomy		B1
CO2	Describe different traditions of Indian Economic thoughts and organization		B3
B1 - Remember; B2 - Understand; B3 - Apply; B4 - Analyze; B5 - Evaluate; B6- Create			
UNIT	Contents	No of Lectures	CO targeted
1	Indian Astronomy <ul style="list-style-type: none"> • Ancient records of the observation of the motion of celestial bodies in the Vedic corpus • Eclipses: Lunar and Solar • Astronomical Institutes in India • Observatories • Astronomical Instruments 	8	CO1
2	Indian Economy -Indian conception of flourishing Economy <ul style="list-style-type: none"> • Basic Chronology • Peculiar features of Indian Economic Idea • Indus Valley Civilisation • Economic Thoughts in Vedas • Buddhist Economics • Economics of Mahavir • Kautilya • Thiruvalluvar 	8	CO2

Reference Books
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, Rashtrrothana Sahitya, Bengaluru, 2021. University Grants Commission 15
16. Dharampal, The Beautiful Tree: Indian Indigenous Education in the Eighteenth Century, Dharampal Classics Series, Rashtrrothana 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

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

Teaching Scheme: 2 Hours / Week	No. of Credits: 2	No. of Practicals: 15	Examination Scheme: CIE: 20 Marks ESE: 30 Marks
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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:**

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

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

UNIT	Contents	No of Practicals	CO targeted
1	Introduction <ul style="list-style-type: none"> • R interpreter, Introduction to major R data structures like vectors, matrices, • arrays, list and data frames, Control Structures, vectorized if and multiple selection, functions. 	2	CO1
2	Installing, loading and using packages <ul style="list-style-type: none"> • Read/write data from/in files, extracting data from websites, 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, Statistical analysis of data for summarizing and understanding data 	2	CO2
3	Data manipulation with R <ul style="list-style-type: none"> • List Management • Data Transformation • Merging Data Frames • Outlier Detection • Combining multiple vectors 	3	CO1,CO2
4	Data Visualization Visualizing data using scatter plot, line plot, bar chart, histogram and box plot, time series plot	3	CO3
5	Common Statistical summaries <ul style="list-style-type: none"> • Single sample summaries • The t-test • Linear regression 	5	CO3

