Syllabus of 4 + 1 Year Integrated UG and PG Programme

w. e. f 2024-25 Academic Year

GRADUATE SCHOOL

Mahatma Gandhi University

P. D. Hills P O

Kottayam, Kerala

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Schools offering Majors

SL.No	School/Centre
1	School of Bio Sciences
2	School of Chemical Sciences
3	School of Computer Sciences
4	School of Environmental Sciences
5	School of Gandhian Thought and Development Studies
6	School of International Relations and Politics
7	School of Pure and Applied Physics
8	School of Social Sciences

Sl. No.	Major	Intake
SCIENCE		
1	Bio Sciences	6**
2	Chemistry	6
3	Computer Science	6
4	Environmental Science	6
5	Physics	6
SOCIAL SCIENCES		
1	Development Studies	5
2	Gandhian Studies	5
3	History	10
4	International Relations and Politics	10

Majors offered and Intake *1 seat shall be sanctioned over and above the intake in each major in the 3rd semester for students who opt for a change of major after two semesters.

**Progression to PG Shall be based on the specialization selected by students as Biochemistry (2 seats) Biotechnology (2 seats) and Microbiology (2 seats) based on merit.

Schools offering Minors/MDCs/AECs/VACs/SECs

SL.No	School/Centre
1	School of Artificial Intelligence And Robotics
2	School of Behavioural Sciences
3	School of Biosciences
4	School of Chemical Sciences
5	School of Computer Sciences
6	School of Data Analytics
7	School of Energy Materials
8	School of Environmental Sciences
9	School of Food Science And Technology
10	School of Gandhian Thought And Development Studies
11	School of Gender Studies
12	School of Indian Legal Thought
13	School of International Relations And Politics
14	School of Letters
15	School of Mathematics And Statistics
16	School of Nanoscience And Nano Technology
17	School of Pedagogical Sciences
18	School of Polymer Science And Technology
19	School of Pure And Applied Physics
20	School of Social Sciences
21	School of Tourism Studies
22	International and Inter University Centre for Nanoscience and Nanotechnology
23	K N Raj School of Economics

Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University
School of Mathematics and Statistics

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
	Major	4			Foundation (100-199)	Not offered in 2024-25
MG1DSCUST141	**Minor B (Statistics):** Fundamentals of Statistical Data Management and Probability	4	4		"	Minor
MG1DSCUMT121	**Minor A (Mathematics):** Differential Calculus and Matrices	4	4		"	Minor
MG1MDCUST101	**MDC (Statistics):** Elements of Statistics and Probability	3	3		"	MDC (Statistics)
MG1MDCUMT101	**MDC (Mathematics):** Mathematical Computing, Trigonometry and Elementary Calculus	3	3			MDC (Mathematics)
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER II						
	Major	4			"	Not offered in 2024-25
MG2DSCUST141	**Minor B (Statistics)**: Probability Models and Relation	4	4		"	Minor

	Analysis					
MG2DSCUMT121	**Minor A (Mathematics):** Integral Calculus and Differential Equations	4	4		"	Minor
MG2MDCUST101	**MDC (Statistics):** Probability Models and Statistical Inference	3	3		"	MDC (Statistics)
MG2MDCUMT101	**MDC (Mathematics):** Operations Research	3	3			MDC (Mathematics)
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER III						
	Major	4			Intermediate (200-299)	
	Major	4				
	Major	4				
MG3DSCUMT221	**Minor A (Mathematics):** Analytic Geometry, Abstract Algebra and Special Functions	4	4			Minor
	MDC	3				
	VAC	3				

SEMESTER IV						
	Major	4				
	Major	4				
	Major	4				
MG4DSCUST241	**Minor B (Statistics):** Statistical Inference and Applications	4	4			Minor
	SEC	3				
	VAC	3				
	Internship/Fieldwork	2				
SEMESTER V						
	Major	4			Higher (300-399)	
	Major	4			“	
	Major	4			“	
	Major	4			“	
	SEC	3			“	

	VAC	3			“	
SEMESTER VI						
	Major	4			“	
	Major	4			“	
	Major	4			“	
	Major (E)	4			“	
	Major (E)	4			“	
	SEC	3			“	
Total Credits		**133**				

SEMESTER VII						
	Major	4			Advanced (400-499)	
	Major (E)	4			“	
	Major (E)	4			“	
MG7DSCUST441	**Minor B** **(Statistics):** Applied Statistics	4			“	
MG7DSCUMT421	**Minor A (Mathematics):**	4			“	

	Vector Calculus and Numerical Analysis					
	Minor A/B (E)	4			"	
SEMESTER VIII						
	Major	4			"	
	Major (E)	4			"	
	Research Project	12			"	
	Major*	4			"	
	Major*	4			"	
	Major*	4			"	
Total Credits		**44**				
SEMESTER IX						
	Major	4			PG Level (500-599)	
	Major	4			"	
	Major	4			"	
	Major	4			"	
	Major	4			"	
SEMESTER X						
	Research Project	20			"	
	Major**	4			"	
	Major**	4			"	
	Major**	4			"	
	Major**	4			"	
	Major**	4			"	
Total Credits		**40**				

*Only for 4-Years Honours Students

**Only for students who opt for theory courses instead of Research Project

Note: General foundations courses shall be offered by different schools. Students can flexibly choose the courses across disciplines.

Level	Foundation (100-199	Intermediate (200-299)	Higher (300-399)	Advanced (400-499)	PG Level (500-599)

Type	Major	Minor	MDC	SEC	VAC	AEC

Mahatma Gandhi University Kottayam
School of Mathematics and Statistics
4+1 Integrated UG and PG Programme
UG Mathematics

Introduction:

The **School of Mathematics & Statistics (SMS)** was established in 2020-21 for providing teaching, research and training in theoretical and applied areas of mathematical sciences with interdisciplinary applications.In the present data driven world all types of research, decisions and planning are deep rooted in mathematics and statistics. Mathematics and Statistics are fundamental disciplines of study and constitutes most important tools for all programs of study and research as well as industry and management. India had a rich heritage of Mathematicians and Statisticians like Srinivasa Ramanujan, Prof. Harish Chandra, Prof. P.C. Mahalanobis, Prof. C. R. Rao, Prof. SRS Varadhan etc. Kerala had a rich heritage of a School of Mathematics and Astronomy during 14th century, founded by Madhava of Sangamagrama which included among its members Parameshvara, Neelakanta Somayaji, Jyeshtadeva, Achyuta Pisharati, Melpathur Narayana Bhattathiri and Achyuta Panikkar.

In this era of information explosion, Mathematics has assumed a key role and distinct dimension, finding its applicability in diverse areas. This ranges from classical subjects like Physics and Chemistry to Systems Biology, Bio informatics, Mathematical Chemistry, Epidemiology etc. Moreover the study of mathematical sciences is to be encouraged in order to make people more literate in Mathematics ad Statistics. At national level the MHRD, DST, NBHM, CSIR etc are encouraging mathematics education and research with good financial support. The Govt. of Kerala, SSA, KSCSTE etc are making all efforts to create interest in mathematics education to students. Every year, Govt. of India has been celebrating National Mathematics Day on 22 December since 2012 The UG curriculum and syllabi are prepared to provide necessary understanding of fundamental mathematical concepts with applications in various disciplines.

Program Specific Outcomes:

PSO1	To provide a fundamental teaching and training in the theory and application of mathematics and enable extension to other areas.	
PSO2	To provide a platform for talented students to undergo higher studies in the subject as well as to train them to suit for the needs of the society.	
PSO3	To allow more flexibility to branch out in other multidisciplinary areas.	
PSO4	To create special interest in interdisciplinary areas in mathematics and to enhance an innovative research mind.	
PSO5	To impart training to pass national level test and other competitive examinations and to empower the employability in India and abroad.	
PSO6	To en able students to apply the mathematical techniques to solve problems and issues in real world life.	

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Mathematics**		
Course Title	**Differential Calculus and Matrices**		
Course Type	**Minor A**		
Course Level	**100-199**		
Course Code	**MG1DSCUMT121**		
Course Overview	This course introduces the Theory and Applications of Differential Calculus as well as Matrices. Partial derivatives and the rules for differentiating several variable functions are also introduced. The students will be enabled to solve systems of linear equations, evaluate characteristic roots and characteristic vectors and apply Cayley Hamilton Theorem for finding inverse.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Mathematics at Plus Two Level/Higher Secondary		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Analyse the behaviour of functions and evaluate limits	An, E	1
2	Analyse the geometrical concepts of partial derivatives and apply the rules for differentiating several variable functions	A, An	2
3	Understand Matrix transformations and evaluate system of	U, E	3

	equations		
4	Evaluate characteristic roots and characteristic vectors for square matrices and utilize the applications of Cayley - Hamilton Theorem.	An, E	4

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Analysis of Functions -I : Increasing, Decreasing, convex and concave functions, Analysis of Functions -II : Relative Extrema, L' Hospital's Rule, Indeterminate Forms, Applications Text-1 : Chapter 3- section 3.1 & 3.2 (Geometric implications of multiplicity, Analysis of polynomials are excluded) and Chapter- 6 section 6.5	**15**	**1**
Module 2		
Partial derivatives, The Chain Rule, Extreme values and Saddle points and their applications. Text-2 : Chapter 14, sections 14,3,14.4 and 14.7	**15**	**2**
Module 3		
Rank of a matrix, Elementary Transformations of a matrix, Reduction to normal form, Employment of only row (column) Transformations, Inverse of a matrix, Systems of linear equations and applications. Text – 3 : Chapter 4 - Sections 4.1 to 4.8 and section 4.11, Chapter 6 : Sections 6.1 to 6.6	**15**	**3**
Module 4		
Characteristic roots and Characteristic vectors, Fundamental Theorems, Cayley - Hamilton Theorem and applications. Text- 3. Chapter-11- Sections 11.1 , 11.2 and section 11.11	**15**	**4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Field activities:** Case studies and Problem solving sessions **Lab based activities:** Softwares will be used
Mode of Assessment	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks 2. Assignments and Quiz: 10 marks

	3. Seminars and Presentations: 10 marks
	B. **End Semester Evaluation (ESE)** **Theory & Practice: 60 marks**

Learning Resources

1. Anton, Howard, Irl C. Bivens , Stephen Davis: *Calculus.* 10 th Edition. John Wiley & Sons, Inc., 2012.
2. Thomas, George B., Jr., and Maurice D. Weir: *Thomas' Calculus*. 12 th Edition. Pearson, 2009
3. Shanti Narayan , P. K Mittal : *A Text Book of Matrices,* S. Chand and Company Limited

Relevance of Learning the Course/ Employability of the Course
Study of differential calculus and its applications is necessary for understanding various applied areas of Physics, Chemistry, Astrophysics Engineering etc. These are widely used in Electro Magnetic Theory, Fractional Calculus, Statistical Physics, Wave Theory, Music etc. Matrix Theory, Linear Algebra, Characteristic roots and vectors are of use in image analysis, Natural language processing etc. These are the emerging tools in Data Science and Machine Learning. Knowledge of these topics ensure wide scope for teaching, research and employment.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**SCHOOL OF MATHEMATICS AND STATISTICS**		
Programme	**Mathematics**		
Course Title	**Mathematical Computing, Trigonometry and Elementary Calculus**		
Course Type	**MDC**		
Course Level	**100-199**		
Course Code	**MG1MDCUMT101**		
Course Overview	This course is expected to give an awareness and understanding of basic concepts and applications of Number system and Logical reasoning, system of equations and solutions, Mathematical Computing, Trigonometry and Elementary Calculus.		
Semester	1	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Plus Two/Higher Secondary Pass in any area		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand number system and apply techniques for solving basic arithmetic.	U,A	1,5
2	Evaluate business problems and acquire skill for financial analysis	E,An,S	3

3	Analyse and simplify equations using trigonometric functions and evaluate practical application in solving problems related to heights and distances.	An,E,S	5
4	Develop the concept of limit, continuity and differentiation.	U,An	1

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1: Number System and Logical Reasoning	**Hours**	**CO No**
Number system and number series, HCF and LCM of Integers, fraction, percentage, ratio and proportion, , profit and loss. Chapter 1(section 1.1 – 1.4,1.7), Chapter 2(section 2.1 – 2.6), Chapter 3(section 3.1,3.2), chapter 5(section 5.1 – 5.4), Chapter 7(section 7.1 – 7.5), Chapter 13(section 13.1 – 13.3)	**15**	**1**
Module 2: Commercial Mathematics		
Nominal rate of interest and effective rate of interest, continuous compounding, compound interest calculation at varying rate of interest, present value, interest and discount, nominal rate of discount, effective rate of discount and force of discount, depreciation Chapter 8 – Section 8.1 – 8.7, Section 8.9	**15**	**2**
Module 3: Trigonometry & Calculus		
Angles - measurements of angles, trigonometric ratios for angles, simple problems in height and distance, identities and trigonometric equations. Part I: Section 1,2,3 and 9 Functions, limits and its computation, continuity, the derivative functions, the chain rule, local linear approximation; differential. Chapter 0(Section 0.1), Chapter 1(Section 1.1, 1.2, 1.5), Chapter 2(Section 2.2, 2.6, 2.9)	**15**	**3, 4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Field activities:** Case studies and Problem solving sessions **Lab based activities:** MS Excel and software will be used
Mode of Assessment	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks 2. Assignments and Quiz: 10 marks 3. Seminars and Presentations: 10 marks

	B. **End Semester Evaluation (ESE)** **Theory & Practice: 60 marks**

Learning Resources

1. AbhijithGuha: *Quantitative Aptitude for Competitive Examination,* McGraw Hill Education 2011, 4th Edition
2. B M Aggarwal: *Business Mathematics & Statistics,* Ane Books Pvt. Ltd
3. S. L. Loney: *Plane Trigonometry*
4. Anton, Bivens, Davis: *Calculus,* 10th Edition, John Wiley & Sons

Relevance of Learning the Course/ Employability of the Course
This course will enable students to understand basic concepts in Mathematics and their applications in everyday life. This can help you to succeed in competitive examinations. This will be of much use for students opting applied subjects in social sciences, management etc.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School for Mathematics and Statistics**		
Programme	**Mathematics**		
Course Title	**Integral Calculus & Differential Equations**		
Course Type	**Minor A**		
Course Level	**100-199**		
Course Code	**MG2DSCUMT121**		
Course Overview	This course introduces the basic concepts and applications of Integral calculus and differential equations. This will enable students to evaluate surface area of solids by double integration as well as to evaluate homogenous and non homogenous higher order differential equations.		
Semester	2	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60		
Pre-requisite	Higher Secondary/ Plus Two level Mathematics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Evaluate surface area of solids by double integration	R,U,E	1
2	Apply the concept of Triple Integration in polar coordinates and rectangular coordinates	A,An	2
3	Analyse and evaluate ordinary differential Equations	A, An	3

4	Evaluate homogenous and non homogenous higher order differential equations	E,C	4

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Double integration, Change of the order of integration, Fubini's Theorem, Double integrals over general regions, area by double integration, Double integration in polar forms. Text-1: Chapter 15- sections 15.1, 15.2 , 15.3, 15.4	**15**	**1**
Module 2		
Triple integrals in polar coordinates, Triple integrals in rectangular coordinates, Substitutions in double integrals, Substitutions in triple integrals Text-1 : Chapter-15 – Sections 15.5, 15.7 & 15.8	**15**	**2**
Module 3		
Exact Differential Equations and Integrating Factors, Separable Equations and Equations Reducible to this form, Linear Equations, Bernoulli Equations Text 2: Chapter 2 – Sections: 2.1 (Theorem 2.1 statement only), 2.2 & 2.3	**15**	**3**
Module 4		
Definition and Basic Existence Theorem, The Homogeneous Equation, Reduction of Order, The Non-Homogeneous Equation, Constant Coefficients, The Method of Undetermined Coefficients Text 2: Chapter 4 – Sections: 4.1 A, 4.1 B, 4.1 C, 4.1 D, 4.2 and 4.3	**15**	**4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Field activities:** Case studies and Problem solving sessions **Lab based activities:** MathematicalSoftwares will be used
Mode of Assessment	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks 2. Assignments and Quiz: 10 marks 3. Seminars and Presentations: 10 marks

	B. **End Semester Evaluation (ESE)** **Theory & Practice: 60 marks**

Learning Resources

1. Thomas, George B., Jr., Maurice D. Weir: *Thomas' Calculus*, 12th ed. Pearson, 2009.

2 . Ross, Shepley L.: *Differential Equations*. 3 rd ed. Wiley. 2013.

Relevance of Learning the Course/ Employability of the Course
A knowledge and deep understanding of Integral Calculus and Differential Equations is needed to get good insights to various concepts in Statistics, Physics, Chemistry and Computer Science. These are widely used in Financial Modelling, Fluid Dynamics, Thermodynamics etc. Those who are experts in these areas have high opportunities for employment and research in Space Technology, Astrophysics, Industrial Mathematics etc.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Mathematics**		
Course Title	**Operations Research**		
Course Type	**MDC**		
Course Level	**200-299**		
Course Code	**MG2MDCUMT101**		
Course Overview	This course gives an elementary level introduction to Operations Research, Linear Programming, Transportation problems, Assignment problems, Project Management using PERT, CPM etc. It enables optimal decision making and project implementation.		
Semester	2	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Pass in Plus Two		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Apply Graphical Method for finding the solutions of Linear Programming Problem.	A	1,5

2	Evaluate transportation network problems and Assignment problems	E	3
3	Explain the concept of PERT and CPM	U	1
4	Explain the Phases of Project management	U	3,4

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1: Introduction to Operations Research (OR), Linear Programming	**Hours**	**CO No**
The origin and definition of OR. Operation Research approach to problem solving. Advantages and Applications of OR, structure, advantages and limitations of linear Programming. General Model of LPP and guidelines on LP model formulation, Mathematical formulation LP problem, Graphical solution of general LPP(only bounded case) Chapter 1 - Sec 1.1 to 1.5, 1.10 to 1.13, Chapter 2- Sec 2.2,2.3,2.6,2.7,2.8,3.1 to 3.3	**20**	**1**
Module 2: Transportation Problem and Assignment Problem		
Mathematical Model of Transportation Problem, the transportation Algorithm, methods of finding initial solution, North-west corner method, least cost method, Vogel's Approximation method. Mathematical model of Assignment problem, solution of Assignment Problem- Hungarian method only, problems based on Hungarian method Chapter 9 - Sec 9.1 to 9.4, Chapter 10 - Sec 10.1 to 10.3	**20**	**2**
Module 3: Project Management-PERT and CPM		
Basic difference between PERT and CPM, significance of using PERT/CPM. Phases of project management, PERT/CPM network components and precedence relationships rules for AOA network construction, Errors and Dummies in Network. Solving problems of drawing network. Chapter 13 - Sec 13.1 to 13.4	**20**	**3,4**

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Field activities:** Case studies and Problem solving sessions

	Lab based activities: MathematicalSoftwares will be used
Mode of Assessment	**MODE OF ASSESSMENT** **A. Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks 2. Assignments and Quiz: 10 marks 3. Seminars and Presentations: 10 marks
	B. End Semester Evaluation (ESE) **Theory & Practice: 60 marks**

Learning Resources

1. Text : J. K Sharma, Operations Research:- Theory and Applications, Sixth Edition, Trinity Press2016.
2. KantiSwarup, P.K Gupta, Man Mohan, Operations Research, Sultan Chand & sons 1990
3. Handy Taha, Operations Research: An Introduction, Tenth edition. Pearson 2016.

Relevance of Learning the Course/ Employability of the Course
Operations Research is a Mathematical management technique used for systematic implementation of projects in industries, business and management firms. This course will be of much use for students from Social Sciences and Management as well as Sciences. This will ensure job opportunities in Project Management. It is of much use in inventory management and networks for making optimal decisions.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Mathematics**		
Course Title	**Analytic Geometry, Abstract Algebra and Special Functions**		
Course Type	**Minor A**		
Course Level	**200-299**		
Course Code	**MG3DSCUMT221**		
Course Overview	This course gives basic knowledge about three different areas in Mathematics-Analytic Geometry, Group Theory and Special Functions. These are widely used in applications of Physics, Chemistry, Statistics etc.		
Semester	**3**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	0	
Pre-requisite	Higher Secondary Level mathematics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Learn basic concepts in Analytic Geometry	U,E	1,5
2	Understand some introductory concepts of Group	R,U,A,	1

	Theory.		
3	Classify different kinds of groups with reference to its various properties.	A,E	1
4	Develop strong foundation about Laplace Transforms.	U,An	1,3

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1: Analytic Geometry	**Hours**	**CO No**
Parametric Equations; Tangent Lines and Arc Length for Parametric Curves, Polar Coordinates, Tangent Lines, Arc Length, and Area for Polar Curves, Conic Sections. **Text 1: Chapter 10 – Sections: 10.1,10.2,10.3& 10.4.**	**15**	**1**
Module 2: Introduction to Group Theory		
Binary Operations – Definitions and Examples, Groups – Definition, Examples, Groups - Elementary Properties, Group Isomorphism, Group Tables and Examples of Abelian Groups. **Text 2: Chapter 1 – Sections: 1,2,3.**	**15**	**2**
Module 3: Types of Groups		
Examples of non-abelian groups and Permutation Group, Group of symmetries of Equilateral Triangles, Dihedral Group, Symmetric Groups and Disjoint Cycles, Subgroups, Cyclic Groups and Cyclic Subgroups. **Text 2: Chapter 1 – Sections: 4,5,6.**	**15**	**3**
Module 4: Special Functions		
Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives and Integrals-ODEs, Differentiation, Unit Step Functions, Second Shifting Theorem(statement only)& applications, Differentiation and Integration of Transforms, Gamma Function and its properties, Beta Function and its properties. **TEXT 3: Chapter 6 – Sections 6.1,6.2,6.3,6.6.** **TEXT 4: Chapter 11 – Section 11.3,11.6& 11.7.**	**15**	**4**

Mode of Transaction	Classroom activities: Problem solving sessions, group discussions, seminars, interactive classes giving more insight onto daily life applications.
Mode of Assessment	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks

	2. Assignments and Quiz: 10 marks 3. Seminars and Presentations: 10 marks
	B. **End Semester Evaluation (ESE)** **Theory & Practice: 60 marks**

Learning Resources

1. Anton, Bivens, Davis. *Calculus*,10thed.,John Wiley & Sons, INC

2. Fraleigh, John B.;. Brand, Neal E. *A First Course in Abstract Algebra* 8th Edition, Pearson Education 2021.

3. Kreyszig, Erwin. *Advanced Engineering Mathematics,* Wiley Student Edition, 8th Edition, 2006.

4. Mary L. Boas. Mathematical Methods in the Physical Sciences, Third Edition, John Wiley & Sons.

Relevance of Learning the Course/ Employability of the Course
Analytic Geometry is a fundamental branch of Mathematics that merges Algebra with Geometry to study shapes using coordinates and equations. It equips students to solve problems related to Geometry. Abstract Algebra serves as the foundation for many modern technologies and innovations, shaping the way we interact with the world around us. It is one of the strong subject areas in Mathematics which enhance the analytic knowledge and combined with basics in Laplace Transforms will improve the problem solving ability of students in different realms such as Physics, Chemistry, Statistics etc.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Mathematics**		
Course Title	**Vector Calculus and Numerical Analysis**		
Course Type	**Minor A**		
Course Level	**400-499**		
Course Code	**MG7DSCUMT421**		
Course Overview	This course is designed to give an introduction to some concepts of vector calculus and various numerical methods to find approximate solutions of mathematical problems rather than the exact ones. It is widely used in Physics, Statistics, Computer Science, Engineering etc.		
Semester	7	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	0	
Pre-requisite	Higher Secondary level Mathematics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Learn the basic concepts of vector algebra and evaluate directional derivatives and gradient vectors.	U, E	1,2
2	Apply Green's theorem in plane and analyse curl and	A, An	4

	divergence in three dimension.		
3	Determine the roots of algebraic and transcendental equations.	U,E	3
4	Estimate the values of unknown data points that fall in between existing known data points.	U, An, E	4

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1 – Vector Differentiation	**Hours**	**CO No**
Vector Algebra (Review), Vector functions, Derivatives of vector functions, Arc length and unit tangent vector, Curvature and normal vectors of a curve, Directional derivatives in planes, Interpretation of directional derivatives, Gradient and Tangents to level curves. **Text 1: Chapter 13 – Sections: 13.1,13.3,13.4** **Chapter 14 – Section 14.5**	**15**	**1**
Module 2 – Vector Integration		
Line integrals, Vector fields and line integrals: work, circulation and flux, Path independence, conservative field and potential function (proofs of theorems excluded),Green's theorem in plane (statement and problems only),Curl, Divergence in three dimensions. **Text 1: Chapter 16– Sections: 16.1, 16.2, 16.3, 16.4, 16.7 (Curl only) & 16.8 (Divergence in three dimension only).**	**15**	**2**
Module 3 – Solutions of Algebraic and Transcendental Equations		
Numerical Analysis: Mathematical Preliminaries, Errors and their Computations, Introduction to algebraic and transcendental equations, Bisection Method, Method of False Position, Iteration Method, Newton-Raphson Method,Generalized Newton's method. **Text 2: Chapter 1 – Sections: 1.1, 1.2, 1.3.** **Chapter 2 – Sections: 2.1, 2.2, 2.3, 2.4, 2.5.**	**15**	**3**
Module 4: Interpolation		**CO**
Introduction to Interpolation, Errors in polynomial Interpolation, Finite Differences - Forward, Backward and Central Differences, Detection of error by use of difference table, Differences of a Polynomial, Newton's Formulae for Interpolation, Central Difference: Gauss's Central difference formulae – Gauss forward formula and Gauss backward formula.	**15**	**4**

Text 2: Chapter3 – Sections: 3.1,3.2,3.3(3.3.4 excluded),3.4,3.5,3.6 & 3.7.1.		

Mode of Transaction	Classroom activities: Problem solving sessions, group discussions, seminars, interactive classes giving more insight onto daily life applications.
Mode of Assessment	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks 2. Assignments and Quiz: 10 marks 3. Seminars and Presentations: 10 marks
	B. **End Semester Evaluation (ESE)** **Theory & Practice: 60 marks**

Learning Resources

1. Thomas, George B., Jr., Maurice D. Weir. *Thomas' Calculus*. 12th Edition. Pearson, 2009.

2. Sastry, S. S. *Introductory Methods of Numerical Analysis,* 5th Edition, PHI Learning Private Limited, 2013.

Relevance of Learning the Course/ Employability of the Course
The concept of Vector Calculus can be incorporated in solving problems in various scientific fields. The physical interpretation of vector calculus is to interpret the gradient of a vector field as giving the direction and magnitude of fastest increase, the curl of a vector field in terms of a rotational motion in a fluid and the divergence of a vector field in terms of expansion and contraction of a fluid. As a branch of Mathematics, Numerical analysis, helps to design the methods that give approximate but accurate numerical solutions, which is useful in cases where the exact solution is impossible or prohibitively expensive to calculate. This is of wide use in Physics, Chemistry, Statistics, Engineering and related areas.

School of Mathematics and Statistics
Scheme for 4 + 1 Integrated UG and PG Programme
Graduate School
Mahatma Gandhi University, Kottayam

Course Code	Title	Credits	Hours per Week		Level	Type
			Theory	Practicals		
SEMESTER I						
	Major	4			Foundation (100-199)	Not offered in 2024-25
MG1DSCUMT121	**Minor A (Mathematics):** Differential Calculus and Matrices	4	4		"	Minor
MG1DSCUST141	**Minor B (Statistics):** Fundamentals of Statistical Data Management and Probability	4	4		"	Minor
MG1MDCUST101	**MDC (Statistics):** Elements of Statistics and Probability	3	3		"	MDC (Statistics)
MG1MDCUMT101	**MDC (Mathematics):** Mathematical Computing, Trigonometry and Elementary Calculus	3	3			MDC (Mathematics)
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER II						
	Major	4			"	Not offered in 2024-25
MG2DSCUMT121	**Minor A (Mathematics):** Integral Calculus and Differential	4	4		"	Minor

	Equations					
MG2DSCUST141	**Minor B (Statistics)**: Probability Models and Relation Analysis	4	4		"	Minor
MG2MDCUST101	**MDC (Statistics):** Probability Models and Statistical Inference	3	3		"	MDC (Statistics)
MG2MDCUMT101	**MDC (Mathematics):** Operations Research	3	3			MDC (Mathematics)
	AEC (Eng)	3			"	
	AEC (Mal)	3			"	
SEMESTER III						
	Major	4			Intermediate (200-299)	
	Major	4				
	Major	4				
MG3DSCUMT221	**Minor A (Mathematics):** Analytic Geometry, Abstract Algebra and Special Functions	4	4			Minor
	MDC	3				
	VAC	3				
SEMESTER IV						
	Major	4				
	Major	4				
	Major	4				
MG4DSCUST241	**Minor B (Statistics):** Statistical Inference and Applications	4	4			Minor
	SEC	3				

	VAC	3				
	Internship/Fieldwork	2				
SEMESTER V						
	Major	4			Higher (300-399)	
	Major	4			“	
	Major	4			“	
	Major	4			“	
	SEC	3			“	
	VAC	3			“	
SEMESTER VI						
	Major	4			“	
	Major	4			“	
	Major	4			“	
	Major (E)	4			“	
	Major (E)	4			“	
	SEC	3			“	
Total Credits		**133**				

SEMESTER VII						
	Major	4			Advanced (400-499)	
	Major (E)	4			“	
	Major (E)	4			“	
MG7DSCUMT421	**Minor A (Mathematics):** Vector Calculus and Numerical Analysis	4			“	
MG7DSCUST441	**Minor B** **(Statistics):** Applied Statistics	4			“	
	Minor A/B (E)	4			“	

	Mathematics/Statistics					
SEMESTER VIII						
	Major	4			“	
	Major (E)	4			“	
	Research Project	12			“	
	Major*	4			“	
	Major*	4			“	
	Major*	4			“	
Total Credits		**44**				
SEMESTER IX						
	Major	4			PG Level (500-599)	
	Major	4			“	
	Major	4			“	
	Major	4			“	
	Major	4			“	
SEMESTER X						
	Research Project	20			“	
	Major**	4			“	
	Major**	4			“	
	Major**	4			“	
	Major**	4			“	
	Major**	4			“	
Total Credits		**40**				

*Only for 4-Years Honours Students

**Only for students who opt for theory courses instead of Research Project

Level	Foundation (100-199	Intermediate (200-299)	Higher (300-399)	Advanced (400-499)	PG Level (500-599)

Type	Major	Minor	MDC	SEC	VAC	AEC

SCHOOL OF MATHEMATICS & STATISTICS
UG STATISTICS

Introduction

In the emerging data driven world, Statistics education is receiving much attention in the national and international levels for making wise decisions. With the establishment of Indian Statistical Institute by Professor P.C. Mahalanobis, India emerged out as a premier centre in statistics teaching, training and research. The School of Mathematics & Statistics was established in the Mahatma Gandhi University, Kottayam during 2020-21.

Kerala has produced a number of reputed statisticians at international level like U.S.Nair, K.R.Nair, KCS Pillai, R.N.Pillai, T. Kailath, Vijayan Nair, A.M. Mathai, Bovas Abraham, Thomas Mathew, Peethambaran Kartha etc. The Ministry of Statistics and Program Implementation (MOSPI) and Central Statistical Office is striving to revamp the Official Statistical System and Teaching, Research and Training in Statistics and related areas. The Central Statistical Commission was formed to monitor these quality enhancement drive. Every year, Govt. of India has been celebrating National Statistics Day on 29 June since 2006, in order to create interest in Mathematics ad Statistics among children and public.

Statistics UG - Program Specific Outcomes (PSO)

PSO 1	After undergoing this program, students will get advanced knowledge in theory and applications in all areas of Statistics and Applied Statistics including Biostatistics, Epidemiology, Data Science, Data Analytics etc.
PSO 2	Students are able to plan and execute statistical surveys and projects for research and development and official purposes as well as to undertake any work involving exploratory data analysis, statistical modeling, data learning etc. using various statistical software's.
PSO 3	Students can quantify and measure uncertainties using probability and statistical data.
PSO 4	Students are well trained to appear in national level tests like UGC-CSIR NET-JRF, GATE examinations, ISS and Civil Services examination etc.
PSO 5	Students are motivated to pursue teaching and research in all emerging areas of research in theoretical and applied branches of statistics and related disciplines.

PSO 6	Students have acquired necessary industrial skills for applications in industry.

	MAHATMA GANDHI UNIVERSITY, KOTTAYAM **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	School of Mathematics and Statistics		
Programme	Statistics		
Course Title	Fundamentals of Statistical Data Management and Probability		
Course Type	Minor B		
Course Level	100-199		
Course Code	MG1DSCUST141		
Course Overview	This course helps to acquire basic knowledge of various statistical methods and data management. Each module is focused on theoretical as well as practical aspects. Students will learn types of data, data management, data visualization, summary statistics, correlation, regression and their real world applications with suitable examples.		
Semester	1	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Plus Two Mathematics/Statistics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Explainandunderstandtheconceptsofdifferenttypesof data, sources of data, scales of measurement, methods of data collection, data managementand data visualization techniques.	R,A,An,C,S	1,2,3,4, 5
2	Summarize data using various measures of central tendency, dispersion, skewness, kurtosis and Lorenz curve.	R,U, A, An, E, S	1,2,3,4,5
3	Understand basic probability concepts including randomexperiments,samplespace, probability for measuring uncertainty, Conditional probability, independence, Bayes'theorem and its applications to update probabilities based on new information and evidence.	R, A, An, E	1,2,3,5,7
4	Understandconcepts of Random variables and Probability Distributions as well as pgf, mgf, characteristic function etc. Also students are able to compute the mean and variance, moments etc. and interpret them.	R, U, E,C,S	1,2,3,4,5

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Data Management Methods	**15**	**1**
1.1 Typesofdataandvariables:Conceptsofprimarydataandsecondary data, various sources of data with examples. 1.2 Scalesofmeasurements:Ordinal,nominal,ratioandinterval. 1.3 Methods of data collection and data management, questionnaire		

and schedule, Classification of data, Data Cleaning and Editing 1.4 Data visualization techniques: Diagrams and Graphs: Bardiagrams, pie diagram, cartograms, frequency table, stem and leaf diagram, frequencygraphs, histogram, frequency curve, ogives. Illustrative examples using real life data; Practical using MS Excel.		
Module 2		
Summarization of Data	**15**	**2**
2.1 Measuresofcentraltendency:ArithmeticMean(AM),GeometricMean(GM),HarmonicMean(HM),medianandmode 2.2 Measures of dispersion: Range, Quartile Deviation (QD), MeanDeviation(MD)andStandardDeviation(SD),CoefficientofVariation(CV), Box Plot and Lorenz Curve. 2.3 Moments, Skewness and Kurtosis. Applications and illustrations using real life data sets; Practical using MS Excel.		
Module 3		
Fundamentals of Probability	**15**	**3**
3.1 Basic probability concepts, random experiments, sample space 3.2 Definitions of probability, classical, empirical, subjective and axiomatic, Conditional probability, Addition and Multiplication rules, Marginal probability, Independence of events. 3.3 Bayes'theorem, prior and posterior probabilities, sensitivity, specificity, false positive, false negative, Illustrations and Applications in real contexts; Practical using MS Excel.		
Module 4		
Random Variables and Probability Distribution	**15**	**4**
4.1 Definition of random variables, Discrete and Continuous random variables. Illustrative examples from real life; pdf and cdf, simple properties, change of variables. Illustrative examples. 4.2 Probability generating function, moment generating function,		

characteristic function and their simple properties. 4.3 Expectation of a random variable, variance and moments, inter relationships and applications. 4.4 Bivariate pdf, joint distribution, marginal and conditional distributions, independence of two random variables, illustrative problems.		

Mode of Transaction	**Classroom activities:** Direct Instruction:Brainstorming lecture, E-learning, interactive Instruction,Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Lab activities:ProblemSolving , Data Analysis & Interpretation** (A practical record with at least 8-10 problems has to be submitted). Students have to solvenumericalproblems and analysis of data &interpretation associated with the topicscovered in various modules.
Mode of Assessment	**MODEOFASSESSMENT** **A. ContinuousComprehensiveAssessment(CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks 2.Assignments, Seminars, Presentations and Quiz: 10 marks 3. Practical(Problem Solving Skills, PracticalRecord): 10 marks
	B. EndSemesterEvaluation(ESE) **Theory& Practice:60marks**

Learning Resources

References:

1. Gupta,S.C.andKapoor,V.K. (2020).*FundamentalsofMathematicalStatistics,*12th Edition, Sultan Chand and Sons.

2. Pal. N. and Sarkar, S. (2005). *Statistics: Concepts and Applications*. Prentice Hall of India.
3. Sarma, K.V.S. (2007). *Statistics Made Simple*. 2nd Edition, Prentice Hall of India.
4. BeverlyJ.Dretzke.(2008).*StatisticswithMicrosoft*Excel,4thEdition,Pearson.

SuggestedReadings:

1. Medhi,J. (2006).*StatisticalMethods*,2ndEdition,NewAgeInternationalPublishers.
2. Gupta,S.P. (2021).*StatisticalMethods*,46thEdition,SultanChandandSons:NewDelhi.
3. Antonisamy, B. Premkumar, P. S. Christopher, S. (2017). *Principles and Practice of Biostatistics,* 1st Edition, Elsevier.
4. Mukhopadhyay,P.(1999).*Mathematical Statistics*, New Central Book Agency Private Limited, Kolkata.

Relevance of Learning the Course/ Employability of the Course
(i) It provides a platform for students to get advanced knowledge in theory and applications of Probability and basic concepts of Statistics and Applied Statistics including Biostatistics, Epidemiology, Data Science, Data Analytics etc. (ii) It enhances students to plan and execute statistical surveys and analysis for research and development and official purposes. (iii) It helps to undertake any work involving exploratory data analysis, official statistics, statistical modeling, data learning etc. (iv)It can lead to careers in Govt. and Private sectors involving Data Management, Risk Analysis etc. (v) It can be applied in teaching and research in all emerging areas ofresearch in theoretical and applied branches of Statistics and related disciplines.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Statistics**		
Course Title	**Elements of Statistics and Probability**		
Course Type	**MDC**		
Course Level	**100-199**		
Course Code	**MG1MDCUST101**		
Course Overview	This course helps to acquire basic knowledge of various statistical methods and probability theory. Each module is focused on theoretical as well as practical applications. Students will learn about various types of data, its management and basics of probability theory. Students can summarize data using statistical techniques and explore the applications in real world contexts.		
Semester	1	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Higher Secondary, Plus Two any stream		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the importance of statistics in the field of data and its management. Understand how statistical concepts	U	1,2, 4,5

	are relevant across disciplines, fostering interdisciplinary thinking and applications.		
2	Summarize and interpret data using various measures of central tendency ,dispersion, skewness, kurtosis and Lorenz curve.	R,U	1,2,4,5
3	Analyze the relationships between variables using scatter diagrams, correlation coefficient sandr egression analysis. Developskillsinsolvingreal-worldproblemsthroughtheapplicationof statistical techniques.	A, An, E	1,2,4,5 ,6
4	Understand basic probability concepts. Conditional probability, Independence of events, Addition and multiplication rules, Bayes' rule and applications	U, E, A	1,2,3,

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
Data Management, Averages and Dispersion	**15**	**1,2**
1.1 Types of data and variables: Concepts of primary data and secondary data, various sources of data with examples.,Scales of measurements: Ordinal, nominal, ratio and interval. Methods of data collection and data management. 1.2 Data visualization techniques: Diagrams and Graphs: Bardiagrams, pie diagram and frequency graphs., Applications of Statistics in various disciplines.Practical using MS Excel. 1.3 Measures of central tendency: Arithmetic Mean(AM), Geometric Mean and Harmonic Mean, Median and Mode, Illustrative examples. 1.4 Measures of dispersion: Range, Quartile Deviation (QD), Mean Deviation (MD) and Standard Deviation (SD), Computation using data sets., Coefficient of Variation(CV), Box Plot and Lorenz Curve. Illustrative examples and applications in real life.		

1.5 Moments, Skewness and Kurtosis with applications. Practical using MS Excel.		
Module 2		
Correlation & Regression	**15**	**3**
2.1 Correlation, scatter diagram, Pearson's correlation coefficient, Spearman's rank correlation coefficient. 2.2 Regression:Linear regression, Regression coefficient, Twotypesofregression lines with examples. 2.3 Multiple Regression, Partial and Multiple Correlation (three variables), Coefficient of determination, Illustrative problems. 2.4 Practical using MS Excel.		
Module 4		
Basics of Probability and its Applications	**15**	**4**
3.1 Deterministic versus Random experiment, sample space and event with examples, measuring uncertainty. 3.2 Elementary ideas of probability: Frequency, classical, subjective and axiomatic definitions with examples from real life contexts. 3.3 Conditional probability, independence of events, marginal probability, Addition and multiplication rules illustrations with examples. 3.4 Bayes' theorem (statement), sensitivity, specificity, False positive, False negative etc. with examples and applications.		

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, case studies, Authentic learning, Presentation by students by group, **Lab based activities: Problem Solving; Data Analysis and Interpretation** (A practical record with minimum 8-10 problems has to be submitted). Solve numerical problems associated with topics covered in various modules.
Mode of	**MODEOFASSESSMENT**

Assessment	**C. ContinuousComprehensiveAssessment(CCA)** 2. Two Internal Examinations: 2*10 = 20 marks 2. Assignments, Seminars, Presentations and Quiz: 10 marks 3. Practical(Problem Solving Skills, PracticalRecord): 10 marks
	D. EndSemesterEvaluation(ESE) **Theory& Practice :60marks**

Learning Resources References:

5. Daniel, W.W. and Cross, C. L. (2014). *Biostatistics: Basic Concepts and Methodology for the Health Sciences.* 10th Edition, Wiley.
6. Gupta,S.C.andKapoor,V.K. (2020).*FundamentalsofMathematicalStatistics*,12thEdition, Sultan Chand and Sons.
7. Antonisamy, B. Premkumar, P. S. Christopher, S. (2017). *Principles and Practice of Biostatistics,* 1st Edition, Elsevier.

SuggestedReadings:

5. Sarma, K.V.S. (2007). *Statistics Made Simple*. 2nd Edition, Prentice Hall of India.
6. Medhi,J.(2006).*StatisticalMethods*,2ndEdition, New Age International Publishers
7. Mukhopadhyay,P. (1999).*AppliedStatistics*,NewCentralBookAgencyPrivateLimited,Kolkata.

Relevance of Learning the Course/ Employability of the Course

(i) It provides a platform for students to get basic knowledge in theory and applications of Statistics and Probability in all areas of Sciences and Social Sciences including Biostatistics, Epidemiology, Data Science, Data Analytics etc.

(ii) It enhances students to plan and execute statistical surveys for research and development and official statistics.

(iii) It helps to undertake any work involving exploratory data analysis, statistical modeling, data learning etc.

(iv)It can lead to careers in Govt. and Private sectors involving Data Management.

(v) It can be applied in teaching and research in all emerging areas of research in theoretical and applied branches of Statistics and related disciplines.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**Mathematics and Statistics**
Programme	**Statistics**
Course Title	**Probability Models and Relation Analysis**
Course Type	**Minor B**
Course Level	100-199

Course Code	MG2DSCUST141		
Course Overview	In this course students are exposed to various Discrete and continuous Probability models and their applications in finance, industry, medicine, management, biostatistics etc. Students are introduced to bivariate and multivariate data sets and related visualization techniques. They study various techniques for relation analysis using correlation and regression, multiple correlation and multiple regression and their applications in real life.		
Semester	2	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Plus Two Mathematics/Statistics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Students are aware of discrete probability models and their applications in statistical modelling	U, A, C	1,2,3
2	Students are exposed to various continuous probability models and their applicationsin various contexts. They are aware of Central Limit Property and Laws of large numbers and their importance in real life contexts.	U, A, C	1,,2,3,4,5
3	Students are enabled to analyse relationships between variables using scatter diagrams, correlation coefficients andr egression analysis.	A, E, S	1,2,3,4
4	Students have acquiredskillsinsolvingreal-worldproblemsthroughthe applicationof partial and multiple correlation &regressiontechniques in the case of more than	E, An, S	1,2,3,6

	two variables.		

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
Discrete Probability Models	**15**	**1**
1.1 Probability Modeling, Discreteuniformdistribution, Bernoullidistribution,Binomialdistribution,Poisson distribution, Limiting property. 1.2 Geometric distribution and lack ofmemoryproperty, Negative Binomial and Hyper-geometric distributions. 1.3 Properties and applications in real life situations, Fitting distributions to data sets from various contexts.		
Module 2		
Continuous Probability Models	**15**	**2**
2.1 Continuous uniform (rectangular), Triangular, exponential distribution and applications, lack ofmemoryproperty 2.2 Beta, and Gamma distributions and inter relations. 2.3 Normal (Gaussian), additive property, lognormal distribution, Laplace distribution and applications, Fitting distributions to real data sets. NB: Simple properties, Mean, Variance, MGF, and Characteristic function, additive property etc.		
Module 3		
Law of Large Numbers and Central Limit Property	**15**	**3**
3.1 Multinomial Distribution, Bivariate Normal Distribution, marginal and conditional distributions, conditional expectation and regression equation. 3.2 Distribution of sample mean from a normal population, Chebychev's inequality, Bernoulli's law of large numbers, Weak law of		

large numbers and applications. 3.3 Central Limit Theorem (Lindberg Levy form only), Binomial, Poisson and Normal populations only, Illustrative problems and applications in real life contexts.Practical using MS Excel.		
Module 4		
Correlation and Regression Analysis	**15**	**4**
4.1 Correlation, Scatterdiagram,Pearson'scorrelationcoefficient and properties, Spearman's rank correlation coefficient. Computation from raw data and frequency tables. 4.2 Regression:Scatter diagram, Curve fitting and Principle of Least Squares, Fitting straight line and Parabola (second degree curve), Exponential Curve, Linear regression, Regression coefficient, Twotypesofregressionlines,properties, applications to real contexts using data sets. 4.3 Multiple Regression, Partial and Multiple correlation,properties and computation using real data, Coefficient of determination. Applications in various contexts. Practical using MS Excel.		

Mode of Transaction	**Classroom activities:** Direct Instruction:Brainstorming lecture, E-learning, interactive Instruction,Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Lab based activities:ProblemSolving and Data Analysis** (A practical record with at least 8-10 problems has to be submitted). Students have to solvenumericalproblems or analyse data associated withtopicscovered in various modules.
Mode of Assessment	**E. ContinuousComprehensiveAssessment(CCA)** 3. Two Internal Examinations: 2*10 = 20 marks 2. Assignments, Seminars, Presentations and Quiz: 10 marks

	3. Practical(Problem Solving Skills, PracticalRecord): 10 marks
	F. EndSemesterEvaluation(ESE) **Theory& Practice :60marks**

Learning Resources

8. Gupta, S. C. and Kapoor, V.K. (2020). *Fundamentals of Mathematical Statistics*,12thEdition, Sultan Chand and Sons.
9. Mood, A.M., Graybill, F.A. and Boes, D.C.(2007).*Introduction to the Theory of Statistics*, 3rd Edition, Tata McGraw-Hill Pub. Co.Ltd.
10. Sarma, K.V.S. (2007). *Statistics Made Simple*. 2nd Edition, Prentice Hall of India.
11. BeverlyJ.Dretzke.(2008).*StatisticswithMicrosoftExcel*,4th Edition,Pearson.

Suggested Readings:

1. Johnson, N.L., Kemp, A.W. and Kotz,S.(2005). *Univariate Discrete Distributions*, 3rd Edition, John Wiley, New York.
2. Johnson, N.L., Kotz,S. and Balakrishnan, N. (1994). *Continuous Univariate Distributions, Vol.I and II,* 2nd Edition. John Wiley, New York.
3. Mukhopadhyay, P.(1999).*Mathematical Statistics*, New Central Book Agency Private Limited, Kolkata.
4. Hogg, R.V., McKean, J.W. and Craig,A.T. (2014). *Introduction to Mathematical Statistics*, 7thEdition, Pearson Education Publication.

Learning the Course/ Employability of the Course
(i) It enables students to get basic knowledge in theory and applications of Probability and Correlation, Regression for use in various areas. (ii) It enhances students to analyze bi-variate and high dimensional data sets and to explore the inter relationships between different variables. (iii) It equips students for exploratory data analysis, statistical modeling, data learning etc. (iv) It can lead to careers in research, statistical modeling, project management etc. (v) It can be applied in teaching and research in all emerging areas and disciplines.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**
Programme	**Statistics**
Course Title	**Probability Models and Statistical Inference**
Course Type	**MDC**
Course Level	**100-199**
Course Code	**MG2MDCUST101**
Course Overview	This course is designed to introduce the concepts of probability models and theory of testing of hypothesis and discuss the inferential statistical tools used in data analysis. This paper deals with the concept of

	parametric tests for large and small samples. It also provides knowledge about non-parametric tests and its applications. It is also expected to give lab illustration of the concepts through original data sets.		
Semester	2	**Credit**	3
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Plus two / higher secondary & Basic knowledge of probability and statistics.		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Students have understood the concept of discrete and continuous distributions and how to apply them in real life situations.	R, U	1, 2, 4
2	Students are able to estimate parameters and compare their efficiencies to find the best estimate among them. . Students become aware of various estimation methods and their applications in real life.	U, A, E	1, 4, 5
3	Students have acquired skill in testing various types of hypothesis and to estimate the confidence interval.	U, An, E, S,	1, 2, 4, 5, 6
4	Students have understood the various non-parametric tests and their applications in practical situations. It will help them to test various hypothesis and interpret the	A, C	1, 2, 5, 6

	conclusions for making appropriate decisions.		

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	**Hours**	**CO No**
PROBABILITY DISTIBUTIONS	**15**	**1**
• Random variables - discrete and continuous, pdf, cdf and properties. • Distributions; Binomial, Poisson, Exponential and Normal distributions, Standard Normal Tables and applications. Central Limit Property. • Sampling distribution of sample mean; Chi square, Students t and F distributions. Use of tables and illustrative problems.		
Module 2		
ESTIMATION OF PARAMETERS	**15**	**2**
• Concepts of Population, Sample, Parameter, Statistic, Standard error, Estimators and Estimates. • Point estimation, Properties of good estimators; unbiasedness, Efficiency, Consistency, Sufficiency, • Methods of Estimation: Method of moments, Method of maximum likelihood and applications. Illustrative Examples.		
Module 3		
TESTING OF HYPOTHESES & CONFIDENCE INTERVALS	**15**	**3, 4**
3.1 Concepts of statistical hypotheses, simple and composite, null and alternative hypothesis, critical region, two types of errors, level of significance and power of a test. One and two tailed tests. 3.2 Use of central limit theorem in testing. Large sample tests: z-test for single mean and equality of two means. z test for proportion and equality of proportions. 3.3 Confidence intervals for mean, proportion etc 3.4 Small sample test: t test for single mean and equality of two means, paired t-test. 3.5 Non - parametric tests for Goodness of fit: Chi-square and Kolmogrov - Smirnov test; Chi-square test for independence of attributes and homogeneity, 3.6 Sign test, Paired sign test, Mann-Whitney U Test, Run test for randomness. Practical using MS Excel.		

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students in groups. **Lab based activities: Problem Solving** (A practical record with at least 8-10 problems has to be submitted). Solve numerical problems associated with topics covered in various modules.
Mode of Assessment	**MODEOFASSESSMENT** • **Continuous Comprehensive Assessment(CCA)** • Two Internal Examinations: 2*10 = 20 marks 2. Assignments, Seminars, Presentations and Quiz: 10 marks 3. Practical(Problem Solving Skills, Practical Record): 10 marks
	B. End Semester Evaluation(ESE) **Theory:60marks**

Learning Resources

References:

- Gupta,S.C.andKapoor,V.K. (2020).FundamentalsofMathematicalStatistics,12th Edition, Sultan Chand and Sons.
- Mood,A.M.,Graybill,F.A.andBoes,D.C. (2007).IntroductiontotheTheoryofStatistics,3rd Edition. (Reprint). TataMcGraw-Hill Pub. Co.Ltd.
- Montgomery, D.C. Runger, G. C. Hubele, N.F. (2011). Engineering Statistics, 5th Edition, Wiley.
- Sarma, K.V.S. (2007). Statistics Made Simple. 2nd Edition, Prentice Hall of India.
- Rajagopalan, M., Dhanavanthan, P. (2012). Statistical Inference, Prentice Hall of India.

Relevance of Learning the Course/ Employability of the Course
(i) It enables students to get advanced knowledge in theory and applications of Estimation

and Statistical Testing for use in various areas.

(ii) It enables students to test the hypothesis and make decisions in real situations.

(iii) It equips students for exploratory data analysis, statistical modeling, data learning etc.

(iv) It can lead to careers in research, project management, data engineering etc.

(v) It can be applied in teaching and research in all emerging areas of research.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**
Programme	**Statistics**
Course Title	**Statistical Inference and Applications**
Course Type	**Minor B**
Course Level	**200-299**
Course Code	MG4DSCUST241
Course Overview	This course is designed to introduce the basic concepts in estimation and testing of hypothesis and discuss the inferential statistical tools used in data analysis. This paper deals with the concept of parametric tests for large and small samples. It also provides knowledge about non-parametric tests and its applications. It is also expected to give lab illustration of the concepts through original data sets.

Semester	4	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Plus Two Mathematics/Statistics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the concept of estimation, estimator and its properties. Students are aware of various estimation methods and its applications in real life data set.	R, U	1, 2, 4
2	Students have understood the concept of testing of hypothesis and to apply Neyman - Pearson theory.	U, A, E	1, 4, 5
3	Students have acquired skill in testing various types of hypothesis and to estimate the confidence interval.	U, An, E, S,	1, 2, 4, 5, 6
4	Students have understood the various non-parametric tests and their applications in practical situations. It will help them to test various hypothesis and interpret the conclusions for making appropriate decisions.	A, C	1, 2, 5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
ESTIMATION OF PARAMETERS	**15**	**1**
1.1 Population, Sample, Parameter, Statistics and Standard Error, Concepts of Estimation, Estimators and Estimates. 1.2 Point estimation , Properties of good estimators; unbiasedness, Efficiency, Consistency , Sufficiency, Factorization theorem (statement only).Minimum Variance Bound and Most Efficient Estimator		

1.3 Methods of Estimation: Method of moments, Method of maximum likelihood, Method of minimum variance, Cramer-Rao inequality (statement only) and applications.		
Module 2		
TESTING OF HYPOTHESIS	**15**	**2**
2.1 Concepts of statistical hypotheses, null and alternative hypothesis, critical region, two types of errors, level of significance and power of a test. One and two tailed tests. Illustrative examples. 2.2 Neyman - Pearson method of testing, Most Powerful Tests and UMP Tests. Neyman – Pearson Lemma, Examples in case of Binomial, Poisson, Exponential and Normal distributions. 2.3 Use of central limit theorem in testing. Large sample tests:ztestforsinglemeanandequalityoftwo means. z test for proportion. Practical using MS Excel.		
Module 3		
SMALL SAMPLE TESTS AND CONFIDENCE INTERVALS	**15**	**3**
3.1 Small sample tests: Tests based on $\chi 2$, t and F. Student's t testforsinglemeanandequalityoftwo means,pairedt test, Test for correlation coefficient, $\chi 2$ test for variance, F test for equality of variances. 3.2 Interval estimation: confidence intervals for mean, variance, proportion.Practical using MS Excel.		
Module 4		
NON-PARAMETRIC TESTS	**15**	**4**
4.1 Non-parametric tests- their advantages and disadvantages, comparison with parametric tests. Measurement scale- nominal, ordinal, interval and ratio. 4.2 $\chi 2$-test and Kolmogorov-Smirnov test for Goodness of fit, Chi-square test for independence of attributes andhomogeneity, Sign test and Wilcoxonsigned rank tests (single and paired samples). 4.3 Two independent sample tests: Wilcoxon –Mann-Whitney U test.Kolmogorov-Smirnov test for identical distributions, Run test for randomness. Practical using MS Excel.		

Mode of Transaction	**Classroom activities:** Direct Instruction:Brainstorming lecture, E-learning, interactive Instruction,Seminar, Group Assignments, Authentic learning, Presentation by

	students group wise. **Lab based activities:ProblemSolving and Data analysis** (A practical record with minimum 8-10 problems has to be submitted). Solvenumericalproblemsassociatedwithtopicscovered in various modules.
Mode of Assessment	**MODEOFASSESSMENT** **G. ContinuousComprehensiveAssessment(CCA)** 4. Two Internal Examinations: 2*10 = 20 marks 2. Assignments, Seminars, Presentations and Quiz: 10 marks 3. Practical(Problem Solving Skills, PracticalRecord): 10 marks
	H. EndSemesterEvaluation(ESE) **Theory& Practice:60marks**

Learning Resources

References:

12. Gupta,S.C.andKapoor,V.K.(2020).*Fundamentals of Mathematical Statistics*,12thEdition, Sultan Chand and Sons.
13. Mood,A.M.,Graybill,F.A.andBoes,D.C.(2007). Introduction to the Theory of Statistics, 3rdEdition. (Reprint). TataMcGraw-Hill Pub. Co.Ltd.
14. Montgomery, D.C. Runger, G. C. Hubele, N.F. (2011). Engineering Statistics, 5th Edition, Wiley.
15. Sarma, K.V.S. (2007). Statistics Made Simple. 2nd Edition, Prentice Hall of India.
16. Rajagopalan, M., Dhanavanthan, P. (2012). Statistical Inference, Prentice Hall of India.

Relevance of Learning the Course/ Employability of the Course
(i) It enables students to get advanced knowledge in theory and applications of Estimation and Statistical Testing for use in Biostatistics, Management etc. (ii) It enhances students to test the hypothesis and enable them to make decisions in real situations. (iii) It equips students for exploratory data analysis, statistical modeling, data learning etc.

(iv) It can lead to careers in research, project management etc.

(v) It can be applied in teaching and research in all emerging areas of research.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**
Programme	**Statistics**
Course Title	**Applied Statistics**
Course Type	**Minor B**
Course Level	400-499
Course Code	MG7DSCUST441
Course Overview	This course is designed to introduce the applications of Statistics in sample surveys, design of experiments, industrial statistics, reliability engineering, survival analysis, official statistics, time series modelling etc. This paper deals with the concept of probability and non-probability sampling techniques, planning and design of experiments, quality control and control charts, official statistical system in India, time series analysis and forecasting etc. It also provides knowledge about various field surveys and experimentation along with practical applications. It is also expected to give lab illustration of the concepts through original data sets. It is expected to conduct sample surveys as well as agricultural experiments to give a practical experience of topics studied in the classrooms.

Semester	7	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Plus Two Mathematics/Statistics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Use appropriate sampling methods and determine optimum sample sizes. They will be able to plan and conduct suitable sample surveys as part of any statistical study to estimate population values.	R, U	1, 2, 4
2	Students will get necessary knowledge in the principles of design of experiments. Students are able to compare different treatment effects using appropriate designs. Students are equipped with practical knowledge of different designs for application in agricultural fields, industry, biostatistics etc.	U, A, E	1, 4, 5
3	Students are able to carry out quality assessment in various contexts using control charts. They are aware of process capability indices for efficient process control.	U, An, E, S,	1, 2, 4, 5, 6
4	The students have understood construction of various index numbers and techniques for analyzing time series data.	A, C	1, 2, 5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
SAMPLE SURVEYS	**15**	**1**
1.1 Census and Sampling methods, Advantages and disadvantages, Principles of sampling theory, Principal steps in a sample survey, Preparation of questionnaires, probability sampling and non-probability sampling, sampling and non-sampling errors, bias, variance and MSE. 1.2 Simple random sampling with and without replacement - estimation of population mean, total and proportions 1.3 Stratified Random Sampling, Systematic Sampling, Cluster Sampling, Determination of the sample size. Practical using MS Excel.		
Module 2		
DESIGN OF EXPERIMENTS	**15**	**2**
2.1 Basic principles of experimental design. 2.2 Analysis of variance- one-way, two way models. Real time examples. 2.3 Completely randomized design (CRD), Randomized block design (RBD), Latin square design (LSD) Models, Layout and ANOVA Table. Practical using MS Excel.		
Module 3		
INDUSTRIAL STATISTICS& RELIABILITY	**15**	**3**
3.1 Meaning of quality, and need for quality control. Meaning and scope of statistical process control, 3.2 General theory of control charts, Shewhart control charts for variables- mean charts, R-charts, and S-charts, Attribute control charts – p charts. 3.3 Basic concepts in reliability: Reliability system, Failure rate, residual life, Hazard rate and relationships, constant, increasing, decreasing hazard rates, exponential and Weibull life times. Illustrative examples. Practical using MS Excel.		
Module 4		
OFFICIAL STATISTICS & TIME SERIES ANALYSIS	**15**	**4**
4.1 Official Statistics, MOSPI, CSO, Index Numbers,Price relatives, Simple and Weighted Index Numbers, Laspeyre's, Paasche's, Fisher's , Marshall-Edgeworth Index Numbers, Tests for good index numbers 4.2 Chain index number, Base shifting, Splicing and Deflating, Construction of Index Numbers, Steps in the construction of index numbers, Standard of living Index number, Wholesale		

price index, National Income estimation, Population Census. 4.3 Time Series, Mathematical model for Time series, Components of Time Series, Time Series Graphics, Basic methods of measuring trend, Estimation of linear trend, Moving Averages, Ratio to trend method, Link relative method, Measurement of Seasonal and Cyclic variations. Exponential smoothing, Box- Jenkin's ARMA models. Illustrations using MS Excel.		

Mode of Transaction	**Classroom activities:** Direct Instruction: Brainstorming lecture, E-learning, interactive Instruction, Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Lab based activities: Problem Solving and Data Analysis** (A practical record with minimum 8-10 problems has to be submitted). Solve numerical problems associated with topics covered in various modules.
Mode of Assessment	**MODEOFASSESSMENT** • **Continuous Comprehensive Assessment(CCA): 40 marks** • Two Internal Examinations: 2*10 = 20 marks 2. Assignments, Seminars, Presentations and Quiz: 10 marks 3. Practical(Problem Solving Skills, Practical Record): 10 marks
	B. End Semester Evaluation (ESE) **Theory: 60 marks**

Learning Resources

References:

- Gupta, S.C. and Kapoor,V.K. (2014) Fundamentals of Applied Statistics, Sultan Chand & Sons., New Delhi.
- Singh, D. and Chowdhary, F.S. (1999): Theory and Analysis of Sample Survey Designs, Wiley Eastern (New Age International), New Delhi.
- Montgomery, C.D. (2012) Design and Analysis of Experiments, John Wiley, New York.

- Montgomery, D.C. (2012). Introduction to Statistical Quality Control, Seventh edition, Wiley.
- Sarma, K.V.S. (2007). Statistics Made Simple. 2nd Edition, Prentice Hall of India.
- Chatfield, C. (1996). The Analysis of Time Series – An Introduction, CRC Press, London.

Suggested Readings:

- Duncan, A.J. (1986) Quality Control and Industrial Statistics, Irwin, Homewood.
- Grant E.L. and Leaven Worth, R.S. (1980) Statistical Quality Control, McGraw Hill.
- Lai, C.D and Xie, M. (2006) Stochastic Ageing and Dependence in Reliability, Springer.
- Cochran, W. G.(1992). Sampling Techniques, Wiley Eastern New Delhi.

Relevance of Learning the Course/ Employability of the Course
(i) It enables students to get advanced knowledge in theory and applications of Statistical methods in various areas such as Industry, Agriculture, Biostatistics, Management etc. (ii) It enhances students to study the advanced methodologies of Statistics in real situations. (iii) It equips students for exploratory data analysis, statistical modeling, data learning etc. (iv) It can lead to careers in research, project management etc. (v) It can be applied in teaching and research in all emerging areas of research.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Mathematics**		
Course Title	**Analytic Geometry, Abstract Algebra and Special Functions**		
Course Type	**Minor A**		
Course Level	**200-299**		
Course Code	**MG3DSCUMT221**		
Course Overview	This course gives basic knowledge about three different areas in Mathematics-Analytic Geometry, Group Theory and Special Functions. These are widely used in applications of Physics, Chemistry, Statistics etc.		
Semester	**3**	**Credit**	**4**
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	60	0	
Pre-requisite	Higher Secondary Level mathematics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Learn basic concepts in Analytic Geometry	U,E	1,5
2	Understand some introductory concepts of Group	R,U,A,	1

	Theory.		
3	Classify different kinds of groups with reference to its various properties.	A,E	1
4	Develop strong foundation about Laplace Transforms.	U,An	1,3

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E) , Create (C), Skill (S))

COURSE CONTENT

Module 1: Analytic Geometry	**Hours**	**CO No**
Parametric Equations; Tangent Lines and Arc Length for Parametric Curves, Polar Coordinates, Tangent Lines, Arc Length, and Area for Polar Curves, Conic Sections. **Text 1: Chapter 10 – Sections: 10.1,10.2,10.3& 10.4.**	**15**	**1**
Module 2: Introduction to Group Theory		
Binary Operations – Definitions and Examples, Groups – Definition, Examples, Groups - Elementary Properties, Group Isomorphism, Group Tables and Examples of Abelian Groups. **Text 2: Chapter 1 – Sections: 1,2,3.**	**15**	**2**
Module 3: Types of Groups		
Examples of non-abelian groups and Permutation Group, Group of symmetries of Equilateral Triangles, Dihedral Group, Symmetric Groups and Disjoint Cycles, Subgroups, Cyclic Groups and Cyclic Subgroups. **Text 2: Chapter 1 – Sections: 4,5,6.**	**15**	**3**
Module 4: Special Functions		
Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives and Integrals-ODEs, Differentiation, Unit Step Functions, Second Shifting Theorem(statement only)& applications, Differentiation and Integration of Transforms, Gamma Function and its properties, Beta Function and its properties. **TEXT 3: Chapter 6 – Sections 6.1,6.2,6.3,6.6.** **TEXT 4: Chapter 11 – Section 11.3,11.6& 11.7.**	**15**	**4**

Mode of Transaction	Classroom activities: Problem solving sessions, group discussions, seminars, interactive classes giving more insight onto daily life applications.
Mode of Assessment	**MODE OF ASSESSMENT** A. **Continuous Comprehensive Assessment (CCA)-40 marks** 1. Two Internal Examinations: 2*10 = 20 marks

	2. Assignments and Quiz: 10 marks 3. Seminars and Presentations: 10 marks
	B. **End Semester Evaluation (ESE)** **Theory & Practice: 60 marks**

Learning Resources

1. Anton, Bivens, Davis. *Calculus*,10thed.,John Wiley & Sons, INC

2. Fraleigh, John B.;. Brand, Neal E. *A First Course in Abstract Algebra* 8th Edition, Pearson Education 2021.

3. Kreyszig, Erwin. *Advanced Engineering Mathematics,* Wiley Student Edition, 8th Edition, 2006.

4. Mary L. Boas. Mathematical Methods in the Physical Sciences, Third Edition, John Wiley & Sons.

Relevance of Learning the Course/ Employability of the Course
Analytic Geometry is a fundamental branch of Mathematics that merges Algebra with Geometry to study shapes using coordinates and equations. It equips students to solve problems related to Geometry. Abstract Algebra serves as the foundation for many modern technologies and innovations, shaping the way we interact with the world around us. It is one of the strong subject areas in Mathematics which enhance the analytic knowledge and combined with basics in Laplace Transforms will improve the problem solving ability of students in different realms such as Physics, Chemistry, Statistics etc.

	MAHATMA GANDHI UNIVERSITY **Graduate School**
	4 + 1 Integrated UG and PG Programme

School	**School of Mathematics and Statistics**		
Programme	**Statistics**		
Course Title	**Statistical Inference and Applications**		
Course Type	**Minor B**		
Course Level	**200-299**		
Course Code	MG4DSCUST241		
Course Overview	This course is designed to introduce the basic concepts in estimation and testing of hypothesis and discuss the inferential statistical tools used in data analysis. This paper deals with the concept of parametric tests for large and small samples. It also provides knowledge about non-parametric tests and its applications. It is also expected to give lab illustration of the concepts through original data sets.		
Semester	4	**Credit**	4
Total Student Learning Time	**Instructional hours for theory**	**Instructional hours for practical/lab work/field work**	
	48	12	
Pre-requisite	Plus Two Mathematics/Statistics		

COURSE OUTCOMES (CO)

CO No.	Expected Course Outcome	Learning Domains	PSO No.
	Upon completion of this course, students will be able to;		
1	Understand the concept of estimation, estimator and its properties. Students are aware of various estimation methods and its applications in real life data set.	R, U	1, 2, 4
2	Students have understood the concept of testing of hypothesis and to apply Neyman - Pearson theory.	U, A, E	1, 4, 5
3	Students have acquired skill in testing various types of hypothesis and to estimate the confidence interval.	U, An, E, S,	1, 2, 4, 5, 6
4	Students have understood the various non-parametric tests and their applications in practical situations. It will help them to test various hypothesis and interpret the conclusions for making appropriate decisions.	A, C	1, 2, 5, 6

*(Learning Domains: Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S))

COURSE CONTENT

Module 1	Hours	CO No
ESTIMATION OF PARAMETERS	**15**	**1**
1.1 Population, Sample, Parameter, Statistics and Standard Error, Concepts of Estimation, Estimators and Estimates. 1.2 Point estimation , Properties of good estimators; unbiasedness, Efficiency, Consistency , Sufficiency, Factorization theorem (statement only).Minimum Variance Bound and Most Efficient Estimator 1.3 Methods of Estimation: Method of moments, Method of maximum likelihood, Method of minimum variance, Cramer-Rao inequality (statement only) and applications.		
Module 2		
TESTING OF HYPOTHESIS	**15**	**2**
2.1 Concepts of statistical hypotheses, null and alternative hypothesis, critical region, two types of errors, level of significance and power of a test. One and two tailed tests. Illustrative examples. 2.2 Neyman - Pearson method of testing, Most Powerful Tests and UMP Tests. Neyman – Pearson Lemma, Examples in case of Binomial, Poisson, Exponential and Normal distributions. 2.3 Use of central limit theorem in testing. Large sample tests:ztestforsinglemeanandequalityoftwo means. z test for proportion. Practical using MS Excel.		
Module 3		
SMALL SAMPLE TESTS AND CONFIDENCE INTERVALS	**15**	**3**

3.1 Small sample tests: Tests based on $\chi 2$, t and F. Student's t testforsinglemeanandequalityoftwo means,pairedt test, Test for correlation coefficient, $\chi 2$ test for variance, F test for equality of variances. 3.2 Interval estimation: confidence intervals for mean, variance, proportion.Practical using MS Excel.		
Module 4		
NON-PARAMETRIC TESTS	**15**	**4**
4.1 Non-parametric tests- their advantages and disadvantages, comparison with parametric tests. Measurement scale- nominal, ordinal, interval and ratio. 4.2 $\chi 2$-test and Kolmogorov-Smirnov test for Goodness of fit, Chi-square test for independence of attributes andhomogeneity, Sign test and Wilcoxonsigned rank tests (single and paired samples). 4.3 Two independent sample tests: Wilcoxon –Mann-Whitney U test.Kolmogorov-Smirnov test for identical distributions, Run test for randomness. Practical using MS Excel.		

Mode of Transaction	**Classroom activities:** Direct Instruction:Brainstorming lecture, E-learning, interactive Instruction,Seminar, Group Assignments, Authentic learning, Presentation by students group wise. **Lab based activities:ProblemSolving and Data analysis** (A practical record with minimum 8-10 problems has to be submitted). Solvenumericalproblemsassociatedwithtopicscovered in various modules.
Mode of Assessment	**MODEOFASSESSMENT** **A. ContinuousComprehensiveAssessment(CCA)** 1. Two Internal Examinations: 2*10 = 20 marks 2. Assignments, Seminars, Presentations and Quiz: 10 marks 3. Practical(Problem Solving Skills, PracticalRecord): 10 marks
	B. EndSemesterEvaluation(ESE) **Theory& Practice:60marks**

Learning Resources

References:

1. Gupta,S.C.andKapoor,V.K.(2020).*Fundamentals of Mathematical Statistics*,12thEdition, Sultan Chand and Sons.
2. Mood,A.M.,Graybill,F.A.andBoes,D.C.(2007). Introduction to the Theory of Statistics, 3rdEdition. (Reprint). TataMcGraw-Hill Pub. Co.Ltd.
3. Montgomery, D.C. Runger, G. C. Hubele, N.F. (2011). Engineering Statistics, 5th Edition, Wiley.
4. Sarma, K.V.S. (2007). Statistics Made Simple. 2nd Edition, Prentice Hall of India.

5. Rajagopalan, M., Dhanavanthan, P. (2012). Statistical Inference, Prentice Hall of India.

Relevance of Learning the Course/ Employability of the Course
(i) It enables students to get advanced knowledge in theory and applications of Estimation and Statistical Testing for use in Biostatistics, Management etc. (ii) It enhances students to test the hypothesis and enable them to make decisions in real situations. (iii) It equips students for exploratory data analysis, statistical modeling, data learning etc. (iv) It can lead to careers in research, project management etc. (v) It can be applied in teaching and research in all emerging areas of research.