UNIVERSITY OF CALICUT

Abstract

General & Academic - Syllabus of Allied core in Mathematics for Integrated MSc Statistics programme - Implemented - Subject to ratification of Academic Council - Orders Issued.

G & A - IV - J

U.O.No. 6826/2021/Admn Dated, Calicut University.P.O, 09.07.2021

Read:-1) U.O.No. 4852/2021/Admn dated, 26.04.2021
2) Item no.3 in the minutes of the meeting of BoS in Mathematics UG, dtd 24.05.2021
3) Remarks of the Dean, Faculty of Science, dated 06.07.2021
4) Orders of the Vice Chancellor in the file of even no, dated 06.07.2021

ORDER

1. The regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) in affiliated colleges w.e.f. 2020 admission was implemented, vide paper read (1) above.
2. Syllabus of Allied core in Mathematics for Integrated MSc Statistics programme w.e.f 2020 admission has been prepared and submitted by the Board of studies in Mathematics UG at its meeting held on 24.05.2021, vide paper read (2) above.
3. The Dean, Faculty of Science, vide paper read (3) above, has approved to implement the Syllabus of Allied core in Mathematics for Integrated MSc Statistics programme, in tune with the regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) in affiliated colleges with effect from 2020 Admission onwards.
4. Considering the urgency, the Vice Chancellor has accorded sanction to implement the syllabus o f Allied core in Mathematics for Integrated MSc Statistics programme, in tune with the regulations for the Integrated Programmes under Choice Based Credit Semester System (CBCSS) in affiliated colleges with effect from 2020 Admission onwards, subject to ratification by the Academic Council.
5. The syllabus of Allied core in Mathematics for Integrated MSc Statistics programme, is therefore implemented with effect from 2020 Admission onwards, subject to ratification by the Academic Council.
6. Orders are issued accordingly. (Syllabus appended)

Arsad M

Assistant Registrar

To

The Principals of all Affiliated Colleges.
Copy to: PS to VC/ PA to Registrar/PA to CE/JCE I/JCE IV/JCE V/DR, SDE/CDC/DoA/EX and EG Sections/GA IF/CHMK Library/CUCC/Information Centres/SF/DF/FC

Forwarded / By Order

Section Officer

.

SYLLABUS

COMPLEMENTARY COURSES
(ALLIED CORE)

MATHEMATICS

for

INTEGRATED M.Sc. STATISTICS PROGRAMME

Programme Outcomes

The programme outcomes of the Integrated M.Sc. Statistics programme are the summation of expected course learning outcomes. The possible outcomes of studying Mathematics as an allied core course, is given below:

PO1 Disciplinary knowledge :

Capability of demonstrating comprehensive knowledge of mathematics and understanding of one or more disciplines which form a part of an undergraduate programme of study.

PO2 Communications skills :

(i) Ability to communicate various concepts of mathematics effectively using examples and their geometrical visualizations.

(ii) Ability to use mathematics as a precise language of communication in other branches of human knowledge.

(iii) Ability to show the importance of mathematics as precursor to various scientific developments since the beginning of the civilization.

PO3 Critical thinking :

Ability to employ critical thinking in understanding the concepts in every area of mathematics.

PO4 Analytical reasoning :

Ability to analyze the results and apply them in various problems appearing in different branches of mathematics.

PO5 Problem solving :

(i) Capability to solve problems using concepts of linear algebra.

(ii) Capability to solve various models such as growth and decay models, radioactive decay model, LCR circuits and population models using techniques of differential equations.

(iii) Ability to solve linear system of equations, linear programming problems and network flow problems.

(iv) Ability to provide new solutions using the domain knowledge of mathematics acquired during this programme.

PO6 Research-related skills :

(i) Capability for inquiring about appropriate questions relating to the concepts in various fields of mathematics.

(ii) To know about the advances in various branches of mathematics.

PO7 Information/digital literacy : Capability to use appropriate software to solve system of equations and differential equations.

PO8 Self-directed learning :

Ability to work independently and do in-depth study of various notions of mathematics.

PO9 Lifelong learning :

Ability to think, acquire knowledge and skills through logical reasoning and to inculcate the habit of self-learning.

PO10 Application skills :

Ability to apply the acquired knowledge in all aspects.

PO11 Experimental skills :

PO12 Moral and ethical awareness/reasoning :

Ability to identify unethical behaviour such as fabrication, falsification ormisrepresentation of data and adopting objective, unbiased and truthful actions in all aspects

Course learning outcomes

Course learning outcomes of each course in Integrated M.Sc. Statistics Programme with Mathematics as a complementary course (Allied Core) have been enshrined in the beginning of course contents of each course.

COMPLEMENTARY COURSES(ALLIED CORE)				
Programme outcomes	Differential Calculus, Logic and Boolean Algebra	Integral Calculus and Transcendental Functions	Linear Mathematical Vector Calculus, Differential Equations, Fourier Analysis and Laplace Transforms	Linear Algebra, Theory of Equations, Numerical Methods and Special Functions
Disciplinary knowledge	✓	✓	✓	✓
Communication skills	✓	✓	✓	✓
Critical thinking	✓	✓	✓	✓
Analytical thinking	✓	✓	✓	
Problem solving	✓	✓	✓	✓
Research related skills	✓	✓	✓	✓
Information/ Digital Literacy	✓	✓	✓	✓
Self-directed learning	✓	✓	✓	✓
Lifelong learning	✓	✓	✓	✓
Applicational skills	✓	✓	✓	✓
Experimental learning	✓	✓	✓	✓
Employability options	✓	✓	✓	✓
Ethics	✓	✓	✓	✓

Credit, Mark and Hour Distribution

Sl. No	Code	Name of the course	Semester	No of contact hours/Week	Credits	Max. Marks			Unty. exam Dur. (Hrs)
						Internal	External	Total	
1	MST1C01	Differential Calculus, Logic and Boolean Algebra	1	4	3	15	60	75	2
2	MST2C02	Integral Calculus and Transcendental Functions	2	4	3	15	60	75	2
3	MST3C03	Vector Calculus, Differential Equations, Fourier Analysis and Laplace Transforms	3	5	3	15	60	75	2
4	MST4C04	Linear Algebra, Theory of Equations, Numerical Methods and Special Functions	4	5	3	15	60	75	2

SEMESTER – I

MST1 C01 : DIFFERENTIAL CALCULUS, LOGIC AND BOOLEAN ALGEBRA

4 Hours/Week 3 Credits 75 Marks[Int: 15 + Ext : 60]

Aims, Objectives and Outcomes

Calculus is the foundation of applied mathematics. The concept of rate of change is discussed in the first module. Then derivative of a function is introduced. Derivatives of trigonometric functions are discussed. The techniques like chain rule and implicit differentiation have many applications which are also discussed in this module. Application of derivatives are analysed in the second module. Extreme values of functions, The Mean value theorem, Monotonic functions and the first derivative are useful in many applications. Partial Derivatives are introduced in third module. Properties of partial derivatives are discussed here. Logic is the backbone of mathematics. Propositions and its properties are discussed in fourth module. Since quantifiers and Boolean algebra have many applications these idea are discussed in detail in this module.

After the successful completion of the course, the students learn the concepts

- Rate of change and limits
- derivative of a function and differentiation rules
- chain rule and implicit differentiation
- Extreme values of functions and the Mean value theorem
- Partial Derivatives
- Proposition and its properties
- Logical equivalence
- Quantifiers.
- Boolean algebra

Syllabus

Text (1)	George B Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson 2008.
Text (2)	Schaum's Outline series - Discrete mathematics, Second edition.

Module – I Text(1) (17 hrs)

Differential Calculus

The derivative of a function, Differentiation Rules, Rate of change, derivative of trignometric functions, the chain rule and implicit differentiation.

(sections 3.1 -3.6)

Module – II Text(1) (13 hrs)

Application of derivatives

Extreme values of functions, The Mean value theorem, monotonic functions and the first derivative test.

(Sections 4.1 – 4.3)

Module – III Text(1) (14 hrs)

Partial Derivatives

Functions of several variables (Definition only), limit and continuity, Partial derivatives, The chain Rule

(Sections 14.1 – 14.4)

Module – IV Text(2) (20 hrs)

Logic and Boolean Algebra

Propositions and Compound Statements, Basic Logical Operations, Propositions and Truth Tables, Tautologies and Contradictions, Logical Equivalence, Algebra of Propositions, Conditional and Biconditional Statements, Arguments, Propositional Functions, Quantifiers, Negation of Quantified Statements

(Sections 4.1 – 4.11)

References:

1. Calculus: Soo T Tan Brooks/Cole, Cengage Learning (2010), ISBN : 978-0-534-46579-7

3. Shanty Narayan : Differential Calculus (S Chand).

4. George B. Thomas Jr. and Ross L. Finney: Calculus, LPE Ninth edition, Pearson Education.

5. Jerrold Marsden & Alan Weinstein : Calculus I and II (2/e) Springer Verlag NY (1985) ISBN 0-387-90974-5 : ISBN 0-387-90975-3

6. Gilbert Strang: Calculus Wellesley Cambridge Press(1991).

7. Robert R. Stoll - Set theory and Logic Eurasia Publishers, New Delhi.

8. B. S. Vatssa - Discrete Mathematics - Third edition.

9. Discrete Mathematics; Proofs, Structures and Applications (3/e): Rowan Garnier& John Taylor CRC Press, Taylor & Francis Group (2009) ISBN:978-1-4398-1280-8(hardback)/ 978-1-4398-1281-5 (eBook - PDF)

SEMESTER – II

MST2 C02 : INTEGRAL CALCULUS AND TRANSCENDENTAL FUNCTIONS

4 Hours/Week 3 Credits 75 Marks[Int: 15 + Ext : 60]

Aims, Objectives and Outcomes

Integral calculus gives mathematical foundation for many sciences. In first module we introduce the fundamental theorem of calculus and its applications. Second module deal with application of integrals. Here we find area of surface of revolution, length of plane curves, and volume of mathematical objects. In module three we discuss about different techniques of integration. In last module we introduce transcendental Functions.

At the end of the course, the students will be able to learn

- Definite integral and the fundamental theorem of Calculus
- Volume of geometrical shapes, lengths of plane curves and areas of surfaces of revolution.
- Different techniques of Integration
- Transcendental Functions

Syllabus

Text	George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.

Module – I (16 hrs)

Integral Calculus

(5.2 – 5.6)

Sigma notation and limit of finite sums. The Definite integral. The fundamental theorem of Calculus, Indefinite integration and substitution rules. Substitution and area between curves.

Module – II (14 hrs)

Application of Integrals

(6.1, 6.3, 6.5)

Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution (the theorem of Pappus excluded).

Module – III (16 hrs)

Techniques of Integration

(8.1 - 8.5)

Basic integration formulas, Integration by parts, Integration of rational functions by partial fractions, Trigonometric integrals, and Trigonometric substitutions.

Module – IV (18 hrs)

Transcendental Functions

(7.1 – 7.4, 7.7-7.8)

Inverse Functions and Their Derivatives, Natural Logarithms, The Exponential Function, a^x, $\log(x)$, Inverse Trigonometric Functions, Hyperbolic Functions

References:

1. George B Thomas Jr. and Ross L Finney : Calculus, LPE, Ninth edition, Pearson Education.
2. Calculus : Soo T Tan Brooks/Cole, Cengage Learning (2010) ISBN : 978-0-534-46579-7
3. Joel Hass, Christopher Heil & Maurice D. Weir : Thomas' Calculus(14/e) Pearson (2018) ISBN 0134438981
4. Shanti Narayan, P K Mittal: Integral Calculus (S. Chand & Company).
5. S.S. Sastry : Engineering Mathematics, Volume 1, 4th Edition PHI.
6. Jon Rogawski & Colin Adams : Calculus Early Transcendentals (3/e) W. H. Freeman and Company(2015) ISBN: 1319116450
7. Anton, Bivens & Davis : Calculus Early Transcendentals (11/e) John Wiley & Sons, Inc.(2016) ISBN: 1118883764

SEMESTER – III

MST3 C03 : VECTOR CALCULUS, DIFFERENTIAL EQUATIONS, FOURIER ANALYSIS AND LAPLACE TRANSFORMS

5 Hours/Week 3 Credits 75 Marks[Int: 15 + Ext : 60]

Aims, Objectives and Outcomes

Vector differential calculus is very imortant in applied mathematics. Mathematical model of many physical problems are differential equations. Fourier series and Laplace transforms used to solve differential equations.

The successful completion of the course will enable the students to learn

- Vector Differential Calculus
- Solution of ordinary differential equations of first order
- Fourier Analysis
- Laplace Transform and solution to ODE using this

Syllabus

Text	Erwin Kreyszig : Advanced Engineering Mathematics, Tenth Edition, Wiley, India.

Module – I (24 hrs)

Vector Differential Calculus

(9.1 – 9.5, 9.7 – 9.9)

Vectors in 2-Space and 3-Space, Inner Product (Dot Product), Vector Product (Cross Product), Vector and Scalar Functions and Their Fields, Vector Calculus: Derivatives, Curves. Arc Length. Curvature. Torsion, Gradient of a Scalar Field. Directional Derivative, Divergence of a Vector Field, Curl of a Vector Field.

Module – II (20 hrs)

Ordinary differential equations of first order

(1.1 – 1.5)

Basic Concepts. Modeling, Geometric Meaning of $y' = f(x, y)$. Direction Fields, Euler's Method, Separable ODEs. Modeling, Exact ODEs. Integrating Factors, Linear ODEs. Bernoulli Equation. Population Dynamics.

Module – III (16 hrs)

Fourier Analysis

(11.1 – 11.3)

Fourier Series, Arbitrary Period. Even and Odd Functions. Half-Range Expansions, Forced Oscillations.

Module – IV (20 hrs)

Laplace Transform

(6.1 – 6.6)

Laplace Transform. Linearity. First Shifting Theorem (s-Shifting), Transforms of Derivatives and Integrals. ODEs, Unit Step Function (Heaviside Function), Second Shifting Theorem (t-Shifting), Short Impulses. Dirac's Delta Function. Partial Fractions, Convolution. Integral Equations, Differentiation and Integration of Transforms, ODEs with Variable Coefficients

References:

1. Shanti Narayan, P.K. Mittal : Vector Calculus, S Chand & Company.
2. Harry F. Davis & Arthur David Snider : Introduction to Vector Analysis, 6th Ed., Universal Book Stall, New Delhi.
3. Murray R Spiegel : Vector Analysis, Schaum;s Outline Series, Asian Student edition.
4. Murray : Differential Equations, Macmillan
5. Calculus : Soo T Tan Brooks/Cole, Cengage Learning (2010) ISBN : 978-0-534-46579-7

SEMESTER – IV

MST4 C04 : LINEAR ALGEBRA, THEORY OF EQUATIONS, NUMERICAL METHODS AND SPECIAL FUNCTIONS

5 Hours/Week 3 Credits 75 Marks[Int: 15 + Ext : 60]

Aims, Objectives and Outcomes

Linear algebra has many applications in applied mathematics. In module 1, we study linear algebra. We solve system of linear equations, vector spaces, inner product spaces and linear transformations. In module 2, we discuss theory of equations. Numerical procedure to find many mathematical problems are discussed in module 3. Improper integrals and special functions are discussed in module 4.

On successful completion of the course, the students shall acquire the following knowledge.

- Linear algebra.
- Theory of Equations
- Numerical methods
- Improper integrals and Special functions

Syllabus

Text (1)	Erwin Kreyszig : Advanced Engineering Mathematics, 10th Edition, Wiley, India.
Text (2)	Theory of Equations : J V Uspensky McGraw Hill Book Company, Inc. (1948)
Text (3)	S.S. Satry - Introductory Methods of Numerical Analysis, Fifth Edition, PHI
Text (4)	Improper Riemann Integrals: Ioannis M. Roussos CRC Press by Taylor & Francis Group, LLC(2014)

Module – I Text (1) (22 hrs)

Linear Algebra

(7.1 – 7.7, 7.9 Text (1))

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication, Linear Systems of Equations. Gauss Elimination, Linear Independence. Rank of a Matrix. Vector Space, Solutions of Linear Systems: Existence, Uniqueness, Second- and Third-Order Determinants, Determinants. Cramer's Rule, Vector Spaces, Inner Product Spaces. Linear Transformations.

Module – II Text (2) (22 hrs)

Theory of Equations

(Chapter II, III)

II.3: Division of polynomials, quotient and remainder, method of detached coefficients

II.4: The remainder theorem,

II.5: Synthetic Division

II.7: Taylor formula, expansion of a polynomial in powers of $x - c$,

III.1: Algebraic equations, roots, maximum number of roots

III.2: Identity theorem,

III.3: The Fundamental theorem of Algebra (statement only), factorisation to linear factors, multiplicity of roots

III.4: Imaginary roots of equations with real coefficients,

III.5: Relations between roots and coefficients

Module – III Text (3) (17 hrs)

Numerical methods

(2.1 – 2.5)

Introduction, Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method.

Module – IV Text (4) (19 hrs)

Improper integrals and Special functions

(1.1 – 1.3, 2.1, 2.2, 2.6)

Definitions and Examples, Cauchy Principal Value, Calculus Techniques [2.1.1 Applications' Omitted], Integrals Dependent on Parameters-upto and including example 2.2.4, The Real Gamma and Beta Functions upto and including Example 2.6.18.

References:

1. Elementary Linear Algebra: Application Version(11/e) : Howard Anton & Chris Rorres Wiley (2014) ISBN 978-1-118-43441-3
2. Kenneth Hoffman, Ray Kunze - Linear Algebra (2nd Edition) PHI.
3. Dickson L.E : Elementary Theory of Equations John Wiley and Sons,Inc. NY(1914)

4. Turnbull H.W : Theory of Equations(4/e) Oliver and Boyd Ltd. Edinburg(1947)

5. Thunter - An elementary treatise on Theory of Equations with examples.

6. Numerical Analysis (10/e) : Richard L. Burden, J Douglas Faires, Annette M. Burden Brooks Cole Cengage Learning (2016) ISBN : 978-1-305-25366-7

7. Kendall E. Atkinson, Weimin Han: Elementary Numerical Analysis(3/e) John Wiley & Sons (2004) ISBN : 0-471-43337-3 [Indian Edition by Wiley India ISBN : 978-81-265-0802-0]

8. James F. Epperson: An Introduction to Numerical Methods and Analysis(2/e) John Wiley & Sons(2013)ISBN: 978-1-118-36759-9