Board of studies in Mathematics (UG)

UNIVERSITY OF KERALA

First Degree Programme in

MATHEMATICS

under Choice Based Credit and Semester System

Revised Syllabus of Complementary Mathematics

for Physics, Chemistry, Statistics and Economics Core

for 2021 admission onwards.

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Physics

Semester I

Mathematics – I
(Calculus and sequences and series)
Code: MM 1131.1

Instructional hours per week: 4 No. of Credits:3

Overview of the course:
This course is designed to get a fairly descent coverage of calculus of one or more variables. A short section on sequences and series is also included. As this course is designed as a complementary course for students of B.Sc. Physics, we may avoid all the proofs of theorems.

Module 1: Differential calculus of one variable (18 Hours)

We start with definition of limits as in 1.1.1 and then move on to discussion on one sided limits, two sided limits and infinite limits, techniques for computing limits may be done as in section 1.2. Limits at infinity for polynomials, rational functions and functions involving radicals are to be discussed as in section 1.3. A general discussion on continuity may be done as in section 1.5. Various techniques for differentiation are to be covered using section 2.1 to to 2.8. This portion will cover the product and quotient rules, derivatives of trigonometric functions, chain rule and implicit differentiation. Basic properties of exponential and logarithemic functions and techniques of differentiation involving these functions may be explored asin sections 6.1 and 6.2. Definition Evaluating and derivatives of inverse trigonometric functions has to be discussed as in section 6.7.

The topics in this module can be found in chapter 1; sections 1.1, 1.2, 1.3, 1.5, chapter 2; sections 2.1 to 2.7 and chapter 6; sections 6.1, 6.2 and 6.7 of text [1].

Module 2 : Integral calculus of one variable (18 Hours)
We start this module with an introduction to indefinite integral as in section 4.2. Integration techniques like substitution, hyperbolic functions, integration by parts, trigonometric substitution and partial fractions has to be dealt as in sections 4.3, 4.5, 4.6, 4.9, 6.8 and 7.1 to 7.5.
The topics in this module can be found in chapter 4; sections 4.2, 4.3, 4.5, 4.6, 4.9 Chapter 6; section 6.8 and chapter 7, sections 7.1 to 7.5 of text [1]

Module 3: Differential calculus of functions of two or more variables (18 Hours)

This module begins with a study of functions of two or more independent variables. We describe the domains, graphs and level curves of such functions as in section 13.1. A discussion about partial differentiation, without going into analytic details of continuity of partial derivatives can be conducted as in section 13.3. Discuss problem 94 of exercise set 13.3. A very short, but important mention has to be made about total differential of a function of two or more variables as in section 13.4 (definition of total differential only). Chain rule for partial differentiation can be practiced as in section 13.5. It is suggestible

to transform 'Laplace's' and 'Cauchy-Riemann' equations from cartesian to polar forms (problems 55 and 57 of exercise set 13.5). Section 13.8 can be used to provide a good course on maxima and minima of function of two or more variables. Section 13.9 will introduce the reader to Lagrange Multiplier metod for constrained optimization. Problem 34 in exercise set 13.9 will provide an easy application of this method.

The topics in this module can be found in chapter 13, sections 13.1, 13.3, 13.4, 13.5, 13.8 and 13.9 of text [1]

Module 4: Sequences and series (18 Hours)

Section 9.1 will introduce the reader to sequences, their limits, convergence and some related theorems. Infinite series, thier convergence and sums, telescoping sums, geometric and harmonic series can be discussed as in section 9.3. Sections 9.4 and 9.5 will present various tests for cheking convergence of infinite series. Section 9.6 discusses alternating series. Sections 9.7 and 9.8 discusses polynomials and series known by the names of Taylor and Maclaurin.

The topics in this module can be found in chapter 9, sections 9.1, and 9.3 to 9.8 of text [1]

Texts

Text 1 – H Anton, I Bivens, S Davis. *Calculus*, 10th Edition, John Wiley & Sons

References

Ref. 1 – George B. Thomas, Ross L. Finney. Calculus and analytic geometry, 9th Edition, Addison-wesley publishing Company.

Ref. 2 – K F Riley, M P Hobson, S J Bence. *Mathematical Methods for Physics and Engineering*, 3rd Edition, Cambridge University Press

Ref. 3 – Mary L Boas. *Mathematics Methods in the Physical Sciences*, 3rd Edition, Wiley

Ref. 4 – Erwin Kreyszig. *Advanced Engineering Mathematics*, 10th Edition, Wiley-India

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Physics

Semester II

Mathematics – II
(Applications of calculus and vector differentiation)

Code: MM 1231.

Instructional hours per week: 4 No. of Credits: 3

Overview of the course:
This course is designed to get a fairly descent coverage of integral calculus of one or more variables and vector differentiation. As this course is designed as a complementary course for students of B.Sc. Physics, we may avoid all the proofs of theorems.

Module 1 : Applications of derivatives (18 hours)

Properties of functions like increase, decrease, concavity, maxima and minima has to be analyzed as in sections 3.1, 3.2 and 3.4. Rolle's theorem and mean value theorem has to be discussed as in section 3.8. This section ends with L'Hôpital's rule for evaluating limits in case of indeterminate forms as in section 6.5.

The topics in this module can be found in chapters 3 and 6 within sections 3.1, 3.2, 3.4, 3.8, and section 6.5 of text [1]

Module 2: Applications of integration (18 Hours)
We can proceed as in section 5.1 to find area between two curves. Sections 5.2 and 5.3 discuss two method to find volumes involving integration in one variable. Arc lengths of curves and area of revolution must be covered as in section 5.4 and 5.5. The use of differentiation and integration to get new power series from already known series has to be discussed as in section 9.10. In exercise set 9.10 problem 41 on carbon dating and problem 44 on gravity has to be mentioned.
The topics in this module can be found in chapter 5, sections 5.1 to 5.5 and chapter 9.10 of text [1]

Module 3 : Multiple Integrals (18 Hours)
A basic introduction to double integrals can be given as in sections 14.1 and 14.2. For the purpose of evaluatingdouble integral in polar coordinates as in 14.3, we shall first give an introduction to polar coordinates as in section 10.2. For evaluating double integrals to find surface area and tripple integrals to find volume as in sections 14.4 and 14.5, a basic knowledge of quadric surfaces is necessary as in section 11.7. For performing integrations in cylindrical and spherical coordinates as in section 14.6 and change of variable as in section 14.7, we first build up a knowledge on these coordinates as in section 11.8.
The topics in this module can be found in chapter 14; sections 14.1 to 14.7, chapter 10 section 10.2 and chapter 11; sections 11.7 and 11.8 of text [1].

Module 4 : Vector differentiation (18 Hours)
After an introduction to vector valued functions as in section 12.1, we can move to derivatives of such functions as in section 12.2. Vector equations of tangent lines to graphs

and derivatives of dot and cross products of functions are to be discussed; while results on integration may be avoided. Section 13.6 will provide enough material on directional derivatives and vector operator - gradient. Besides the usual exercise problems; problems 73, 74, and 76 of excercise set 13.6 may be discussed.
The topics in this module can be found in chapter 12; sections 12.1, 12.2, and chapter 13; section 13.6 of text [1].

Texts

Text 1 – H Anton, I Bivens, S Davis. *Calculus*, 10th Edition, John Wiley & Sons

References

Ref. 1 – George B. Thomas, Ross L. Finney. Calculus and analytic geometry, 9th Edition, Addison-wesley publishing Company.

Ref. 2 – K F Riley, M P Hobson, S J Bence. *Mathematical Methods for Physics and Engineering*, 3rd Edition, Cambridge University Press

Ref. 3 – Mary L Boas. *Mathematics Methods in the Physical Sciences*, 3rd Edition, Wiley

Ref. 4 – Erwin Kreyszig. *Advanced Engineering Mathematics*, 10th Edition, Wiley-India

MM 1331.1 —(1/2)

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Physics

Semester III

Mathematics III
(Linear Algebra, Special Functions and Calculus)

Code: MM 1331.1 **Instructional hours per week: 5** **No. of Credits: 4**

Module 1 : Linear Algebra : Determinants, Matrices (24 Hours)

Introduction to Determinants and Matrices, Rank of a Matrix, Solution of Linear System of Equations (exclude Matrix Inversion Method), Consistency of Linear System of Equations, Linear Transformations, Vectors, Eigen Values, Properties of Eigen Values (Statements only), Cayley-Hamilton Theorem (Statement only), Reduction to Diagonal Form.

The topics in this section can be found in chapter 2 [sections 2.1, 2.2, 2.4, 2.7, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16] of text [1].

Module 2 : Ordinary Differential Equations (36 Hours)

- Differential Equations of the First Order :- Definitions, Solution of a Differential Equation, Equations of the First order and First Degree Variables Separable, Homogeneous Equations, Equations Reducible to Homogeneous Form, Linear Equations, Bernoulli's Equation, Exact Differential Equations, Equations reducible to exact equations, Equations of the First Order and Higher Degree, Clairaut's Equation.
- Applications of Differential Equations of First Order :- Orthogonal Trajectories.
- Linear Differential Equations :- Definitions, Theorem without proof, Operator D, Rules For Finding the Complementary Function, Inverse Operator, Rules for Finding the Particular Integral, Working Procedure to Solve the Equation, Two Other Methods of Finding P.I, Equations reducible to Linear equations with Constant Coefficients, Linear Dependence of Solutions.

The topics in this module can be found in chapter 11 [sections 11.1, 11.4-11.14], chapter 12 [section 12.3] and chapter 13 [sections 13.1-13.10] of text [1].

Module 3 : Vector Integration and Special Functions (30 hours)

Vector Integration

Vector Fields, Line Integrals, Independence of Path and Conservative Vector Fields, Green's theorem, Surface Integrals, Applications of Surface Integrals; The Divergence Theorem, Stokes' Theorem.

[All theorems in this section should be discussed without proof].
The topics in this section can be found in chapter 15 [sections 15.1 to 15.8] of text [2].

Special Functions

The Factorial Function, Definition of the Gamma Function; Recursion Relation, The Gamma Function of Negative Numbers, Some Important Formulas Involving Gamma Functions, Beta Functions, Beta Functions in Terms of Gamma Functions.

The topics in this section can be found in chapter 11 [sections 2 to 7] of text [3].

Text [1] : B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

Text [2] : Howard Anton, Irl Bivens, Stephen Davis. Calculus, 10th Edition, John Wiley & Sons.

Text [3] : Mary L. Boas. Mathematical Methods in the Physical Sciences, Third Edition, John Wiley & Sons.

References

I) K. F. Riley, M. P. Hobson, S.J. Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press.

II) George .B. Arfken, Hans. J. Weber, Frank .E .Harris. Mathematical Methods for Physicists, 7th Edition, Academic Press.

III) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

MM 1431.1 — (1/2)

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Physics

Semester IV

Mathematics - IV
(Fourier Series, Complex Analysis and Probability Theory)

Code: MM 1431.1 **Instructional hours per week: 5** **No. of Credits: 4**

Module 1: Fourier Series (24 Hours)

Introduction, Euler's Formulae (without proof), Conditions for a Fourier Expansion, Functions Having Points of Discontinuity, Change of Interval, Even and Odd Functions, Half Range Series, Fourier Transforms, Properties of Fourier Transforms.

The topics in this module can be found in chapter 10 [sections 10.1 to 10.7] and Chapter 22 [sections 22.4, 22.5] of the text.

Module 2 : Complex Analysis (36 Hours)

Complex Numbers and Functions :- Complex Numbers, Geometric Representation of Imaginary Numbers, Geometric Representation of z_1+z_2, De-Moivre's Theorem (without proof), Roots of a Complex Number, Complex Function, Exponential Function of a Complex variable.

Calculus of Complex Functions :- Introduction, Limit of a Complex Function, Derivative of f(z), Analytic Functions, Harmonic Functions, Complex Integration, Cauchy's Theorem, Cauchy's Integral Formula, Laurent's Series, Zeros of an Analytic Function, Residues, Calculation of Residues, Evaluation of Real Definite Integrals.

[All Theorems in this module should be considered without proof]
The topics in this module can be found in chapter 20 [sections 20.1 to 20.5, 20.12 to 20.14, 20.16 (Laurent Series only), 20.17 to 20.20] of the text.

Module 3: Probability and Statistics (30Hours)

Probability and Distributions :- Introduction, Basic Terminology, Probability and Set Notations, Addition Law of Probability, Independent Events, Baye's Theorem, Random Variable, Discrete Probability Distribution, Continuous Probability Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution.

MM 1431.1 — (2/2)

The topics in this module can be found in chapter 26 [sections 26.1 to 26.9, 26.14 to 26.16] of the text.

Text : B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

References

I) K.F. Riley, M. P. Hobson, S .J. Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press.

II) H. Anton, I. Bivens, S. Davis. Calculus, 10th Edition, John Wiley & Sons.

III) George. B. Afken, Hans. J. Weber, Frank .E. Harris. Mathematical Methods for Physicists, 7th Edition, Academic Press.

IV) Erwin Kreyszig. Advanced Engineering Mathematics, 10th Edition, Wiley-India.

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

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Chemistry

Semester I

Mathematics – I
(Differential Calculus and sequences and series)
Code: MM 1131.2

Instructional hours per week: 4 No. of Credits:3

Overview of the course:
This course is designed to get a fairly descent coverage of differential calculus of one or more variables. A short section on sequences and series is also included. As this course is designed as a complementary course for students of B.Sc. Chemistry, we may avoid all the proofs of theorems.

Module 1: Differential calculus of one variable (18 Hours)

We start with definition of limits as in 1.1.1 and then move on to discussion on one sided limits, two sided limits and infinite limits, techniques for computing limits may be done as in section 1.2. Limits at infinity for polynomials, rational functions and functions involving radicals are to be discussed as in section 1.3. A general discussion on continuity may be done as in section 1.5. Various techniques for differentiation are to be covered using section 2.1 to to 2.8. This portion will cover the product and quotient rules, derivatives of trigonometric functions, chain rule and implicit differentiation. Basic properties of exponential and logarithemic functions and techniques of differentiation involving these functions may be explored asin sections 6.1 and 6.2 (avoid results on integration). Definition Evaluating and derivatives of inverse trigonometric functions has to be discussed as in section 6.7 (avoid results on integration).

The topics in this module can be found in chapter 1; sections 1.1, 1.2, 1.3, 1.5, chapter 2; sections 2.1 to 2.7 and chapter 6; sections 6.1, 6.2 and 6.7 of text [1].

Module 2 : Applications of derivatives (18 hours)

Properties of functions like increase, decrease, concavity, maxima and minima has to be analyzed as in sections 3.1, 3.2 and 3.4. Rolle's theorem and mean value theorem has to be discussed as in section 3.8. This section ends with L'Höpital's rule for evaluating limits in case of indeterminate forms as in section 6.5.

The topics in this module can be found in chapters 3 and 6 within sections 3.1, 3.2, 3.4, 3.8, and section 6.5 of text [1]

Module 3: Differential calculus of functions of two or more variables (18 Hours)

This module begins with a study of functions of two or more independent variables. We describe the domains, graphs and level curves of such functions as in section 13.1. A discussion about partial differentiation, without going into analytic details of continuity of partial derivatives can be conducted as in section 13.3. Discuss problem 94 of exercise set 13.3. A very short, but important mention has to be made about total differential of

a function of two or more variables as in section 13.4 (definition of total differential only). Chain rule for partial differentiation can be practiced as in section 13.5. It is suggestible to transform 'Laplace's' and 'Cauchy-Riemann' equations from cartesian to polar forms (problems 55 and 57 of exercise set 13.5). Section 13.8 can be used to provide a good course on maxima and minima of function of two or more variables. Section 13.9 will introduce the reader to Lagrange Multiplier metod for constrained optimization. Problem 34 in exercise set 13.9 will provide an easy application of this method.

The topics in this module can be found in chapter 13, sections 13.1, 13.3, 13.4, 13.5, 13.8 and 13.9 of text [1]

Module 4: Sequences and series (18 Hours)

Section 9.1 will introduce the reader to sequences, their limits, convergence and some related theorems. Infinite series, thier convergence and sums, telescoping sums, geometric and harmonic series can be discussed as in section 9.3. Sections 9.4 and 9.5 will present various tests for cheking convergence of infinite series. Section 9.6 discusses alternating series. Sections 9.7 and 9.8 discusses polynomials and series known by the names of Taylor and Maclaurin.

The topics in this module can be found in chapter 9, sections 9.1, and 9.3 to 9.8 of text [1]

Texts

Text 1 – H Anton, I Bivens, S Davis. *Calculus*, 10th Edition, John Wiley & Sons

References

Ref. 1 – George B. Thomas, Ross L. Finney. Calculus and analytic geometry, 9th Edition, Addison-wesley publishing Company.

Ref. 2 – K F Riley, M P Hobson, S J Bence. *Mathematical Methods for Physics and Engineering*, 3rd Edition, Cambridge University Press

Ref. 3 – Mary L Boas. *Mathematics Methods in the Physical Sciences*, 3rd Edition, Wiley

Ref. 4 – Erwin Kreyszig. *Advanced Engineering Mathematics*, 10th Edition, Wiley-India

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Chemistry

Semester II

Mathematics – II
(Integral calculus and vector differentiation)

Code: MM 1231.2

Instructional hours per week: 4 No. of Credits: 3

Overview of the course:
This course is designed to get a fairly descent coverage of integral calculus of one or more variablesand vector differentiation. As this course is designed as a complementary course for students of B.Sc. Chemistry, we may avoid all the proofs of theorems.

Module 1 : Integral calculus of one variable (18 Hours)
We start this module with an introduction to indefinite integral as in section 4.2. Integration techniques like substitution, hyperbolic functions, integration by parts, trigonometric substitution and partial fractions has to be dealt as in sections 4.3, 4.5, 4.6, 4.9, 6.8 and 7.1 to 7.5.
The topics in this module can be found in chapter 4; sections 4.2, 4.3, 4.5, 4.6, 4.9 Chapter 6; section 6.8 and chapter 7, sections 7.1 to 7.5 of text [1]

Module 2: Applications of integration (18 Hours)
We can proceed as in section 5.1 to find area between two curves. Sections 5.2 and 5.3 discuss two method to find volumes involving integration in one variable. Arc lengths of curves and area of revolution must be covered as in section 5.4 and 5.5. The use of differentiation and integration to get new power series from already known series has to be discussed as in section 9.10. In exercise set 9.10 problem 41 on carbon dating and problem 44 on gravity has to be mentioned.
The topics in this module can be found in chapter 5, sections 5.1 to 5.5 and chapter 9.10 of text [1]

Module 3 : Multiple Integrals (18 Hours)
A basic introduction to double integrals can be given as in sections 14:1 and 14.2. For the purpose of evaluatingdouble integral in polar coordinates as in 14.3, we shall first give an introduction to polar coordinates as in section 10.2. For evaluating double integrals to find surface area and tripple integrals to find volume as in sections 14.4 and 14.5, a basic knowledge of quadric surfaces is necessary as in section 11.7. For performing integrations in cylindrical and spherical coordinates as in section 14.6 and change of variable as in section 14.7, we first build up a knowledge on these coordinates as in section 11.8.
The topics in this module can be found in chapter 14; sections 14.1 to 14.7, chapter 10 section 10.2 and chapter 11; sections 11.7 and 11.8 of text [1].

Module 4 : Vector differentiation (18 Hours)
After an introduction to vector valued functions as in section 12.1, we can move to derivatives of such functions as in section 12.2. Vector equations of tangent lines to graphs and derivatives of dot and cross products of functions are to be discussed; while results

on integration may be avoided. Section 13.6 will provide enough material on directional derivatives and vector operator - gradient. Besides the usual exercise problems; problems 73, 74, and 76 of excercise set 13.6 may be discussed.
The topics in this module can be found in chapter 12; sections 12.1, 12.2, and chapter 13; section 13.6 of text [1].

Texts

Text 1 – H Anton, I Bivens, S Davis. *Calculus*, 10th Edition, John Wiley & Sons

References

Ref. 1 – George B. Thomas, Ross L. Finney. Calculus and analytic geometry, 9th Edition, Addison-wesley publishing Company.

Ref. 2 – K F Riley, M P Hobson, S J Bence. *Mathematical Methods for Physics and Engineering*, 3rd Edition, Cambridge University Press

Ref. 3 – Mary L Boas. *Mathematics Methods in the Physical Sciences*, 3rd Edition, Wiley

Ref. 4 – Erwin Kreyszig. *Advanced Engineering Mathematics*, 10th Edition, Wiley-India

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Chemistry

Semester III

Mathematics - III
(Linear Algebra, Probablity Theory & Numerical Solutions)

Code: MM 1331.2 **Instructional hours per week: 5** **No. of Credits: 4**

Module 1 : Linear Algebra : Determinants, Matrices (24 Hours)

Introduction to Determinants and Matrices, Rank of a Matrix, Solution of Linear System of Equations (exclude Matrix Inversion Method), Consistency of Linear System of Equations, Linear Transformations, Vectors, Eigen Values, Properties of Eigen Values (Statements only), Cayley-Hamilton Theorem (Statement only), Reduction to Diagonal Form.

The topics in this section can be found in chapter 2 [sections 2.1, 2.2, 2.4, 2.7, 2.9, 2.10, 2.11, 2.12, 2.13, 2.14, 2.15, 2.16] of the text.

Module 2: Probability and Statistics (30 Hours)

Probability and Distributions :- Introduction, Basic Terminology, Probability and Set Notations, Addition Law of Probability, Independent Events, Baye's Theorem, Random Variable, Discrete Probability Distribution, Continuous Probability Distribution, Binomial Distribution, Poisson Distribution, Normal Distribution.

The topics in this module can be found in chapter 26 [sections 26.1 to 26.9, 26.14 to 26.16] of the text.

Module 3: Numerical Solutions (36 Hours)

- Numerical Solution of Equations :- Introduction, Solution of Algebraic and Transcendental equations, Useful Deductions From the Newton-Raphson Formula, Solution of Linear Simultaneous Equations, Direct Methods of Solution (exclude Factorization Method), Iterative Methods of Solution (exclude relaxation method).
- Finite Differences and Interpolation :- Finite Differences, To Find One or More Missing Terms (First method only), Newton's Interpolation Formulae, Lagrange's Interpolation Formula.
- Numerical Integration :- Numerical Integration, Trapezoidal Rule, Simpson's One-Third Rule, Simpson's Three-Eighth Rule, Weddle's Rule.
- Numerical Solution of Ordinary Differential Equations :- Taylor's Series Method, Runge-Kutta Method, Predictor-Corrector Methods, Milne's Method.

The topics in this module can be found in chapter 28 [sections 28.1 to 28.3, 28.5 to 28.7], chapter 29 [Sections 29.1, 29.5, 29.6, 29.10], chapter 30 [sections 30.4, 30.6 to 30.8, 30.10] and chapter 32 [sections 32.3, 32.7 to 32.9] of the text.

Text : B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

References

I) K.F. Riley, M. P. Hobson, S .J. Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press.

II) H. Anton, I. Bivens, S. Davis. Calculus, 10th Edition, John Wiley & Sons.

III) George. B. Afken, Hans. J. Weber, Frank .E. Harris. Mathematical Methods for Physicists, 7th Edition, Academic Press.

IV) Erwin Kreyszig. Advanced Engineering Mathematics, 10th Edition, Wiley-India.

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

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Chemistry

Semester IV

Mathematics-IV
(Differential Equations, Vector Calculus, and Abstract Algebra)

Code: MM 1431.2 **Instructional hours per week: 5** **No. of Credits: 4**

Module 1 : Ordinary Differential Equations (36 Hours)

Differential Equations of the First Order :- Definitions, Solution of a Differential Equation, Equations of the First order and First Degree Variables Separable, Homogeneous Equations, Equations Reducible to Homogeneous Form, Linear Equations, Bernoulli's Equation, Exact Differential Equations, Equations reducible to exact equations, Equations of the First Order and Higher Degree, Clairaut's Equation.
Applications of Differential Equations of First Order :- Orthogonal Trajectories.
Linear Differential Equations :- Definitions, Theorem without proof, Operator D, Rules For Finding the Complementary Function, Inverse Operator, Rules for Finding the Particular Integral, Working Procedure to Solve the Equation, Two Other Methods of Finding P.I, Equations reducible to Linear equations with Constant Coefficients, Linear Dependence of Solutions.

The topics in this module can be found in chapter 11 [sections 11.1, 11.4-11.14], chapter 12 [section 12.3] and chapter 13 [sections 13.1-13.10] of text [1].

Module 2 : Vector Integration (24 hours)

Vector Fields, Line Integrals, Independence of Path and Conservative Vector Fields, Green's theorem, Surface Integrals, Applications of Surface Integrals; The Divergence Theorem, Stokes' Theorem.

[All theorems in this module should be discussed without proof].
The topics in this module can be found in chapter 15 [sections 15.1 to 15.8] of text [2].

Module 3: Abstract Algebra (30 Hours)

- Introduction and Examples, Binary Operations, Groups, Subgroups (only statements of theorems), Cyclic Groups (only statements of theorems except theorem 6.1).
- Groups of Permutations [exclude the section Cayley's Theorem].

- Rings and Fields [exclude the section Homomorphisms and Isomorphisms].

The topics in this module can be found in chapter I [sections 1,2,4,5,6], chapter II [section 8] and chapter IV [section 18] text [3].

Text [1] : B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

Text [2]: Howard Anton, Irl Bivens, Stephen Davis. Calculus, 10th Edition, John Wiley & Sons.

Text [3]: John B. Fraleigh, A First Course in Abstract Algebra, Seventh Edition, Pearson.

References

I) K. F. Riley, M. P. Hobson, S.J. Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press.

II) Mary. L. Boas. Mathematics Methods in the Physical Sciences, 3rd Edition, Wiley.

III) George .B. Arfken, Hans. J. Weber, Frank .E .Harris. Mathematical Methods for Physicists, 7th Edition, Academic Press.

IV) Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley-India.

V) David M Bishop, Group theory and Chemistry, Dover Publications.

VI) J.A. Gallian, Contemporary Abstract Algebra, Narosa Publications.

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Statistics
Semester I
Mathematics I
(Differential Calculus)
Code: MM 1131.4

Instructional hours per week: 4 No. of Credits:3

Overview of the course: This course is designed to get a fairly descent coverage of differential calculus of one or more variables. As this course is designed as a complementary course for students of B.Sc. Statistics, we may avoid all the proofs of theorems.

Module 1: Differential calculus of one variable (24 Hours)

We start with definition of limits as in 1.1.1 and then move on to discussion on one sided limits, two sided limits and infinite limits, techniques for computing limits may be done as in section 1.2. Limits at infinity for polynomials, rational functions and functions involving radicals are to be discussed as in section 1.3. A general discussion on continuity may be done as in section 1.5. Various techniques for differentiation are to be covered using section 2.1 to to 2.8. This portion will cover higher derivatives, the product and quotient rules, derivatives of trigonometric functions, chain rule and implicit differentiation. Basic properties of exponential and logarithemic functions and techniques of differentiation involving these functions may be explored as in sections 6.1 and 6.2 (avoid results on integration). Definition Evaluation and derivatives of inverse trigonometric functions has to be discussed as in section 6.7 (avoid results on integration).

The topics in this module can be found in chapter 1; sections 1.1, 1.2, 1.3, 1.5, chapter 2; sections 2.1 to 2.7 and chapter 6; sections 6.1, 6.2 and 6.7 of text [1].

Module 2 : Applications of derivatives (24 hours)

Properties of functions like increase, decrease, concavity, maxima and minima has to be analyzed as in sections 3.1, 3.2 and 3.4. Rolles theorem and mean value theorem has to be discussed as in section 3.8. This section ends with LHopitals rule for evaluating limits in case of indeterminate forms as in section 6.5.

The topics in this module can be found in chapters 3 and 6 within sections 3.1, 3.2, 3.4, 3.8, and section 6.5 of text [1]

Module 3: Differential calculus of functions of two or more variables (24 Hours)

This module begins with a study of functions of two or more independent variables. We describe the domains, graphs and level curves of such functions as in section 13.1. A discussion about partial differentiation, without going into analytic details of continuity of partial derivatives can be conducted as in section 13.3. Discuss problem 94 of exercise set 13.3. A very short, but important mention has to be made about total differential of a function of two or more variables as in section 13.4 (definition of total differential only). Chain rule for partial differentiation can be practiced as in section 13.5. It is suggestible to transform Laplaces and Cauchy-Riemann equations from cartesian to polar forms (problems 55 and 57 of exercise set 13.5). Section 13.8 can be used to provide a good course on maxima and minima of function of two or more variables. Section 13.9 will introduce the reader to Lagrange Multiplier metod for constrained optimization. Problem 34 in exercise set 13.9 will provide an easy application of this method.

The topics in this module can be found in chapter 13, sections 13.1, 13.3, 13.4, 13.5, 13.8 and 13.9 of text [1]

Text

Text 1 H Anton, I Bivens, S Davis. Calculus, 10th Edition, John Wiley & Sons

References

Ref. 1 George B. Thomas, Ross L. Finney. Calculus and analytic geometry, 9th Edition, Addison-wesley publishing Company.

Ref. 2 K F Riley, M P Hobson, S J Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press

Ref. 3 Mary L Boas. Mathematics Methods in the Physical Sciences, 3rd Edition, Wiley

Ref. 4 Erwin Kreyszig. Advanced Engineering Mathematics, 10th Edition, Wiley-India 2

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Statistics
Semester II
Mathematics II
(Integral calculus and sequences and series)
Code: MM 1231.4

Instructional hours per week: 4 No. of Credits:3

Overview of the course: This course is designed to get a fairly descent coverage of integral calculus of one or more variables.A short section on sequences and series is also included. As this course is designed as a complementary course for students of B.Sc. Statistics, we may avoid all the proofs of theorems.

Module 1 : Integral calculus of one variable (18 Hours)

We start this module with an introduction to indefinite integral as in section 4.2. Integration techniques like substitution, hyperbolic functions, integration by parts, trigonometric substitution and partial fractions has to be dealt as in sections 4.3, 4.5, 4.6, 4.9, 6.8 and 7.1 to 7.5.

The topics in this module can be found in chapter 4; sections 4.2, 4.3, 4.5, 4.6, 4.9 Chapter 6; section 6.8 and chapter 7, sections 7.1 to 7.5 of text [1]

Module 2: Applications of integration (18 Hours)

We can proceed as in section 5.1 to find area between two curves. Sections 5.2 and 5.3 discuss two method to find volumes involving integration in one variable. Arc lengths of curves and area of revolution must be covered as in section 5.4 and 5.5. The use of differentiation and integration to get new power series from already known series has to be discussed as in section 9.10. In exercise set 9.10 problem 41 on carbon dating and problem 44 on gravity has to be mentioned.

The topics in this module can be found in chapter 5, sections 5.1 to 5.5 and chapter 9.10 of text [1]

Module 3 : Multiple Integrals (18 Hours)

A basic introduction to double integrals can be given as in sections 14.1 and 14.2. For the purpose of evaluatingdouble integral in polar coordinates as in 14.3, we shall first give an introduction to polar coordinates as in section 10.2. For evaluating double integrals to find surface area and tripple integrals to find volume as in sections 14.4 and 14.5, a basic knowledge of quadric surfaces is necessary as in section 11.7. For performing integrations in cylindrical and spherical coordinates as in section 14.6 and change of variable as in section 14.7, we first build up a knowledge on these coordinates as in section 11.8.

The topics in this module can be found in chapter 14; sections 14.1 to 14.7, chapter 10 section 10.2 and chapter 11; sections 11.7 and 11.8 of text [1].

Module 4: Sequences and series (18 Hours)

Section 9.1 will introduce the reader to sequences, their limits, convergence and some related theorems. Infinite series, thier convergence and sums, telescoping sums, geometric and harmonic series can be discussed as in section 9.3. Sections 9.4 and 9.5 will present various tests for cheking convergence of infinite series. Section 9.6 discusses alternating series. Sections 9.7 and 9.8 discusses polynomials and series known by the names of Taylor and Maclaurin.

The topics in this module can be found in chapter 9, sections 9.1, and 9.3 to 9.8 of text [1]

Texts

Text 1 H Anton, I Bivens, S Davis. Calculus, 10th Edition, John Wiley & Sons

References

Ref. 1 George B. Thomas, Ross L. Finney. Calculus and analytic geometry, 9th Edition, Addison-wesley publishing Company.

Ref. 2 K F Riley, M P Hobson, S J Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press

Ref. 3 Mary L Boas. Mathematics Methods in the Physical Sciences, 3rd Edition, Wiley

Ref. 4 Erwin Kreyszig. Advanced Engineering Mathematics, 10th Edition, Wiley-India

MM 1331.4 —(V1)

University of Kerala
Complementary Course in Mathematics
for First Degree Programme in Statistics
Semester III
Mathematics III
(Fourier series, Numerical Methods and ODE)
Code: MM 1331.4

Instructional hours per week: 5 No. of Credits:4

Module 1: Fourier Series (20 Hours)

Introduction, Eulers Formulae (without proof), Conditions for a Fourier Expansion, Functions Having Points of Discontinuity, Change of Interval, Even and Odd Functions, Half Range Series, Fourier Transforms, Properties of Fourier Transforms.

The topics in this module can be found in chapter 10 [sections 10.1 to 10.7] and Chapter 22 [sections 22.4, 22.5] of the text.

Module 2 : Numerical Solutions (35 Hours)

Numerical Solution of Equations :-Introduction, Solution ofAlgebraic and Transcendental equations, Useful Deductions From the Newton-Raphson Formula, Solution of Linear Simultaneous Equations, Direct Methods of Solution(exclude Factorization Method), Iterative Methods of Solution(exclude relaxation method).

Finite Differences and Interpolation:-Finite Differences, To Find One or More Missing Terms(First method only), Newtons Interpolation Formulae, Lagranges Interpolation Formula.

Numerical Integration :-Numerical Integration, Trapezoidal Rule, Simpsons One-Third Rule, Simpsons Three-Eighth Rule, Weddles Rule.

Numerical Solution of Ordinary Differential Equations :-Taylors Series Method,Runge-Kutta Method, Predictor-Corrector Methods, Milnes Method

The topics in thismodule can be found in chapter 26 [sections26.1 to 26.9, 26.14 to 26.16] of the text

Module 3: Ordinary Differential Equations (35 Hours)

Differential Equations of the First Order :- Definitions, Solution of a Differential Equation, Equations of the First order and First Degree Variables Separable, Homogeneous Equations, Equations Reducible to Homogeneous Form, Linear Equations, Bernoullis Equation, Exact Differential Equations, Equations reducible to exact equations, Equations of the First Order and Higher Degree, Clairauts Equation.

Applications of Differential Equations of First Order :- Orthogonal Trajectories.

Linear Differential Equations :- Definitions, Theorem without proof, Operator D, Rules For Finding the Complementary Function, Inverse Operator, Rules for Finding the Particular Integral, Working Procedure to Solve the Equation, Two Other Methods of Finding P.I, Equations reducible to Linear equations with Constant Coefficients, Linear Dependence of Solutions.

The topics in this module can be found in chapter 13, sections 13.1, 13.3, 13.4, 13.5, 13.8 and 13.9 of text [1]

Text

Text : B.S. Grewal, Higher Engineering Mathematics, 42nd Edition, Khanna Publishers.

References

I) K.F. Riley, M. P. Hobson, S .J. Bence. Mathematical Methods for Physics and Engineering, 3rd Edition, Cambridge University Press.

II) H. Anton, I. Bivens, S. Davis. Calculus, 10th Edition, John Wiley & Sons.

III) George. B. Afken, Hans. J. Weber, Frank .E. Harris. Mathematical Methods for Physicists, 7th Edition, Academic Press.

IV) Erwin Kreyszig. Advanced Engineering Mathematics, 10th Edition, Wiley-India.

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

MM 1131.5 (71)

University of Kerala
Complimentary course in Mathematics for first degree programme in Economics
Semester I
Mathematics for Economics - I

Code : MM 1131.5

Instructional hours per week: 3

No.of Credits:2

Module 1: Theory of Sets

Finite and infinite sets, set operations- ordered pairs, cartesian products, Relations, Functional Relations and Functions.

Chapter 1: 1.1, 1.2, 1.3, 1.4, 1.5, 1.6,1.7, 1.8, 1.9 and 1.14, 1.15,1.16, 1.17 of Text 1

Module 2: Equations

Equations and identities:- Linear quadratic equations, solutions of equations, solutions of quadratic equations, simultaneous equations, solutions of simultaneous equations, Applications in Economics. Functions and curves in Economics:- Demand functions and curves, total revenue curve, cost curves.

Chapter 3: 3.1 and Appendix to chapter 4 of Text 1

Text.1 Mehta Madnani, Mathematics for Economics,Sultan Chand and Sons Educational Publishers, New Delhi

References

1. Knut Sydsaeter and Peter Hammond with Arne Strom, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson Education limited.

2. Allen.R.G.D, Mathematical Analysis for Economics, Mc Millan Press, London

3. Chiang.A.C, Fundamental Methods of Mathematical Economics, Mc Graw Hill, New Delhi.

MM 1231.5 – (1/1)

University of Kerala
Complimentary course in Mathematics for first degree programme in Economics
Semester II
Mathematics for Economics -II

Code : MM 1231.5

Instructional hours per week: 3

No.of Credits:3

Module 1: Differential Calculus: One variable

Differentiation: Basic definition, process of diffrentiation, Rules of differentiation, some standard results(without proof), Derivatives of higher order with simple problems involving polynomial functions (exept trigonometric and logarithmic functions).

Chapter 6: 6.3, 6.4, 6.5 of Text 1

Module 2: Differentiation II

Sign of the differential coefficients, Second derivative and nature of curve, maximum and minimum value of a function, order condition for maximum-minimum(extreme) values.
Applications of simple derivatives: Differential coefficient and elasticity of demand.

Chapter 6: 6.6,6.7, 6.8, 6.9 of Text 1

Chapter 7: 7.1 of Text 1

Text.1 Mehta Madnani, Mathematics for Economics,Sultan Chand and Sons Educational Publishers, New Delhi

References

1. Knut Sydsaeter and Peter Hammond with Arne Strom, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson Education limited.

2. Allen.R.G.D, Mathematical Analysis for Economics, Mc Millan Press, London

3. Chiang.A.C, Fundamental Methods of Mathematical Economics, Mc Graw Hill, New Delhi.

University of Kerala
Complimentary course in Mathematics for first degree programme in Economics
Semester III
Mathematics for Economics -III

Code : MM 1331.5

Instructional hours per week: 3

No.of Credits:3

Module 1: Simple Integration

Basic definition, constant of integration, basic rule of integration, standared results, Methods of integration(substitution methods only with simple problems), integration by parts(exept trigonometric functions and logarithmic functions), definite integral, properties of definite integrals(Without problems), Applications of definite integrals .

Chapter 12: 12.1, 12.2, 12.3, 12.4, 12.5 and 12.9 of Text 1

Chapter 13: 13.4 of Text 1

Module 2: Matrices and Determinants

Matrices: Addition and sutraction of matrices, matrix multiplication, transpose of a matrix, properties of transpose of a matrix(without problems), some special form of square matrices, Determinants, inverse if a matrix(Co factor method only). Solutions simultaneous equation by determinants- Cramer's rule.

Chapter 5: 5.1, 5.2, 5.3 , 5.5 , 5.6, 5.7, 5.10, 5.13 and 5.15 of Text 1

Text.1 Mehta Madnani, Mathematics for Economics,Sultan Chand and Sons Educational Publishers, New Delhi

References

1. Knut Sydsaeter and Peter Hammond with Arne Strom, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson Education limited.

2. Allen.R.G.D, Mathematical Analysis for Economics, Mc Millan Press, London

3. Chiang.A.C, Fundamental Methods of Mathematical Economics, Mc Graw Hill, New Delhi.

University of Kerala
Complimentary course in Mathematics for first degree programme in Economics
Semester IV
Mathematics for Economics -IV

Code : MM 1431.5

Instructional hours per week: 3

No.of Credits:3

Module 1: Partial Derivatives

Technique of partial differentiation, partial differentiation of second order, cross partial differentiation, partial derivatives of functions of more than two variables, Maxima and minima of a function of two variables, maxima and minima under given condition(constrained extreme values) use of Lagrange multiplier(first order condition).

Chapter 8: 8.2, 8.3, 8.4, 8.5, 8.10, 8.12 of Text 1

Module 2: Differential Equations

Definition, Kinds of differential equation, order of differential equation, degree of differential equation, solutions of differential equation, variable seperable form, general first order differential equation, linear differential equation with constant coefficients, second order linear differential equation with constant coefficient, Rules for obtaining particular integral (involving e^x only).
Applications od differential equation: Harrold-Domar model, Domar model.

Chapter 14: 14.1, 14.2, 14.3, 14.4, 14.5, 14.6, 14.10, 14.11, 14.12 of Text 1

Chapter 15: 15.3(A and B) of Text 1

Text.1 Mehta Madnani, Mathematics for Economics,Sultan Chand and Sons Educational Publishers, New Delhi

References

1. Knut Sydsaeter and Peter Hammond with Arne Strom, Essential Mathematics for Economic Analysis, Fourth Edition, Pearson Education limited.

2. Allen.R.G.D, Mathematical Analysis for Economics, Mc Millan Press, London

3. Chiang.A.C, Fundamental Methods of Mathematical Economics, Mc Graw Hill, New Delhi.