MM 1131.1 -(1/2)

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

MM 1231.1 -(1/2)

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'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 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.

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.