Syllabus for the Complementary course in Mathematics for the First Degree Programme in Physics and Computer Application

UNIVERSITY OF KERALA

Semester I

MATHEMATICS I
(Calculus, Infinite Series and Vector Algebra)
Code: MM1131.6

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

MODULE 1

Differentiation and its Applications 18 Hours

Differentiation (a review) - Leibnitz theorem - Special points of a function - Curvature - Theorems of Differentiation - Mean Value Theorem - Rolle's Theorem.

The topics in this module can be found in Chapter 2, sections 2.1 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 2 and Chapter 3 of **Reference [1].**

MODULE 2

Integration and its Apllications 24 Hours

Integration by parts - Reduction formulae - Infinite and Improper Integrals - Plane polar coordinates - Integral inequalities - Applications of Integration (Mean Value of function, Length of Curve, Surface Area of revolution, Volume of revolution.)

The topics in this module can be found in Chapter 2, sections 2.2.8 ***to*** 2.2.13 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 4, Chapter 5 and Chapter 7 of **Reference [1].**

MODULE 3

Infinite Series 24 Hours

Summation of series - Arithmetic series - Geometric series - Arithmetico-geometric series - The difference method - Series involving natural numbers - Transformation of series - Convergence of infinite series - Absolute and conditional convergence - Convergence of a series containing only real positive terms - Alternating series test - Operations with series - Power series - Convergence of power series - Operations with power series - Taylor series - Taylors theorem (Proof of these theorems excluded) - Approximation errors in Taylor series - Standard Maclaurin series.

The topics in this module can be found in Chapter 4, sections 4.1 ***to*** 4.6 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 9 of **Reference [1]** *and Chapter 1 of* **Reference [2].**

MODULE 4

Vector Algebra 24 Hours

Scalar Triple Product - Vector triple product - Equations of lines, planes and spheres - Using vectors to find distances - Reciprocal vectors

The topics in this module can be found in Chapter 7, sections 7.6 ***to*** 7.9 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 11 of **Reference [1]** *and Chapter 6 of* **Reference [2].**

Text

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

References

1 **Howard Anton, Irl C. Bivens, Stephen Davis,** *Calculus*, 10th Edition, John Wiley & Sons.

2 **Mary L Baos**, *Mathematics Methods in the Physical Sciences,* 3rd Edition, Wiley.

3 **Erwin Kreyszig**, *Advanced Engineering Mathematics*, 10th Edition, Wiley-India.

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Semester II

MATHEMATICS II
(Parial Differentiation, Vector Differentiation, Complex Numbers and Multiple Integrals)
Code: MM1231.6

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

MODULE 1

Partial Differerentiation 18 Hours

The total differential and total derivative - Exact and inexact differentials - Theorems of partial differentiation - The chain rule - Change of variables - Taylors theorem for many-variable functions - Stationary values of many-variable functions - Stationary values under constraints.

The topics in this module can be found in Chapter 5, sections 5.1 ***to*** 5.9 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 13 of **Reference [1].**

MODULE 2

Vector Calculus - Differentiation 24 Hours

Differentiation of vectors -Differentiation of composite vector expressions - Differential of a vector - Integration of vectors - Space curves - Vector functions of several arguments - Surfaces - Scalar and vector fields - Vector operators - Gradient of a scalar field - Divergence of a vector field - Curl of a vector field - Vector operator formulae - Vector operators acting on sums and products - Combinations of grad, div and curl - Cylindrical and spherical polar coordinates - Cylindrical polar coordinates - Spherical polar coordinates.

The topics in this module can be found in Chapter 10, sections 10.1 ***to*** 10.9 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 3 of **Reference [3].**

MODULE 3

Complex Numbers 24 Hours

de Moivress Theorem - Trigonometric identities - Finding the nth roots of unity - Solving polynomial equations - Complex logarithms and complex powers - Applications to differentiation and integration - Hyperbolic functions - Inverses of hyperbolic functions - Calculus of hyperbolic functions.

The topics in this module can be found in Chapter 3, sections 3.4 ***to*** 3.7 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 6 of **Reference [1]** *and Chapter 13 of* **Reference [4].**

MODULE 4

Multiple Integrals 24 Hours

Double integrals - Triple integrals - Applications of multiple integrals - Areas and volumes only (Masses, centres of mass and centroids - Pappus theorems - Moments of inertia - Mean values of functions are excluded) - Change of variables in multiple integrals - Change of variables in double

integrals- Evaluation of some special infinite integrals - Change of variables in triple integrals - General properties of Jacobians.

The topics in this module can be found in Chapter 6, sections 6.1 ***to*** 6.4 ***of*** **Text [1].**

More exercises related to the topics in this module can be found in Chapter 14 of **Reference [1]** *and Chapter 6 of* **Reference [2].**

Text

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

References

1 Howard Anton, Irl C. Bivens, Stephen Davis, *Calculus*, 10th Edition, John Wiley & Sons.

2 Mary L Baos, *Mathematics Methods in the Physical Sciences,* 3rd Edition, Wiley.

3 George B Arfken, Hans J Weber, Frank E Harris, *Mathematical Methods for Physcists*, 7th Edition, Academic Press.

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

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Semester III

MATHEMATICS III
(Theory of Matrices, Vector Integration, Differential Equations and Fourier Series)
Code: MM1331.6

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

MODULE 1

Theory of Matrices 24 Hours

Matrices and row reduction - Determinants - Cramers Rule for solving system of equations - Vectors - Lines and Planes - Linear Combinations - Linear Functions - Linear Operators - Linear Dependence and Independence - Special Matrices like Hermitian matrices and Formulas - Linear Vector Spaces - Eigenvalues and Eigenvectors - Diagonalizing Matrices - Applications of Diagonalization.

The topics in this module can be found in Chapter 3 of **Text [2].**

More exercises related to the topics in this module can be found in Chapter 7 and 8 of **Text [3].** *This topics can be referred in* **Reference [4].**

MODULE 2

Vector Calculus - Integration 24 Hours

Evaluating Line integrals - Physical examples of line integrals - Line integrals with respect to a scalar - Connectivity of regions - Greens theorem in a plane - Conservative fields and potentials - Surface integrals - Evaluating surface integrals - Vector areas of surfaces - Physical examples of surface integrals - Volume integrals - Volumes of three-dimensional regions - Integral forms for grad, div and curl - Greens theorems (without proof) - Other related integral theorems - Physical applications of the divergence theorem - Stokes theorem and related theorems (without proof) - Related integral theorems - Physical Applications.

The topics in this module can be found in Chapter 11 of **Text [1].**

More exercises related to the topics in this module can be found in Chapter 3 of **Text [2].**

MODULE 3

Differential Equations 24 Hours

First Order Ordinary Differential Equations - Exact ODEs. Integrating Factors - Linear ODEs - Bernoulli Equation - Orthogonal Trajectories - Homogeneous Linear ODEs with Constant Coefficients - EulerCauchy Equations, Nonhomogeneous ODEs.

The topics in this module can be found in Chapter 1 and 2, sections 1.4*,* 1.5*,* 1.6*,* 2.2*,* 2.5 ***and*** 2.7 ***of*** **Text [3].**

More exercises related to the topics in this module can be found in Chapter 8 of **Text [2]** and **Reference [2]**

MODULE 4

Fourier Series and Fourier Transforms 18 Hours

Introduction - Simple Harmonic Motion and Wave Motion - Periodic Functions - Applications of Fourier Series - Average Value of a Function - Fourier Coefficients - Dirichlet Conditions - Complex Form of Fourier Series - Other Intervals - Even and Odd Functions - Parsevals Theorem - Fourier Transforms.

The topics in this module can be found in Chapter 7 of **Text [2].**

More exercises related to the topics in this module can be found in Chapter 11 of **Text [3].**

Text

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

2 **Mary L Baos**, *Mathematics Methods in the Physical Sciences,* 3rd Edition, Wiley.

3 **Erwin Kreyszig**, *Advanced Engineering Mathematics*, 10th Edition, Wiley-India.

References

1 **Howard Anton, Irl C. Bivens, Stephen Davis,** *Calculus*, 10th Edition, John Wiley & Sons.

2 **B. S. Grewal** *Higher Engineering Mathematics 39th Edition*, Khanna Publishers.

3 **George B Arfken, Hans J Weber, Frank E Harris,** *Mathematical Methods for Physcists*, 7th Edition, Academic Press.

4 **David C Lay**, *Linear Algebra and its Applications*, Thomson Publications, 2007.

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Semester IV

MATHEMATICS IV
(Abstract Algebra, Laplace Transforms, Special Functions and Functions of A Complex Variable)
Code: MM1431.6

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

MODULE 1

Abstract Algebra 24 Hours

Groups - definition and Examples - Elementary properties - Finite Groups and Subgroups - Cyclic Groups - Elementary Properties
Rings - definition and Examples (Finite and Infinite) - Integral Domian and Field - definition and examples (Finite and Infinite)

The topics in this module can be found in **Text [1].**

More exercises related to the topics in this module can be found in **Reference [1].**

MODULE 2

Laplace Transforms and its Applications 24 Hours

Laplace transforms - Elementary Functions - Inverse Transform - Partial Fraction Expansion - Laplace transforms of derivatives - Dirac Delta Function (excluded) - Other Properties - Translation - Derivative of a Transform - Integration of Transforms - Limits of IntegrationUnit Step Function - Convolution (Faltungs) Theorem - Inverse Laplace transforms.
The topics in this module can be found in Chapter 15, sections 15.8 ***to*** 15.12 ***of*** **Text [2].**

More exercises related to the topics in this module can be found in **Reference [2].**

MODULE 3

Special Functions 18 Hours

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 module can be found in Chapter 11 of **Text [3].**

More exercises related to the topics in this module can be found in chapter 13 of **Text [2].**

MODULE 4

Fuunctions of A Complex Variable 24 Hours

Functions of a complex variable - Analytic Functions - Cauchy-Riemann Relations - Contour Integrals - Cauchy's Theorem - Cauchy's Integral Formula - Laurent Series - The Residue Theorem - Methods of Finding Residues - Evaluation of Definite Integrals by Use of the Residue Theorem - Residues at Infinity.

The topics in this module can be found in Chapter 14, sections 1 ***to*** 8 ***of*** **Text [3].**

More exercises related to the topics in this module can be found in Chapter 14, 15 and 16 of **Reference [2]**

Text

1 John B Fraleigh *A first course in Abstract Algebra*, Narosa Publications.

2 George B Arfken, Hans J Weber, Frank E Harris, *Mathematical Methods for Physcists*, 7th Edition,

3 Mary L Baos, *Mathematics Methods in the Physical Sciences,* 3rd Edition, Wiley Academic Press.

References

1 D A R Wallace *Groups, Rings and Fields*, Springer.

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

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