# 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: 4**                                        **No. of Credits: 3**

## 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**             18 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**             18 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**             18 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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# Syllabus for the Complementary course in Mathematics for the First Degree Programme in Physics and Computer Application

## UNIVERSITY OF KERALA

### Semester II

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

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

### 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**                                            18 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**                                                              18 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**                                                           18 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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# Syllabus for the Complementary course in Mathematics for the First Degree Programme in Physics and Computer Application

## UNIVERSITY OF KERALA

### 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**                                                18 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**                                                        30 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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# Syllabus for the Complementary course in Mathematics for the First Degree Programme in Physics and Computer Application

## UNIVERSITY OF KERALA

### 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**                                                                      30 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**                                                   18 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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