Syllabus for the Complementary course in Mathematics for the First Degree Programme in Chemistry and Industrial Chemistry

UNIVERSITY OF KERALA

Semester I

MATHEMATICS I
(Calculus, Complex Numbers and Vector Algebra)
Code: MM1131.7

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
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** [**3**].

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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Semester II

MATHEMATICS II
(Parial Differentiation, Vector Differentiation, Infinite Series and Multiple Integrals)
Code: MM1231.7

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
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 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]**.

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MODULE 4

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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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UNIVERSITY OF KERALA

Semester III

MATHEMATICS III
(Theory of Matrices, Vector Integration, Special Functions and Theory of Equations)
Code: MM1331.7

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 **Reference** [**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 **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

Theory of Equations   24 Hours

Polynomial Equations - Fundamental Theorem of Algebra (without Proof) - Applications of the fundamental theorem to equations having one or more complex roots, rational roots or multiple roots - Reciprocal equations - Method of finding its roots - Cardano's method for solving cubic equations - Ferrari's Metod for solving quartic equations - Descarte's rule of signs.

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

More exercises related to the topics in this module can be found in **Reference [4].**

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 Academic Press.

3 **Bernard and Child** *Higher Algebra*, Macmillan.

References

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

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

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

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

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Semester IV

MATHEMATICS IV
(Abstract Algebra, Laplace Transforms, Fourier Sries and Differential Equations)
Code: MM1431.7

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
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 [3]**.

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

MODULE 4
Differential Equations   18 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 [4]**.

More exercises related to the topics in this module can be found in Chapter 8 of **Text [3]** *and* **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, Academic Press.

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

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

References

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

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

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