Semester 2

Common Course (Major/Minor)

Course Code: 2MTMCOC1 (Credit: 4, Lectures: 60 Hours; Full Marks; 100)

Course Name: Basic Mathematics 2

Course Outcome: In this course, students will explore sequences, and functions on real numbers and its subsets. These topics are essential for subsequent courses in algebra, analysis, topology, and metric spaces. Additionally, the course covers ordinary differential equations, including the classification of ODEs, solution techniques for first-order ODEs, higher-order ODEs with constant coefficients, and the concept of trajectories. This knowledge serves as a foundation for future courses in differential equations and mechanics. Students will also be familiar with groups and its properties which is essential for advanced algebra, number theory courses.

Course Content:

Group A (15 Hours Lecture)

Analysis 1

1. Sequence of real numbers**:** bounds, limits, convergence and non-convergence of a sequence, operations on limits. Sandwich rule. monotone sequences and their convergence, theorem on nested intervals. Cauchy's general principle of convergence, Cauchy sequence. Cauchy's first and second limit theorem, subsequence, Bolzano – Weierstrass theorem for sequence, subsequential limits. upper limit and lower limit of a sequence, results on upper and lower limits.
2. Infinite Series of real numbers**:**

a. convergence, Cauchy's criterion of convergence.
b. series of non-negative real numbers**:** tests of convergence – comparison test, Cauchy's condensation test, ratio test;
c. statements and applications of: Cauchy root test, Abel – Pringsheim's test, Kummer's test, Raabe's test, Bertrand's test, logarithmic test and Gauss's test.
d. series of arbitrary terms**:** absolute and conditional convergence.
e. alternating series**:** Leibnitz test.
f. non-absolute convergence**:** Abel's and Dirichlet's test (statements and applications).
g. Riemann's rearrangement theorem and rearrangement of absolutely convergent series.

References

1. Introduction to Real Analysis – Donald R. Sherbert and Robert G. Bartle
2. Mathematical Analysis – T. M. Apostol.
3. Principles of Mathematical Analysis – Walter Rudin.
4. Real Analysis – S. K. Mapa.
5. Real analysis – Goldberg.

Group B (15 Hours Lecture)

Abstract Algebra 1

1. Group, elementary properties of groups. semi-group, integral power (multiple) of an element of a group, order of an element of a group, order of a group, subgroups, centre of a group, centralizer of an element of a group, cyclic group.
2. Permutation, order of a permutation, cycle and transposition, even and odd permutations, symmetric group and alternating group.
3. Coset and Lagrange's theorem – applications.

References

1. Contemporary Abstract Algebra – Joseph A. Gallian
2. Topics in Algebra – I. N. Herstein.
3. Topics in Abstract Algebra – Sen, Ghosh, Mukhopadhyay and Maity.
4. Algebra- Artin.
5. Basic Abstract Algebra - Jain, Nagpaul and Bhattacharya

Group C (30 Hours Lecture)

Ordinary Differential Equation-1

1. Significance of ordinary differential equation, geometrical and physical consideration, formation of differential equation by elimination of arbitrary constant, meaning of the solution of ordinary differential equation, concept of linear and non-linear differential equations.
2. Equations of first order and first degree**:** statement of existence and uniqueness theorem, separable, homogeneous and exact equation, condition of exactness, integrating factor, rules of finding integrating factor, (statement of relevant results only).
3. First order linear equations**:** integrating factor (Statement of relevant results only), equations reducible to first order linear equations (Bernoulli's Equation), method of variation of parameters.
4. Equations of first order but not of first degree. Clairaut's equation, singular solution.
5. Applications**:** geometric applications, ω-trajectories, orthogonal trajectories.
6. Higher order linear equations with constant coefficients**:** complementary function, particular integral, Wronskian – its properties and applications, method of undetermined coefficients, symbolic operator D, method of variation of parameters, exact equation, Euler's homogeneous equation and reduction to an equation of constant coefficients.

References

1. An Introductory Course on Ordinary Differential Equation – D. A. Murray.
2. Differential Equations – S. L. Ross.
3. Differential Equations – H. T. H. Piaggio.
4. A Text Book of Ordinary Differential Equations – Kiseleyev, Makarenko & Krasnov.
5. Differential Equations with Application & Programs – S. Balachanda Rao, H. R. Anuradha.
6. Text Book of Ordinary Differential Equations (2nd Ed.) – S. G. Deo, V. Lakshmikantham and V. Raghavendra (Tata McGraw Hill).
7. An Introduction to Differential Equations - Ghosh & Maity.
8. Differential Equations - Chakraborty & Ghosh.
9. Differential Equations with Applications and Historical Notes- G. F. Simmons