SHIV NADAR UNIVERSITY

Department of Mathematics School
of Natural Sciences

MAT 103 – Mathematical Methods I

Core course for all B.Tech. programs and for B.Sc. (Research) Chemistry **Credits**

(Lec:Tut:Lab)= 3:1:0 (3 lectures and 1 tutorial weekly) **Prerequisites:** None

Overview: In this course we study multi-variable calculus. Concepts of derivatives and integration will be developed for higher dimensional spaces. This course has direct applications in most engineering applications.

Detailed Syllabus:

1. Review of high school calculus.
2. Parametric curves (Vector functions): plotting, tangent, arc-length, polar coordinates, derivatives and integrals.
3. Functions of several variables: level curves and surfaces, differentiation of functions of several variables, gradient, unconstrained and constrained optimization.
4. Double and triple integrals: integrated integrals, polar coordinates, cylindrical and spherical coordinates, change of variables.
5. Vector fields, divergence and curl, Line and surface integrals, Fundamental Theorems of Green, Stokes and Gauss.

References:

1. A Banner, *The Calculus Lifesaver*, Princeton University Press.
2. James Stewart, *Essential Calculus – Early Transcendentals*, Cengage.
3. G B Thomas and R L Finney, *Calculus and Analytic Geometry*, Addison-Wesley.
4. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley.

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MAT 104 – Mathematical Methods II

Core course for all B.Tech. Programs and for B.Sc. (Research) Chemistry **Credits**

(Lec:Tut:Lab)= 3:1:0 (3 lectures and 1 tutorial weekly) **Prerequisites:** None

Overview: This course is a continuation of Mathematical Methods I. We will study Ordinary Differential Equations which are a powerful tool for solving many science and engineering problems. This course also coves some basic linear algebra which is needed for systems of ODEs.

Detailed Syllabus:

1. First order ODEs: separable, exact, linear
2. Second order ODEs: homogeneous and nonhomogeneous linear, linear with constant coefficients, Wronskian, undetermined coefficients, variation of parameters
3. Laplace transform: definition and inverse, linearity, shift, derivatives, integrals, initial value problems, time shift, Dirac's delta function and partial fractions, convolution, differentiation and integration of transform
4. Matrices: operations, inverse, determinant, eigenvalues and eigenvectors, diagonalization
5. Systems of ODEs: superposition principle, Wronskian, constant coefficient systems, phase plane, critical points, stability

References:

1. James Stewart, *Essential Calculus – Early Transcendentals*, Cengage.
2. Erwin Kreyszig, *Advanced Engineering Mathematics*, Wiley.

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MAT 205 – Mathematical Methods III

Core course for some B.Tech. Programs

Credits (Lec:Tut:Lab)= 3:0:0 (3 lectures weekly)

Prerequisites: None

Overview: Probability is the means by which we model the inherent randomness of natural phenomena. This course introduces you to a range of techniques for understanding randomness and variability, and for understanding relationships between quantities. The concluding portions on Statistics take up the problem of testing our theoretical models against actual data, as well as applying the models to data in order to make decisions.

Detailed Syllabus:

1. **Probability:** sample space and events, classical and axiomatic probability, permutations and combinations, conditional probability, independence, Bayes' formula
2. **Random Variables**: discrete and continuous probability distributions, mean and variance, binomial and Poisson, normal, joint distributions, covariance, correlation and regression (linear)
3. **Mathematical Statistics:** exploring data, random samples, point estimation, Central limit theorem, Maximum likelihood, chi-square, t and F-distributions, confidence intervals, hypothesis testing

References:

1. *Advanced Engineering Mathematics* by Erwin Kreyszig, Wiley.
2. *Introduction to Probability and Statistics for Engineers and Scientists* by Sheldon Ross, 2nd edition, Harcourt Academic Press.
3. *Theory and Problems of Beginning Statistics* by L. J. Stephens, Schaum's Outline Series, McGraw-Hill
4. *John E. Freund's Mathematical Statistics with Applications* by I. Miller & M. Miller, 7th edition, Pearson, 2011