List of Value-Added Courses in Mathematics

VAC-1   Basic Mathematics

Unit I: Differential Calculus
Limits and differentiation-Derivative of functions- Derivative interactive graphs-Differential
Equations in Physics
Unit II: Integral Calculus
Finite sums- Limits of finite sums-Definite integrals-Integration of functions-Fundamental
theorem of calculus
Unit III: Determinant and Matrix
Basics of determinants and matrices-Types of matrices- Simultaneous linear equations-
Eigenvalue and eigenvectors-Matrices in Physics
Unit IV: Vector Calculus
Differentiation of vectors-Gradient, divergence, curl-Integration of vectors-line, surface and
volume integral

VAC-2   Advanced Mathematics

Unit I: Few Basic Functions in Physics
Plotting of functions-Beta and Gamma Function-Riemann Zeta Function-Dirac Delta
Function
Unit II: Statistics
Mean, Mode, Median, Correlation and Regression
Unit III: Probability
Probability, Multiplicity, Combinatorics-Bernoulli Distribution-Poisson and Gaussian
Distribution
Unit IV:

VAC-3   Introduction to SCILAB

Unit I: INTRODUCTION TO SCILAB Introduction to Numerical Computing Various
Software Alternatives History Installation Workspace Command Prompt Variable Browser
SciNotes

Unit II: Working with Scilab Files Formatting Command Prompt Display Operator
Precedence Variable Browser Window Clearing Variables Comments Predefined Constants
Common Mathematical Functions Variable Assignment Operator = Naming Conventions for
Variables Global and Local Variables List of Variables Data Types Numerical Data How to
Store Floating Point Numbers Formatted Display of Numbers Boolean Data Strings

Unit III: ARRAYS and Loops Introduction Arrays and Vectors Operations on Arrays and
Vectors Elementwise Operations Matrix Multiplication Inverse of Matrices det() rank()
trace() meshgrid, ndgrid Magnitude of a Vector Random Matrix, Using Indices to Make New
Vectors Slicing Appending Rows and Columns Deleting a Row and/or Column of a Matrix
Concatenation along a Dimension Logical Operations on Arrays Automatic Generation of
Vectors Linearly Spaced Vectors Logarithmically Spaced Vectors Matrix Manipulations
Scaling a Matrix Reshaping a Matrix Special Matrices Upper and Lower Triangular Matrices.

Introduction Loops while Infinite Loops for if-else, if-else

Unit IV: PLOTTING Introduction 2D Plotting plot(x, y) plot2d(), plot2d2(), plot2d3(), and plot2d4() polarplot() Plotting Multiple Plots in the Same Graph Plotting Multiple Plots Separately 3D Plots

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Course outcome
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1. Evaluate, analyse and plot results.
2. Develop programs in SciLab
3. Understanding of linear algebra and numerical methods
4. Analyse various SciLab commands
5. Implement and illustrate 2-D graphs and 3-D graphs.

VAC-4   Mathematical Modelling

Unit I: Role of Mathematics in problem-solving, characteristics of Mathematical Modelling, Problem definitions,

Unit II: System Characterizations: System vs Variable vs Parameter, System vs Environment, Relationship between variables, Static vs Dynamic, Continuous Time vs Discrete Time, Mathematical formulations, Analysis of Mathematical formulations.

Unit III: Simple population growth model, Simple Epidemics model, Prey-predator model, Linear growth and decay model, Non-Linear growth and decay model

Unit IV: Deterministic models and Stochastic models

VAC-5   Basic Algebra

Unit I: The Integers
Properties of Integers, Greatest common divisor, Unique Factorization, Mathematical Induction, Equivalence Relations and Congruences.
Unit II: Groups
Definition and examples of Groups, Finite groups, Subgroups, Cyclic groups, Permutation groups.
Unit III: Group Homomorphisms
Definition and Examples, Properties of Homomorphism.
Unit IV: Ring Theory
Rings, Ideals, Ring Homomorphisms, Polynomial Rings.

VAC-6 Numerical Methods

Unit I: Roots of Algebraic and Transcendental Equations
Introduction to significant digits and errors, Bisection method, Regula-Falsi method, Newton-Raphson method and convergence criteria

Unit II: Solution of system of linear Equations
Direct methods, Iterative methods, Ill-conditioned systems

Unit III: Interpolation
Finite difference operators, difference tables, Newton's Forward/Backward difference, Divided differences, Lagrange interpolation and Newton's divided difference interpolation

Unit IV: Numerical Differentiation and Integration
Numerical Differentiation using Forward/Backward formula, Trapezoidal and Simpson's rules for integration

Unit V: Solution of ordinary differential equations
Picards method, Euler method, Euler modified method and Runge-Kutta methods