NUMERICAL METHODS, PROBABILITY AND STATISTICS (EEE)

Course Code: 19BM1108

L	T	P	C
3	0	2	4

Course Objectives:

- This course focuses on Techniques for finding roots of equations, interpolation, numerical integration & differentiation, solution of differential equations
- Providing students with a formal treatment of probability distributions.
- Equipping students with essential tools for estimation of parameters and statistical analysis

Course Outcomes:

At the end of the course, the student will be able to

CO1: calculate a root of algebraic and transcendental equations. Explain the relation between the finite difference operators.

CO2: solve ordinary differential equations numerically using Euler's and RK methods.

CO3: determine mean and variance of discrete and continuous random variables

CO4: estimate the confidence interval for the mean of a population and test a hypothesis concerning means.

CO5: estimate the confidence intervals, test a hypothesis concerning variances and proportions.

Unit I: Solution to algebraic equations and Interpolation

10 Lectures

Solution of polynomial and transcendental equations: bisection method, Newton-Raphson method and Regula-Falsi method. Finite differences, relations between operators, interpolation using Newton's forward and backward difference formula. Interpolation with unequal intervals: Lagrange's interpolation formula.

(Sections 28.1 - 28.3, 29.1, 29.2, 29.4-29.6, 29.9-29.10 of the textbook 1)

Learning Outcomes:

At the end of this unit, the student will be able to

1. determine approximate roots of an equation by using different numerical methods (L3)

2. explain various discrete operators and find the relation among operators (L2)
3. evaluate an interpolating polynomial for the given tabular data (L5)

Unit II: Numerical integration and Numerical solutions to ODE

10 Lectures

Numerical integration- Trapezoidal rule and Simpson's 1/3rd and 3/8th rules. Ordinary differential equations - Euler and modified Euler's methods, Runge-Kutta method of fourth order.

(Sections 30.4-30.8, 32.4, 32.5, 32.7 of the textbook 1)

Learning Outcomes:

At the end of this unit, the student will be able to

1. evaluate the area bounded by non negative functions by a numerical method (L5)
2. determine the solution of an ODE by Euler's method (L3)
3. illustrate the solution of an ODE using R-K method (L4)

Unit III: Random Variables

10 Lectures

Discrete and continuous random variables, cumulative distribution function, probability density function, mean and variance, normal distribution: calculating normal probabilities, normal approximation to the binomial distribution.

(Sections 4.1, 4.4, 5.1-5.3 of textbook 2)

Learning Outcomes:

At the end of this unit, the student will be able to

1. determine mean and variance of a probability distribution (L3)
2. interpret the properties of normal distribution and its applications (L2)
3. evaluate a binomial probability by normal approximation (L5)

Unit IV: Estimation and Test of Hypothesis of Means

10 Lectures

Point estimation, interval estimation, introduction to test of hypothesis, hypothesis concerning one mean, hypothesis concerning two means, matched pair comparisons.

(Sections 7.1, 7.2, 7.4, 7.5, 7.6, 8.2, 8.3, 8.4 of textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

1. calculate confidence intervals for the mean of a population (L3)
2. discuss the test of a hypothesis concerning population mean (L2)
3. test a hypothesis concerning two means (L5)

Unit V: Estimation, Test of Hypothesis of Variances and Proportions

10 Lectures

Estimation of variance, hypothesis concerning one variance, hypothesis concerning two variances, estimation of proportion, hypothesis concerning one proportion, hypothesis concerning several proportions.

(Sections 9.1- 9.3, 10.1 – 10.3 of textbook)

Learning Outcomes:

At the end of this unit, the student will be able to

1. calculate confidence intervals for variance and proportion of a population (L3)
2. discuss the test of a hypothesis concerning population variance(L2)
3. test a hypothesis concerning proportions (L5)

Lab Modules

Programming Exercises:

Exercise 1 To find a root of an equation of a single variable using Bisection Method.

Exercise 2 To find a root of an equation of a single variable using Regula Falsi Method.

Exercise 3 To find a root of an equation of a single variable using Newton's Method.

Exercise 4 To find interpolated value from a given set of tabular points using Newton’s Forward difference method.

Exercise 5 To find interpolated value from a given set of tabular points using Newton’s Backward difference method.

Exercise 6 To find interpolated value from a given set of tabular points using Lagrange interpolation method.

Exercise 7 To evaluate definite integral from a given set of tabular points of a function using Trapezoidal rule.

Exercise 8 To evaluate definite integrals from a given set of tabular points of a function by using Simpson's rule.

Exercise 9 To find a numerical solution of ordinary differential equations using Euler's method.

Exercise 10 To find a numerical solution of ordinary differential equations using RK method.

Textbooks:

1. B. S. Grewal, "*Higher Engineering Mathematics*", 44th edition, Khanna publishers, 2017.

2. Richard A. Johnson, Miller & Freund's "*Probability and Statistics for Engineers*", 8th edition, PHI

Learning India Private Limited, 2011.

3. S. C. Chapra& R. P. Canale, "*Numerical Methods for Engineers*", 6th Edition, McGrawHill (2012).

References:

1. Veerarajan T., Engineering Mathematics, Tata McGraw-Hill, New Delhi, 2008.

2. Erwin kreyszig, "*Advanced Engineering Mathematics*", 9th edition, John Wiley & Sons, 2006.

3. N.P. Bali and Manish Goyal, "*A textbook of Engineering Mathematics*", Laxmi Publications, Reprint,

2010.