NUMERICAL METHODS, PROBABILITY AND STATISTICS

(Common to the branches Civil, EEE, Mechanical, Mechanical (Robotics) and IT)

Course Code: 22BM1111

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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 **(L3)**.

CO2: solve ordinary differential equations numerically using Euler's and RK methods **(L3)**.

CO3: determine the mean and variance of discrete and continuous random variables **(L3)**

CO4: measure the confidence interval for the mean of a population and test a hypothesis concerning means **(L5)**

CO5: test a hypothesis concerning variances and proportions **(L5)**

UNIT-I **10 Lectures**

Solution to algebraic equations and Interpolation:

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

- determine approximate roots of an equation by using different numerical methods (L3)
- explain various discrete operators and find the relation among operators (L2)
- evaluate an interpolating polynomial for the given tabular data (L5)

UNIT-II **10 Lectures**

Numerical integration and Numerical solutions to ODE:

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

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

UNIT-III **10 Lectures**

Random Variables:

Random variables, types of random variables, probability distribution function, probability density function, the mean and variance of a probability distribution, Binomial distribution, Poisson distribution, Normal distribution: calculating normal probabilities, normal approximation to the binomial distribution. (Sections 4.1, 4.2, 4.4, 4.6, 5.1-5.3 of textbook 2)

Learning Outcomes:

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

- determine the mean and variance of a random variable (L3)
- calculate the probabilities using density and distribution function (L3)

- interpret the properties of the normal distribution and its applications (L2)

UNIT-IV **10 Lectures**

Sampling Distribution and Test of Hypothesis of Means:

Population and sample, sampling distribution of the mean (σ known), sampling distribution of the mean (σ unknown), Point estimation, interval estimation, introduction to test of hypothesis, hypothesis concerning one mean, hypothesis concerning two means, matched pair comparisons.
(Sections 6.1, 6.2, 7.1, 7.2, 7.4, 7.5, 7.6, 8.2, 8.3, 8.4 of textbook 2)

Learning Outcomes:

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

- determine the mean and variance of a sampling distribution of means (L3)
- calculate confidence intervals for the mean of a population (L3)
- test a hypothesis concerning one and two means (L5)

UNIT-V **10 Lectures**

Test of Hypothesis of Variances and Proportions

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 2)

Learning Outcomes:

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

- calculate the confidence interval for the variance and the proportion of a population (L3)
- discuss the test of a hypothesis concerning population variance (L2)
- test a hypothesis concerning proportions (L5)

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.

Reference Books:

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.
4. Web References: https://nptel.ac.in/courses/111/105/111105090/
   https://nptel.ac.in/courses/111/107/111107105/