SUBJECT DESCRIPTION AND OBJECTIVES

DESCRIPTION

Statistical mechanics is a branch of physics that applies probability theory, which contains mathematical tools for dealing with large populations, to the study of the *thermodynamic*behaviour of systems composed of a *large*number of particles. Statistical mechanics provides a framework for relating the microscopic properties of individual atoms and molecules to the macroscopic bulk properties of materials that can be observed in everyday life, thereby explaining thermodynamics as a result of the classical- and quantum-mechanical descriptions of statistics and mechanics at the microscopic level.

Statistical mechanics provides a molecular-level interpretation of macroscopic thermodynamic quantities such as work, heat, free energy, and entropy. It enables the thermodynamic properties of bulk materials to be related to the spectroscopic data of individual molecules. This ability to make macroscopic predictions based on microscopic properties is the main advantage of statistical mechanics over classical thermodynamics. Both theories are governed by the second law of thermodynamics through the medium of entropy. However, entropy in thermodynamics can only be known empirically, whereas in statistical mechanics, it is a function of the probability distribution of the system on its micro-states

With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science, engineering and technology. This course gives a complete procedure for solving different kinds of problems occur in engineering numerically.

The development and analysis of computational methods (and ultimately of program packages) for the minimization and the approximation of functions, and for the approximate solution of equations, such as linear or nonlinear (systems of) equations and differential or integral equations. Originally part of every mathematician's work, the subject is now often taught in computer science departments because of the tremendous impact which computers have had on its development. Research focuses mainly on the numerical solution of (nonlinear) partial differential equations and the minimization of functions.

OBJECTIVES

The main objectives of the sampling theory are:

- To obtain the optimum results, i.e., the maximum information about the characteristics of the population with the available sources at our disposal in terms of time, money and manpower by studying the sample values only.
- To obtain the best possible estimates of the population parameters.

The main objectives ofnumerical methods and their uses are summarized as follows:

- The roots of nonlinear (algebraic or transcendental) equations, solutions of large system of linear equations and eigen value problem of a matrix can be obtained numerically where analytical methods fail to give solution.
- When huge amounts of experimental data are involved, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.

- The numerical differentiation and integration find application when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.
- Since many physical laws are couched in terms of rate of change of one/two or more independent variables, most of the engineering problems are characterized in the form of either nonlinear ordinary differential equations or partial differential equations.
- The methods introduced in the solution of ordinary differential equations and partial differential equations will be useful in attempting any engineering problem.

MA 2266 STATISTICS AND NUMERICAL METHODS L T P C
(Common to Mechanical, Automobile & Production) **3 1 0 4**

UNIT I TESTING OF HYPOTHESIS 9 + 3

Sampling distributions - Tests for single mean, Proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – chi-square test for goodness of fit – Independence of attributes.

UNIT II DESIGN OF EXPERIMENTS 9 + 3

Completely randomized design – Randomized block design – Latin square design - 22 - factorial design.

UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9 + 3

Newton-Raphson method- Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method .

UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION 9 + 3

Lagrange’s and Newton’s divided difference interpolation –Newton’s forward and backward difference interpolation - Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal and Simpson’s 1/3 rules.

UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS 9 + 3

Taylor’s series method - Euler’s method - Modified Euler’s method - Fourth order Runge-Kutta method for solving first and second order equations - Milne’s predictor-corrector methods for solving first order equations - Finite difference methods for solving second order equation.

L = 45 T = 15 TOTAL = 60 PERIODS

TEXT BOOKS

1. R.A. Johnson and C.B. Gupta, “Miller and Freund’s Probability and Statistics for Engineers”, Pearson Education, Asia, 7th edition, 2007 (For units 3, 4 and 5).
2. Grewal, B.S. and Grewal,J.S., “ Numerical methods in Engineering and Science”, 6th Edition, Khanna Publishers, New Delhi, 2004.

REFERENCES:

1. R.E. Walpole, R.H. Myers, S.L. Myers, and K Ye, “Probability and Statistics for Engineers and Scientists”, Pearson Education, Asia , 8th edition, 2007.
2 M.R. Spiegel, J. Schiller and R.A. Srinivasan, “Schaum’s Outlines Probability and Statistics”, Tata McGraw Hill edition, 2004.
4. Chapra, S. C and Canale, R. P. “Numerical Methods for Engineers”, 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
5. Gerald, C. F. and Wheatley, P. O., “Applied Numerical Analysis”, 6th Edition, Pearson Education Asia, New Delhi, 2006.

MICRO LESSON PLAN

HOURS	TOPICS TO BE COVERED	TEXT / REF. BOOK
UNIT I TESTING OF HYPOTHESIS		
1 – 6	Sampling distributions - Tests for single mean,Proportion, Difference of means (large and small samples)	T 1
7 – 9	Tests for single variance and equality of variances	
10 – 12	chi-square test for goodness of fit – Independence of attributes	
UNIT II DESIGN OF EXPERIMENTS		
13 – 18	Completely randomized design – Randomized block design	T 1
19 - 24	Latin square design - 22 -factorial design	
UNIT III SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS		
25 – 27	Newton-Raphson method- Gauss Elimination method	T 2
28 – 29	Pivoting - Gauss-Jordan methods	
30 – 33	Iterative methods of Gauss-Jacobi and Gauss-Seidel	
34 – 36	Eigenvalues of a matrix by Power method	
UNIT IV INTERPOLATION, NUMERICAL DIFFERENTIATION AND NUMERICAL INTEGRATION		
37 – 41	Lagrange's and Newton's divided difference interpolation –Newton's forward and backward difference interpolation	T 2
42 – 44	Approximation of derivatives using interpolation polynomials	
45 – 48	Numerical integration using Trapezoidal and Simpson's 1/3 rules	
UNIT V NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS		
49 – 52	Taylor's series method - Euler's method - Modified Euler's method	T 2
53 – 56	Fourth order Runge- Kutta method for solving first and second order equations	
57 – 58	Milne's predictor-corrector methods for solving first order equations	
59 – 60	Finite difference methods for solving second order equation	