REF NO: To be filled by CD office

MA21110: Mathematics – IIIA

[Numerical Analysis, Complex Analysis and Probability and Statistics]

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites: Elementary idea of Counting Techniques, Derivative and Integration, Complex numbers, Ordinary Differential Equations.

Objectives:

1. To make students aware of numerical techniques to solve algebraic and transcendental equations
2. To enlighten the students with the different numerical techniques to interpolate a set of data points to a polynomial (Known as interpolating polynomial).
3. To make students aware Techniques of Numerical Integration .
4. To make students aware of the methods to solve ordinary differential equations numerically.
5. To make students aware of Complex Analysis and its applications in evaluating contour Integrals.
6. To introduce the fundamental concepts of of probability and probability distributions.
7. To make students aware of Sampling and hypothesis testing.
8. To make students aware of the concept of correlation and regression.

Course Details:

Unit 1: Numerical solution of Transcendental and Linear System of Equations: (07 Hrs)

U1.1. **Numerical methods:** Approximation and round of errors. **[T_1]**
Roots of equation: Newton-Raphson method, Secant Method, Muller's method. **[T_1]**
Interpolation: Lagrange Interpolation, Newton's forward and backward interpolation. **[T_2]**

U1.2. Self Study Topics : Solution of System of Linear equations by Gauss-Seidel method.

Unit 2: Numerical Integration and Numerical Solutions of Ordinary Differential Equations: (07 Hrs)

U2.1. **Numerical integration:** The trapezoidal rule, The Simpson's rules, Gauss quadrature. **[T_1]**
Numerical Solutions of Ordinary Differential Equations: Euler's method, Improvement of Euler's method, Runge-Kutta methods. **[T_1]**

U2.2. Self Study Topics : Adam-Bashforth and Adam-Moulton Multistep Methods to solve Ordinary Differential Equations.

Unit 3: Complex Analysis: (12 Hrs)

U3.1. **Complex Analytic functions:** Complex Analytic functions, Cauchy-Riemann equations, Laplace equation.
Complex Integration: Cauchy's Integral Theorem and formula, Derivatives of analytic functions. **[T_2]**
Laurent Series and Residue Integration: Laurent's series, Singularities and zeros, Residue integration method, Evaluation of real integrals. **[T_2]**

U3.2 Self Study Topics: Uniform Convergence of Complex Power Series.

Unit 4: **Probability Theory:** **(07 Hrs)**

U4.1. Probability: Probability, Random variables, Probability distributions, Mathematical Expectation, Mean and variance of distribution, Binomial, Poisson, and Normal distributions. **[T_2]** Central Limit Theorem. **[T_3]**

Random Processes – Temporal Characteristics: Introduction, The Random Process Concept, Stationary and Independence, Correlation Functions. **[T_3]**

U4.2. Self Study Topics: Distribution of several random variables.

Unit 5: Mathematical Statistics: **(07 Hrs)**

U5.1. Mathematical Statistics: Mean and Variance of a data, Random sampling, Estimation of Parameters, Confidence Intervals, Testing of hypothesis, Acceptance sampling, Chi square test for goodness of fit , Regression Analysis, Fitting Straight Lines, Correlation analysis. **[T_2]**

U5.2. Self Study Topics : Nonparametric Tests.

Note: Five assignments to be given to the students on self study, comprising of one assignment from each unit.

Text Books:

T1. Numerical methods for Engineers, Steven C. Chapra and Raymond P. Canale, Tata McGraw-Hill Publishing Company Limited, New Delhi,, Fifth Edition,2007.
Chapters 2, 5 (5.2, 5.3), 6 (6.4), 16(16.1, 16.2), 20(20.1, 20.2, 20.3).

T2. Advanced Engineering Mathematics, Erwin Kreyszig, John Willy and Sons, 8th Edition, 1999.
Chapters: 12(12.3, 12.4), 13(13.2 – 13.4), 15, 17(17.3), 22 (22.5-22.8), 23(23.1-23.4, 23.6, 23.7, 23.9, 23.10)

T3. Probability, Random Variables and Random Signal Principles, Peyton Z. Peebles, JR., Tata Mc-Graw – Hill, 4th Edition, 2010.
Chapters: 1(1.1 – 1.5), 2(2.0 – 2.5), 3(3.0 – 3.2), 6(6.0 – 6.3)

Reference Books

R1. Numerical Methods For Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R.K. Jain, New Age International Publishers, Sixth Edition, 2014.

R2. Fundamental of Mathematical Statistics, S. C. Gupta and V.K.Kapoor, Sultan Chand and Company, New Delhi, 11th Edition (reprint), 2014.

R3. *Probability & Statistics for Engineers & Scientists*, Ronald E. **Walpole**, Raymond H. Myers, Sharon L. Myers & Keying Ye, Pearson Education Inc., New Delhi, Eighth Edition, 2007.

R4. Advanced Engineering Mathematics . P. V. O'Neil, CENGAGE Learning, 2012.

R5. Fundamental of Complex Analysis, E.B. Saff, A. D. Snider, Third Edition, Pearson Education, New Delhi, 2008.

R6. Higher Engineering Mathematics, B. V. Ramana, TMH, 1st Reprint, 2007.

R7. Engineering Mathematics, S. Pal and S.C. Bhunia Oxford Publishers, 1st Edition, 2014.

R8. Higher Engineering Mathematics, B. S. Grewal, Khanna Publishers, 43rd Edition, 2014.

R9. Introductory Method of Numerical Analysis, S. S. Sastry, PHI Learning PVT LTD, New Delhi, Fourth Edition, 2009.

R10. Numerical Mathematics and Computing, W.Cheney and D. Kincaid, Thomson/CENGAGE Learning, Fifth Edition, 2014.

R11. Taub's Principles of Communication Systems, Herbert Taub, Donald L Schilling, Goutam Saha, Tata Mc-Graw – Hill Publishing Company Limited, 3rd Edition, 2008.

Course Outcomes: Students will be

CO1: enlightened with the ideas and methods of solving algebraic and transcendental equations numerically.

CO2: able to solve ordinary differential equations by single step numerical methods.

CO3: able to say whether a function of complex variable is analytic, can represent a function of complex variables by its power series, and integrate functions of complex variables using complex integration techniques.

CO4: able to solve problems and learn important concepts/characteristics involving probability theory and probability distributions.

CO5: enlightened with the concepts of finding statistical measures such as mean and variance of data, sampling, testing of hypotheses, correlation regression.