General Sir John Kotelawala Defence University

Department Mathematics

Module Descriptor – Numerical Methods and Complex Variables

Detail Syllabus

<table>
<tr><td>Module Code</td><td>MA 2203</td><td>Module Title</td><td colspan="4">Numerical Methods and Complex Variables</td></tr>
<tr><td>Credits</td><td>3</td><td rowspan="2">Hours/ Semester</td><td>Lectures</td><td>30</td><td rowspan="2">Prerequisites</td><td rowspan="2">2103</td></tr>
<tr><td>GPA/ NGPA</td><td>GPA</td><td>Continuous Assessment/Tutorials</td><td>30</td></tr>
<tr><td colspan="2">Module Objectives</td><td colspan="5">To provide the students with the knowledge of linear algebra, numerical techniques and functions of a complex variable to develop the mathematical skills required to solve engineering problems.</td></tr>
<tr><td colspan="2">Learning Outcomes</td><td colspan="5">After the completion of this module, the student will be able to
LO1: Define the concepts of vector spaces, sub spaces, linear independent sets of vectors, bases, and dimensions of vector spaces
LO2: Determine the Kernel and image of a linear transformation, diagonalization of a matrix.
LO3: Perform numerical differentiation and integration and find numerical solutions of ordinary and partial differential equations.
LO4: Apply numerical techniques to determine roots of non- linear equations.
LO5: Evaluate line integrals, contour integrals over the complex plane.
LO6: Classify singularities of functions of a complex variable and find Taylor’s and Laurent series expansion of a complex valued function.</td></tr>
<tr><td colspan="2" rowspan="3">Content</td><td colspan="4">Linear Algebra:
Vector spaces, subspaces, linear combination, spanning sets, linear independence, bases and dimension. Linear transformation, the Kernel and image of a linear transformation, Diagonalisation of a matrix and Quadratic forms, Bilinear forms.</td><td>LO1
LO2</td></tr>
<tr><td colspan="4">Numerical Methods:
Numerical Solutions of System of Linear Equations: LU Factorization, LDL^T factorization, Gauss –Seidel and Jacobi Methods. Solutions of Non-linear Equations: Bisection, Iterative, Newton-Raphson and Regula-falsi methods. Polynomial Approximation of Functions: Lagrange Polynomials, Newton’s Divided Differences, Least Square Polynomials and Functions, Finite Differences, Interpolation and Extrapolation, Numerical Differentiation, Numerical Integration: Trapezoidal, Simpson’s Rules, Numerical Solution of Ordinary Differential Equations: Euler’s Method, Taylor Series Method, Runge-Kutta methods. Numerical solutions of Partial Differential Equations using the Finite Difference Method</td><td>LO3
LO4</td></tr>
<tr><td colspan="4">Functions of a Complex Variable:
Functions of a Complex variable, Limit, Continuity, Analytic functions, Harmonic functions, Integration in the Complex plane, Contour Integrals , Cauchy-Riemann equations, Line integrals in Complex plane, Cauchy’s Theorem, Cauchy’s integral formula, Taylor’s series, Laurent series, Zeros and singularities , Poles, Residues , Residue Theorem, Evaluation of Real integrals, Conformal mapping.</td><td>LO5
LO6</td></tr>
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Method of Assessment	Continuous assessment : 30% End semester exam: 70%
References	1. Advanced Engineering Mathematics (Second Edition) by MichelD.Greenberg 2. Advanced Engineering Mathematics by H.K.DASS 3. Mathematical Techniques for Engineering and Scientists by LarryC.Andrews, RonaldL.Phillips. 4. Mathematical Methods by S.R.K.Lyengar, R.K.Jain 5. Fundamentals of Complex Analysis by E.B.Saff and A.D.Shinder. 6. Numerical Methods for Mathematics, Science , and Engineering by JohnhMathews