Numerical Methods

Course code: MAOE03

Course Credits: 4:0:0

Course Objectives:
The Student will Learn
1. The concept of different types of errors.
2. To obtain roots of algebraic and transcendental equations.
3. The concept of interpolation, differentiation and integration of a tabulated function.
4. The technique of solving simultaneous and second order ODE’s
5. To solve system of linear algebraic equations and to find eigenvalues and eigenvectors of a given square matrix.
6. The stability of Numerical method applied to PDE’s and some techniques to solve Elliptic, Parabolic and Hyperbolic equations.

Course contents:

Unit-I

Unit-II
Interpolation: Hermite and cubic spline interpolation, Bivariate interpolation-Lagrange’s bivariate interpolation, Newton’s bivariate interpolation for equispaced data.

Numerical differentiation: Derivatives using forward and backward differences up to error of second order and central differences up to error of fourth order.

Numerical integration: Richardson extrapolation, Romberg integration, Gaussian Quadrature, Double integration by Trapezoidal and Simpson’s (1/3) rd rules.

Unit-III

Unit-IV
Linear Algebra: Condition number of a matrix, matrix inversion method, LU factorization method, Cholesky method, partition method, Relaxation method, bounds for Eigen values, Gerschgorin’s circle theorem, Jacobi’s method, Given’s method.
Unit-V


Text Books:

Reference Books:

Course Outcomes
On completion of this course student will have improved ability to
1. Analyze different types of errors in numerical computation and find roots of algebraic and transcendental equations and also able to solve system of non liner algebraic equations that arise in Science and Engineering problems.
2. Interpolate, Differentiate and Integrate a function for a given set of tabulated data.
3. Solve initial and boundary value problems.
4. Solve the system of linear equations and able to find to find eigenvalues and eigenvectors using orthogonal transformations.
5. Solve PDE’s arising in Science and Engineering using Numerical techniques and also able to comment on stability of numerical methods used to solve PDE’s.

Note: Demonstration of problems using Scilab.
## Course Assessment and Evaluation:

<table>
<thead>
<tr>
<th>Direct Assessment Methods</th>
<th>What</th>
<th>To whom</th>
<th>When/ Where (Frequency in the course)</th>
<th>Max marks</th>
<th>Evidence collected</th>
<th>Contributing to Course Outcomes</th>
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<tbody>
<tr>
<td>C I E</td>
<td>Internal assessment tests</td>
<td>Students</td>
<td>Thrice(Average of the best two will be computed)</td>
<td>30</td>
<td>Blue books</td>
<td>1, 2, 3, 4, 5</td>
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<tr>
<td></td>
<td>Problem solving using open source software</td>
<td></td>
<td>Once</td>
<td>10</td>
<td>Program sheets</td>
<td>1, 2, 3, 4</td>
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<td></td>
<td>Quiz Test</td>
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<td>Once</td>
<td>10</td>
<td>Quiz answers</td>
<td>1, 2, 3, 4</td>
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<tr>
<td>S E E</td>
<td>Standard examination</td>
<td></td>
<td>End of course (Answering 5 of 10 questions)</td>
<td>100</td>
<td>Answer scripts</td>
<td>1, 2, 3, 4</td>
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<th>Indirect Assessment Methods</th>
<th>What</th>
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<th>When/ Where (Frequency in the course)</th>
<th>Max marks</th>
<th>Evidence collected</th>
<th>Contributing to Course Outcomes</th>
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<tbody>
<tr>
<td></td>
<td>End of course survey</td>
<td>Students</td>
<td>End of course</td>
<td>-</td>
<td>Questionnaire</td>
<td>1 to 5, Effectiveness of delivery of instructions and assessment methods</td>
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