(BM-223) - Differential Equations and Fourier Series

Course Outline:

1. **1-st Order Differential Equations:**
    1. Basic concept;
    2. Formation of differential equations and solution of differential equations by direct integration and by separating the variables;
    3. Homogeneous equations and equations reducible to homogeneous from;
    4. Linear differential equations of the order and equations reducible to the linear form;
    5. Bernoulli's equations and orthogonal trajectories; Application in relevant Engineering.
2. **2nd and Higher Orders Equations:**
    1. Special types of IInd order differential equations with constant coefficients and their solutions;
    2. The operator D;
    3. Inverse operator l/D;
    4. Solution of differential by operator D methods;
    5. Special cases, Cauchy's differential equations;
    6. Simultaneous differential equations; simple application of differential equations in relevant Engineering.
3. **Partial Differential Equation:**
    1. Basic concepts and formation of partial differential equations;
    2. Linear homogeneous partial differential equations and relations to ordinary differential equations;
    3. Solution of first order linear and special types of second and higher order differential equations;
    4. D' Alembert's solution of the wave equation and two dimensional wave equations;
    5. Lagrange's solution: Various standard forms.
4. **Laplace Integral & Transformation:**
    1. Definition.
    2. Laplace transforms of some elementary functions.
    3. First translation or shifting theorem.
    4. Second translation or shifting theorem.
    5. Change of scale property.
    6. Laplace transform of the nth order derivative.
    7. Initial and final value theorem.
    8. Laplace transform of integrals.
    9. Laplace transform of functions t^n F(t) and F(t)/ t.
    10. Laplace transform of periodic function.
    11. Evaluation of integrals,
    12. Definition of inverse Laplace transform and inverse transforms.
    13. Convolution theorem.
    14. Solutions of ordinary differential using Laplace transform.
5. **Fourier series:**
    1. Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients;
    2. Expansion of function with arbitrary periods. Odd and even functions and their Fourier series;
    3. Half range expansions of Fourier series, "DFT and FFT, Fourier Spectrum".
6. **Fourier Transform**
    1. Fourier transform of simple functions
    2. Magnitude and phase spectra
    3. Fourier transform theorems
    4. Inverse Fourier transform
    5. Solution of differential equation using Fourier transform

Suggested Teaching Methodology:

- Lecturing

- Written Assignments Report Writing ## **Suggested Assessment:** ### **Theory (100%)**
- Sessional (20%)
- Quiz (12%)
- Assignment (8%)
- Midterm (30%)
- Final Term (50%)

Laboratory (100%)

- Labs
- Open-Ended Labs

Recommended Text and Reference Books:

1. Erwin Kreyszig, Advance Engineering Mathematics, 10th Edition, ISBN: 9780470458365
2. Robert L. Borrelli and Courtney S. Coleman, Differential Equations: A Modeling Perspective, 2nd Edition, ISBN: 9780471433323
3. Dennis G. Zill and Warren S. Wright, Differential Equations with Boundary- Value Problems, 8th Edition, ISBN: 9781111827069
4. Eric W. Hansen, Fourier Transforms: Principles and Applications, 1st Edition, ISBN: 9781118479148
5. J. F. James, A Student's Guide to Fourier Transforms: With Applications in Physics and Engineering, 3rd Edition, ISBN: 9780521176835
6. R. J. Beerends and H. G. ter Morsche, Fourier and Laplace Transforms, 2003, ISBN: 9780521806893