(BM-401) - Numerical Methods for Biomedical Engineers

Course Outline:

Theory:

1. **Error analysis**
    1. Floating points
    2. Errors and types of errors
2. **Solution of non-linear equation**
    1. Bisection,
    2. Regula-Falsi,
    3. Fixed-point iterative and Newton-Raphson's methods.
    4. Solution of linear algebraic equations.
3. **Direct methods**
    1. Crout's and Cholescky methods;
4. **Iterative methods**
    1. Jaccobi's and Guass-Seidal methods.
5. **Eigen values and eigen vectors**
    1. Characteristics equation and Power methods.
6. **Interpolations and extrapolations**
    1. Forward, backward, central difference operators and their relations.
    2. Newtons Forward, Backward and Divided Difference Interpolation Formulae.
    3. Lagrange's and Stirling's Interpolation Formulae.
7. **Numerical differentiation**
    1. Newton's-Forward and Backward differentiation Formulae.
8. **Numerical quadrature**
    1. Trapezoidal, Simpson's one-third, Simpson's three-eight and Weddle's rules and Gaussian quaderature.
9. **Solution of OD Eqns**
    1. Taylor Series, Euler's and its modified,
    2. Runge-Kutta, Miline's,
    3. Adam-Moltan (Predictor-Corrector) methods.
10. **Solution of Higher Order Differential Equations**
    1. Runge-Kutta methods.
    2. Solution of Partial Differential Equations by Finite Differences Methods (Explicit, Implicit and Crank-Niclson techniques) and ADI Method.

Suggested Teaching Methodology:

- Lecturing
- Written Assignments Report Writing

Suggested Assessment:

Theory (100%)

- Sessional (20%)
- Quiz (12%)
- Assignment (8%)
- Midterm (30%)
- Final Term (50%)

Recommended Text and Reference Books:

1. Dunn, Stanley M, Alkis Conastantinides, Numerical Methods in Biomedical Engineering 2006

2. Canal and Chapra “Numerical Methods for Engineers”.
3. Curits F. Gerald “Applied Numerical Analysis”.
4. Erwin Kreyszig “Advanced Engineering Mathematics”.
5. Chung Yau Lam “Applied Numerical Methods for the Solution of Partial Differential Equations”
6. Dr Saeed Akhtar Bhatti “A First Course in Numerical Analysis”.
7. John L. Van Iwaarden “Ordinary Differential Equations with Numerical Techniques”.
