APPLIED NUMERICAL METHODS

Unit. I

Linear Algebraic Equations: Introduction. Gauss Elimination, LU **Decomposition,** Gauss-Jordan Elimination, Gauss-Siedel methods. Nonlinear Algebraic Equations: Introduction, single variable successive substitutions (Fixed point method), Multivariable successive substitutions, single variable Newton-Raphson Technique, Multivariable Newton-Raphson Technique

Unit. II

Eigen values and Eigenvectors: Introduction, power method. Function Evaluation: Introduction, least squares curve-fit (linear regression), interpolation - Newton's forward formulae, Newton's backward formulae.

Unit. III

Interpolation Polynomial, Lagrangian Interpolation (Unequal Intervals), Pade' approximations . Ordinary Differential Equations - Initial Value Problems (ODE-IVPs):Introduction, explicit Adams-Bashforth techniques, Predictor-Corrector Techniques, Runge-Kutta methods.

Unit. IV

Ordinary Differential Equations- Boundary Value Problems (ODE-B VPs)
Introduction. Galerkin Finite Element (GFE) Technique, Shooting
Techniques.

Unit. V

Partial l) differential Equations (PDEs): Introduction, the finite difference technique (method of lines), TheGalerkin Finite Element (GFE) Technique.

Text References:

1. Mathematical Methods in Chemical Engg. S.Pushpavanam, Prentice Hall of India
2. Numerical methods in engineering, S.K. Guptha., Tata McGraw Hill.
3. Numerical methods — P.Konda Sainy, K. Thilagravathy, K. Gunavathy. S.Chand **&** Company Ltd.
4. Introduction to the finite element methods, Erik 0. Thompson, John Wiley **&** Sons **2004.**

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Max Marks: 100 Time: 3 hours

All questions carry equal marks.
Answer any FIVE

1. The spent acid from a nitrating process contains 35%HNO_3, 35%H_2SO_4 and 30%H_2O by weight. This acid is to be strengthened by the addition of 95%H_2SO_4 and 70%HNO_3. The final acid mixture is to contain 40%H_2SO_4 and 42%HNO_3.Calculate the amounts of the spent acid and concentrated acids that should be mixed together to give 1000 kg of desired mixed acid using gauss elimination method.
2. Solve $\frac{1}{\sqrt{f}} = 2log_{10}\left(N_{Re}\sqrt{f}\right) - 0.8$ by Newton Raphson method. Assume N_{Re}=10^4
3. The temperature gradient in a furnace wall heated from one side at a particular instant of time is given by the following equation.

$$\frac{dT}{dx} = -20x^3 + 60x^2 + 12x - 50$$

Where x is in meters. Solve by Euler method to calculate temperature profile for $0 \leq x \leq 0.5$ in steps of 0.05m. T(0)=1000K

4. Experimental data on constant pressure filtration of 169.8Kg/m^3 $CaCO_3$ slurry through a canvas medium of area $5.48\times10^{-4}m^2$ is given below

In this process y is represented by $y=a_0+a_1x$. Find a_0 and a_1.

5. A boundary value problem is given by

$$y'' + y + 1 = 0, 0 \leq x \leq 1$$

where y(0)=0 and y(1)=0

(a) with h (increment in x) =0.5, use finite difference method to determine the value of y(0.5)

(b) With h (increment in x) =0.25, use finite difference method to determine the value of y(0.5)

6. A batch sedimentation test is made with a pulp containing 7.44%$CaCO_3$ of an average size of 5μm and 2260kg/m^3 density in water at 20^0C gave the following results

t of the interface, cm					
in min					

Estimate the setting velocity in cm/min as a function of time by the method of three point formula.

7. (a) Explain numerical solution of ordinary differential equations briefly

   (b) Solve heat equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial t^2}$, subject to the conditions u(x,0)=0, u(0,t)=0, u(1,t)=t, compute 'u' for t=1/8 in two steps using Crank Nicholson method.

8. A solid body occupying the space between x=0 to x=∞ is at a temperature T_0. At time t=0, the surface at x=0 is suddenly raised to a temperature T_1 and maintained at that temperature for t>0. Find the time dependent temperature profile T(x,t).