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08MTP/MFD/MAU/CFD/AUE11

M.Tech. Degree Examination, June-July 2009
Applied Mathematics

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. What are the sources of Error? Explain, how these arise in numerical computations. **(08 Marks)**

b. Explain the propagation of errors in the output of a procedure due to the error in the input data. **(07 Marks)**

c. Find the binary form of the number 193. **(05 Marks)**

2 a. Define the vector norm. Find the L_1, L_2, L_∞ of the vector $\vec{x} = \begin{bmatrix} 2 \\ -5 \\ 3 \end{bmatrix}$. **(04 Marks)**

b. Find the solution of the following system of equations using cramer's rule $x_1 - x_2 + x_3 = 3$; $2x_1 + x_2 - x_3 = 0$; $3x_1 + 2x_2 + 2x_3 = 15$. **(08 Marks)**

c. Solve the following equations using LU decomposition procedure $2x_1 - x_2 + x_3 = 4$; $4x_1 + 3x_2 - x_3 = 6$; $3x_1 + 2x_2 = 2x_3 = 15$ **(08 Marks)**

3 a. Convert the following eigen value problem into the standard form **(10 Marks)**

$$\lambda\begin{bmatrix} 4 & -1 & 1 \\ -1 & 6 & -4 \\ 1 & -4 & 5 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 300 & -200 & 0 \\ -200 & 500 & -300 \\ 0 & -300 & 300 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

b. Generate the function $f_i(\lambda)$, i = 0, 1, 2, 3 and 4 for the tridiagonal matrix **(10 Marks)**

$$[B] = \begin{bmatrix} 3 & -2 & 0 & 0 \\ -2 & 5 & -3 & 0 \\ 0 & -3 & 7 & -4 \\ 0 & 0 & -4 & 9 \end{bmatrix}$$

4 a. The pressure (p), specific volume (v) relationship of superheated water vapor at 350°C is given by van der walls-equation $P = \frac{RT}{\gamma - b} - \frac{a}{\gamma^2}$ where R = specific gas constant = 0.461889 KJ/kg-k, T = temperature in Kelvin = 623.15 K, a = 1.7048 and b = 0.0016895. Expand the pressure in Taylor's series and estimate the value of p at γ = 0.051, 0.054 and 0.060 assuming that the value of p and its derivatives are known at γ = 0.05. **(10 Marks)**

b. The displacement of an instrument subjected to a random vibration test, at different instants of time, is found to be as follows

Station, i	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Time, f_i(sec	**0.05**	**0.10**	**0.15**	**0.20**	**0.25**	**0.30**	**0.35**	**0.40**	**0.45**	**0.50**	**0.55**	**0.60**
Displacement, y_i(inch)	**0.144**	**0.172**	**0.213**	**0.296**	**0.070**	**0.085**	**0.525**	**0.110**	**0.062**	**0.055**	**0.042**	**0.035**

Determine the velocity $\left(\frac{du}{dt}\right)$, acceleration $\left(\frac{d^2u}{dt^2}\right)$ and jerk $\left(\frac{d^3u}{dt^3}\right)$ at t = 0.05, 0.20 and 0.60sec using suitable finite difference formula with step size, Δt, of 0.05 sec. **(10 Marks)**

5 a. Apply Romberg's integration method to evaluate $\int_{1}^{1.8} \cosh x\,dx$ by applying Trapezoidal rule with h = 0.8, 0.4 and 0.2. **(06 Marks)**

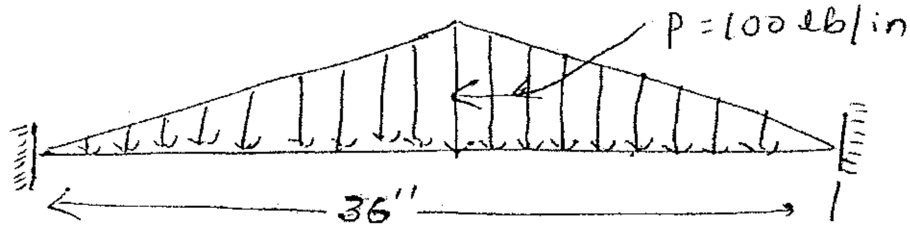
b. Evaluate $\int_{0.2}^{1.5} e^{-x^2} dx$ by using Gauss-Lagendre three-point formula. **(05 Marks)**

c. Evaluate $I = \int_{0}^{0.5}\int_{0}^{0.5} \frac{\text{Sin}(xy)}{1+xy}\,dxdy$ using Simpson's rule with h = k = 0.25. **(09 Marks)**

6 a. Find the solution of the initial value problem $y' = y + 2x - 1$ with $y\ (x = 0) = 1$ over the interval $o \le x \le 1$. **(10 Marks)**

b. Derive an Adams-Bash forth open formulas. **(10 Marks)**

7 a. Find the deflection of the uniform fixed-fixed beam shown in Fig.Q.7(a) using the finite-difference method. **(10 Marks)**



The data are: h = 9″, E = 30 x 10^6 psi, l = 36″, and I = 2 in^4.

b. THE equation governing the free transverse vibration of a uniform beam is given by $\frac{d^4w}{dx^4} - \beta^4 w = 0$, where $\beta^4 = \frac{\rho A W^2}{EI}$. Determine the natural frequencies and mode shapes of a beam simply supported at both ends. Use the following data:
ρg = 0.29 eb/in^3, A = 3 in^2, I = 1 in^4, E = 30 x 10^6 psi, l = 36″ and h = 9″ (N = 4). **(10 Marks)**

8 a. Derive the equation governing the temperature distribution in a one-dimensional f_l n. **(10 Marks)**

b. Derive the finite – difference equations for solving the Poisson equation $\frac{\partial^2\phi}{\partial x^2} + \frac{\partial^2\phi}{\partial y^2} = f(x, y)$, over a rectangular region of size 10″ x 12″ using Δx = 5″ and Δy = 6″ with the following boundary conditions

$\frac{\partial\phi}{\partial x} - \phi = 2$ at $x = 0$

$\frac{\partial\phi}{\partial y} - 2\phi = -1$ at $y = 0$

$\phi = 3$ at x = 10 in

$\phi = 4$ at y = 12 in. **(10 Marks)**

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