M.Tech. Mechanical Engineering Design CBCS Pattern Semester-I

MED11 - Advanced Engg Mathematics

P. Pages : 3 **GUG/W/23/14186**

Time : Three Hours Max. Marks : 70

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Notes : 1. All questions carry equal marks.
2. Use of non-programmable calculator is permitted.

1. a) Explain local conservation law of the flux quantity. **7**

b) A student in three titrations used 18:00 ml, 17.80 ml & 18.90 ml of base to neutralize 10.00 ml acid. **7**

a) What is the precision

b) If the true value is 15.77 ml. Calculate the accuracy of the experiment.

OR

2. a) Consider rounding arithmetic on a binary machine. In order to show that **7**

$Fl(1+2^{-n})>1$

b) Nitrite was measured in rain water as mg/L & the following results were obtained 0.079, 0.088, 0.073, 0.097, 0.070 & 0.068. The true value of the mass of nitrite present is 0.092 mg/L. **7**

i) Calculate the precision as standard deviation.

ii) Calculate the precision as % deviation.

3. a) Solve in series the equation **7**

$$\frac{d^2y}{dx^2}+xy=0$$

b) Prove that **7**

i) $J_n''(x)=\frac{1}{4}\left[J_{n-2}(x)-2J_n(x)+J_{n+2}(x)\right]$

ii) $\frac{d}{dx}\left[x J_n(x) J_{n+1}(x)\right]=x\left[J_n^2(x)-J_{n+1}^2(x)\right]$

OR

4. a) Solve $(2+3x)^2\frac{d^2y}{dx^2}+3(2+3x)\frac{dy}{dx}-36y=3x^2+4x+1$ **7**

b) Find the largest eigen value & eigen vector for the matrix. **7**

$$A=\begin{bmatrix}4 & 1\\1 & 3\end{bmatrix}$$

5. a) If $\frac{dy}{dx} = x^2 + y^2$ given that $y(0) = 1$ find y_1 & y_2 by using Picard's method. **7**

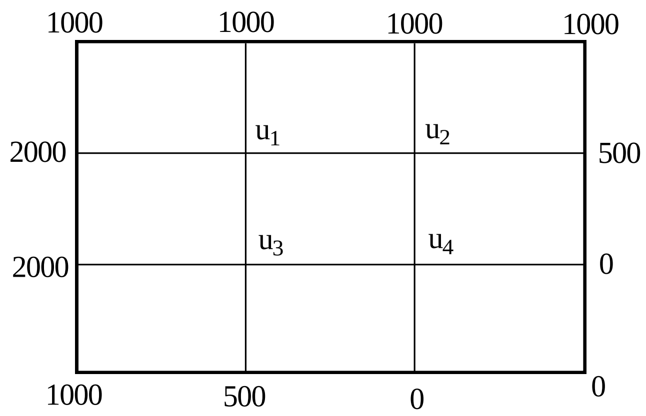
b) If $\frac{dy}{dx} = \frac{1}{2}(y^2 + xy^2)$ given $y(0) = 1$. Find $y(0.1)$ by using Taylor's series method. **7**

OR

6. a) If $\frac{dy}{dx} = y + e^x$ given that $y(0) = 0$ & $h = 0.2$. Find $y(0.4)$ by using Euler's modified method. **7**

b) Solve $\frac{dy}{dx} = \frac{y - x}{y + x}$ given that $y(0) = 1$ & $h = 0.1$ Find $y(0.2)$ by using Runge – Kutta method. **7**

7. a) Given the value of $u(x, y)$ on the boundary of the square in the fig. Evaluate the function $u(x, y)$ satisfying the Laplace equation $\nabla^2 u = 0$ at the pivotal points of this fig. **7**



b) Find the values of $u(x, t)$ satisfying the parabolic equation $\frac{\partial u}{\partial t} = 4\frac{\partial^2 u}{\partial x}8$ the boundary conditions $u(0, t) = 0 = u(8, t)$ & $u(x, 0) = 4x - \frac{1}{2}x^2$ at the point $x = i,\ i = 0, 1, 2, 3, ..., 8$ & $t = \frac{1}{8}j, j = 0, 1, 2, ..., 5$. **7**

OR

8. a) The transverse displacement u of a point at a distance x from one end & at any time t of a vibrating string satisfies the equation $\frac{\partial^2 u}{\partial t^2} = 4\frac{\partial^2 u}{\partial x^2}$, with boundary conditions $u = 0$ at $x = 0, t > 0$ & $u = 0$ at $x = 4, t > 0$ & initial conditions $u = x(4 - x)$ & $\frac{\partial u}{\partial t} = 0$ at $t = 0, 0 \le x \le 4$. Solve this equation numerically for one half period of vibration, taking $h = 1$ & $k = \frac{1}{2}$. **7**

b) Find the solution of the parabolic equation $u_{xx} = 2u_t$ when $u(0,t) = u(4,t) = 0$ & $u(x,0) = x(4-x)$ taking $h = 1$. Find the values upto $t = 5$. **7**

9. a) Fit a straight line to the following data. **7**

x	1	2	3	4	6	8
y	2.4	3	3.6	4	5	6

b) Fit a curve $y = ax + bx^2$ for the following data **7**

x	1	2	3	4	5	6
y	2.51	5.82	9.93	14.84	20.55	27.06

OR

10. a) Fit the curve $y = ax^b$ to the following data by least square method. **7**

x	1	2	3	4	5	6
y	2.98	4.26	5.21	6.10	6.80	7.50

b) Fit the curve $y = ae^{bx}$ to the following data. **7**

x	1	2	3	4	5	6
y	1.6	4.5	13.8	40.2	125	300

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