M.TECH. Mechanical Engineering Design (CBCS) Sem-I

MED11 : Advanced Engineering Mathematics

P. Pages : 2 **GUG/W/22/14186**

Time : Three Hours * 3 3 3 3 * Max. Marks : 70

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

1. a) If X = 3.26426, find Absolute, Relative and Percentage error. **7**
i) X is truncated to the 4^{th} decimal places.
ii) X is rounded to the 4^{th} decimal places.

b) Explain: **7**
i) Precision and accuracy ii) Absolute error
iii) Relative error iv) Truncation error

OR

2. a) Explain with example : **7**
i) Error propagation
ii) Importance of error in propagation

b) If $u = \frac{4x^2y^3}{z^4}$ and errors in x, y, z be 0.001, compute the relative maximum error in u, when x = y = z = 1 **7**

3. a) Solve in series the equation $\frac{d^2y}{dx^2} + xy = 0$. **7**

b) Express $f(x) = x^4 + 3x^3 + 5x - 2$ in terms of Legendre polynomials. **7**

OR

4. a) A body weighing 10 kg is hung from a spring. A pull of 20 kg. wt. will stretch the spring to 10 cm. The body is pulled down to 20 cm below the static equilibrium position and then released. Find the displacement of the body form its equilibrium position at time t sec. the maximum velocity and the period of oscillation. **7**

b) Obtain the solution of the following differential equation in terms of Bessel function **7**
$y'' + \frac{y'}{x} + \left(8 - \frac{1}{x^2}\right) y = 0$.

5. a) Given that **7**

x :	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y :	7.989	8.403	8.781	9.129	9.451	9.750	10.031

Find $\frac{dy}{dx}$ and $\frac{d^2y}{dx^2}$ at (a) x = 1.1
(b) x = 1.6

b) Using Picard's process of successive approximation, obtain a solution upto the fifth approximation of the equation $dy/dx = y + x$, such that y = 1 when x = 0. Check your answer by finding the exact particular sol^n. **7**

OR

6. a) Apply Taylor's method to obtain approximate value of y at x = 0.2 for the differential equation $dy/dx = 2y + 3e^x, y(0) = 0$. Compare the numerical sol^n obtained with the exact sol^n. **7**

b) Using Runge – Kutta method of fourth order, solve $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$ with y(0) = 1, at x = 0.2. **7**

7. a) Define the concept of finite difference equivalence to partial derivatives. **7**

b) Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the square mash of fig. A following with boundary values as shown. **7**

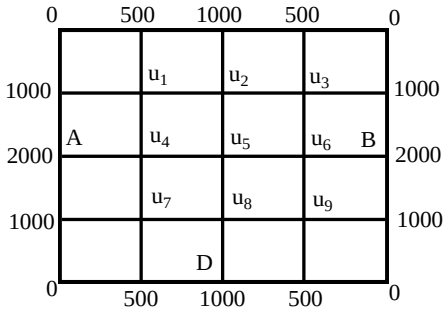

fig. A

OR

8. a) Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(x,0) = \sin \pi x,\ 0 \le x \le 1;$ $u(0,t) = u(1,t) = 0$. Carry out computations for two levels, taking $h = 1/3, k = 1/36$. **7**

b) Evaluate the pivotal values of the equation $u_{tt} = 16 u_{xx}$, taking $h \cong 1$ upto t = 1.25. The boundary conditions are $u(0,t) = u(5,t) = 0,\ u(x,0) = 0$ and $u(x,0) = x^2(5-x)$. **7**

9. a) By the method of least squares, find the straight line that best fits the following data. **7**

x :	1	2	3	4	5
y :	14	27	40	55	68

b) Find the least squares fit of the form $y = a_0 + a_1 x^2$ to the following data. **7**

x :	– 1	0	1	2
y :	2	5	3	0

OR

10. a) Fit a second degree parabola to the following data. **7**

x :	1989	1990	1991	1992	1993	1994	1995	1996	1997
y :	352	356	357	358	360	361	361	360	359

b) An experiment gave the following values **7**

v (ft/min) :	350	400	500	600
t (min) :	61	26	7	2.6

It is known that v and t are connected by relation $v = a\, t^b$ find the best possible value of a and b.

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