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

MED11 - Advanced Engineering Mathematics

P. Pages : 2 **GUG/S/25/14186**

Time : Three Hours * 2 4 8 0 * Max. Marks : 70

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

1. a) Show that $\int_0^x x^{n+1} J_n(x)\,dx = x^{n+1} J_{n+1}(x)$, if $n > -1$ **7**

b) Express in terms of Legendre's polynomials. **7**

i) $1 + x - x^2$ ii) $x^3 + 1$

OR

2. a) Find relative maximum error in the function $u = \frac{5xy^2}{z^3}$ at $X = y = z = 1$ with $\Delta x = \Delta y = \Delta z = 0.001$. **7**

b) Show that- **7**

i) $P_n(-x) = (-1)^n P_n(x)$,

ii) $P_n(-1) = (-1)^n$.

3. a) Find the percentage error in calculating the area of standard Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, when error of +1% is made in measuring the major and minor axes. **7**

b) Solve in series $x(1-x)\frac{d^2y}{dx^2} - 3x\frac{dy}{dx} - y = 0$ **7**

OR

4. a) Using Euler's modified method, solve the equation $\frac{dy}{dx} = x + |\sqrt{y}|$, given $y = 1$, when $x = 0$ for range $0 \le x \le 0.6$ Taking h = 0.2. **7**

b) Find relative maximum error in the function $u = \frac{5xy^2}{z^3}$ at $X = y = z = 1$ with $\Delta x = \Delta y = \Delta z = 0.001$. **7**

5. a) Use modified Euler's method to solve the equation. **7**

$\frac{dy}{dx} = x + y$ for a given that $y(0) = 1,\ h = 0.05$.

b) Solve the following by Runge-Kutta method. **7**

$\frac{dy}{dx} = 3x + y^2, y(0) = 1,$ find y (0.2).

OR

6. a) Solve the series $9x(1-x)\frac{d^2y}{dx^2} - 12\frac{dy}{dx} + 4y = 0$. **7**

b) Find the approximate value of y when $x = 0.1$, if $\frac{dy}{dx} = x - y^2$ **7**

7. a) Prove that $J_{\frac{-1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\cos x$ **7**

b) Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}}\sin x$ **7**

OR

8. a) Solve $\frac{dy}{dx} = \frac{1}{2}\left(y^2 + xy^2\right)$, given $y(0) = 1$, find series solution Up to Four terms by Taylar's series method and find $y(0.1)$. **7**

b) Use Runge-Kutta method to find approximate value of y for $X = 0.2$, when $\frac{dy}{dx} = xy + y^2$, given $y(0) = 1,\ h = 0.1$. **7**

9. a) Solve $\frac{dy}{dx} = x^2 + y$, given $y(0) = 1$, find $y(0.1)$ by using modified Euler's Method. **7**

b) Solve $y' = x - y^2, y = 0$. When $x = 0$, find $y(1)$ by using Milne's predicted method. **7**

OR

10. a) Fit a straight line to the following set of data points- **7**

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

b) Find the best-fit values of a and b so that $y = a + bx$ fits the data given in the table. **7**

x	0	1	2	3	4
y	1	1.4	3.3	4.5	6.3

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