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J 3281

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Fourth Semester

Civil Engineering

MA 1251 — NUMERICAL METHODS

(Common to B.E./B.Tech. Mechatronics Engineering, Metallurgical Engineering, Petroleum Engineering, Aeronautical Engineering and Electrical and Electronics Engineering)

(Regulation 2004)

(Common to B.E. (Part-Time) Third Semester Civil Engineering Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the condition for the convergence of the iteration method for solving $x = \phi(x)$?

2. Using Gauss elimination method, solve $x + y = 2$, $2x + 3y = 5$.

3. A third degree polynomial passes through $(0,-1)$, $(1,1)$, $(2,1)$ and $(3,-2)$. Find its value at $x = 4$?

4. Define the terms interpolation and extrapolation.

5. What is the order of the error in trapezoidal rule?

6. Write down the formula for $(y')_{x=x_n}$ using Newton's backward difference formula.

7. By Taylor series method find $y(1.1)$ given that $y' = x + y$ and $y(1) = 0$.

8. Write down the modified Euler's formula for ODE?

9. Obtain the finite difference scheme for solving Laplace equation.

10. Write down the explicit scheme to solve the one dimensional wave equation.

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Find an approximate root of $x \log_{10} x - 1.2 = 0$ by false position method. (8)

(ii) Using power method, find the largest eigen value of $A = \begin{bmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{bmatrix}$ in magnitude and its corresponding eigen vector. (8)

Or

(b) (i) Find the root of $4x - e^x = 0$ that lies between 2 and 3 by Newton's method. (6)

(ii) Apply Gauss-Seidal method to solve the following system of equations.

$20x + y - 2z = 17$; $3x + 20y - z = -18$; $2x - 3y + 20z = 25$. (10)

12. (a) (i) Find the cubic polynomial which takes the following values.

x :	0	1	2	3
$f(x)$:	1	2	1	10

Hence find $f(4)$. (8)

(ii) The following values of x and y are given.

x :	1	2	3	4
y :	1	2	5	11

Find the cubic splines and evaluate $y(1.5)$ and $y'(3.0)$. (8)

Or

(b) (i) Find the values of y when $x = 218$ and $x = 410$ for the given data : (8)

x :	100	150	200	250	300	350	400
y :	10.63	13.03	15.04	16.81	18.42	19.90	21.27

(ii) The following are data from the steam table : (8)

Temperature C° :	140	150	160	170	180
Pressure kgf/cm² :	3.685	4.854	6.302	8.076	10.225

Using Newton's formula, find the pressure of the steam for a temperature of 142°.

13. (a) (i) Using the following data, find $f'(5)$: (10)

x :	0	2	3	4	7	9
$f(x)$:	4	26	58	112	466	922

(ii) Evaluate $I = \int_0^1 \frac{dt}{1+t}$ by Gauss formula with two points, and three points. (6)

Or

(b) (i) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Romberg's method. (8)

(ii) Evaluate $\int_0^1 \int_0^1 \frac{dx\,dy}{1+x+y}$ by Trapezoidal rule. (8)

14. (a) Determine the value of $y(0.4)$ using Milne's method given $y' = xy + y^2$, $y(0) = 1$. Use Taylor series method to get the values of $y(0.1)$, $y(0.2)$ and $y(0.3)$. (16)

Or

(b) Find $y(0.1)$, $y(0.2)$, $y(0.3)$ from $y' = x - y^2$ by using Runge-Kutta method of order 4 using step value $h = 0.1$, and then find $y(0.4)$ by Adam's method. (16)

15. (a) Solve $u_{xx} + u_{yy} = 0$ over the square mesh of side 4 units, satisfying the following boundary conditions.

(i) $u(0, y) = 0$ for $0 \le y \le 4$

(ii) $u(4, y) = 12 + y$ for $0 \le y \le 4$

(iii) $u(x, 0) = 3x$ for $0 \le x \le 4$

(iv) $u(x,4) = x^2$ for $0 \le x \le 4$. (16)

Or

(b) Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(x,0) = \sin \pi x$, $0 \le x \le 1$; $u(0, t) = u(1, t) = 0$ using Crank - Nicolson method. Carry out the computations for two levels, taking $h = \frac{1}{3}$ and $k = \frac{1}{36}$. (16)
