Reg. No. : | | | | | | | | | | | |

D 4223

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2008.

Fourth Semester

(Regulation 2004)

Civil Engineering

MA 1251 — NUMERICAL METHODS

(Common to Aeronautical Engineering, Electrical and Electronics Engineering, Mechantronics Engineering, Metallurgical Engineering and Petroleum Engineering)

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

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What are the merits of Newton's method of iteration?

2. Give two direct methods to solve a system of linear equations.

3. Give the inverse of Lagrange's interpolation formula.

4. State the properties of cubic spline.

5. Why is trapezoidal rule so called?

6. Using two point Gaussian quadrature formula, evaluate $\int_{-1}^{1} \frac{1}{1+x^2} dx$.

7. Write down the Runge-Kutta method of order 4 for solving initial value problems in ordinary differential equations.

8. Write Milne's predictor corrector formula.

9. In the parabolic equation $u_t = \alpha^2 u_{xx}$ if $\lambda = \frac{k\alpha^2}{h^2}$ where $k = \Delta t$ and $h = \Delta x$, then for what values of λ, explicit method is stable and implicit method is convergent?

10. Write down the finite difference scheme of $f_x - f_{yy} = 0$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Solve the equation $2x - \log_{10} x = 7$ by the method of false position. (8)

(ii) Solve the given system of equations by using Gauss-Seidel method.

$20x + y - 2z = 17$; $3x + 20y - z = -18$; $2x - 3y + 20z = 25$. (8)

Or

(b) (i) Find the inverse of the matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$ using Gauss-Jordan method. (8)

(ii) Find the dominant eigen value and the corresponding eigen vector of $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ with the initial eigen vector $X_0 = \begin{Bmatrix} 1 \\ 1 \\ 1 \end{Bmatrix}$. (8)

12. (a) (i) The population of a city in a census taken once in ten years is given below. Estimate the population in the year 1955. (8)

Year :	1951	1961	1971	1981
Population in thousands :	35	42	58	84

(ii) Find $f(x)$ as a polynomial in x from the given data :

x :	3	7	9	10
$f(x)$:	168	120	72	63

and find $f(8)$. (8)

Or

(b) Obtain the cubic spline for the following data :

x :	-1	0	1	2
y :	-1	1	3	35

given that $y_0'' = y_3'' = 0$. (16)

13. (a) A jet fighter's position on an aircraft carrier's runway was timed during landing :

t, sec :	1.0	1.1	1.2	1.3	1.4	1.5	1.6
y, m :	7.989	8.403	8.781	9.129	9.451	9.750	10.031

where y is the distance from the end of the carrier. Estimate velocity $\left(\frac{dy}{dt}\right)$ and acceleration $\left(\frac{d^2y}{dt^2}\right)$ at (i) t = 1.1 (ii) t = 1.6 using numerical differentiation. (16)

Or

(b) (i) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Romborg's method. Hence deduce an approximate value of π. (8)

(ii) Evaluate $\int_2^{2.4}\int_4^{4.4} xy\,dx\,dy$ using Simpson's $\frac{1}{3}$rd rule. (Divide the range of x and y into 4 equal parts). (8)

14. (a) Using Runge-Kutta method of order 4, solve $y'' - 2y' + 2y = e^{2x}\sin x$ with $y(0) = -0.4$, $y'(0) = -0.6$ to find $y\,(0.2)$. (16)

Or

(b) (i) Using Taylor series method, find y at x = 0.1, given $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 0$. (8)

(ii) Solve $2y' - x - y = 0$ given $y\,(0) = 2$, $y\,(0.5) = 2.636$, $y\,(1) = 3.595$, $y\,(1.5) = 4.968$ to get $y\,(2)$ by Adam's method. (8)

15. (a) Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ given $u(x, 0) = 0$, $u(0, t) = 0$ and $u(1, t) = t$ by taking $h = 1/4$, $k = 1/16$ using Crank-Nicholson method for 2 time steps. (16)

Or

(b) Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown, using the Liebmann's iteration procedure. (16)