Reg. No. : [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Question Paper Code : 80221

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2019.

Fourth Semester

Aeronautical Engineering

MA 8491 – NUMERICAL METHODS

(Common to Electrical and Electronics Engineering/Chemical Engineering/ Chemical and Electrochemical Engineering/Plastic Technology/Polymer Technology/Textile Technology/Civil Engineering/B.E. Electronics and Instrumentation Engineering/Instrumentation and Control Engineering)

(Regulation 2017)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Find the Newton Raphson formula to find $\sqrt[3]{N}$, where N is a positive integer.
2. Compare Gauss elimination method and Gauss-Jordan method for solving a linear system.
3. Using Lagrange's interpolation, construct a quadratic interpolating polynomial $y(x)$ for unequal interval given that the points are (x_0, y_0), (x_1, y_1) and (x_2, y_2).
4. Find $\nabla^2(\sin x)$, where h is length of the interval.
5. Write the Newton Raphson backward formula for the first and second order derivatives at the value $x = x_n$.
6. Evaluate $\int_{-1}^{1} \frac{x^4}{1+x^2}\,dx$ using Trapezoidal rule with $h = 0.25$.
7. By Euler's method find $y(1.1)$, given $\frac{dy}{dx} = 2(x+y), y(1) = 0$.
8. State Adams-Bash forth predictor corrector formulae.
9. Obtain the finite difference scheme for the differential equation $\frac{d^2y}{dx^2} - y = 2$.
10. Write the diagonal five point formula to solve the Laplace equation $u_{xx} + u_{yy} = 0$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the real root of $\cos x - 2x + 3 = 0$ method correct to 3 decimal places using iteration method. (6)

(ii) Find the eigen values and eigen vectors of $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 3 & -1 \\ 0 & -1 & 3 \end{pmatrix}$, using Jacobi method. (10)

Or

(b) (i) Solve the system of equations by Gauss-Jordan method $3x - y + 2z = 12$, $x + 2y + 3z = 11$ and $2x - 2y - z = 2$. (8)

(ii) Using Power method find the largest eigen value and the corresponding eigen vector of the matrix $\begin{pmatrix} 1 & 3 & -1 \\ 3 & 2 & 4 \\ -1 & 4 & 10 \end{pmatrix}$ with initial vector $\begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix}^1$. (8)

12. (a) (i) Using Newton's divided difference formula, find the polynomial $y(x)$ and hence find $y(3)$ from the following data. (8)

x	–2	0	1	4
y	0	–2	0	90

(ii) Using Newton's forward interpolation formula, find the polynomial $f(x)$ from the following data and hence find $f(3)$. (8)

x	0	2	4	6
$f(x)$	–14	6	18	118

Or

(b) (i) The following values of x and y are given (8)

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

Find the cubic splines.

(ii) Using Newton's backward interpolation formula, find the Polynomial $y(x)$ from the following data and hence find $y(5)$. (8)

x:	–2	0	2	4
$y(x)$:	–21	9	7	165

13. (a) (i) The table give below reveals the velocity v of a body during the time 't' specified. Find its acceleration at $t = 1.1$ (8)

t	1.0	1.1	1.2	1.3	1.4
v	43.1	47.7	32.1	56.4	60.8

(ii) Evaluate $\int_2^3 \frac{x}{1+x^3}\,dx$ by Gaussian two point and three point quadrature formula. (8)

Or

(b) (i) Find the gradient of the road at the initial point of the elevation above a datum line of seven points of road which are given below: (8)

x :	0	300	600	900	1200	1500	1800
$f(x)$:	135	149	157	183	201	205	193

(ii) Evaluate $\int_2^3 \int_1^2 \frac{dxdy}{4xy}$ using Simson's rule by four sub intervals. (8)

14. (a) (i) Apply Taylor's series method, find $y(0.1)$ and $y(0.2)$ correct to three decimal places if $\frac{dy}{dx} = 1 - 2xy$ and $y(0) = 0$. (8)

(ii) Apply Runge-Kutta method of order 4 to find an approximate value of y for $x = 0.2$ in steps of 0.1, if $\frac{dy}{dx} = x + y^2$ given that $y = 1$ when $x = 0$. (8)

Or

(b) (i) Using Modified Euler method, find $y(0.1)$ and $y(0.2)$ given $\frac{dy}{dx} = x^2 + y^2; y(0) = 1$. (8)

(ii) Solve numerically $\frac{dy}{dx} = 2e^x - y$ at $x = 0.4$ by Milne's predictor and corrector method, given their values at the four points $x = 0, 0.1, 0.2$ and 0.3 as $y_0 = 2y_1 = 2.010$, $y_2 = 2.040$ and $y_3 = 2.090$. (8)

15. (a) Solve the equation $u_{xx} + u_{yy} = 0$ over a square region of side 4. Boundary condition are $u(0, y) = 0, u(4, y) = 8 + 2y$, $u(x,0) = \frac{x^2}{2}, u(x, 4) = x^2$, $0 \le x \le 4$ and $0 \le y \le 4$. (16)

Or

(b) (i) Solve $u_{xx} = u_{tt}, 0 < x < 1, t > 0$ given $u(0,t) = 0$, $u(1,t) = 100 \sin \pi t$, $u(x,0) = 0$ and $u_t(x,0) = 0$. Compute u for 4 time steps with $h = 0.25$. (8)

(ii) Solve $16\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(x, 0) = 0, u(0, t) = 0$ and $u(1, t) = 100t$. Compute u for one step in t direction, taking $h = \frac{1}{4}$ using Crank-Nicolson formula. (8)
