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**Question Paper Code : 21776**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Sixth Semester

Computer Science and Engineering

MA 2264/MA 41/MA 51/MA 1251/080280026/10177 MA 401/10144 CSE 21/  
10144 ECE 15 – NUMERICAL METHODS

(Common to Sixth Semester – Electronics and Communication Engineering  
Industrial Engineering and Information Technology, Fifth Semester – Polymer  
Technology, Chemical Engineering and Polymer Technology, Fourth Semester –  
Aeronautical Engineering, Civil Engineering, Electrical and Electronics  
Engineering and Mechatronics Engineering)

(Regulations 2008/2009)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Derive Newton's algorithm for finding the  $p^{\text{th}}$  root of a number  $N$ , where  $N > 0$ .
2. Explain the procedure involved in the Gauss Jordan elimination method.
3. Show that  $\Delta_{bcd}^3 \left( \frac{1}{a} \right) = -\frac{1}{abcd}$ .
4. Derive Newton's forward difference formula by using operator method.
5. State two point Gaussian quadrature formula.
6. Evaluate  $\int_{\frac{1}{2}}^1 \frac{1}{x} dx$  by Trapezoidal rule, dividing the range into 4 equal parts.
7. State the disadvantages of Taylor series method.
8. Using Euler's method find  $y(0.1)$ , given  $\frac{dy}{dx} = x + y$ ,  $y(0) = 1$ .
9. Write the finite difference approximations for  $y'(x)$ ,  $y''(x)$ .
10. Write the Crank-Nicholson scheme to solve  $u_t = \alpha^2 u_{xx}$ .

PART B — (5 × 16 = 80 marks)

11. (a) (i) Solve  $e^x - 3x = 0$  by the method of fixed point iteration. (8)
- (ii) Solve the following system by Gauss-Seidal iterative procedure :  
 $10x - 5y - 2z = 3, 4x - 10y + 3z = -3, x + 6y + 10z = -3$ . (8)

Or

- (b) (i) Using Gauss-Jordan method, find the inverse of  $\begin{bmatrix} 2 & 2 & 6 \\ 2 & 6 & -6 \\ 4 & -8 & -8 \end{bmatrix}$ . (8)
- (ii) Using power method, find all the eigenvalues of  $A = \begin{pmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{pmatrix}$ . (8)

12. (a) (i) Find the Lagrange polynomial  $f(x)$  satisfying the following data :

|            |    |     |     |     |
|------------|----|-----|-----|-----|
| $x$        | 1  | 3   | 5   | 7   |
| $y = f(x)$ | 24 | 120 | 336 | 720 |

and hence find  $f(4)$ . (8)

- (ii) From the following table :

|     |    |    |    |
|-----|----|----|----|
| $x$ | 1  | 2  | 3  |
| $y$ | -8 | -1 | 18 |

Compute  $y(1.5)$  and  $y'(1)$ , using cubic spline. (8)

Or

- (b) (i) Using Newton's divided difference formula determine  $f(3)$  from the data : (8)

|        |   |    |    |   |   |
|--------|---|----|----|---|---|
| $x$    | 0 | 1  | 2  | 4 | 5 |
| $f(x)$ | 1 | 14 | 15 | 5 | 6 |

- (ii) From the following data, find  $\theta$  at  $x = 43$  and  $x = 84$ .

|            |     |     |     |     |     |     |
|------------|-----|-----|-----|-----|-----|-----|
| $x$ :      | 40  | 50  | 60  | 70  | 80  | 90  |
| $\theta$ : | 184 | 204 | 226 | 250 | 276 | 304 |

Also express  $\theta$  in terms of  $x$ . (8)

13. (a) (i) Find  $f'(3)$  and  $f''(3)$  for the following data : (8)

|        |     |         |        |        |       |     |
|--------|-----|---------|--------|--------|-------|-----|
| $x$    | 3.0 | 3.2     | 3.4    | 3.6    | 3.8   | 4.0 |
| $f(x)$ | -14 | -10.032 | -5.296 | -2.256 | 6.672 | 14  |

(ii) Evaluate  $\int_1^2 \int_3^4 \frac{1}{(x+y)^2} dx dy$  taking  $h = k = 0.5$  by both Trapezoidal rule and Simpson's rule. (8)

Or

(b) (i) Evaluate  $\int_0^2 \frac{x^2 + 2x + 1}{1 + (x+1)^4} dx$  by Gaussian three point formula. (8)

(ii) Using Romberg's method, evaluate  $I = \int_0^1 \frac{dx}{1+x}$  correct to three decimal places and hence evaluate the value of  $\log_e^2$ . (8)

14. (a) (i) Using Taylor series method solve  $\frac{dy}{dx} = 1 + xy$  with  $y(0) = 2$ . Find  $y(0.1)$ ,  $y(0.2)$  and  $y(0.3)$ . (8)

(ii) Using Milne's method find  $y(4.4)$  given  $5xy' + y^2 - 2 = 0$ , given  $y(4) = 1$ ,  $y(4.1) = 1.0049$ ,  $y(4.2) = 1.0097$  and  $y(4.3) = 1.0143$ . (8)

Or

(b) (i) Find  $y(0.8)$  given that  $y' = y - x^2$ ,  $y(0.6) = 1.7379$  by using Runge-Kutta method of order four. Take  $h = 0.1$ . (8)

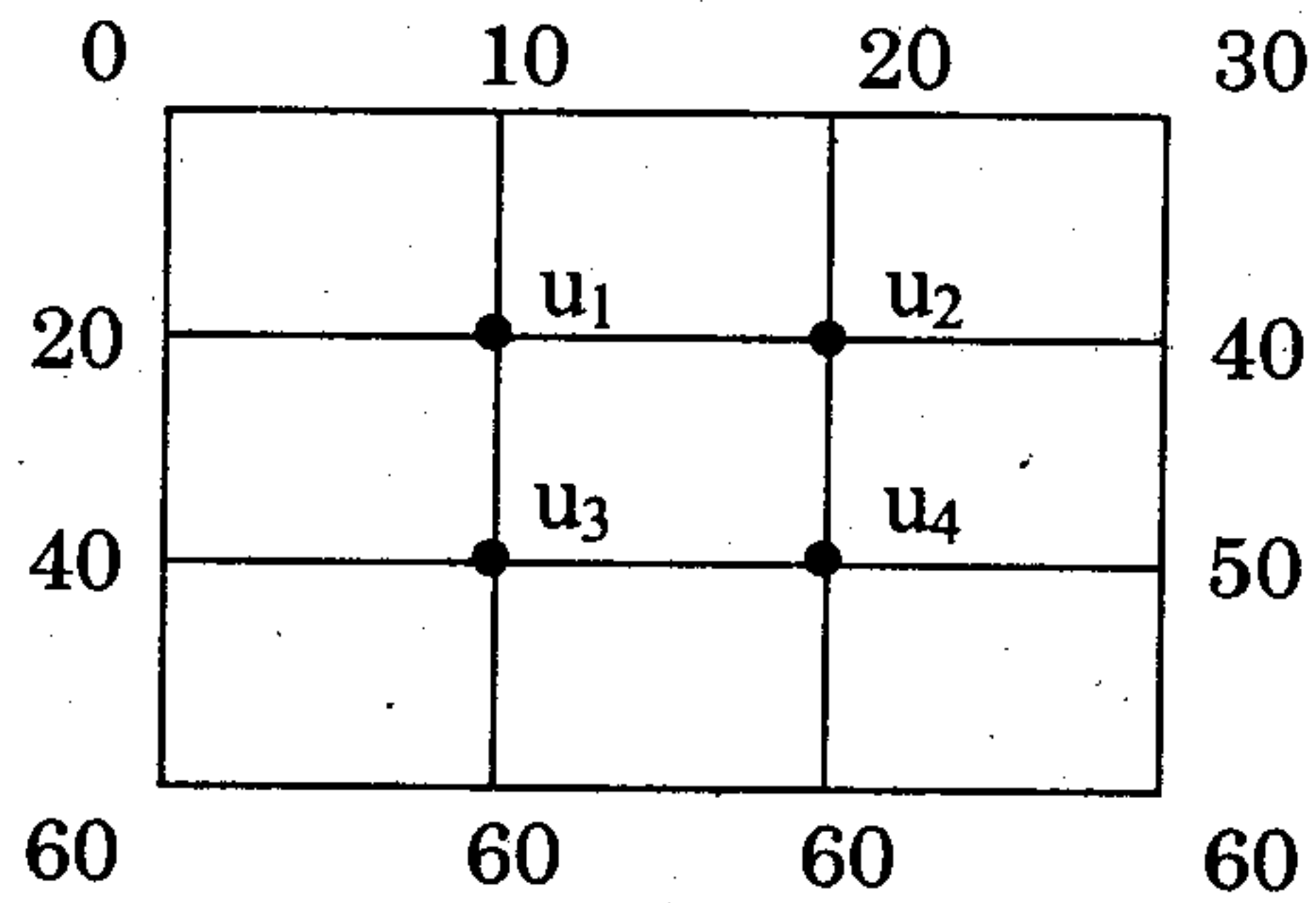
(ii) Given  $\frac{dy}{dx} = x^2(1+y)$ ,  $y(1) = 1$ ,  $y(1.1) = 1.233$ ,  $y(1.2) = 1.548$ ,  $y(1.3) = 1.979$ , evaluate  $y(1.4)$  by Adams-Bashforth method. (8)

15. (a) (i) Solve  $y'' - y = 0$  with  $y(0) = 0$ ,  $y(1) = 1$  using finite difference method with  $h = .2$ . (8)

(ii) Solve numerically  $4u_{xx} = u_{tt}$  with the boundary conditions  $u(0,t) = 0 = u(4,t)$  and the initial conditions  $u_t(x,0) = 0$  and  $u(x,0) = x(4-x)$ , taking  $h = 1$ , for 4 time steps. (8)

Or

- (b) (i) Solve  $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$  at the nodal points of the following square grid using the boundary values indicated. (8)



- (ii) Find the values of the function  $u(x,t)$  satisfying the differential equation  $u_t = 4u_{xx}$  and the boundary condition  $u(0,t) = 0 = u(8,t)$  and  $u(x,0) = 4x - \frac{x^2}{2}$  at the point  $x = i$ ,  $x = 0, 1, 2, 3, 4, 5, 6, 7, 8, t = \frac{1}{8}j$ ,  $j = 0, 1, 2, 3, 4, 5$ . (8)