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B.Tech.(CE) (2011 Onwards) (Sem.–6)

# NUMERICAL METHODS IN CIVIL ENGINEERING

Subject Code : BTCE-604

Paper ID : [A2291]

Time : 3 Hrs. Max. Marks : 60

**INSTRUCTIONS TO CANDIDATES :**

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

## SECTION-A

**1. Write briefly :**

(a) Define algebraic & transcendental equations.

(b) Write difference between Gauss-Seidal and Gauss-Jacobi’s method for simultaneous linear equations.

(c) Write formula of Modified Euler's method for ordinary differential equation.

(d) Define initial value problem and boundary value problem.

(e) Write classification of linear partial differential equation :

$$A\frac{\partial^2 u}{\partial x^2} + B\frac{\partial^2 u}{\partial x \partial y} + C\frac{\partial^2 u}{\partial y^2} + D\frac{\partial u}{\partial x} + E\frac{\partial u}{\partial y} + Fu = G.$$

(f) Write two lines of regression by the principle of least square.

(g) Write the condition when New mark's method is unconditionally stable.

(h) Define Stability of Explicit method.

(i) Define Karl Pearson's coefficient of correlation.

(j) Write hyperbolic partial differential equation.

## SECTION-B

2. Solve the following system of equations using gauss Elimination method with partial pivoting

$x + y + z = 7$

$3x + 3y + 4z = 24$

$2x + y + 3z = 16$

3. Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 8x^2 \ y^2$ for the square mesh given u=0 on the four boundaries dividing the square into 16 sub-square of length one unit.

4. Use Galerkin's method of least square to find the approximate solution of the following boundary value problem. $x \frac{d^2 y}{dx^2} + \frac{dy}{dx} + y = x; \ y(0) = 0; \ y(1) = 1$.

5. Calculate the coefficient of correlation and obtain the least square regression lines for the following data :

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **x** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **y** | 9 | 8 | 10 | 12 | 11 | 13 | 14 | 16 | 15 |

Also obtain an estimate of y which should correspond on the average to x=6.2.

6. Explain New mark's algorithm for a SDOF system.



## SECTION-C

7. Apply the power method to find the dominant Eigen value of the matrix

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}.$$

8. Determine values of y at the pivotal points of the interval (0, 1) if $y$ satisfies the boundary value problem $y^{iv} + 81y = 81x^2$, $y(0) = y(1) = y''(0) = y''(1) = 0$ take (n = 3).

9. Solve the problem $\frac{dy}{dx} = -2y + x; \ y(0) = 1$ for $y(0.1)$, $y(0.2)$ by using

(a) Runga kutta method of third order (b) Runga kutta method of fourth order