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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION

Civil Engineering

(Structural Engineering and Construction Management)

04 CE 6401- Analytical methods in Engineering

Max. Marks : 60 Duration: 3 Hours

Part-**A**

Answer all questions

Each question carries **3**marks

1. Solve the differential equation $\frac{d^3y}{dx^3} + 6\frac{d^2y}{dx^2} + \frac{dy}{dx} + 6y = 0$
2. Solve $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} - 6\frac{\partial^2 z}{\partial y^2} = 0$
3. Using the method of separation of variables ,solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$
4. Solve $\frac{\partial u}{\partial x} = 2\frac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$
5. Classify the partial differential equation $\frac{\partial^2 z}{\partial x^2} = \frac{\partial^2 z}{\partial y^2}$
6. In which part of the xy-plane the following equation is elliptic

   $$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial x \partial y} + (x^2 + 4y^2)\frac{\partial^2 u}{\partial y^2} = 2sinxy.$$

7. Derive standard 5-point formula
8. Derive diagonal 5-point formula

(8 x 3 = 24 marks)

Part-**B**

Answer one choice in each question

Each question carries **6**marks

9.

a. Solve$(3x+2)^2\frac{d^2y}{dx^2} + 3(3x+2)\frac{dy}{dx} - 36y = 3x^2 + 4x + 1$

Or

b. Apply the method of variation of parameters to solve$\frac{d^2y}{dx^2} + 4y = 4sec^2 2x$

10.

a. Solve $(y-z)p + (x-y)q = z - x$

Or

b. Show that the equations $\frac{\partial z}{\partial x} = (x+y)^2, \frac{\partial z}{\partial y} = x^2 + 2xy + y^2$ are compactible and solve them.

11.

a. Solve $z^2 = pqxy$

Or

b. Solve $r - 4s + 4t = e^{2x+y}$

12.

a. A string is stretched and fastened to two points l apart.Motionis started by displacing the string in the form $y = a\, sin\frac{\pi x}{l}$ from which it is released at time $t = 0$.Show that the displacement of any point at a distance x from one end at time t is given by $y(x,t) = a\, sin\frac{\pi x}{l} cos\frac{\pi ct}{l}$

Or

b. An infinitely long plane uniform plate is bounded by two parallel edges and an end at right angles to them.The breadth isπ;this end is maintained at a temperature u_0 at all points and other edges are at zero temperature.Determine the temperature at any point of the plate in steady state.

13.

a. Derive the finite difference approximation for the partial derivative u_{xx} with diagram.

Or

b. Derive the finite difference approximation for the partial derivative u_{yy} with diagram.

14.

a. Solve the elliptic equation $u_{xx} + u_{yy} = 0$ for the square mash of the following fig.with boundary values

$u(1,0) = 500, u(2,0) = 1000, u(3,0) = 500, u(4,0) = 0, u(0,0) = 0,$
$u(0,1) = 1000, u(0,2) = 2000, u(0,3) = 1000, u(0,4) = 1000$,
$u(1,4) = 500, u(2,4) = 1000, u(3,4) = 500, u(4,4) = 0, u(4,1) = 1000$
$u(4,2) = 2000, u(4,3) = 1000$

	u_1 C	u_2	u_3
A	u_4	u_5	u_6 B
	u_7	u_8	u_9
	D		

Or

b. Evaluate the pivotal values of the equation $u_{tt} = 16u_{xx}$,taking h=1 upto $t = 1.25$.The boundary conditions are $u(0,t) = u(5,t) = 0$,

$u_i(x, 0) = 0 \; and \; u(x, 0) = x^2(5 - x)$.

(6 x 6 = 36 marks)