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A Total Pages **2**

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SAINTGITS COLLEGE OF ENGINEERING
KOTTAYAM, KERALA

(AN AUTONOMOUS COLLEGE AFFILIATED TO
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH. DEGREE EXAMINATION(R), MARCH 2021
(STRUCTURAL ENGINEERING AND CONSTRUCTION MANAGEMENT)

Course Code: 20CESCT101

Course Name: ANALYTICAL METHODS IN ENGINEERING

Max. Marks: **60** **Duration:** **3 Hours**

Note: Non-programmable scientific calculators may be permitted in the examination hall.

PART A

(Answer all questions. Each question carries3 marks)

1. Solve $\frac{d^2x}{dt^2} + \frac{5dx}{dt} + 6x = 0$,given $x(0) = 0, x'(0) = 15$.

2. Solve the Lagrange's equation $p \tan x + q \tan y = \tan z$.

3. Solve the second order partial differential equation, $r - 2s + t = 0$.

4. Solve the two-dimensional Laplace's equation using the method of separation of variables.

5. Describe the general rule to classify a second order partial differential equation.

6. Find the conditions for which the homogeneous partial differential equation$U_{xx} + 4U_{xy} + (x^2 + 4y^2)U_{yy} = \sin(x + y)$ is (i) elliptic (ii) parabolic and (iii) hyperbolic.

7. Derive the standard five-point formula to solve the Laplace's Equation numerically.

8. Derive a numerical approximation for first order partial derivative of the function $u(x, t)$ with respect to x using basic assumptions of finite difference.

PART B

(Answer one full question from each module, each question carries 6 marks)

MODULE I

9. Solve the differential equation $(D - 2)^2 y = 8(e^{2x} + \sin 2x + x^2)$. (6)

OR

10. Using method of variation of parameters ,solve $y'' - 2y' + y = e^x \log x$. (6)

MODULE II

11. Find the integral surface of the equation$(2xy-1)p+(z-2x^2)q=2(x-yz)$, which is passes through the line $x=1, y=0$. (6)

OR

12. Solve $(y-z)p+(x-y)q=z-x$ (6)

MODULE III

13. Solve the second order non-linear partial differential equation, $(p^2+q^2)y=qz$ completely under suitable assumptions (6)

OR

14. Solve the homogeneous linear partial differential equation, $(D^2-3DD'+2D'^2)z=\sin(x+2y)+e^{x-y}$. (6)

MODULE IV

15. The points of trisection of a string are pulled aside through the same distance on opposite sides of the position of equilibrium and the string is released from rest. Derive an expression for the displacement of the string at subsequent time and show that the midpoint of the string always remains at rest. (6)

OR

16. An infinitely long plain uniform plate is bounded by two parallel edges and an end at right angles to them. The breadth is π; 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 the steady state. (6)

MODULE V

17. Using suitable assumptions derive the finite difference approximations for U_{xx} and U_{yy} of a bi-variate function $U(x,y)$. (6)

OR

18. Classify the partial differential equation, $y^2u_{xx}-2u_{xy}+x^2u_{yy}+2\,u_x-\ 3u=0$ based on the values of x & y. (6)

MODULE VI

19. Solve the Laplace's equation $\nabla^2u=0$ numerically using a rectangular mesh with four interior nodes having boundary values (marked from north west corner in anti-clockwise direction)$b_1=1000,\ b_2=1000,\ b_3=1000,\ b_4=1000,\ b_5=500,\ b_6=b_7=b_8=0,\ b_9=500,\ b_{10}=1000, b_{11}=2000, b_{12}=2000$. (6)

OR

20. Derive the numerical formula to solve one dimensional wave equation using finite difference approach. (6)

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