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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

(MACHINE DESIGN)

Course Code: 20MEMDT101

Course Name: ADVANCED ENGINEERING MATHEMATICS

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Find the extremals of the function, $\int_{x_0}^{x_1} \frac{y'^2}{x^3}\, dx$
2. Show that $J_{1/2}(x) = \sqrt{\left(\frac{2}{\pi x}\right) \sin x}$
3. What are the possible solutions for heat equation
4. Obtain the Rodrigue's formula.
5. Classify the equation $x^2 \frac{\partial^2 u}{\partial x^2} + y^2 \frac{\partial^2 u}{\partial y^2} = x \frac{\partial u}{\partial x} - y \frac{\partial u}{\partial y}$
6. Expand the summation convention $\bar{G}_{ij}\overline{dx^i dx^j}; i = 1\ to\ 3,\ j = 1\ to\ 3$
7. Prove that contraction of outer product of tensors A^p and B_q is invariant
8. Outline the various steps for ANOVA testing in one way classification.

PART B

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

MODULE I

9. Solve the boundary value problem $y'' - y + x = 0, (0 \le x \le 1), y(0) = y(1) = 0$ by Rayleigh-Ritz method (6)

OR

10. Find the curve passing through the points (x_1, y_1) and (x_2, y_2) which rotates about x axis gives a minimum surface area. (6)

MODULE II

11. (a) Express $J_5(x)$ in terms of $J_0(x)$ and $J_1(x)$ (6)

    (b) Show that $\frac{d}{dx}\left(x^n J_n(x)\right) = x^n J_{n-1}(x)$

OR

12. Solve in series, the equation $\frac{d^2y}{dx^2} + xy = 0$ (6)

MODULE III

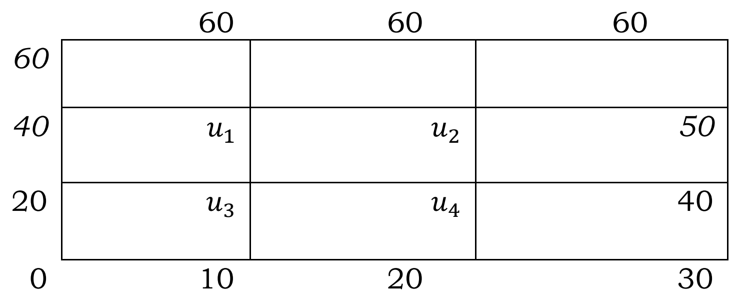
13. Obtain the solution of $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ with boundary conditions $u(x, 0) = 3\,sin\,n\,\pi x$, $u(l, t) = u(0, t) = 0,\ 0 < x < 1, t > 0$ (6)

OR

14. Solve using the method of separation of variables, $\frac{\partial u}{\partial x} = 4\frac{\partial u}{\partial y}$ where $u(0, y) = 8e^{-3y}$ (6)

MODULE IV

15. Solve the equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ for the mesh with boundary values (6)



OR

16. Solve numerically the equation $4U_{xx} = U_{tt}$ with the boundary conditions $U(0, t) = 0, U(4, t)$=0 and the initial conditions $U_t(x, 0) = 0$ and $U(x, 0) = x(4 - x)$ taking h= 1(for 4 time steps) (6)

MODULE V

17. Find the components of first and second fundamental tensors in spherical co-ordinates (6)

OR

18. A covariant tensor has components $x + y, xy, 2z - y^2$ in rectangular co-ordinates. Find its covariant components in spherical co-ordinates. (6)

MODULE VI

19. Following are the weekly sale records (in thousand Rs) of three salesman A, B and C of a company during 13 sale-calls (6)

A	300	400	300	500	
B	600	300	300	400	
C	700	300	400	600	500

Test whether the sales of three sales men are different

OR

20. For the following data representing the number of units of production per day turned out by 5 workers using four machines, set-up the ANOVA table. (6)

	Machine type			
Worker	A	B	C	D
I	4	-2	7	-4
II	6	0	12	3
III	-6	-4	4	-8
IV	3	-2	6	-7
V	-2	2	9	-1

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