

Register No.: Name:

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), DECEMBER 2023**(MACHINE DESIGN)****(2021 Scheme)****Course Code :** 21MD101**Course Name:** Advanced Engineering Mathematics**Max. Marks :** 60**Duration: 3 Hours***Statistical table is permitted inside the Examination Hall.***PART A***(Answer all questions. Each question carries 3 marks)*

1. Using functionals, show that the shortest distance between any two points is a straight line.
2. Define ordinary point with an example.
3. Obtain the Rodrigues formula.
4. Classify the equation, $\frac{\partial^2 u}{\partial x^2} + 4 \frac{\partial^2 u}{\partial x \partial y} + 4 \frac{\partial^2 u}{\partial y^2} - \frac{\partial u}{\partial x} + 2 \frac{\partial u}{\partial y} = 0$.
5. Expand the summation convention $\bar{G}_{ij} \overline{dx^i dx^j}$; $i = 1$ to 3, $j = 1$ to 3.
6. Let A_{rst}^{pq} be a tensor: choose $p = t$ and $q = s$ and show that A_{rst}^{pq} is a tensor. What is its rank?
7. Explain briefly the fundamental principles of design of experiments.
8. Describe the steps involved in ANOVA two-way classified data with one observation per cell.

PART B*(Answer one full question from each module, each question carries 6 marks)***MODULE I**

9. Find the curve on which the functional $\int_0^1 y'^2 + 12xy \, dx$, (6)
 $y(0) = 0, y(1) = 1$.

OR

10. Obtain the extremal of the functional, $\int_0^2 y'^2 dx$ under the constraint $\int_0^2 y \, dx = 1$. (6)

MODULE II

11. Solve the equation in power series, about $x = 0$ (6)
 $2x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} - (x + y)y = 0$

OR

12. Give the Legendre's equation. Express $x^3 + 2x^2 - x - 3$ in terms of the Legendre's polynomials. (6)

MODULE III

13. Determine the solution of one-dimensional heat equation $\frac{\partial u}{\partial x} = c^2 \frac{\partial^2 u}{\partial t^2}$ with conditions $u(0, t) = u(l, t) = 0$ and $u(x, 0) = f(x)$. (6)

OR

14. Solve the one-dimensional wave equation using the method of separation of variables. (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

	1	2	
	4	5	
1	u_1	u_2	4
2	u_3	u_4	5

OR

16. Solve by Crank – Nicholson method $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the conditions $u(x, 0) = 0$, $u(0, t) = 0$, $u(1, t) = t$. for two time steps. (6)

MODULE V

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

OR

18. Find the components of metric tensor and conjugate tensor in cylindrical coordinates. (6)

MODULE VI

19. A manufacturing company has purchased three new machines of different makes and wishes to determine whether one of them is faster than others in producing certain outputs. Five hourly figures are observed at random from each machine and the results are given in the table:

(6)

	Machine A1	Machine A2	Machine A3
Observations	25	31	24
	30	39	30
	36	38	28
	38	42	25
	31	35	28

Use analysis of variance technique and determine whether the machines are significantly different in their mean speeds. Use $\alpha=5\%$.

OR

20. Five doctors each test 5 treatments for a certain disease and observe the number of days each patient takes to recover. The results are (recovery time in days) given in table

Doctors	Treatments				
	1	2	3	4	5
1	10	14	23	18	20
2	11	15	24	17	21
3	9	12	20	16	19
4	8	13	17	17	20
5	12	15	19	19	22

(6)

Discuss the significance of the difference between:

- (a) doctors and
 (b) treatments
