Register No.: …………………………… Name: …………………………………………………………..

SAINTGITS COLLEGE OF ENGINEERING (AUTONOMOUS)

(AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

FIRST SEMESTER M.TECH DEGREE EXAMINATION (Regular), FEBRUARY 2022
(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. Show that a circle is a plane curve of fixed perimeter and maximum area.
2. Define a regular singular point with an example.
3. Write down the basic assumptions of wave equation model.
4. Find the deflection of a vibrating string of unit length having fixed ends with initial velocity zero and initial deflection $f(x) = k(sinx - sin2x)$.
5. Classify the equation, $x^2 \frac{\partial^2 u}{\partial x^2} + (1 - y^2)\frac{\partial^2 u}{dx^2} = 0$, $-\infty < x < \infty, -1 < y < 1$.
6. Show that $a_{ij}A^{kj} = \Delta \delta_i^k$, where Δ is the determinant of order 3 and A^{ij} are cofactors of a^{ij}
7. If $ds^2 = 5(dx^1)^2 + 3(dx^2)^2 + 4(dx^3)^2 - 6dx^1dx^2 + 4dx^2dx^3$, find the values of g_{ij} and g^{ij}.
8. Explain briefly (i) replication (ii) randomization in ANOVA.

PART B

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

MODULE I

9. Obtain the extremals for

$$\int_0^{\frac{\pi}{2}} \left(2xy + \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2 \right) dt.$$ (6)

OR

10. Solve $y'' + y + x = 0, y(0) = y(1) = 0$ using Rayleigh-Ritz method. (6)

MODULE II

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

OR

12. State and prove the orthogonality property of Legendre's polynomials. (6)

MODULE III

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

OR

14. Solve $3\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0, u(x,0) = 4e^{-x}$. (6)

MODULE IV

15. Solve $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ in $0 < x < 5$, $t \geq 0$ given that u (x,0) = 20, u (0,t) = 0, u (5,t) = 100. Compute u for the time step with h = 1 by Crank-Nicholson method. (6)

OR

16. Solve $\frac{\partial^2 u}{\partial t^2} = \frac{\partial^2 u}{\partial x^2}$, $0 < x < 1$, $t > 0$ given $u(x,0) = 0$ $u_t(x,0) = 0$, $u(0,t) = 0$ $u(1,t) = 100 \sin\pi t$. Compute u for 4-time steps with h = 0.25. (6)

MODULE V

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

OR

18. Show that any inner product of the tensors A_r^p and B_t^{qs} is a tensor of rank three. (6)

MODULE VI

A software company was testing a software with three input variables and wishes to determine which one is significant. Five periodic output readings are observed at random with each variable and the results are given in the table

19.

	Variable A	Variable B	Variable C
Readings	24	31	25
	30	39	30
	28	38	36
	25	42	38
	28	35	31

(6)

Use analysis of variance technique and determine whether the variables are significantly different in their mean values. Use α=5%

OR

20. A farmer applies three types of fertilizers on 4 separate plots. The figure on yield per acre are given below (6)

Fertilzers	Yield				
	Plot A	Plot B	Plot C	Plot D	Total
Nitrogen	6	4	8	6	24
Potash	7	6	6	9	28
phosphate	8	5	10	9	32
Total	21	15	24	24	84

Find out if plots are materially different in fertility, as also, if the three fertilizers make any material difference in yields.

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