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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATION, FEBRUARY 2016

Mechanical Engineering

(Machine Design)

04ME 6501Advanced Engineering Mathematics

Max. Marks: 60 Duration: 3 Hours

Part A: 3 marks each

1. Show that the geodesics on a plane are straight lines.
2. Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre polynomials.
3. Using d'Alembert's method find the deflection of a vibrating string of unit length having fixed ends with initial velocity zero and initial deflection $f(x) = k(\sin x - \sin 2x)$
4. Determine whether the following equation is elliptic or hyperbolic?
   $(x+1)u_{xx} - 2(x+2)u_{xy} + (x+3)u_{yy} = 0$
5. Show that any inner product of the tensor A_r^p *and* B_t^{qs} is a tensor of rank 3
6. Show that the velocity of a fluid at any point is a covarient tensor of order one.
7. What is Latin square design? Under what conditions can this design be used?
8. Explain the fundamental principles of design of experiments.

Part B: 6 marks each

9. Show that the functional $\int_0^{\pi/2}(2xy + \left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2)dt$ such that x(0)=0, x(π/2)=-1, y(0)=0, y(π/2)=1 is stationary for x=-sint, y=sint.

OR

10. Find the curves on which the functional $\int_0^1 [y'^2 + 12xy]dx$ with y(0)=0 and y(1)=1 can be extremised.

11. Prove that $\int_0^1 xJ_n(\alpha x)J_n(\beta x)\,dx = \begin{cases} 0, & \alpha \neq \beta \\ \frac{1}{2}[J_{n+1}(\alpha)]^2, & \alpha = \beta \end{cases}$

OR

12. Solve in series the equation $9x(1-x)\frac{d^2y}{dx^2} - 12\frac{dy}{dx} + 4y = 0$

13. A tightly stretched string of length *l* with fixed ends is initially in equilibrium position. It is set vibrating by giving each point a velocity $v_0 \sin^3 \frac{\pi x}{l}$. Find the displacement y(x,t)

OR

14. The ends A and B of a rod 20cm long have the temperature at 30^0C and 80^0C until steady state prevails. The temperature of the ends are changed to 40^0C and 60^0C respectively. Find the temperature distribution in the rod at time t

15. Using Crank Nicholson method solve $u_{xx} = 16u_t$, $0 \le x \le 1$, $t \ge 0$ given $u(x,0) = 0$, $u(0,t) = 0$ $u(1,t) = 50t$. Compute u for 2 steps in t direction taking h=1/4

OR

16. Evaluate the pivotal values of the equation $u_{tt} = 16u_{xx}$, taking h= 1 upto t= 1.25 The boundary conditions are $u(0,t) = u(5,t) = 0$, $u(x,0) = x^2(5-x)$

17. A covariant tensor has components $2x - z, x^2y, yz$ in Cartesian co-ordinate system find its components in spherical co-ordinates.

OR

18. Find the components of first and second fundamental tensors in cylindrical co- ordinates.

19. A professor wishes to select a good text from four different ones available. He has 37 students whom he distributes at random into four groups of 9, 10,11 and 7 students assigning the books at random to the groups. After the course is over, all the students take the same test obtaining scores as given in table. Explain if any of the four books is to be preferred over the others

Text books	A	B	C	D
Scores obtained in the test	68 68 69 60 73 64 71 67 75	41 47 54 65 32 73 44 48 64 54	54 44 51 56 47 61 59 49 41 31 73	44 51 69 59 59 55 66

OR

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

Fertilizers	Yield			
	Plot A	Plot B	Plot C	Plot D
Nitrogen	6	4	8	6
Potash	7	6	6	9
Phosphates	8	5	10	9

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