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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
GEOMECHANICS AND STRUCTURES

Course Code: 20CEGST101

Course Name: APPLIED MATHEMATICS FOR CIVIL ENGINEERS

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

PART A

(Answer all questions. Each question carries 3 marks)

1. Write the expansion of $J_1(x)$
2. Use convolution theorem to evaluate $L^{-1}\left[\frac{s}{(s^2+a^2)^2}\right]$
3. Define contraction of tensors.
4. Define Fredholm and Volterra integral equation.
5. Find the solution of the Laplace's equation when $\frac{d^2X}{dx^2} = p^2X$ where p is a constant.
6. What are the three possible solutions of wave equation?
7. Evaluate $\int_{-2}^{2} e^{-x/2}\,dx$ by Gauss two point formula
8. What is the condition for convergence in Guass-Seidel method?

PART B

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

MODULE I

9. Express $f(x) = x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre Polynomial (6)

OR

10. Show that $e^{\frac{1}{2}x(t-1/t)} = \sum_{n=-\infty}^{\infty} t^n J_n(x)$ (6)

MODULE II

11. Solve by transform method $y'' + 4y' + 3y = e^{-t}, \quad y(0) = y'(0) = 1$ (6)

OR

12. Find Fourier sine transform of e^{-ax} and hence deduce Fourier cosine transform of xe^{-ax} (6)

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MODULE III

13. i) Prove that there is no distinction between contravariant and covariant vectors if the transformation law is of the form $\bar{x}^i = a^i_m x^m + b^i$, where a's and b's are constants such that $a^i_r\, a^i_m = \delta^r_m$ (4)

ii) Write down the law of transformation for the tensor A^{jk}_i (2)

OR

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

MODULE IV

15. Solve $y(x) = (1 + x) + \int_0^x (x - t)y(t)dt$ (6)

OR

16. Convert $y''(x) + y(x) = 0\,; y(0) = y'(0) = 0$ into an integral equation. (6)

MODULE V

17. A tightly stretched flexible string has its end at $x = 0$ and $x = l$. At time $t = 0$, the string is given a shape defined by $f(x) = \mu\, x(l - x)$, where μ is a constant and then released. Find the displacement of any point x of the string at any time $t > 0$. (6)

OR

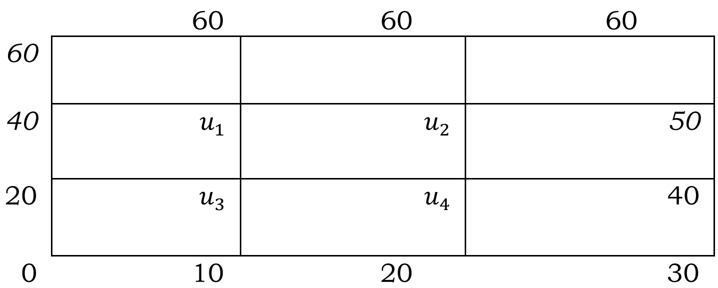
18. Solve the Laplace's equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ subject to the conditions $u(0, y) = u(l, y) = u(x, 0) = 0$ *and* $u(x, a) = \sin\frac{n\pi x}{l}$. (6)

MODULE VI

19. Solve by decomposition method, the following system : (6)
x+5y+z = 14
2x+y+3z = 13
3x+y+4z =17

OR

20. 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)



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