Name:....................
Reg. No:................

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

FIRST SEMESTER M.TECH DEGREE EXAMINATIONS, DECEMBER 2018

Branch: Civil Engineering

(Specialization: Geomechanics and Structures)

04CE 6301 - Applied Mathematics for Civil Engineers

(Note: Non-programmable calculators may be permitted)

Time: Three hrs | Max. Marks: 60

PART A

(Answer all questions. Each question carries 3 marks)

1. Calculate the Bessel's function $\mathscr{J}_{1/2}(x)$. (3)

2. Find $\mathscr{L}(t \sin at)$. (3)

3. Develop the first order general contravariant Tensor of rank 1. (3)

4. Form the dynamic equation corresponding to $y(x) = \int_0^x (x+t)y(t)dt + 1$. (3)

5. Solve $r = t$ using Monges Method. (3)

6. Using d Alembert's method find the deflection of a beam of unit length having fixed ends with initial velocity zero and initial deflection $f(x) = kx$. (3)

7. Evaluate the area bounded by a surface $\frac{1}{1+x^2}$ in $(0,1)$ numerically with six partitions. (3)

8. Solve $20x + y - 2z = 17, 3x + 20y - z = -18, 2x - 3y + 20z = 25$ using Gauss- Siedal iterative method. (3)

PART B

(Answer all questions. Each full question carries 6 marks)

9. Solve the Bessel's equation $x^2 \frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0$ (6)

OR

10. (a) Prove that $(1-2xt+t^2)^{-1/2} = \sum_{n=0}^{\infty} t^n P_n(x)$, where $P_n(x)$ represents the Legendre Polynomial. (3)

    (b) Express $x^4 + 3x^3 - x^2 + 5x - 2$ in terms of Legendre Polynomials. (3)

11. (a) Find the Fourier transform of $f(x) = \begin{cases} 1 & ; |x| < 1 \\ 0 & ; |x| > 1 \end{cases}$ (3)

    (b) Show that $\mathscr{F}_s(xf(x)) = -\frac{d}{ds}\mathscr{F}_c(s)$. (3)

OR

12. (a) Find $\mathscr{L}\left(\frac{\cos at - \cos bt}{t}\right)$ (3)

(b) Solve $y''' + 2y'' - y' - 2y = 0$, where $y(0) = y'(0) = 0, y''(0) = 6$. (3)

13. (a) Show that $a_{ij}A^{kj} = \Delta\delta_i^k$, where Δ is the determinant and A^{ij} s are cofactors of a_{ij}. (3)

(b) Expand the sum $a_{ij}x^j$ using the summation principle. (3)

OR

14. (a) Prove that the following transformation T is admissible and find their respective inverse. (3)

$$T = \begin{cases} y^1 & = x^1 \sin x^2 \cos x^3 \\ y^2 & = x^1 \sin x^2 \cos x^3 \\ y^3 & = x^1 \cos x^3 \end{cases}$$

(b) Develop the covariant and contravariant tensors with suitable mathematical analogy. (3)

15. (a) Show that $y = 2 - x$ is a solution of $\int_0^x e^{x-t} y(t) dt = e^x + x - 1$. (3)

(b) Solve $y(x) = 3x^2 + \int_0^x \cos(x - t) y(t) dt$. (3)

OR

16. (a) Solve $\dfrac{dy}{dx} + 3y + 2\int_0^x y dx = x$, where $y(0) = 0$. (3)

(b) Using the method of successive approximation, solve the Fredholm integral equation (3)

$$y(x) = 1 + x + \int_0^x (x - t) y(t) dt$$

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17. (a) Solve by Monges method $(x - y)(xr - ys + yt) = (x + y)(p - q)$ (3)

(b) 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 $f(x) = a(x - x^2)$. (3)

OR

18. An infinitely long plane uniform plate is bounded by two parallel edges and an end at right angle to them. The breadth is π; this end is maintained at a temperature u_0 at all points and other edges are at zero temperature. Determine the temperature at any point x of the plate in the steady-state. (6)

19. (a) Solve (3)

$$x + 4y - z = -5$$
$$x + y - 6z = -12$$
$$3x - y - z = 4$$

(b) Solve the system of non-linear equations (3)

$$x^2 + y = 11$$
$$y^2 + x = 7$$

OR

20. (a) Solve using Gauss-Siedal iteration method (3)

$$20x + y - 2z = 17$$
$$3x + 20y - z = -18$$
$$2x - 3y + 20z = 25$$

(b) A solid of revolution is formed by rotating about the x-axis, the area between the $x-$ axis, the lines $x = 0$ and $x = 1$ and the curve through the points with the following co-ordinates (3)

x:	0.00	0.25	0.50	0.75	1.00
y:	1.0000	0.9896	0.9589	0.9089	0.8415