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Reg No.:_____ Name:_____

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

B.Tech S1,S2 (S) Examination September 2020 (2015 Scheme)

**Course Code: MA102**

**Course Name: DIFFERENTIAL EQUATIONS**

Max. Marks: 100 Duration: 3 Hours

**PART A**

***Answer all questions, each carries 3 marks***

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|---|---|---|
| 1 | Find the ODE $y'' + ay' + by = 0$ for the basis $\{e^x, xe^x\}$ | (3) |
| 2 | Reduce to first order and solve $2xy'' = 3y'$. | (3) |
| 3 | Find the particular integral of $y'' + 4y' + 4y = x^2$. | (3) |
| 4 | Using a suitable transformation, convert the differential equation $(x^2D^2 - 4xD + 6)y = x$ into a linear differential equation with constant coefficients. | (3) |
| 5 | If $f(x)$ is a periodic function of period $2L$ defined in $[-L, L]$. Write down Euler's Formulas $a_0$, $a_n$, $b_n$ for $f(x)$. | (3) |
| 6 | Find the Fourier series of the function $f(x) = x$ in the range $-\pi < x < \pi$. | (3) |
| 7 | Find the PDE by eliminating arbitrary constants $a$ and $b$ from $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$. | (3) |
| 8 | Find the particular integral of $(D^3 - 4D^2D' + 4DD'^2)z = \cos(2x + y)$. | (3) |
| 9 | Write all possible solutions of one dimensional wave equation. | (3) |
| 10 | A homogeneous string is stretched and its ends are fixed at $x = 0$ and $x = 40$. Motion is started by displacing the string into the form $f(x) = \sin\left(\frac{\pi x}{40}\right)$ from which it is released at time $t = 0$. Write the boundary and initial conditions.. | (3) |
| 11 | Solve one dimensional heat equation for $\lambda < 0$. | (3) |
| 12 | Find the steady state temperature distribution in a rod of length 40 cm if the ends are kept at $0^0C$ and $100^0C$. | (3) |

## PART B

***Answer six questions, one full question from each module***

### Module 1

13 a) Solve $y'' - 2y' - 3y = 0, y(-1) = e, y'(1) = -\frac{e}{4}$. (6)

b) Show that the functions $x^3$ and $x^5$ are the basis of solutions of ODE $x^2y'' - 7xy' + 15y = 0$. (5)

**OR**

14 a) Solve ODE $y^v - 3y^{iv} + 3y''' - y'' = 0$. (6)

b) Solve the ODE $xy'' + 2y' + xy = 0$. Given that $y_1 = \frac{cosx}{x}$ is a solution. (5)

### Module 1I

15 a) By the method of variation of parameters, solve $y'' + y = secx$. (6)

b) Solve $x^2y'' - 4xy' + 6y = x^5$. (5)

**OR**

16 a) Solve $(2x + 3)^2y'' - 2(2x + 3)y' - 12y = 6x$. (6)

b) Solve $y'' + 2y' - 3y = e^{2x}sinx$. (5)

### Module 1II

17 a) Find the Fourier series of $f$ defined by $f(x) = e^x$ in $(-\pi, \pi)$. (11)

**OR**

18 a) Obtain Fourier series for the function $f(x) = x^2, -\pi \leq x \leq \pi$. (6)

b) Expand $f(x) = cosx$ as a half range sine-series in $0 \leq x \leq \pi$. (5)

### Module 1V

19 a) Solve $r + s - 2t = \sqrt{2x + y}$. (6)

b) Find the general solution of $x^2p + y^2q = (x + y)z$. (5)

**OR**

20 a) Solve $4r + 12s + 9t = e^{3x-2y}$. (6)

b) Solve $(D^2 - DD' - 6D'^2)z = xy$. (5)

### Module V

21 a) Using method of separation of variables, solve $y^2u_x - x^2u_y = 0$. (5)

b) Find the displacement of a finite string of length $l$ that is fixed at both ends and is released from rest with an initial displacement of $2\sin\left(\frac{\pi x}{l}\right)$. (5)

**OR**

22 Derive one dimensional wave equation. (10)

**Module VI**

23 A rod of length L is heated so that its ends A and B are at zero temperature .If its initial temperature is given by $u = \frac{cx(L-x)}{L^2}$, find the temperature at time t. (10)

**OR**

24 A rod of length 40cm has its ends A and B kept at $0^0C$and $100^0C$ respectively until steady state conditions prevail. Suddenly the temperature at A is raised to $20^0C$ and the end B is decreased to $60^0C$ . Find the temperature distribution in the rod at time t. (10)

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