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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech S1 (S,FE) S2 (S) Examination February 2023 (2015 Scheme)

Course Code: MA102

Course Name: DIFFERENTIAL EQUATIONS

Max. Marks: 100 Duration: 3 Hours

PART A

Answer all questions, each carries 3 marks

1	Find the general solution of the differential equation $y'' + y = 0$	(3)
2	Reduce to first order and solve $yy'' = 3(y')^2$.	(3)
3	Find the particular solution of the differential equation $y''' + y = cos2x$.	(3)
4	Using a suitable transformation, convert the differential equation $(x+1)^2y'' + (x+1)y' + y = 4\cos(\log(1+x))$ into a linear differential equation with constant coefficients.	(3)
5	Find the Fourier series of the function $f(x) = x + \pi$ in the range $-\pi < x < \pi$.	(3)
6	Find the Fourier sine series of $f(x) = x$, in $0 \le x \le 3$	(3)
7	Find the partial differential equation of all spheres having their centre lies on z-axis.	(3)
8	Solve $2r + 5s + 2t = 0$.	(3)
9	Solve $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 0$ using method of separation of variables.	(3)
10	Write the three possible solutions of one dimensional wave equation.	(3)
11	Find the steady state temperature distribution in a rod of 50 cm having its ends at 20^0C and 70^0C respectively.	(3)
12	Write the three basic laws which are used in the derivation of one dimensional heat equation.	(3)

PART B

Answer six questions, one full question from each module

Module 1

13	a)	Solve the initial value problem $y''' + y'' + 4y' + 4y = 0, y(0) = 2, y'(0) = -5, y''(0) = -3$.	(5)

b) Find a basis of solutions of the differential equation $y'' - 3y' + 2y = 0$ (6)

OR

14 a) Find a basis of solution of the ODE $(x^2)y'' + xy' - 4y = 0$ if $y_1 = x^2$ is a solution. (5)

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

Module 1I

15 a) Solve $x^2y'' - xy' + 4y = \cos(logx) + xsin(logx).$ (5)

b) Use method of variation of parameters solve $y'' + y = secx.$ (6)

OR

16 a) Solve $y'' - 4y' + 4y = 8x^2e^{2x}sin2x.$ (5)

b) Solve $y'' + 4y = tan2x.$ (6)

Module 1II

17 Find the Fourier series for the function $f(x) = \begin{cases} x, & 0 < x < 1 \\ 1 - x, & 1 < x < 2 \end{cases}$. Hence deduce that $1 + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \ldots. = \frac{\pi^2}{8}.$ (11)

OR

18 a) Find the Fourier series of $f(x) = \begin{cases} 1 - x, -\pi < x \le 0 \\ 1 + x, 0 \le x \le \pi \end{cases}.$ (6)

b) Find the Fourier cosine series of $f(x) = cosx$ in $0 < x < \frac{\pi}{2}.$ (5)

Module 1V

19 a) Solve $(y^2(x + y))p + (x^2(x + y))q = (x^2 + y^2)z.$ (5)

b) Find the particular integral of $(D^3 - 10D^2D' + D'^3)$ z = cos (2x+3y) (6)

OR

20 a) Solve $xy\ dx + y^2\ dy = zxy - 2x^2$ (5)

b) Solve $(D^2 + 3DD' + 2D'^2)z = x^2y^2$ (6)

Module V

21 Derive one dimensional wave equation. (10)

OR

22 Find the deflection of the vibrating string which is fixed at the ends x=0 and x=2 (10)

and the motion is started by displacing the string into the form $sin^3 \frac{\pi x}{2}$ and released it with zero initial velocity at t=0.

Module VI

23 The ends A and B of a rod of length 20 cm are maintained at temperatures 30^0C and 80^0C respectively until steady state conditions prevail. The temperature of the ends are changed to 40^0C and 60^0C respectively. Find the temperature distribution in the rod at time t. (10)

OR

24 Find the temperature distribution in a bar of length π whose surface is thermally insulated with end points maintained at 0^0C. The initial temperature distribution in the rod is $u(x,0) = \begin{cases} x, 0 \leq x \leq \frac{\pi}{2} \\ \pi - x, \frac{\pi}{2} \leq x \leq \pi \end{cases}$ (10)

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