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Name of Examination : **Summer 2021** - (Preview)

Course Code & Course Name : **SH296U - Advanced Engineering Mathematics**

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Maximum Marks : **60**   Duration : **3 Hrs**

Edit   Print   View Answer Key   Close   **Answer Key Submission Type:** Marking scheme with model answers and solutions of numerical

Instructions:

1. *All questions are compulsory.*
2. *Illustrate your answer with suitable figures/sketches wherever necessary.*
3. *Assume suitable additional data; if required.*
4. *Use of logarithmic table, drawing instruments and non programmable calculators is allowed.*
5. *Figures to the right indicate full marks.*

1) a) Solve the ODE $x^3 \frac{d^3 y}{dx^3} - 4x^2 \frac{d^2 y}{dx^2} + 6x \frac{dy}{dx} = 4x$ [5]

b) Solve the ODE by the method of variation of parameters $(D^2 + 1)y = cosec\ x$ [4]

c) Solve the simultaneous linear differential equations   [6]
$$\frac{dx}{dt} + 2x - 3y = t;\ \ \frac{dy}{dt} + x + 2y = e^{2t}$$

OR

c) A spring fixed at the upper end supports a weight of 980 gm. at its lower end. The spring stretches ½ cm. under a load of 10gm. and the resistance (in gm. wt.) to the motion of the weight is numerically equal to 1/10 of the speed of the weight in cm/sec. The weight pulled down ¼ cm. below its equillibrium position and then released. Find the expression for the distance of weight from its euillibrium position at time t during its first upward motion.   [6]

2) a) Solve the PDE $p\ tan\ x + q\ tan\ y = tan\ z$ [4]

b) If $\frac{\partial^2 y}{\partial t^2} = a^2 \frac{\partial^2 y}{\partial x^2}$ represents the vibrations of a stretched string of length l fixed at both ends, find the solution with boundary conditions   [6]
$$(i)\ y(0, t) = 0, \qquad (ii)y(l, t) = 0$$
and initial conditions
$$(i)\ y(x, 0) = m(lx - x^2), \qquad 0 \le x \le l, \quad (ii) \left(\frac{\partial y}{\partial t}\right)_{t=0} = 0$$

3) a) Find the Laplace Transform of the function $f(t) = \begin{cases} e^{2t} & 0 \le t \le 1 \\ 2 + t^2 & 1 < t \le 2 \\ t - sin\ t & t > 2 \end{cases}$ [5]

b) Evaluate $L\left\{\frac{e^{-3t} \sin 3t \cosh t}{t}\right\}$ [5]

c) Solve by using Laplace transform $y''' - 3y'' + 3y' - y = t^2 e^t$, where $y(0) = 1; y'(0) = 0, y''(0) = -2$.   [6]

OR

c) Using Fourier integral representation prove that   [6]
$$\int_0^\infty \left[\frac{\cos \lambda x + \lambda \sin \lambda x}{1 + \lambda^2}\right] d\lambda = \begin{cases} 0 & if \quad x < 0 \\ \frac{\pi}{2} & if \quad x = 0 \\ \pi e^{-x} & if \quad x > 0 \end{cases}$$

4) a) Find the Lagrange interpolation polynomial by using the following data   [4]

x	-2	1	3	5
y	0	-1.8	-1.2	-1.6

b) Use Runge-Kutta fourth order method to find $y(0.1)$, $y(0.2)$, given that $\frac{dy}{dx} = 2xy - y$, $y(0) = 1$.   [6]

OR

b) An experiment conducted on 9 different cigarette smoking subjects resulted in the following data –   [6]

Subject Number	Cigarettes smoked per week	Number of years lived
	(averaged over the last 5 years of their life)	
1	25	63
2	36	68
3	9	72
4	35	60
5	80	55
6	75	46
7	60	51
8	42	58
9	50	55

Calculate the coefficient of correlation between the number of cigarettes smoked and the longevity of a test subject.

5) a) Given the following data set, find the least squares curve for the following functions   [5]

Xi	1	2	3	4	5
yi	0.7	2.2	5.7	12.8	20.4

$$y = f(x) = Ce^{Ax}$$

b) Approximate the integral $\int_0^1 \exp(x^2)\, dx$ by use of Simpson's 1/3rd rule with dividing the interval into 6 parts.   [4]

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