Name: **Enrolment No:**	

UPES

End Semester Examination, December 2024

Course: Ordinary Differential Equations (Minor) **Semester: III**
Program: B.Sc. (H) Physics by Research **Time: 03 hrs**
Course Code: MATH2048 **Max. Marks: 100**

Instructions: Read all the below mentioned instructions carefully and follow them strictly:

1. Mention Name and Roll No. at the top of the question paper.
2. Attempt all questions. There are internal choices for question 9 and question 11.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Solve the following differential equation by using a suitable method: $$(2x-y+1)dx+(2y-x-1)dy=0$$	**4**	**CO1**
Q 2	Solve the following differential equation $$(D^3+3D^2+3D+1)y=0\,; \quad D\equiv\frac{d}{dx}$$	**4**	**CO3**
Q 3	A metal bar at a temperature of 100° F is placed in a room at a constant temperature of 0° F. If after 20 minutes the temperature of the bar is half, find an expression for the temperature of the bar at any time.	**4**	**CO2**
Q 4	Solve the following differential equation $$(x^2\text{- }4xy\text{ -}2y^2)\,dx+(\,y^2-4xy-2x^2)dy=0$$	**4**	**CO1**
Q 5	Find the particular integral of $$(D^2-6D+8)y=(e^{2x}+1)^2;\ \ D\equiv\frac{d}{dx}$$	**4**	**CO3**

SECTION B
(4Qx10M= 40 Marks)

Q 6	Solve the following differential equation $$(D^4-m^4)y=\sin mx\ ;\ D\equiv\frac{d}{dx}$$	**10**	**CO3**
Q 7	Solve the following differential equation using method of undetermined coefficients $$(D^2+3D+2)y=x+\cos x\ ;\ D\equiv\frac{d}{dx}$$	**10**	**CO3**

Q 8	A certain radioactive material is known to decay at rate proportional to the amount present. If initially 500 mg of the material is present and after 3 years 20 per cent of the original mass has decayed, find an expression for the mass at any time.	**10**	**CO2**
Q 9	Find the solution of the following differential equation, passes through (0,0). $$\left(xy^2 + e^{-\frac{1}{x^3}}\right)dx - x^2y\,dy = 0$$ **OR** Reduce the equation $xp^2 - 2yp + x + 2y = 0$ to Clairaut's form by using substitution $y = u$ and $xy = v$ and hence find its general and singular solution	**10**	**CO1**
SECTION-C (2Qx20M=40 Marks)			
Q 10	Explain the SIR model for influenza. Further, let in a population of 1000 people, 990 are susceptible, 10 are infected, and none have recovered at time t=0. If the transmission rate β is 0.3 and the recovery rate γ is 0.1. Find the rate of change of susceptible, infected, and recovered individuals. Also determining the basic reproduction number.	**20**	**CO4**
Q. 11	Solve the following nonhomogeneous linear differential equation by using variation of parameter method: $$(D^2 + 4)y = \cot 2x\ ; \quad D \equiv \frac{d}{dx}$$ OR Solve the following Cauchy- Euler linear differential equation: $$x^3\frac{d^3y}{dx^3} + 3x^2\frac{d^2y}{d^2x} + x\frac{dy}{dx} + 8y = 65\cos(\log x)$$	**20**	**CO3**