Name: **Enrolment No:**	

UPES

End Semester Examination, May 2025

Course: Introduction to MATLAB Programming **Semester : IV**

Program: B.Sc. Physics by Research **Time : 03 hrs.**

Course Code: CSEG 2054K **Max. Marks: 100**

Instructions: ***Read the questions clearly and provide needed details only*****.**

All questions are mandatory in Section A.

Internal choices are given in questions 6 and 11 of Sections B and C respectively.

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain what MATLAB is and how MATLAB is different from other computational software such as MATHEMATICA and MAPLE?	**4**	**CO1**
Q 2	Using MATLAB, compute the radius of a circle having unit area.	**4**	**CO1**
Q3	Compute the following using MATLAB: $e^3, \ln(e^3), \log_{10}(10^5)$	**4**	**CO2**
Q 4	Using MATLAB programming, compute the following trigonometric functions: $\sin^2\frac{\pi}{6} + \cos^2\frac{\pi}{6}$ and $y = \cosh^2 x - \sinh^2 x$, with $x = 32\pi$	**4**	**CO2**
Q5	Using for loop statement in MATLAB write the code to compute the factorial of a given number.	**4**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
Q6	Using the curve fitting methods in MATLAB computer programming, fit the data generated from the $y = A\sin(Bx + C)$, where A, B, C are constants. **OR** Using the curve fitting methods in MATLAB computer programming fit the data generated from the $y = AExp(B.x)$, and $y = Alog(x) + B$, where A, B are constant.	**10**	**CO3**
Q7	Given the electric field of a point charge in free space:	**10**	**CO4**

	$$\vec{E} = \frac{q}{4\pi\varepsilon_0}\frac{\vec{r}}{r^3}$$ Using MATLAB programming, examine the divergence of the given electric filed and verify Gauss's law in differential form.		
Q8	(a) Explain the quiver function. (b) Create a 2D meshgrid for $x, y \in [-5, 5]$. (c) Calculate the gradient of the function: $f(x, y) = x^2 + y^2$. (d) Plot the gradient vectors using the quiver function in MATLAB programming.	**10** **(**3+2+3+2**)**	**CO4**
Q9	A hot object cools down to an ambient temperature at a rate proportional to the temperature difference. If the ambient temperature is 20^0C and the initial object temperature is 80^0C with a cooling constant of 0.07. Using MATLAB computer programming, find the temperature after 30 minutes.	**10**	**CO2**
SECTION-C **(2Qx20M=40 Marks)**			
Q10	The three-dimensional vector field is given by: $$\vec{F} = 2x^2y\,\hat{i} + y^2z\,\hat{j} + z^2x\,\hat{k}$$ Using MATLAB programming compute: (a) The divergence of the vector field at (-2, 3, 4). (b) Visualize the vector field using quiver function. (c) Plot the diverging filed using isosurface function.	**20** **(**10+5+5**)**	**CO4**
Q11	The velocity of a free vortex is : $$V = \left(\frac{-ky}{x^2+y^2}, \frac{-kx}{x^2+y^2}, 0\right)$$ where k is a constant. Using MATLAB compute: (a) The curl of the given vector field. (b) Plot the given vector field. (c) Visualize the vorticity distribution. **OR**	**20** **(**10+5+5**)**	**CO4**

	A fluid is rotating like a rigid body with velocity: $$V = (-\omega y, \omega x, 0)$$ where ω is a constant angular velocity. (a) Find the curl $\nabla \times V$. What does this represent physically? (b) Plot the vector function. (c) Plot the curl of the vector function.		