Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2024

Course: Introductory Mathematical Physics **Semester: I**

Program: BSC-H-Geology, BSC-H-Mathematics & BSC-H-Mathematics by Research, BSC-H-Chemistry

Time: 03 hours

Course Code: PHYS1031 **Max. Marks: 100**

Instructions:

(1) All questions are compulsory. Section A has 5 questions; Section B has 4 questions with an internal choice in one question; Section C has 2 questions with an internal choice in one question.

(2) Use of scientific calculators is permitted.

SECTION A

(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	List any two properties of the Dirac-Delta function.	**4**	**CO1**
Q2	If any two complex numbers $a + ib$ and $c + id$ are equal, show that $a = c$ and $b = d$.	**4**	**CO2**
Q3	Solve the following integral: $\int_{-\infty}^{\infty} e^{-5t}\delta(t-2)dt$.	**4**	**CO2**
Q4	Solve $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 4y = 0$.	**4**	**CO3**
Q5	Determine the constant 'a' such that the vector $\vec{A} = (x + 3y)\hat{\imath} + (2y + 3z)\hat{\jmath} + (x + az)\hat{k}$ is solenoidal.	**4**	**CO3**

SECTION B

(4Qx10M= 40 Marks)

There is an internal choice in Q8.

Q6	Prove that $\Gamma(n+1) = n\Gamma(n)$ where Γ is the Gamma function.	**10**	**CO2**
Q7	Derive a relation between the Beta function and Gamma function.	**10**	**CO2**
Q8	Show that $e^{i\theta} = \cos\theta + i\sin\theta$. **OR** Express in polar form the complex number: $1 - \sqrt{2} + i$.	**10**	**CO3**
Q9	Find the Fourier Series representation of the function $f(x) = x$ where $0 < x < 2\pi$.	**10**	**CO3**

SECTION-C (2Qx20M=40 Marks) There is an internal choice in Q11.			
Q10	Use the technique of separation of variables to find the solution $u\ (x,t)$ to the following Partial Differential Equation (*k* is a constant): $$\frac{\partial^2 u}{\partial x^2} = \frac{1}{k}.\frac{\partial u}{\partial t}$$	**20**	**CO4**
Q11	(a) Using the Divergence Theorem, illustrate that $\iint \nabla(x^2+y^2+z^2)\overrightarrow{ds} = 6V$ where *S* is any closed surface enclosing the volume *V*.	**15**	**CO4**
	(b) Determine the value of: $i^{49} + i^{103} + 3$.	**5**	**CO3**
	OR		
	(a) Evaluate $\iint \vec{F}.\overrightarrow{dS}$ where $\vec{F} = 4x\hat{\imath} - 2y^2\hat{\jmath} + z^2\hat{k}$ and S is the surface bounding the region $x^2+y^2=4$, $z=0$ and $z=3$.	**15**	**CO4**
	(b) Solve: $\frac{1+i}{3+4i}$.	**5**	**CO3**

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