QP CODE: D3BPH2404	(Pages: 2)	Reg. No : .....
		Name : .....

THIRD SEMESTER FYUGP EXAMINATION, NOVEMBER 2025

Discipline Specific Core (DSC) Course - Minor

PHY3MN201 : Mathematical Methods for Physics

(Credits: 4)

Time: 2 Hours **Maximum Marks: 70**

Section A

Answer the following questions. Each carries 3 marks (Ceiling: 24 marks)

1.	What does it imply if the divergence of a vector field is zero? Give an example.	BL1	CO1
2.	What does the condition $\vec{\nabla}.\vec{E} = \rho/\epsilon_0$ physically represent?	BL2	CO1
3.	Express in polar form $\frac{1+3i}{1-2i}$.	BL2	CO2
4.	Solve the differential equation $y \log y dx + (x - \log y)dy = 0$.	BL2	CO1
5.	Solve the differential equation: $x\frac{dy}{dx} + 2y = x^2 \log x$.	BL2	CO1
6.	Find the electric field inside a uniformly charged spherical shell of radius, r.	BL3	CO3, CO4
7.	What are the scale factors (h_1, h_2, h_3) in cylindrical coordinates?	BL2	CO1
8.	Solve the differential equation, $\frac{dy}{dx} = (4x + y + 1)^2$.	BL2	CO1
9.	If $Z_1 = 2 - i$ and $Z_2 = -2 + i$, find, (a). $Re(\frac{Z_1 Z_2}{Z_1})$ (b). $Im(\frac{1}{Z_1 Z_2})$.	BL2	
10.	Simplify the following, a). i^{60} b). i^{-22} c). i^{103}	BL2	

Section B

Answer the following questions. Each carries 6 marks (Ceiling: 36 Marks)

11.	Explain the difference between scalar and vector point functions with two physical examples from physics.	BL1	CO1, CO3

(PTO)

12.	Explain the motion of a simple pendulum as an example of SHM. State the condition for its validity.	BL2	CO6
13.	Explain the addition of complex numbers by geometry.	BL2	
14.	(a). Form a differential equation representing all straight lines in the plane. (b). Form the differential equation of all parabolas of the form $y^2 = 4ax$.	BL2	CO1
15.	Solve the homogeneous equations, (i). $\frac{dy}{dx} = \frac{x+y}{x-y}$, (ii). $(x^2 - y^2)dx - 2xydy = 0$.	BL2	CO1
16.	Derive Gauss's law for magnetism in differential form starting from its integral form.	BL1	CO1
17.	In an L-R-C series circuit, resistance is 255 Ω, inductance is 45 mH, capacitance is 0.400 μF, and the source has a voltage amplitude of 55 V. The inductive reactance is equal to the resistance. Find, (a). the frequency of the source, (b). the impedance.	BL2	CO2
18.	Express $x\hat{i} + 2y\hat{j} + yz\hat{k}$ in spherical polar coordinates.	BL2	CO1
	Section C		
	Answer any one question. Each carries 10 marks (1 x 10 = 10 Marks)		
19.	Compute $\vec{\nabla}.\vec{F}$ and $\vec{\nabla} \times \vec{F}$, (i). $\vec{F} = (x^2 - y^2)\hat{i} - 2xy\hat{j} + (y^2 - xy)\hat{k}$ (ii). $\vec{F} = (6xyz^2 + 3yz)\hat{i} + (3x^2z)\hat{j} - (3xyz^3)\hat{k}$.	BL2	CO1
20.	A cylindrical shell of inner radius a and outer radius b carries a uniform charge density ρ, (i) Find the electric field in the regions $r < a$, $a < r < b$, and $r > b$. (ii) Illustrate the variation of the field with r using a graph.	BL3	CO3, CO4
	CO : Course Outcome		
	BL : Bloom's Taxonomy Levels (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)		