

QP Code: D134296	Total Pages:02	Name:
		Register No.
THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER 2025		
(CUFYUGP)		
PHY3MN201: Mathematical Methods for Physics		
2024 Admission onwards		
Maximum Time :2 Hours	Maximum Marks :70	
Section A		
All Questions can be answered. Each Question carries 3 marks (Ceiling : 24 Marks)		
1	Explain the geometrical meaning of gradient.	
2	A vector field is given by $\vec{A} = (x^2 + xy^2)\hat{i} + (y^2 + x^2y)\hat{j}$. Show that the field is irrotational.	
3	Solve for θ such that the expression $\frac{3+2i \sin \theta}{1-2i \sin \theta}$ is imaginary.	
4	If $x + iy = \frac{1}{a+ib}$, prove that $(x^2 + y^2)(a^2 + b^2) = 1$.	
5	Find the modulus and principal argument of the complex number $1 + \cos \alpha + i \sin \alpha$.	
6	Solve the differential equation $y\sqrt{1+x^2}.dy + x\sqrt{1+y^2}.dx = 0$.	
7	Solve the differential equation $\frac{dy}{dx} + \frac{y}{x} = x^3 - 3$.	
8	Using Gauss's law, Find the field outside a uniformly charged solid sphere of radius R and total charge q.	
9	Convert the Cartesian coordinates of a point P(1, 1, 2) into cylindrical coordinates.	
10	Convert the spherical coordinates $(r, \theta, \phi) = (2, \frac{\pi}{6}, \frac{\pi}{3})$ of a point P to Cartesian coordinates (x, y, z) .	
Section B		
All Questions can be answered. Each Question carries 6 marks (Ceiling : 36 Marks)		
11	(i). What is meant by directional derivative? (ii). Find the directional derivative of $x^2y^2z^2$ at the point (1, 1, -1) in the direction of the tangent to the curve $x = e^t, y = \sin 2t + 1, z = 1 - \cos t$ at $t = 0$.	
12	(i). State and explain Gauss's law. (ii). An infinite plane carries a uniform surface charge σ . Find its electric field.	
13	If z_1 and z_2 are two complex numbers such that $ z_1 + z_2 = z_1 - z_2 $, prove that $\arg. z_1 - \arg. z_2 = \frac{\pi}{2}$.	
14	A 200Ω resistor is connected in series with a $5\mu\text{F}$ capacitor. The voltage across the resistor is $V_R = (1.2V) \cos(2500 \text{ rad/s})t$ (a). What is the circuit current? (b). Calculate the reactance of the capacitor. (c). Obtain the voltage across the capacitor.	
15	Solve the differential equation $(x^2 + y^2)dy = xy dx$	
16	Solve $\tan y \frac{dy}{dx} + \tan x = \cos y. \cos^2 x$	
17	A long cylinder carries a charge density that is proportional to the distance from the axis: $\rho = ks$, for some constant k . Find the electric field inside this cylinder.	
18	Express $z\hat{i} - 2x\hat{j} + y\hat{k}$ in cylindrical co-ordinates.	

Section C	
Answer any ONE .Each Question carries 10 marks (1x10=10 Marks)	
19	(i). If f and g are two scalar point functions, prove that $\text{div}(f \nabla g) = f \nabla^2 g + \nabla f \cdot \nabla g$ (ii). For a solenoidal vector \vec{F} , show that $\text{curl curl curl curl } \vec{F} = \nabla^4 \vec{F}$
20	(i). An airplane is flying in a straight line at a constant altitude. If a wind gust strikes and raises the nose of the airplane, the nose will bob up and down until the airplane eventually returns to its original attitude. Are these oscillations (i) undamped; (ii) underdamped; (iii) critically damped; or (iv) overdamped? Explain. (ii). The shock absorbers in an old car with mass 1000 kg are completely worn out. When a 980 N person climbs slowly into the car at its center of gravity, the car sinks 2.8 cm. The car (with the person aboard) hits a bump, and the car starts oscillating up and down in SHM. Model the car and person as a single body on a single spring, and find the period and frequency of the oscillation.