BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: IMSc — **SEMESTER : III**
BRANCH: PHYSICS — **SESSION : MO/2022**

SUBJECT: PH213 MATHEMATICAL PHYSICS II

TIME: 3:00 Hours — **FULL MARKS: 50**

INSTRUCTIONS:
1. **The question paper contains 5 questions each of 10 marks and total 50 marks.**
2. **Attempt all questions.**
3. **The missing data, if any, may be assumed suitably.**
4. **Before attempting the question paper, be sure that you have got the correct question paper.**
5. **Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

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Q.1(a)	What are the characteristic curves.	[2]	1	2
Q.1(b)	Define exact and inexact differentials with examples.	[3]	1	2
Q.1(c)	Find the general solution to the following differential equation $2\frac{\partial u}{\partial x} - 3\frac{\partial u}{\partial y} + 8u = 0$	[5]	1	3
Q.2(a)	Define tangent, principal normal to a curve.	[2]	2	1
Q.2(b)	Derive the equation for tangent plane of an arbitrary surface.	[3]	2	2
Q.2(c)	Reduce the following differential equation to canonical form $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$	[5]	2	3
Q.3(a)	What is a directional derivative?	[2]	3	1
Q.3(b)	State the Gauss theorem, Stokes theorem and Green's theorem.	[3]	4	2
Q.3(c)	Give geometrical explanation of gradient, divergence and curl.	[5]	3	2
Q.4(a)	What is Jacobian of a coordinate transformation?	[2]	4,5	1
Q.4(b)	Prove the Green's theorem in 2D plane.	[3]	4	2
Q.4(c)	Evaluate $\int_{(1,0)}^{(-1,0)} \frac{-y\,dx + x\,dy}{x^2 + y^2}$ along the semi-circle of unit radius in $y \geq 0$ region.	[5]	4	3
Q.5(a)	Define the Dirac delta function.	[2]	5	2
Q.5(b)	Prove the following where x_i are the zeroes of $f(x)$. $\delta[f(x)] - \sum_i \delta(x - x_i)/f'(x_i)$	[3]	5	2
Q.5(c)	For the following coordinate transformation $x^2 + y^2 = u_1^2, y/x = \tan u_2$, show that the new curvilinear coordinate system is orthogonal.	[5]	5	3

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