Roll No. Total No. of Pages : 02

Total No. of Questions : 09

B.Sc. (Non Medical) (2018 & Onwards) (Sem.–1)

MATHEMATICAL PHYSICS

Subject Code : BSNM-103-18

M.Code : 75744

Time : 3 Hrs. Max. Marks : 50

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying ONE marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Write briefly :

a) Find the Wronskian of $\{x^2, -2x^2, 3x^3\}$

b) Solve $y^3 dx + (xy + x^2)\, dy = 0$.

c) Find the integrating factor of the equation

$$(x^4 e^x - 2mxy^2)\, dx + 2mx^2 y dy = 0$$

d) Find the angle between the planes $x + y + z = 1$ and $x + 2y + 3z = 0$.

e) Prove that vector product is not associative, in general,

i.e., $a \times (b \times c) \neq (a \times b) \times c$

f) Prove that $\oint_C \phi\, d\vec{r} = \iint_S d\vec{S} \times \nabla\phi$

g) If the vector function $\vec{f}(t)$ have constant magnitude then prove $\vec{f}.\frac{d\vec{f}}{dt} = \vec{0}$.

h) Define dirac delta function.

i) Evaluate ∇f, if $f(r, \theta) = r^2 - b^2 \cos\theta$ where b is a constant.

j) Show that $f(r, \theta, \phi) = r \sin\theta \cos\phi$ satisfies Laplace's equation.

SECTION-B

2. Solve $(3x + y - z)\, p + (x + y - z)\, q = 2\,(z - y)$.

3. Find the volume of the parallelepiped if the edge vectors are [4, 9, –1], [2, 6, 0], [5, -4, 21].

4. For the function $f = \dfrac{y}{x^2 + y^2}$, find the value of directional derivative making an angle 30° with the positive x-axis at point (0, 1).

5. Apply Green's theorem in the plane to evaluate $\oint_C [(2x^2 - y^2)\,dx + (x^2 + y^2)\,dy]$ where C is boundary of the surface enclosed by the x-axis and the semi-circle $y = \sqrt{1 - x^2}$.

6. Evaluate $I(\sigma) = (2\pi\sigma^2)^{-\frac{1}{2}} \int_{-\infty}^{\infty} e^{-\frac{(x - x_0)^2}{2\sigma^2}} \sin x\, dx$ explicity and let $\sigma \to 0$ to show that $\lim_{\sigma \to 0} I(\sigma) = \sin x_0$.

SECTION-C

7. Define scalar triple product and their interpretation in terms of volume.

8. State and prove Stoke's theorem.

9. Use a CAS to evaluate div u and curl u if $u\,(r, \theta, z) = r^2 \cos\theta\, e_r - rz^2 \sin^2\theta\, e_\theta + e^z e_k$.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.