

K20U 0477

Reg. No. :

Name :

II Semester B.Sc. Degree (CBCSS (OBE) – Regular) Examination, April 2020
(2019 Admission)

Core Course In Physics

2B02PHY : MATHEMATICAL PHYSICS AND ERROR ANALYSIS

Time : 3 Hours

Max. Marks : 40

SECTION – A

Answer **all** questions. **Each** question carries 1 mark.

1. What is meant by derivative of a function ?
2. Give the transformation law of vectors about an arbitrary axis.
3. What is meant by an operator ? Give example.
4. Express the cylindrical unit vectors in terms of cartesian unit vectors.
5. How do we represent the divergence in spherical polar coordinate system ?
6. Distinguish between homogeneous and nonhomogeneous linear second order differential equations. (6×1=6)

SECTION – B

Answer **any 6** questions. **Each** question carries 2 marks.

7. Define and explain fundamental theorem of curl.
8. Define gradient and explain its geometrical interpretation.
9. Explain the spherical polar coordinate system and write down the coordinates in it and their relation with the cartesian coordinate system.
10. Find the formulas for cylindrical coordinates in terms of cartesian coordinate system.
11. Explain the method to find the solutions of a first order exact differential equation.
12. What is the geometrical meaning of a first order differential equation of the form $y' = f(x,y)$?
13. What is the square root rule for a counting experiment ?
14. What are mean and standard deviation in a measurement ? Briefly explain its importance. (6×2=12)

SECTION – C

Answer **any 4** questions. **Each** question carries **3** marks.

15. Find the angle between the body diagonals of a cube.

16. Check the product rule $\vec{\nabla} \cdot (\vec{A} \times \vec{B}) = \vec{B} \cdot (\vec{\nabla} \times \vec{A}) - \vec{A} \cdot (\vec{\nabla} \times \vec{B})$ for the functions

$$\vec{A} = 2x\hat{i} + 3y\hat{j} + z\hat{k} \quad \text{and} \quad \vec{B} = y\hat{i} - 3x\hat{j}.$$

17. Compute the gradient and Laplacian of the function $F = (\cos\theta \cos\phi + \sin\theta)$.

18. Making use of spherical polar coordinate system, find the volume of a sphere of radius R.

19. The efficiency of engines of airplanes depends on air pressure and usually is maximum near about 35000 ft. Find the air pressure $y(x)$ at this height. $y'(x)$ is proportional to the pressure. At 18000 ft it is half its value $y_0 = y(0)$ at sea level.

20. Students A and B measure the activity of a radioactive sample by counting the alpha particles it emits. A watches for 3 minutes and count 28 particles whereas B watches for 30 minutes and count 310 particles.

a) What should student A report for the average number emitted in 3 minutes with her uncertainty ?

b) What should student B report for the average number emitted in 30 minutes with her uncertainty ?

c) What are the fractional uncertainties in the 2 measurements ?

(4×3=12)

SECTION – D

Answer **any 2** questions. **Each** question carries **5** marks.

21. a) Briefly explain a method to solve a second order homogeneous linear differential equations with constant coefficients.

b) Find the solution for $y'' - 4y' + 4y = 0$, $y(0) = 3$, and $y'(0) = 1$.

22. What is meant by the rules for the error propagation ? Briefly explain the rules for error propagation.

23. Set up a model for analyzing the free oscillations of a mass-spring system. Find the solutions for both damped and undamped cases.

24. a) Prove that the two dimensional rotation matrix preserves dot product.

b) Find the transformation matrix that describes a rotation by 120 deg. about an axis from the origin through the point (1,1,1). The rotation is clockwise as you look down the axis toward the origin.

(2×5=10)