Reg. No. : ....

Name : ....

Second Semester B.Sc. Degree (CBCSS – OBE-Regular/Supplementary/ Improvement) Examination, April 2024
(2019 Admission Onwards)
CORE COURSE IN PHYSICS
2B02 PHY : Mathematical Physics and Error Analysis

Time : 3 Hours

Max. Marks : 40

PART – A

Short answer type. **Each** carries **1** mark. Answer **all** questions.

1. Define gradient of a scalar function. What is its physical significance ?

2. What is the resultant of two vectors $\vec{A}$ and $\vec{B}$ acting at an angle θ ?

3. What are the limiting values of r, θ, φ in spherical polar co-ordinates ?

4. Give an example of first order differential equation.

5. Explain the uncertainty in q where q = x + y – u.

6. What are systematic errors ? **(6×1=6)**

PART – B

Short essay questions. **Each** carries **2** marks. Answer **any 6** questions.

7. How are the errors propagated in the measurement of difference of two quantities ?

8. A student measures the acceleration due to the gravity, five times with the results (all the results in m/s^2) 9.9, 9.8, 9.7, 9.6 and 9.5. Find the mean of the readings.

9. State the Gauss's divergence theorem.

10. Differentiate between irrotational and solenoidal field.

11. Show that vectors $\vec{A} = 2\hat{i} - 3\hat{j} + 4\hat{k}$ and $\vec{B} = 6\hat{i} + 9\hat{j} - 12\hat{k}$ are parallel to each other.

12. Solve the equation :

    $$\frac{dy}{dx} = \frac{y}{x} + x\sin\frac{y}{x}.$$

13. Obtain relations for volume element in curvilinear co-ordinate systems.

14. Two resistances $R_1 = (150 \pm 2)\ \Omega$, $R_2 = (250 \pm 3)\ \Omega$, are connected in series. What is their equivalent resistance ? **(6×2=12)**

PART – C

Short Essay/Problem. **Each** carries **3** marks. Answer **any 4** questions.

15. The resultant of two vectors P and Q is R. On reversing the direction of Q, the resultant becomes S. Prove that $R^2 + S^2 = 2(P^2 + Q^2)$.

16. Find the gradient of the function $f(x, y, z) = x^2 + y^3 + z^4$.

17. Obtain gradient, divergence, curl in curvilinear co-ordinates.

18. Solve $(x + 1)\dfrac{dy}{dx} - y = e^x(x + 1)^2$.

19. A physical quantity x is given by $x = \dfrac{a^3 b^2}{c\sqrt{d}}$. If the percentage errors of measurement in a, b, c and d are 4%, 2%, 3% and 1% respectively then calculate the percentage error in the calculation of x.

20. The length and breadth of a rectangle are (8.7 ± 0.1) cm and (5.4 ± 0.2) cm respectively. Calculate the area and perimeter of the rectangle with error limits. **(4×3=12)**

PART – D

Long essay type. **Each** carries **5** marks. Answer **any 2** questions.

21. Define divergence of a vector field. Mention it geometrical interpretation.
    If $\vec{A} = 3x^2\hat{i} + 5xy^2\hat{j} + xyz^2\hat{k}$ find $\nabla \cdot A$ at the point (1, 2, 3).

22. Define curvilinear coordinates system and derive the expression for gradient operator, divergence, and curl in spherical polar coordinates.

23. Let Δx and Δy are the errors associated with variable x and y. Find the propagated error associated with variable z, Δz, for (i) z = ax + by, (ii) z = xy, (iii) z = x/y and (iv) z = x^c, where a, b, c are constants.

24. Solve $\tan y \dfrac{dy}{dx} + \tan x = \cos y \cos^2 x$.   **(2×5=10)**

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