

UG (Sem-I) Examination- 2023
(Session- 2023-27)
PHYSICS
MIC-1
MODEL QUESTION PAPER

TIME: 3 Hrs.

FULL MARKS: 70

Candidates are required to give their answers in their own words as far as practicable.

The figure in the margin indicates full marks.

Answer from all the Groups as directed. Group - A is compulsory.

Group-A

1. Choose the correct answer of the following questions : (10×2 = 20)
- A.** Find $\text{div}(f)$ if $f = 2xi + 5yj - 3k$:
- i) 0
 - ii) 7
 - iii) 3
 - iv) 1
- B.** If F is a scalar point function, the value of $\text{curl grad } F$ is :
- i) 0
 - ii) 1
 - iii) 2
 - iv) None of the above
- C.** The order and degree of the differential equation $\left[1 + \left(\frac{dy}{dx}\right)^3\right]^2 = \frac{d^2y}{d^2x}$ is :
- i) 1,2
 - ii) 2,5
 - iii) 2,1
 - iv) 3,2
- D.** The general solution of differential equation $(xy \frac{dy}{dx} - 1) = 0$ is :
- i) $xy = \log x + c$
 - ii) $\frac{x^2}{2} = \log y + c$
 - iii) $\frac{y^2}{2} = \log x + c$
 - iv) none of the above
- E.** A unique idea that was considered in the special theory of relativity was :
- i) The time period of any event in every frame of reference will be the same.
 - ii) Speed of light is constant for all frames of reference.
 - iii) For observers, all laws related to physical phenomenon are different in different frames of reference.
 - iv) None of the above
- F.** Which of the following statement is not correct for Coriolis force:
- i) It is maximum at the pole.
 - ii) It is absent at the equator.
 - iii) It deflects the wind to the right direction in Southern hemisphere.
 - iv) It deflects the wind to the right direction in Northern hemisphere.

G. Special theory of relativity deals with :

- i) Rotational frame of reference
- ii) Space-time curvature
- iii) Inertial frame of reference
- iv) Singularity

H. In physics, frame of references are classified by :

- i) Real and imaginary
- ii) Real and non-inertial
- iii) Non-inertial and inertial
- iv) Imaginary and frictional

I. Curl of a gradient of any scalar function is :

- i) Unity
- ii) Infinity
- iii) Zero
- iv) A unit vector

J. The divergence of the vector $V = 3xz\mathbf{i} + 2xy\mathbf{j} - yz^2\mathbf{k}$ at point (1,1,1) is :

- i) 7
- ii) 4
- iii) 3
- iv) 0

Group-B

(4×5 = 20)

2. Find out $\nabla^2\Phi$, if $\Phi = 2x^3y^2z^4$.
3. Show that $\text{div curl } \mathbf{f} = 0$, where \mathbf{f} is a vector function.
4. Solve the given differential equation:

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

5. The vectors $\mathbf{i}+2\mathbf{j}+3\mathbf{k}$, $-3\mathbf{i}+2\mathbf{k}-\mathbf{j}$, and $2\mathbf{i}-5\mathbf{k}$ represent the edges of a parallelepiped, obtain its volume.
6. State the postulates of the special theory of relativity.
7. What do you mean by a non-inertial frame of reference? And what is fictitious force & why it is called so?

Group-C

(3×10 = 30)

8. Obtain the values of (i) $\text{div}(\mathbf{r})$, (ii) $\text{curl}(\mathbf{r})$ and (iii) $\nabla^2(r^n\mathbf{r})$, where $\mathbf{r} = x\mathbf{i} + y\mathbf{j} + z\mathbf{k}$.
9. Solve :
$$\sin x \frac{dy}{dx} + 2y = \tan^3\left(\frac{x}{2}\right).$$
10. What is Coriolis forces? Under what conditions does it come into play? Discuss in general terms the effect of the Coriolis force produced as a result of the earth's rotation.
11. Derive the Lorentz transformation equation. Deduce the time dilation result using Lorentz transformation.
12. Describe the Michelson-Morley experiment and explain the physical significance of the negative results.