

TDC Odd Semester Exam., 2020
held in July, 2021

PHYSICS

(Pass)

(1st Semester)

Course No. : PHSP-101

(Mathematical Physics, Mechanics and General
Properties of Matter)

Full Marks : 35

Pass Marks : 12

Time : 2 hours

The figures in the margin indicate full marks
for the questions

Answer **five** questions, taking **one** from each Unit

UNIT—I

1. (a) Find $\vec{A} \times (\vec{B} \times \vec{C})$ for the following vectors
 \vec{A} , \vec{B} and \vec{C} : 4

$$\vec{A} = 2\hat{i} - \hat{j} + 3\hat{k}$$

$$\vec{B} = -3\hat{i} + 2\hat{j} - \hat{k}$$

$$\vec{C} = -5\hat{i} - 3\hat{j} - 2\hat{k}$$

- (b) Find the angle between the two vectors
 \vec{A} and \vec{B} , where

$$\vec{A} = 2\hat{i} + 2\hat{j} - \hat{k}$$

$$\vec{B} = 4\hat{i} - 3\hat{j}$$

3

2. (a) Give the physical meaning of gradient,
divergence and curl. 3

- (b) Find the divergence and curl of the
vector \vec{A} given by

$$\vec{A} = 3x^2yz\hat{i} + \sin(z^2)\hat{j} + cy^2\hat{k}$$

4

UNIT—II

3. (a) For the two matrices A and B

$$A = \begin{bmatrix} 1 & 3 \\ 4 & -2 \end{bmatrix} \text{ and } B = \begin{bmatrix} -2 & 1 \\ 3 & 4 \end{bmatrix}$$

prove that $AB \neq BA$. 3

- (b) Find the inverse of the matrix A

$$A = \begin{bmatrix} 1 & 4 & 3 \\ 2 & 1 & 2 \\ 3 & 0 & 5 \end{bmatrix}$$

4

(3)

4. (a) Give the definitions of an identity matrix, a skew-symmetric matrix and an orthogonal matrix. 3
- (b) Prove that any matrix A can be written as the sum of a symmetric matrix and a skew-symmetric matrix. 4

UNIT—III

5. (a) State the theorem of moment of inertia for parallel axes. 2
- (b) Find the moment of inertia of a thin uniform rod about an axis passing through its centre and perpendicular to its length. 3
- (c) Hence, apply the theorem of parallel axes to find its moment of inertia about an axis passing through one end of the rod and perpendicular to its axis. 2
6. (a) What do you mean by Lissajous figures? Also, investigate the conditions under which a circle and an ellipse are obtained. 3
- (b) Describe how you will measure g using a bar pendulum. 4

(4)

UNIT—IV

7. (a) A solid cylindrical wire is fixed at one end, and is twisted by the application of a torque at the other end. Find an expression for the torque per unit twist if L , r and η are the length, radius and rigidity modulus of the wire. 4
- (b) What is a torsional pendulum? Find an expression for the time period of a torsional pendulum of moment of inertia, I and restoring torque per unit twist, C . 3
8. (a) Find the excess pressure inside a spherical liquid bubble of surface tension T and radius r . 3
- (b) Calculate the work done in spraying a drop of mercury of radius 1 cm into 10^6 droplets of equal size. Surface tension of mercury is $487 \text{ dynes.cm}^{-1}$. 4

UNIT—V

9. (a) What is the purpose of carrying out the Michelson-Morley experiment? Describe the result of the experiment. 4
- (b) Prove that for small velocities, the Lorentz transformation equations reduce to the Galilean transformation equations. 3

(5)

10. (a) What is time dilation? Show that

$$T = \frac{T_0}{\sqrt{1 - \frac{v^2}{c^2}}}$$

where T_0 is the time measured in rest frame, T is the time measured in a frame moving with a velocity v and c is the velocity of light. 1+4=5

- (b) Find the energy equivalent of 1 amu in units of MeV. 2
