



বিদ্যাসাগর বিশ্ববিদ্যালয়  
**VIDYASAGAR UNIVERSITY**  
**Question Paper**

**B.Sc. Honours Examinations 2020**

(Under CBCS Pattern)

**Semester - I**

**Subject: PHYSICS**

**Paper : C 2-T & C 2-P**

**(Mechanics)**

**Full Marks : 60 (Theory-40 + Practical-20)**

**Time : 3 Hours**

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

*The figures in the margin indicate full marks.*

**C 2 - T**

Full Marks : 40

Answer any *two* questions :

2 × 20 = 40

1. (a) The magnitude of  $\vec{r} \times \frac{d\vec{r}}{dt}$  is equal to twice the area swept out by the radius vector in unit time. Prove it.
- (b) A particle is moving in a straight line with simple harmonic motion. Its velocity has the values 5 ft/s and 4 ft/s, when its distances from the centre point of its motions are 2 ft and 3 ft respectively. Find the length of its path, the frequency of its oscillation, and the phase of its motion, when it is at a distance of 4 ft from the centre.

6+4

(c) A particle moves in a three dimensional space and at any time the particle is located at  $P(r, \theta, \phi)$  point. Prove that the

(i) Velocity of the particle  $\vec{V} = \dot{r}\hat{r} + r\dot{\theta}\hat{\theta} + r\sin\theta\dot{\phi}\hat{\phi}$  and

(ii) Acceleration

$$\vec{a} = (\ddot{r} - r\dot{\theta}^2 - r\dot{\phi}^2 \sin^2 \theta)\hat{r} + (2\dot{r}\dot{\theta} + r\ddot{\theta} - r\sin\theta\cos\theta\dot{\phi}^2)\hat{\theta} + (2\dot{r}\dot{\phi}\sin\theta + 2r\cos\theta\dot{\theta}\dot{\phi} + r\sin\theta\ddot{\phi})\hat{\phi}$$

6+4+(4+6)

2. (a) Draw the schematic diagram of Michelson-Morley Experimental setup and define used apparatus. Write the basic principle and outcome of the experiment.

(b) Write the postulates of special theory of relativity and basic concept of non-inertial frame.

(c) Find an expression for the gravitational potential due to a thin spherical shell at a point outside the shell.

(d) Prove the parallel and perpendicular axes theorem on momentum of inertia

5+5+5+5

3. (i) Find the position of the centre of mass of a uniform semi circular disc.

(ii) Find the coriolis deflection of a bullet fired towards north at a velocity 400 m/s after 10 second of firing. The latitude of the gun-man is  $45^\circ N$ .

(iii) Show that the potential of central force is spherically symmetric.

(iv) Show for a system of particles :  $\vec{N} = \frac{d\vec{L}}{dt}$  where  $\vec{N}$  is total external torque and  $\vec{L}$  is total angular momentum.

5+5+5+5

4. (a) Write the Poiseuille's equation for flow of a liquid through a capillary tube.

(b) Show that the volume of Poisson's ratio,  $\sigma$ , can't be greater than 0.5.

(c) Show that the angular momentum of a particle moving under central force is conserved.

(d) Write the equation of simple harmonic motion in damping medium.

(e) What is Doppler Effect ?

(f) Write the Lorentz transformation of a moving particle with speed  $c/2$ ;  $c$  is the velocity of light in vacuum.

(g) If a vector  $\vec{A}$  of constant magnitude rotates with angular velocity  $\vec{\omega}$ , then show

$$\text{that } \frac{d\vec{A}}{dt} = \vec{\omega} \times \vec{A} \qquad 2+3+3+3+2+3+4$$

**Paper - C-2-P**

**(Mechanics)**

**(Practical)**

Full Marks : 20

Answer any **one** question from the following :

$1 \times 20 = 20$

1. Determine the acceleration due to gravity ( $g$ ) using bar pendulum -

- (a) Write down the working formula explaining each term and draw a schematic diagram.
- (b) Briefly explain the process of data collection
- (c) Draw the theoretical variation of time period ( $T$ ) with the distance  $d$  of knife edges from one fixed end.
- (d) Deduce the formula for maximum proportional error and comment.

2. Determine the elastic Constants of a wire by Searle's method

- (a) Write down the working formula explaining each term
- (b) Briefly explain the process of data collection
- (c) Draw the theoretical graph for mass ( $m$ ) versus elongation ( $l$ ) and explain
- (d) Deduce the formula for maximum proportional error
- (e) Explain the main sources of error in this experiment

3. Determine the coefficient of viscosity of water by capillary flow method.
- (a) Write down the working formula explaining each term
  - (b) Give the tables for measurement of each measurable parameter
  - (c) Briefly write the experimental procedure.
  - (d) Derive the formula of proportional error.
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