

11. Discuss the dependence of viscosity of liquids and gases on temperature and pressure.
12. Explain fully the significance of transient beats in forced vibration.
13. State Young-Helmholtz law for plucked string and struck string.
14. Compare the rate of flow of a liquid through two capillary tubes having radii of cross section in the ratio 2 : 1 and pressure difference at the two ends in the ratio 1 : 2.
15. Write down the features of shock wave.
16. What is the effect of damping force on amplitude and frequency?
17. What is Newtonian and non-Newtonian liquid?
18. Distinguish between torsional rigidity and flexural rigidity.

Total Pages : 4

**End Semester Examination of Semester-I, 2015**

**Subject : PHYSICS (HONS) (UG)**

**Paper : IA (Theory)**

**Full Marks : 40**

**Time : 2 Hrs**

*The figures in the margin indicate the marks corresponding to the question.*

*Candidates are requested to give their answers in their own word as far as practicable.*

*Illustrate the answers wherever necessary.*

**Group A**

Answer any two out of four questions : 10x2=20

1. a) Using Stoke's theorem prove that

$$\oint_c \phi \, d\vec{r} = \iint_s d\vec{s} \times \nabla \phi$$

Where  $\phi$  is a scalar function of  $\vec{r}$ ,  $s$  is an open surface bounded by a closed curve. 5

- b) Verify Green's theorem in the plane for

$$\oint_c [(xy - x^2)dx + x^2ydy], \text{ where } C \text{ is the closed curve}$$

of the triangle bounded by the lines  $y = 0$ ,  $x = 1$  and  $y = x$ . 5

( 2 )

2. a) If  $u\vec{F} = \nabla v$  where  $u, v$  are scalar fields and  $\vec{F}$  is a vector field, show that  $\vec{F} \cdot \text{curl } \vec{F} = 0$ . 3
- b) Find the work done in moving a particle in the force field  $\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$  along the straight line from  $(0, 0, 0)$  to  $(2, 1, 3)$ . 5
- c) Define analytic function with example. 2
3. a) Deduce the working formula of determination of Young's modulus of a weightless beam having rectangular cross-section by Flexure method. 6
- b) Prove that if a number of rods are joined end to end, the torsional rigidity of the combination is given by  $\tau$   
where  $\frac{1}{\tau} = \frac{1}{\tau_1} + \frac{1}{\tau_2} + \frac{1}{\tau_3} + \dots$   
(Symbols having relevant meaning). 4
4. a) Establish a general differential equation of wave motion in an isotropic elastic medium. Show that the velocity of propagation solely depends on density and appropriate elastic constant of this medium. 5
- b) Explain group velocity and phase velocity. Find the relation between them. 5

( 3 )

**Group B**

Answer any two out of four questions : 5x2=10

5. Solve  $\frac{\partial u}{\partial x} = 4 \frac{\partial u}{\partial y}$  given  $u(0, y) = 8e^{-3y}$  by method of separation of variables. 5
6. Deduce Poiseuille's equation for incompressible fluid flowing through a narrow horizontal capillary tube. 5
7. Prove  $\int_{-1}^{+1} P_m(x) P_n(x) dx = 0$  [ $m \neq n$ ]  
 $= \frac{2}{2l+1}$  [ $m = n$ ]  
where  $P_m(x)$  and  $P_n(x)$  are Legendre polynomials of order  $m$  and  $n$  respectively. 5
8. Show that the expression of the energy density of a progressive wave is given by  $2\rho\pi^2 v^2 a^2$  where  $\rho$  is the density of the medium,  $v$  and  $a$  are the frequency and amplitude of the wave respectively.

**Group C**

Answer any five out of 10 questions : 2x5=10

9. Write the physical significance of curl of a vector field.
10. Prove  ${}^{2n}H_{n-1}(x) = H_n'(x)$  symbols have their usual meaning.