53 (PH 101) ENPH

2017

ENGINEERING PHYSICS

Paper : PH-101

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

Answer ***any five*** *questions.*

1. *(a)* State Gauss divergence theorem. 5

(b) Find the gradient of $r=\left(x^2+y^2+z^2\right)^{1/2}$. 5

(c) Show that the curl of the velocity vector of a rotating body equals twice the angular velocity of the body. 5

(d) Evaluate $\iint_S (y^2 z\hat{i} + y^3\hat{j} + xz\hat{k}).d\vec{a}$, where '$S$' is the boundary of a cube defined by $-1 \le x \le 1$, $-1 \le y \le 1$, and $-1 \le z \le 1$. 5

2. (a) Establish the relation between the three elastic constants. 5

(b) Distinguish between Streamline flow, Laminar flow and Turbulent flow. Write the expressions for Terminal velocity and Reynold number. 5

(c) A large artery in a dog has an inner radius of $4 \times 10^{-3} m$. Blood flows through the artery at the rate of $1{\cdot}0 \times 10^{-6} m^3 s^{-1}$. The blood has a viscosity of $2{\cdot}084 \times 10^{-3} Pa.s$ and a density of $1{\cdot}06 \times 10^3 kg.m^{-3}$. Calculate *(i)* the average blood velocity in the artery and *(ii)* the pressure drop in a $0{\cdot}1 m$ segment of the artery. 5

(d) Obtain the relation between torque and angular momentum. 5

3. (a) Define Simple harmonic motion (SHM). What are the characteristics of simple harmonic motion ? With the help of energy-displacement curve verify the law of conservation of total energy for a body executing simple harmonic motion. 5

(b) Show that in simple harmonic motion, the acceleration of the moving body is directly proportional to the displacement at the given instant. 5

(c) What type of forces causes a body to execute simple harmonic motion ? At what condition is the force maximum or minimum ? The force acting on a body executing simple harmonic motion is $5N$, when it is $5cm$ away from the mean position.Find the force constant. 5

(d) A particle executes simple harmonic motion with amplitude '*A*'. At what distance from the mean position its kinetic energy is equal to its potential energy ? 5

4. (a) State and explain Gauss's law. Using Gauss's law derive an expression for electric field intensity at any point inside a uniformly charged sphere. 7

(b) Write down the Poisson's equation and give its physical interpretation. 3

(c) In an LCR series circuit the values of respective circuit elements are $R = 200\Omega$, $X_C = 150\Omega$, $X_L = 80\Omega$ and the frequency of the ac cycle is $f = 60Hz$. Determine the phase difference between current and voltage. Also find the power factor of the circuit. 5

(d) State and explain Ampere's circuital law. Using above theorem derive an expression for magnetic field at a point due to infinitely straight current carrying conductor. 5

5. (a) Write down the Maxwell's relation in differential as well as integral form in free space. 5

(b) Distinguish between dia-para and ferromagnetic materials. 5

(c) Derive Maxwell's electromagnetic equation in free space in terms of $\vec{E}$ & $\vec{B}$ vector. Also verify that light is an electro magnetic radiation. 5

(d) In free space verify the transverse nature of Maxwell's electromagnetic wave. 5

6. (a) Write the difference between damped vibration and forced vibration. 5

(b) Derive the differential equation for progressive wave. 5

(c) What do you mean by resonance of wave ? Discuss the relation between sharpness of resonance and quality factor. 5

(d) The displacement of a wave is given by

$$y = 0{\cdot}25 \times 10^{-3} \sin(500t - 0{\cdot}025x)$$

Determine 5

(i) the amplitude

(ii) the time period

(iii) the angular frequency

(iv) the particle velocity.

7. (a) What is LASER ? Write down the basic characteristics of laser radiation. 5

(b) Describe the principle of laser action. Discuss population inversion and pumping mechanism. 7

(c) What is aberration in lenses ? Write down the spherical and chromatic aberration. 8

8. (a) Write down the first and second law of thermodynamics. 5

(b) What is Carnot engine ? Write Carnot theorem. 5

(c) What is the difference between adiabatic and isothermal changes ? 5

(d) A black body of 27°C surrounds another at (-73°C). Calculate the net heat transferred per square meter of the body at higher temperature. 5