53 (PH 101) ENPH

2016

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)* What is Stoke's and Green's theorem ? 5

(b) Compute the curl of the following vector functions 6

(i) $V_a = -y\hat{x} + x\hat{y}$

(ii) $V_b = \left[e^x \cos y,\ e^x \sin y, 0\right]$

(c) Write a note on line, surface and volume integral. 4

(d) Calculate the divergence of the following functions 5

(i) $V_a = x^2\hat{x} + 3xz^2\hat{y} + 2xz\hat{z}$

(ii) $V_b = xy\hat{x} + 2yz\hat{y} + 3zx\hat{z}$

2. (a) Describe the basic principle and operation of LASER and discuss population inversion. 5

(b) Write a note on induced absorption, spontaneous emission and induced emission for a LASER. 5

(c) Explain the spherical aberration. How this defect can be minimized in lenses ? 6

(d) A lens made of crown glass has focal length 50*cm*. Calculate the longitudinal aberration. Given $\mu_C = 1{\cdot}5206$ and $\mu_F = 1{\cdot}5249$ 4

3. *(a)* State Gauss's theorem and use it to show that the electric field near an infinite charge conducting surface is $\sigma/2\varepsilon_0$, where σ is the charge density. 6

(b) Derive the Poisson's and Laplace's equations from Gauss' theorem. 4

(c) A wire carrying a current of 100 amperes is bent into the form of a circle of radius 5·08*cm*. Calculate the magnetic field at the center of the coil. 5

(d) What is Faraday's law of electromagnetic induction. Derive the equation in differential and integral form. 5

4. *(a)* Write down the Maxwell's equations in differential and integral form and discuss their significance. 6

(b) Show that electromagnetic wave are transverse in nature. Calculate the velocity in free space. 7

(c) What is paramagnetic material ? Discuss the spontaneous and saturation magnetization while discussing the Curie temperature of a ferromagnet. 7

5. (a) What is angular momentum ? State the direction of it in rotational motion. 3

(b) How does angular momentum differ from linear momentum ? 4

(c) Write a short note on general motion of a rigid body. 7

(d) An electron of mass $9\times10^{-31}kg$ revolves in a circle of radius of $0{\cdot}53A^{\circ}$ around the nucleus of hydrogen atom with a velocity of $2{\cdot}2\times10^{6}ms^{-1}$. Find the angular momentum of the electron. 5

(e) An earth satellite is moving around the earth in a circular orbit. In such case, what physical quantity is conserved ? 1

6. (a) Explain elastic behaviour of a body. 3

(b) Derive an expression for the elastic potential energy of a wire under strain. 7

(c) Under what conditions Bernoulli's theorem can be used ? 3

(d) Derive Stokes' law of fluid. 4

(e) Water is conveyed through a horizontal tube of $0{\cdot}08m$ in diameter and $4km$ length at the rate of 20 *litres/sec.* Assuming only viscous resistance, calculate the pressure difference required to maintain the flow. $\left(\eta = 10^{-3} NSm^{-2}\right)$ 3

7. (a) Write the difference between damped vibration and forced vibration. 4

(b) Define the resonance, sharpness of resonance and quality factor. 6

(c) What is simple harmonic motion ? Give typical examples of SHM. 3

(d) Discuss the superposition of *two* linear simple harmonic motion. 7

8. (a) Define entropy in a thermodynamical process. Give its unit. 3

(b) Explain the working of the Otto cycle. 7

(c) Write a short note on pyrometer. 5

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