53 (PH 101) ENPH

2018

ENGINEERING PHYSICS

Paper : PH 101 (Back)

Full Marks : 100

Time : Three hours

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

*Answer **any five** questions.*

1. *(a)* Write the physical interpretation of the gradient of a scalar function. Distinguish between scalar and vector functions. 3+2=5

   (b) Find the gradient of the following functions :

   (i) $f(x,y,z) = x^2y^3z^4$. 2

   (ii) $f(x,y,z) = e^x \sin(y) \ln(z)$. 3

   (c) State and explain Stokes' theorem. 5

   (d) Prove that the divergence of a curl is always zero. 5

2. *(a)* Derive Bernoulli Equation. 10

(b) Write the definition of three elastic constants. 6

(c) What do you mean by Terminal velocity and Reynold number ? 4

3. *(a)* Write down Maxwell's equations both in differential and integral forms. 8

(b) Write short notes on : 12

(i) Displacement current

(ii) Hysteresis and

(iii) Faraday's law of electromagnetic induction.

4. *(a)* Explain Dia-, Para- and Ferromagnetism with suitable examples. 8

(b) An RLC series circuit has $R = 160\,\Omega$, $X_L = 87\,\Omega$, $X_C = 177\,\Omega$, $f = 60\,Hz$ and $\varepsilon_m = 36\,V$. Find — 6

(a) the impedance z for the circuit

(b) the current amplitude i_m and

(c) the phase constant ϕ.

(c) Write the mathematical vector form of the following :

(i) Biot-Savart law. 2

(ii) Gauss's theorem. 2

(iii) Ampere's law 2

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

(b) What is population inversion and pumping mechanism in LASER ? Write a short note. 7

(c) What is the difference between spontaneous and stimulated emission ? 5

6. (a) What is Carnot engine ? Explain with details about Carnot Cycle. 8

(b) A system is undergoing through adiabatic and isothermal changes. Explain this process with diagram. 7

(c) An ideal gas heat engine operates in Carnot Cycle between $227°C$ and $127°C$. It absorbs 6×10^2 *cal* of heat at higher temperature. Calculate the amount of heat supplied to the engine from the source in each cycle. 5

7. *(a)* Write the differential equation of SHM and write expressions for the velocity and acceleration of a particle in SHM. At what points are the quantities zero and maximum ? 5+2

(b) 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

(c) Discuss the superposition of two linear simple harmonic motions with same frequency ω and phase ϕ and hence illustrate special cases. 8

8. *(a)* What do you mean by damping ? How is it related to Q-factor ? 7

(b) Derive the differential equation for progressive wave. 6

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