Total number of printed pages: **Programme (UG)/Semester-I/Paper Code:UPH101**

2022

ENGINEERING PHYSICS

Full Marks: 100

Time: THREE hours

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

*Answer **Any Five***

Multiple Choice Questions 2 x 10=20

1. i. A vector field is said to be solenoidal if its---------- vanishes.
   a. div
   b. curl
   c. grad
   d. None of these

   ii. Divergence of a Curl is always----------
   a. 1.
   b. -1
   c. 0.
   d. None of above

   iii. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled and charge becomes half, then the outward flux will ----------
   a. be doubled.
   b. increase by four times.
   c. Be reduced to half.
   d. Remain the same.

   iv. Which of the following cannot be computed using Biot Savart law?
   a. Magnetic field intensity
   b. Magnetic flux density
   c. Electric field intensity
   d. Permeability

   v. The First Law of Thermodynamics states that

a. we cannot get as much out of a process as we put in.

b. we can get more out of a process than we put in.

c. we can get out of a process exactly what we put in.

d. work and temperature are the same thing.

vi. When compared to a Carnot engine operating between the same two temperatures, real engines are

a. more efficient.

b. Less efficient.

c. hotter

d. colder

vii. If damping coefficient of the medium is 0.2 s^{-1} then its amplitude relaxation time is

a. 10 s

b. 20 s

c. 30 s

d. 5 s

viii If work function of the material is 2 eV then its threshold frequency is close to

a. $2x10^{16}$ Hz

b. $5x10^{16}$ Hz

c. $5x10^{15}$ Hz

d. None of the above.

ix. Constructive interference between waves from two sources occurs when the path difference is

a. λ

b. $\lambda/2$

c. 2λ

d. 3λ

x What is the need to achieve population inversion?

a. To excite most of the atoms

b. To bring most of the atoms to ground state

c. To achieve stable condition

d. To reduce the time of production of laser

2.	a.	Find the gradients of the function: (i) $f(x,y,z) = x^2 + y^3 + z^4$ (ii) Prove that, $\vec{\nabla} r^n = n r^{n-1} \hat{r}$	2x5
	b.	If 'V' and 'F' are respectively scalar and vector, then find the value of the following vector identities. (i) $\vec{\nabla} \times (\vec{\nabla V})$ (ii) $\vec{\nabla}.(\vec{\nabla} X \vec{F})$	05+05
3.	a.	(a) A 3.0-kg object attached to a spring oscillates with amplitude of 4.0 cm and a period of 2.0 s. (a) What is the total energy? (b) What is the maximum speed of the object? (c) At what position x_1 is the speed equal to half its maximum value?	07
	b.	Write the differential equation for a damped harmonic oscillator and explain its each term. Write the general solution of the equation. Discuss with neat diagrams the three damping conditions.	10
	c.	What is meant by simple harmonic oscillation? Explain with an example.	03
4.	a.	Write down the Maxwell's equations in differential and integral form and discuss their physical significance.	10
	b.	(i) Derive electromagnetic wave equation in free space in terms of E and B. (ii) State and explain 1st and 2nd law of thermodynamics.	05+05
5.	a.	What is Photoelectric effect? What are the experimental observations on it?	05
	b.	X rays are scattered from a carbon target. The scattered radiation is viewed at 90 degree to the incident beam. Compute the Compton shift $\Delta\lambda$. Take mass of the electron is 9.11×10^{31} kg and $h = 6.63 \times 10^{-34}$ J.s.	05
	c.	Establish Schrodinger's time independent equation in one dimension for particle moving in a potential V(x).	10
6.	a.	Discuss the experimental setup for Newton's ring and derive the expression for diameter of dark and bright rings.	10
	b.	Discuss the diffraction at a single slit and the intensity distribution pattern.	05
	c.	If diameter of 9^{th} and 16^{th} dark rings are 0.25mm and 0.45mm respectively find the wavelength of light used if radius of curvature of plano-convex lens is 70 cm.	05
7.	a.	What is the basic difference between Fresnel and Fraunhofer diffraction	05
	b.	Write down the basic characteristics of LASER radiations.	05
	c.	Write and discuss the components of LASER system.	10