JULY 2023

APPLIED PHYSICS-II

Time Allowed: 2.5 Hours *Full Marks: 60*

Answer to Question No. 1 is compulsory and Answer any Five (05) Questions from the rest.

1. Answer the following questions (any five): 3x5

   i. In which position the velocity of a particle executing SHM is maximum? Explain.

   ii. On what factors does the focal length of a lens depend?

   iii. Is the electric potential necessarily be zero at a point where the electric field strength is zero? Explain.

   iv. What are the differences between Peltier effect and Joule effect?

   v. A wire cuts across a flux of 0.002 Weber in 0.12 seconds. What is the emf induced in the wire?

   vi. Write down the basic principle of operation of a solar photo voltaic cell.

   vii. What are the unique properties of LASER?

   viii. Mention three uses of nanotechnology.

2. (a) The equation of a particle vibrating in SHM is $y = 5 \sin 2\pi/5(10t+x)$, where y and x are in m and t is in s. Find out the frequency and amplitude of vibration.
   (b) Write down a few differences between Oscillatory and Periodic motion.
   (c) What is ultrasonic wave? Write down the properties and applications of it. 2+3+(1+3)

3. (a) A lens is composed of different layers made of two different materials. A point object is placed on the axis. How many images of the object will be formed and why?
   (b) Calculate the speed of light in a medium whose critical angle is 45°.
   (c) Draw a ray diagram to show image formation when the convex lens produces a real, inverted and magnified image of the object. .
   (d) Write two features to distinguish between the interference patterns in Young's double slit experiment with the diffraction pattern obtained due to a single slit. 3+2+2+2

4. (a) Compare conductor, semiconductor and insulator in terms of energy band diagram.
   (b) A student wants to use two p-n junction diodes to convert alternating current into direct current. Draw the labelled circuit diagram he/she would use and explain it.
   (c) Draw the typical input and output characteristics of an n-p-n transistor in CE configuration. Show how these characteristics can be used to determine (i) the input resistance (r_i), and (ii) current amplification factor (β). 3+(2+1)+3

5. (a) State Lenz's law. Does it obey the principle of conservation of energy?
   (b) Deduce an expression for the magnitude of the magnetic field at the centre of a circular coil of N turns.
   (c) A straight wire carrying current of 12A is bent into a semi-circular arc of radius 0.02m. Find the magnitude of the magnetic field at the centre of the arc. (2+2)+2+3

6. (a) State Biot-Savart law and express this law in the vector form.
(b) An electron travelling with velocity 30 cms^{-1} enters a region of uniform magnetic field 0.2T, acting perpendicular to its paths. Calculate the magnitude of force on the electron, (charge of electron = 1.6×10^{-19}C).
(b) State and explain Lenz's law.
(d) A galvanometer of resistance 100Ω gives full scale deflection when a current of 500μA passes through it. How can this be converted to a voltmeter reading up to 5V? Draw necessary circuit diagram. (2+1)+2+2+2

7. (a) What are the differences between intrinsic and extrinsic semiconductors ?
(b) Calculate the tube voltage required to be applied to an X-ray tube to get minimum wavelength 1Å. (Planck's constant h = 6.626×10^{-34} J.s)
(c) Define population inversion. Discuss some method to achieve population inversion. 3+2+(1+3)

8. (a) Draw the curve showing the variation of intensity with wavelength of X-rays and mark cut off wavelength, continuous & characteristic X-rays. Write down two important applications of X-rays.
(b) Draw the energy level diagram of He-Ne Laser.
(c) State some advantages of optical fibre over conducting wire. (3+2)+2+2