November 2022 202(N)

APPLIED PHYSICS - II

Time Allowed: 2.5 Hours *FullMarks:60*

Answer the following questions from Group A, B & C as directed

GROUP - A

1. Choose the correct answer (Any ten): 1x10 = 10

(i) The equation of a particle executing S.H.M. is $y = 5 \sin \frac{2\pi}{5}(10t + x)$. The frequency and amplitude of vibration is (a) 10, 5 (b) 5, 2 (c) 2, 5 (d) $\frac{5}{\pi}$, 5

(ii) If two progressive waves given by $y_1 = 6 \sin 250\pi t$ and $y_2 = 3\sin 256\pi t$ superpose, the number of beats formed per second is
(a) 3 (b) 5 (c) 6 (d) 8

(iii) The focal lengths of a convex lens for blue and yellow light are f_b and f_y respectively. The correct relation is
(a) $f_b = f_y$ (b) $f_b > f_y$ (c) $f_b < f_y$ (d) $f_b << f_y$

(iv) The speed of light in air is 3×10^8 ms^{-1}. Its speed in diamond of refractive index 2.4 is
(a) 3×10^8 ms^{-1} (b) 7.2×10^8 ms^{-1} (c) 1.25×10^8 ms^{-1} (d) none of these.

(v) If the current flowing through a circuit is 0.5 A in 5 mins, the amount of charge flowing through it is
(a) 216 C (b) 300 C (c) 150 C (d) 25 C

(vi) Specific resistance of the material of wire is $45 \times 10^{-8}\Omega$m. The length of the wire (radius 0.25 mm) required to make a resistance of 8 Ω is
(a) 5 m (b) 4.5 m (c) 3.5 m (d) 2.5 m

(vii) A Carbon resistor has three strips of red colour and a gold strip. What is the value of the resistor?
(a) $(200 \pm 5\%)\Omega$ (b) $(2000 \pm 5\%\ \Omega)$ (c) $(2200 \pm 5\%)\Omega$ (d) $(2220 \pm 5\%)\Omega$

(viii) The formula for the magnetic field well inside a long solenoid of length L & total number of turns N, carrying a current I is
(a) $\mu_0 NI/2$ (b) $\mu_0 NI/2L$ (c) $\mu_0 NI/L$ (d) None of these

ix) Lenz's law in electromagnetic induction is another form of the law of
(a) Conservation of energy (b) Conservation of charge (c) Conservation of mass (d) None of these

x) Which of the following does not exist?
(a) Static charge (b) Moving charge (c) Magnetic dipole (d) Magnetic monopole

xi) In transistor the base is doped
(a) heavily (b) moderately (c) lightly (d) randomly

xii) If the voltage of X-ray tube is doubled, the intensity of X-rays will become
(a) half (b) doubled (c) four times (d) unchanged

xiii) Which of the following is a unique property of laser?
(a) Low level of directionality b) Polychromatic c) High coherence (d) Low intensity

xiv) If I_{diff} and I_{drift} are the diffusion current and drift current in an unbiased p-n junction diode, then
(a) $I_{diff} = I_{drift}$ b) $I_{diff} > I_{drift}$ c) $I_{diff} >> I_{drift}$ d) $I_{diff} < I_{drift}$

xv) The energy of the first excited state of hydrogen atom is
a) – 13.6 eV b) – 3.4 eV c) -1.51 eV d) none of these

2. Fill in the blanks (Any ten): 1 x 10 = 10

i) The absorption coefficient of an open window is _____.

ii) In case of _____ wave, direction of vibration of the particles is perpendicular to the direction of propagation of the wave.

iii) Two or more light waves are said to be coherent if they are in same _____.

iv) For total internal reflection, light should travel from _____ medium to _____ medium.

v) The electric field inside a hollow charged sphere is _____.

vi) Keeping the charge same, if the capacitance of a capacitor is increased, the potential difference across it will _____.

vii) The equivalent resistance in parallel combination of three resistances 7Ω , 5Ω , 3Ω is _____.

viii) Seebeck effect is a _____ process

ix) The SI unit of magnetic flux density is _____.

x) In a moving coil galvanometer _____ is produced to rotate the pointer.

xi) Doping of Indium to silicon leads to _____ type semiconductor.

xii) X-rays are produced by hitting a target (heavy metal) with a stream of _____.

xiii) In the depletion region of a p-n junction, there is a shortage of _____ and _____.

xiv) A semiconductor has_____temperature coefficient of resistance.
xv) Staying time of atoms in metastable states is normally _____ seconds.

3. Answer the following questions in one or two sentences (Any ten): 1 x 10 = 10

i) If A & w are the amplitude and the angular frequency respectively of a particle in SHM, then write down the formula for the maximum acceleration of the particle.
ii) In which medium transverse wave cannot propagate?
iii) If a lens is immersed in water what will happen to its focal length?
iv) Which one of the core and cladding in an optical fiber has higher refractive index?
v) Find out the equivalent capacitance for two capacitors of capacitance 30μF and 50μF connected in series.
vi) If the voltage across a bulb is decreased by 1%, what will be the percentage change in its power?
vii) If a static charge is placed inside a magnetic field, will there be any force acting on it?
viii) Why induced emf is also called back emf?
ix) Among K_α and K_β X-ray which has higher energy?
x) Two parallel wires carry same current in same direction. What will happen?
xi) Which one of Silicon or Germanium has higher energy band gap?
xii) Which bias causes breakdown in p-n junction diode?
xiii) Which type of biasing gives a semiconductor diode very high resistance?
xiv) Name two types of pumping mechanism in laser production.
xv) Write the full form of CNT in respect to nanotechnology?

GROUP-B

4. Answer the following questions (Any six): 2 x 6 = 12

i) Will there be any change in critical angle if the colour of light is changed? Give reason.
ii) What happens to the capacitance of a capacitor when a dielectric slab is placed between its plates? Explain with relevant formula.
iii) Out of resistance (R) and specific resistance (ρ), which one is more fundamental and why?
iv) State the factors on which the thermo-emf developed in a thermocouple depends.
v) What are the measures to be taken to reduce the reverberation in a hall?
vi) Are Electromotive force and Potential Difference same for a cell? Explain.
vii) What will happen if a very high resistance, instead of a low resistance, is connected in parallel to a galvanometer to convert it into an ammeter?
viii) Draw the necessary circuit diagram for studying the forward bias characteristic curve (V – I curve) of a p-n junction diode.
ix) What are the different types of breakdown in p-n junction diode?
x) Describe briefly the phenomenon of Stimulated emission.

GROUP-C

5. Answer the following question (Any one of (i), (ii) & (iii)):

i)
a) What are damped and forced vibrations?
b) Determine the focal length of the lens of refractive index 1.7 when placed in air. The radii of curvature of the two spherical surfaces of the lens are 20cm and 35cm.
c) Write down the characteristics of simple harmonic motion. (2+2+2)

ii)
a) A particle executing S.H.M has a maximum displacement of 4 cm and its acceleration at a distance of 1.0 cm from its mean position is 3 cm/s^2. What will be its velocity when it is at a distance of 2cm from its mean position?
b) Indicate in ray diagram the kind of lens needed, the position of the object and the position of the image to obtain a magnified virtual image.
c) Define optical center of a lens with diagram. (2+2+2)

iii)
a) The equation of a progressive wave is given by $y = 5\sin(100\pi t - 0.4\pi x)$ where y and x are in m and t is in s. Find out the wavelength, frequency and velocity of the wave.
b) Write down the conditions for total internal reflection of light.
c) An object is placed at a certain distance from a convex lens of focal length 20 cm. Find the distance of the object if the image obtained is magnified 4 times. (2+2+2)

6. Answer the following question (Any one of (i), (ii) & (iii)):

i) a) Two point charges A and B, having charges +Q and -Q respectively, are placed at certain distance apart and force acting between them is F. If 25% charge of A is transferred to B, then what will be the force between them.

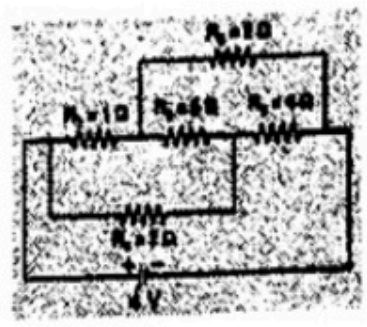
b) Prove that the energy stored in parallel plate capacitor is $\frac{1}{2}CV^2$.

c) Write the differences between Peltier Effect and Joule effect. (2+2+2)

ii)

a) What is an equipotential surface? Why work done in taking a charge from one point to another on such surfaces is zero?

b) Five resistances are connected to a cell of potential difference 4V as shown in the figure. Find the current drawn from the cell in the given network.



c) An electric heater of resistance 200 Ω connected to 220 V power supply is immersed in water of mass 1 kg. How long the electrical heater has to be switched on to increase the temperature of water from 30°C to 80°C. (The specific heat of water is s = 4200 J kg^{-1}) (1+1+2+2)

iii)

a) Define neutral temperature, inversion temperature in respect to thermo-emf. What is relation between them?

b) Calculate the voltage of a battery connected to a parallel plate capacitor with a plate area 2.0 cm^2 and a plate separation 2.0 mm if the charge stored on the plates is 4.0 pC.

c) What are meant by ohmic and non ohomic conductor? (1+1+1+2+1)

7. Answer the following question (Any one of (i), (ii) & (iii)):

i)

a) State Faraday's laws of electromagnetic induction.

b) Draw the circuit diagram of a full wave rectifier (Centre taped) using p-n junction diode and give its input and output wave forms. https://www.wbscteonline.com

c) Write one advantage and one disadvantage of solar cell. (2+2+2)

ii)

a) State Biot-Savart's law and write down its mathematical form in SI unit.

b) Draw the circuit diagram of a CE mode amplifier using n-p-n transistor. Show the input and output wave forms.

c) What is meta-stable state in lasing action? (2+3+1)

iii)

a) Calculate the tube voltage required to be applied to an X-ray tube to get minimum wavelength 2.0 Å. ($h = 6.626 \times 10^{-34}$ Js)

b) A proton enters a uniform magnetic field of strength 0.500 T with a velocity of 2.0×10^5 m/s. The magnetic field is directed along the Y-axis and the velocity is directed along X-axis. Find the magnitude of the force acting on the proton and its acceleration. (charge of proton = 1.60×10^{-19}C, mass of proton = 1.67×10^{-27} kg)

c) Draw the energy level diagram of He-Ne Laser. (2+2+2)