Total No. of Printed Pages:3

F.E. Semester – II (Revised Course 2016-17)
EXAMINATION JULY 2021
Applied Science (Physics)

[Duration : Two Hours] **[Total Marks : 60]**

INSTRUCTIONS

1) Answer THREE FULL QUESTIONS with ONE QUESTION FROM EACH PART.
2) Assume additional data, if required
3) Draw diagrams wherever required.

Physical constants:

Planck's constant	= 6.626×10^{-34} J-s
Electron charge	= 1.6×10^{-19} C
Boltzmann's constant	= 1.38×10^{-23} J/K
Electron mass	= 9.1×10^{-31} kg
Rydberg constant	= 1.097×10^{7} / m
Velocity of light	= 3×10^{8} m/s

Part A

Q.1 a. Derive an expression for conductivity of a semiconductor in terms of mobility of charge carriers. (5)

b. With the help of a neat ray diagram obtain the condition for interference maxima and minima due to transmitted light from a parallel thin film. (5)

c. Explain paramagnetism. Give 5 properties of paramagnetic materials. (5)

d. Calculate the velocity of ultrasonic waves in a liquid used in an acoustic diffraction experiment using the following data: (5)
Wavelength of light used = 6000Å
Frequency of ultrasonic transducer = 1 MHz
Angle of diffraction for 2^{nd} order maxima=$5^{o}36'$

Q.2 a. What are soft and hard magnetic materials? Give their properties applications. (5)

b. Explain any 3 methods of detection of Ultrasonic Waves. (5)

c. With neat diagram explain working of magnetic lens. Where is magnetic lens used? (5)

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d. Calculate the concentration of donor atoms to produce n-type material with resistivity of 0.2 Ωm and electron mobility of $0.36m^2$ / V.s. What will be the diffusion constant of the above material at 57°C? (5)

Q.3

a. Obtain expression for Hall voltage. What are the applications of Hall Effect experiment? (5)

b. In Newton's Rings experiment the diameter of the 5^{th} and 20^{th} dark rings formed due to reflected light were measured as 0.3 cm and 0.6 cm respectively. What is the radius of curvature of the plano-convex lens if wave length of light used is 6000 Å ? What will the diameter of the 5th ring change to if a liquid of refractive index 1.33 is introduced between the lens and plate? (5)

c. Draw block diagram of CRO. What is the purpose of trigger circuit in the CRO? Explain how to measure voltage and frequency of a. c. signal using CRO. (10)

Part B

Q.4

a. With neat diagram explain construction & working of Ruby laser. What are its drawbacks? (5)

b. Explain briefly Meissner effect and silsbee effect in superconductors. (5)

c. State Moseley's Law and explains its significance. (5)

d. When a potential difference of 15 KV is applied across the x-ray tube a current of a 2mA flows through it. Calculate: (5)
   i. The number of electrons striking the target per second
   ii. The speed with which they strike
   iii. The shortest wavelength of x-rays emitted

Q.5

a. Derive expression for Acceptance Angle of an optical fiber. What is acceptance cone? (5)

b. What is x-ray diffraction? With neat diagram explain the working of Bragg's spectrometer. (5)

c. What is population inversion and why is it necessary for light amplification? Why is population inversion sometimes is called negative temperature state? (5)

d. A photon of wavelength 0.05 Å strikes an electron at rest and is scattered at an angle of 75^o to the original direction. Find the wavelength and speed of the scattered (5)

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photon.

Q.6

a. With neat diagrams explain the different types of optical fibers. (5)

b. The mode separation of a 2 mW He-Ne laser operating at 6943 Å is 1000 Mhz. What must be the length of the laser cavity to ensure that only one longitudinal mode oscillates. How many photons will be emitted from the laser in one second? (5)

c. Using the theory of elastic collisions derive the expression for Compton shift. Show that the wavelength of modified component is greater than that of unmodified component. (10)

Part C

Q.7

a. Explain interference in wedge shaped film and hence derive expression for fringe width. Draw necessary diagrams. (5)

b. Discuss the various applications of superconductivity. (5)

c. Explain the following applications of US waves: (5)

i) Detection of flows in metal casting
ii) Echo sounding

d. Monochromatic x-rays of wavelength 1.55 Å are made to reflect from a crystal with interplanar spacing of 4.2 Å. Determine the highest order of reflection that can be observed with this radiation and the glancing angle corresponding to the highest order. (5)

Q.8

a. Derive expression for Continuity equation for p-type semiconductor. (5)

b. A step-index fibre in air has N.A. of 0.18, core R.I of 1.52 and core diameter of $60\mu m$. determine the v-number for the fibre when light of wavelength 1.15 μm is transmitted. Also estimate the number of modes the fiber will support. (5)

c. With neat diagrams explain the construction and working of He-Ne laser. (10)

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