FE102

Total No. of Printed Pages: 3

F. E Semester-I (Revised Course 2016-17)
EXAMINATION OCTOBER 2020
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	$= 6.626 \times 10^{-34}$ J-s
Electron charge	$= 1.6 \times 10^{-19}$ C
Boltzmann's constant	$= 1.38 \times 10^{-23}$ J/K
Electron mass	$= 9.1 \times 10^{-31}$ kg
Rydberg constant	$= 1.097 \times 10^{7}$/m
Velocity of light	$= 3 \times 10^{8}$ m/s

PART A

Q.1 a) Derive condition of bright and dark interference due to reflected rays from a parallel sided thin film (5)

b) Draw and explain B-H curve for a ferromagnetic material placed in a magnetic field. (5)

c) The R_H of a specimen is $+ 3.66 \times 10^{-4}$ m^3/c. Its resistivity is 8.93×10^{-3} Ω-m. Determine (5)
(i) Conductivity type (ii) mobility (iii) hole concentration

d) Draw the block diagram of CRO and briefly explain its application to measure frequency of ac mains. (5)

Q.2 a) What is magnetostriction? Briefly explain magnetostriction method for producing ultrasonic waves. (5)

b) Explain the working of an electrostatic electron lens. (5)

c) Briefly explain the physical origin of Hall Effect. Derive an expression for hall voltage in terms of current through the semiconductor material. (5)

d) A wedge shaped air film having an angle of 45 sec is illuminated by monochromatic light. (5)

The interference fringes are observed normally. If the fringe width is 0.12 cm, calculate wavelength of light used.

Q.3 a) What are ferrites? Briefly explain properties and applications of ferrites. (two each) (5)

b) Newton's rings are formed with reflected light of wavelength 589 nm. A liquid when introduced between the lens and glass plate, the diameter of sixth bright ring is found to be 0.3 cm. Determine refractive index of the liquid if radius of curvature of the lens is 104 cm. (5)

c) What is continuity equation? Derive continuity equation for electrons and holes in a semiconductor. (10)

PART B

Q.4 a) What are step index and graded index optical fibers? Draw their refractive index profiles. (5)

b) With the help of energy level diagram. Explain construction & working of ruby laser. (5)

c) Using Mosley's law, evaluate wavelength of k_α line for an atom of atomic number 92. Given – screening constant for k series =1. (5)

d) What are matter waves? Using the concept of matter waves, obtain Bohr's condition for quantization of angular momentum (5)

Q.5 a) Describe the construction and working of He-Ne laser. Draw necessary diagram. (5)

b) Derive expression for numerical aperture of an optical fiber in terms of refractive indices of core and cladding material. Also express numerical aperture in terms of fractional index change. (5)

c) Describe the production of x-rays by Coolidge tube. How are intensity & quality of x-rays controlled? (5)

d) Find the relative populations of two states in a ruby laser that produces a light beam of wavelength $6939A^o$ at 300 k. (5)

Q.6 a) How are Laser different from conventional source of light? Discuss two industrial applications of Laser. (5)

b) What is critical angle and acceptance angle for a step index fiber with refractive index of (5)

core & cladding material 1.40 and 1.35 respectively?

c) Briefly explain Compton Effect. Derive an expression for Compton shift and show that the wavelength shift of scattered photons depends only on the scattering angle and not on the wavelength of incident radiation. (10)

PART C

Q.7 a) What is meant by population inversion? Give an account of different type of pumping mechanism in laser. (5)

b) Calculate the velocity of ultrasonic wave passing through an acoustic grating from following data:- frequency of ultrasonic transducer = 180 MHz
Wavelength of monochromatic light used = 5890A°
And angle of diffraction for first order = 2^0, 18' (5)

c) Write short note on phase change due to reflection of light from the surface of denser medium. Explain the salient features of interference pattern formed due to a wedge shaped air film. (5)

d) Explain the terms:- (i) phase velocity
(ii) Silsbee effect (5)

Q.8 a) State 2 advantages of optical fiber communication over conventional ones. Briefly explain different transmission losses in optical fiber. (5)

b) Write down any two features of paramagnetic material. How are ferro, antiferro and ferromagnetic materials different in terms of magnetic dipole moment. (5)

c) Give an account of 'cut off wavelength' in continuous x-ray spectrum. Calculate minimum wavelength of x-rays produced in x-ray tube operating at 10kv. (5)

d) Give an account of drift & diffusion current in a semiconductor. Determine drift velocity of an electron moving in an electric field of intensity 0.03 v/m with mobility 0.4 m^2/ v-s. (5)

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