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BMS College of Engineering, Bangalore-560019

(Autonomous Institute, Affiliated to VTU, Belgaum)

May 2016 Semester End Main Examinations

Course: **ENGINEERING PHYSICS** Duration: **3 Hours**

Course Code: **14PY2ICPHY** Max Marks: **100**

Date: 04.05.2016

Instructions: **Answer FIVE FULL questions, choosing one from each unit.**

Physical constants:

Planck's constant, h = 6.625 x 10^{-34} Js

Mass of neutron or proton=1.675 x 10^{-27} kg,

Boltzmann constant, k = 1.38 x10^{-23} J K^{-1},

Velocity of light, c = 3 x 10^8 m s^{-1},

Permittivity of free space μ_0=4 π x 10^{-7} H m^{-1}.

Mass of electron, m_e= 9.11 x 10^{-31} kg,

Charge of electron, e = 1.602 x 10^{-19} C,

Avogadro's number, N_A = 6.02 x 10^{26} $k^{-1}mol^{-1}$,

Permittivity of vacuum, ε_0=8.85 x 10^{-12} F m^{-1},

UNIT -1

1. a) "Material particles exhibit dual nature". Justify this statement in the light of de Broglie's hypothesis. Show that the de Broglie wavelength of an electron accelerated through a potential difference of V volts is $\lambda = 12.26/(V)^{½}$ Å. 9

   b) State Heisenberg uncertainty principle and show that an electron does not exist inside the nucleus. 7

   c) Calculate the de Broglie wavelength of the following and justify your answer 4
   i) a 1000 kg automobile travelling at 100 m/s
   ii) a smoke particle of mass 10^{-9}g moving at 1cm/s
   iii) an electron with kinetic energy 1eV

OR

2. a) Apply Schrödinger wave equation for a particle in a box problem and calculate the eigen energy value and eigen function for the same particle. 9

   b) Define group velocity and obtain the relationship between group velocity and particle velocity. 7

   c) For a free particle in space show that the ratio [$8\pi^2 mE/h^2$] is equal to k^2, where the terms have their usual meaning. 4

UNIT-2

3. a) Define Miller Indices. Explain the rules for obtaining them with a suitable example 8

   b) Derive Bragg's equation. Explain how Bragg's spectrometer is used to determine wavelength of X-ray source. 8

   c) Calculate the glancing angle for incidence of X-rays of wavelength 0.58Å on the plane (1 3 2) of NaCl which results in the second order diffraction maxima, taking the lattice spacing as 3.81 Å 4

UNIT-3

4 a) State Wiedmann -Franz law. Deduce the classical expression for thermal conductivity of a metal. 8

b) Give the experimental setup and theory to determine thermal conductivity by Lee and Charlton's method. 8

c) Calculate the electrical conductivity and Lorentz number of a metal at 300 K with the relaxation time 10^{-14} s and thermal conductivity 123.9 W/m/K and free electron concentration 6×10^{28} /m^3. 4

UNIT-4

5 a) Explain electronic polarization mechanism and arrive at an expression for electronic polarizability for a monoatomic gas. 7

b) What is magnetic hysteresis? Explain magnetic hysteresis on the basis of domain theory. List the characteristic properties of hard and soft magnets based on magnetic hysteresis loop. 9

c) The dielectric constant of Sulphur is 3.4. Assuming a cubic lattice for its structure, find the electronic polarizability of sulphur, given no. of sulphur atoms per m^3 = 6×10^{26}. 4

UNIT-5

6 a) What are Einstein's A and B coefficients? Derive an expression for energy density of radiation under equilibrium condition in terms of Einstein's coefficients. 8

b) Discuss briefly the classification of optical fibers 8

c) A pulse from laser with power 1 mW last for 10 ns. If the number of photons emitted per second is 3.491×10^7, calculate the wavelength of laser. 4

OR

7 a) What is numerical aperture? Derive an expression for the numerical aperture of an optical fiber and then arrive at the condition of propagation. 8

b) Explain the construction and working of semiconductor laser. 8

c) Calculate the number of modes that can propagate inside an optical fiber with core refractive index 1.53 and cladding refractive index 1.50. Given the core radius 50 μm, wavelength 1 μm. 4

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