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10PHY12/22

# First/Second Semester B.E. Degree Examination, Dec.2016/Jan.2017
## Engineering Physics

Time: 3 hrs. Max. Marks:100

**Note:** *1. Answer any FIVE full questions, choosing at least two from each part.*
*2. Physical constants: $h = 6.63 \times 10^{-34}$ JS, $C = 3 \times 10^{8}$ m/s, $e = 1.6 \times 10^{-19}$ C, 1ev = $1.6 \times 10^{-19}$ J, $m_e = 9.1 \times 10^{-31}$ kg, $m_n = 1.674 \times 10^{-27}$ kg, NA = $6.025 \times 10^{26}$/Kmol.*



## PART – A

1 a. Choose the correct answers for the following : **(04 Marks)**

i) The wavelength ($\lambda$) associated with a particle of mass m, moving with a velocity v is given by

A) $\lambda = \frac{h}{mv}$ B) $\lambda = \frac{hv}{m}$ C) $\lambda = \frac{mv}{h}$ D) $\lambda = \frac{m}{hv}$

ii) In black body radiation spectrum, the Wein's distribution law is applicable for
A) Longer wavelength B) Shorter wavelength
C) Entire wavelength D) None of these

iii) If the group velocity of particle is $4.7 \times 10^6$ m/s, then its phase velocity is
A) $6 \times 10^9$ m/s B) $4.7 \times 10^9$ m/s C) $9.4 \times 10^6$ m/s D) $1.91 \times 10^{10}$ m/s

iv) Photo electric effect establishes
A) Wave nature of light B) Particle nature of light
C) Dual nature of light D) None of these

b. What is Planck's radiation law? Show how Wein's law and Rayleigh-Jean's law can be derived from it. **(06 Marks)**

c. Describe Davisson and Germer experiment for the justification of de Broglie waves. **(06 Marks)**

d. Find the energy of neutrons in eV whose de Broglie wavelength is 1 Å. Given the mass of neutron is $1.674 \times 10^{-27}$ kg. **(04 Marks)**

2 a. Choose the correct answers for the following : **(04 Marks)**

i) The product of uncertainties between position and momentum is given by

A) $\Delta x\, \Delta p \geq \lambda$ B) $\Delta x\, \Delta p \geq \frac{h}{4\pi}$ C) $\Delta x\, \Delta p \geq mv$ D) $\Delta x\, \Delta p \geq \frac{nh}{2\pi}$

ii) The energy corresponding to the first permitted energy level is given by
A) Excited energy B) Metastable state energy
C) Zero point energy D) None of these

iii) The wave function is acceptance wave function if it is
A) Finite every where B) Continuous everywhere
C) Single valued everywhere D) All of these

iv) If the electron moves in one dimensional potential box of length 2nm, the normalization constant is

A) $1(\text{nm})^{-1/2}$ B) $2(\text{nm})^{-1}$ C) $\left[\sqrt{2}\,\text{nm}\right]^{-1}$ D) None of these.

b. Using time independent Schrodinger wave equation obtain the expression for the normalized wave function for a particle in one dimensional potential well of infinite height. **(08 Marks)**

c. Explain Heisenberg's uncertainty principle. **(04 Marks)**

d. An electron is confined to a box of length $10^{-9}$m, calculate the minimum uncertainty in its velocity. **(04 Marks)**

3 a. Choose the correct answers for the following : **(04 Marks)**

i) The free electrons in classical free electron theory are treated as
A) Rigidly fixed lattice points B) Liquid molecules
C) Gas molecules D) None of these

ii) If the mobility of electrons in a metal increases, the resistivity
A) Increases B) Decreases C) Remains constant D) None of these

iii) Matthiessen's rule is given by
A) $\rho = \rho_{ph} - \rho_i$ B) $\rho = \frac{\rho_{ph}}{\rho_i}$ C) $\rho = \rho_{ph} + \rho_i$ D) $\rho = \frac{\rho_i}{\rho_{ph}}$

iv) The value of Fermi function in Fermi level at $T \neq 0K$ is,
A) ZERO B) 0.5 C) 0.75 D) 1

b. Using the classical free electron theory, derive an expression for electrical conductivity in metals. **(06 Marks)**

c. Define Fermi energy and Fermi factor. Discuss the variation of Fermi factor with temperature. **(06 Marks)**

d. Calculate the conductivity of sodium given $\tau_m = 2 \times 10^{-14}$s. Density of sodium is 971 kg/m$^3$, its atomic weight is 23 and has one conduction electron per atom. **(04 Marks)**

4 a. Choose the correct answers for the following : **(04 Marks)**

i) The electric dipole moment per unit volume is
A) Magnetization B) Bipole moment
C) Electric polarization D) Electric susceptibility

ii) For Ferromagnetic substances, the Curie-weiss law is
A) $\psi = \frac{C}{T}$ B) $\psi = \frac{C}{T-\theta}$ C) $\psi = \frac{T-\theta}{C}$ D) $\frac{C}{T+\theta}$

iii) The relation between B, M and H is
A) $H = \mu_0 (M + B)$ B) $B = \mu_0 (H + M)$ C) $M = \mu_0 (H + B)$ D) None of these

iv) In the inverse piezoelectric effect
A) Ultrasonic waves are produced B) Electromagnetic waves are produced
C) Microwaves are produced D) None of these

b. What is internal field? Derive an expression for the internal field in the case of one dimensional array of atoms in dielectric solids. **(07 Marks)**

c. Distinguish between hard and soft magnetic materials. **(05 Marks)**

d. Sulphur is elemental solid dielectric whose dielectric constant is 3.4. Calculate the electronic polarizability if its density is $2.07 \times 10^3$ kg/m$^3$ and atomic weight is 32.07. **(04 Marks)**

## PART – B

5 a. Choose the correct answers for the following : **(04 Marks)**

i) Wavelength of LASER can be used as a standard of
A) Time B) Temperature C) Length D) Angle

ii) The lifetime of atoms in meta stable state is of the order of
A) Milliseconds B) Microseconds C) Nanoseconds D) Unlimited

iii) Which of these is not a LASER property?
A) Highly monochromatic B) Highly divergent
C) Highly directional D) Highly intense

iv) Pumping technique used in semiconductor LASER is
A) Electrical discharge B) Forward bias C) Optical pumping D) None of these

b. Describe the construction and working of He-Ne LASER. **(07 Marks)**

c. What is holography? Explain the principle of recording of hologram with suitable diagrams. **(05 Marks)**

d. The ratio of population of two energy levels is $1,059 \times 10^{-30}$. Find the wavelength of light emitted at 330K. **(04 Marks)**

6 a. Choose the correct answers for the following : **(04 Marks)**

i) The NA of an optical fiber is 0.2, when surrounded by air. The acceptance angle when it is in water of refractive index 1.33 is

A) 8.21° B) 8.65° C) 0.11° D) None of these

ii) Superconductors are

A) Ferromagnetic B) Paramagnetic C) Anti Ferromagnetic D) Diamagnetic

iii) Below critical temperature, if the temperature of superconductor is increased, the critical field

A) Increases B) Decreases

C) Remains constant D) First increases, then decreases

iv) Attenuation in optical fiber is due to

A) Absorption B) Scattering C) Radiation loss D) All the above

b. Discuss various types optical fibers with suitable diagrams. **(06 Marks)**

c. Write a note on Maglev vehicles. **(05 Marks)**

d. The refractive indices of the core and cladding of a step index fiber are 1.45 and 1.40 respectively and its core diameter is 45μm. Calculate its relative refractive index difference, V-number at wavelength 1000nm and the number of modes. **(05 Marks)**

7 a. Choose correct answers for the following : **(04 Marks)**

i) The relation between atomic radius R and its lattice constant 'a' in FCC is

A) $a = 2R$ B) $a = 2\sqrt{2}R$ C) $a = \frac{\sqrt{3}}{4}R$ D) $a = \frac{\sqrt{3}}{2}R$

ii) The coordination number in the case of BCC is

A) 6 B) 8 C) 10 D) 12

iii) A plane intercepts at a, b/2, 2c in a simple cubic cell. The miller indices of the plane are.

A) (214) B) (241) C) (421) D) (124)

iv) Brogg's equation is expressed as

A) $2d\sin\theta = n\lambda$ B) $2a\sin\theta = n\lambda$ C) $2\sin\theta = n\lambda$ D) None of these

b. What is atomic packing factor? Calculate APF in the case of BCC and FCC. **(06 Marks)**

c. What are miller indices of planes? Explain how to find the muller indices of planes with an example. **(06 Marks)**

d. A monochromatic X-ray beam of wavelength 1.5 Å undergoes 2nd order Bragg reflection from the plane (211) of a cubic crystal at a glancing angle of 54.38°. Calculate the lattice constant. **(04 Marks)**

8 a. Choose the correct answers for the following : **(04 Marks)**

i) The elastic behavior of the liquid is characterized by its

A) Young's modulus B) Modulus of rigidity

C) Bulk modulus D) Poisson's ratio

ii) The state of the matter around nanosize is known as

A) Liquid state B) Plasma state C) Mesoscopic state D) Solid state

iii) A bulk material reduced to one dimension is called quantum

A) Dot B) Well C) Particle D) Wire

iv) The frequency of ultrasonic waves is

A) < 20kHz B) Between 20Hz and 20kHz

C) > 20kHz D) None of these

b. What are nanomaterials? Explain any two methods of preparation of nanomaterials with neat sketches and mention any one application. **(08 Marks)**

c. Describe a method of measuring velocity of ultrasonic waves in solids. Using this how can we find the rigidity modulus of the solid? **(08 Marks)**

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