



10PHY12/22

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**First/Second Semester B.E. Degree Examination, June/July 2018**  
**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 : Planck's constant  $h = 6.63 \times 10^{-34} \text{ J-S}$ ,  
Electron charge  $e = 1.6 \times 10^{-19} \text{ C}$ , Electron mass  $m = 9.11 \times 10^{-31} \text{ kg}$ , Velocity of  
light  $C = 3 \times 10^8 \text{ m/s}$ , Neutron mass  $= 1.675 \times 10^{-27} \text{ kg}$ ,  $\epsilon_0 = 8.85 \times 10^{-12} \text{ F m}^{-1}$ ,  
 $K = 1.38 \times 10^{-23} \text{ J/K}$

**PART - A**

- 1 a. Choose the correct answers for the following : (04 Marks)
- According to Wein's law, the wavelength of maximum intensity  $\lambda_m$  is  
A)  $\lambda_m \propto T$       B)  $\lambda_m \propto \frac{1}{T}$       C)  $\lambda_m \propto T^4$       D)  $\lambda_m \propto \frac{1}{T^4}$
  - de Broglie wave length of an electron accelerated by a potential of 100V is  
A) 0.0012nm      B) 0.1226 nm      C) 1.226 nm      D) 12.26 nm
  - The wave nature associated with electrons in motion was verified by  
A) Photoelectric effect      B) Compton effect  
C) Raman effect      D) Diffraction by Crystals
  - The momentum of a free particle carrying energy E and mass m is  
A) 2mE      B)  $\sqrt{2mE}$       C)  $2\sqrt{mE}$       D)  $m^2 E^2$
- 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. What is Matter wave? Derive an expression for de - Broglie wavelength using group velocity concept. (06 Marks)
- d. Find the energy of the neutron i.e eV whose de - Broglie wavelength is  $1 \text{ \AA}$ . (04 Marks)
- 2 a. Choose the correct answers for the following : (04 Marks)
- The Product of Uncertainties between position and momentum is given by  
A)  $\Delta x \Delta p \geq \lambda$       B)  $\Delta x \Delta p \geq \frac{h}{2}$       C)  $\Delta x \Delta p \geq mv$       D)  $\Delta x \Delta p \geq \frac{h}{4\pi}$
  - The probability of locating a particle is maximum  
A) within the wave packet      B) at the nodes of the wave packet  
C) cannot be determined      D) none of these
  - The energy corresponding to the first permitted energy level for a particle in an infinite potential well is called  
A) excited state      B) zero point energy  
C) meta stable state energy      D) none of these
  - If an electron moves in one dimensional box of length 2nm, the normalization constant is  
A)  $1(\text{nm})^{-1}$       B)  $2(\text{nm})^{-1}$       C)  $\sqrt{2}(\text{nm})^{-1}$       D) zero
- b. Set up time independent Schrodinger wave equation. (06 Marks)
- c. Show that electrons cannot exist in the nucleus of an atom. (06 Marks)
- d. An electron is bound in one dimensional box of width 0.16nm. Find the energy values in the ground state and first excited state. (04 Marks)





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- 3 a. Choose the correct answers for the following : (04 Marks)
- i) Specific heat of 1 mole of electron gas under constant volume is  
A)  $\frac{3}{5}R$       B)  $\frac{R}{2}$       C)  $3R$       D)  $\frac{3}{2}R$
- ii) The expression of electrical resistivity  $P$  is  
A)  $\frac{ne^2\tau}{m}$       B)  $\frac{m}{ne^2\tau}$       C)  $\sqrt{\frac{ne^2\tau}{m}}$       D)  $\sqrt{\frac{m}{ne^2\tau}}$
- iii) The fermi factor for  $E = E_f$  at  $T > 0$  K is  
A) 1      B)  $\frac{1}{2}$       C) 0      D) 2
- iv) According to quantum free electron theory, the energy levels in metal are  
A) continuous      B) discrete      C) overlapping      D) none
- b. Using the free electron theory, derive an expression for electrical conductivity in metals. (06 Marks)
- c. Discuss the probability of occupation of various energy states by electron by  $T = 0^0$ K and  $T > 0^0$ K on the basis of fermi factor. (06 Marks)
- d. Find the temperature at which there is 1.0% probability that a state with an energy  $0.5eV$  above fermi energy will be occupied. (04 Marks)

- 4 a. Choose the correct answers for the following : (04 Marks)
- i) Electronic Polarization  
A) Independent of temperature      B) Increases with temperature  
C) Decreases with temperature      D) None of these
- ii) For Ferromagnetic substance, the Curie – Weiss law is given by  
A)  $X = \frac{C}{T}$       B)  $X = \frac{C}{(T-0)}$       C)  $X = \frac{(T-0)}{C}$       D)  $X = \frac{C}{(T+0)}$
- iii) The Polarisation that occurs in the frequency range  $10^{12}Hz$  is  
A) ionic      B) electronic      C) orientation      D) space charge
- iv) Sulphur is an elemental solid dielectric of atomic weight 32.07 and density  $2.07 \times 10^3$  kg/m<sup>3</sup>. The number of atoms per unit volume for sulphur is  
A)  $3.89 \times 10^{28}/m^3$       B)  $3.89 \times 10^{25}/m^3$       C)  $9.3 \times 10^{24}/m^3$       D) None of these
- b. What is Internal field? Derive an expression for internal field in case of one dimensional array of atoms in dielectric solids. (08 Marks)
- c. Write note on Ferroelectrics. (04 Marks)
- d. An elemental solid dielectric material has Polarizability  $7 \times 10^{-40} F - m^2$ . Assuming the internal field to be Lorentz field. Calculate the dielectric constant for the material , if it has  $3 \times 10^{28}$  atoms/m<sup>3</sup>. (04 Marks)

**PART - B**

- 5 a. Choose the correct answers for the following : (04 Marks)
- i) The Pumping action in diode laser is by  
A) Optical pumping      B) Electric discharge  
C) Reverse bias      D) Forward bias
- ii) The distribution of number of atoms in different discrete energy states is governed by  
A) Fermi – Dirac distribution      B) Maxwell – Boltzmann distribution  
C) Bose – Einstein distribution      D) None of these
- iii) The life time of the meta stable is about \_\_\_\_\_ sec  
A)  $10^{-3}$       B)  $10^{-13}$       C)  $10^2$       D)  $10^{-9}$





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- iv) Image is stored on a hologram in the form of  
A) Interference pattern                      B) Diffraction pattern  
C) Photography                                 D) None of these
- b. Explain the terms spontaneous emission and stimulated emission. (04 Marks)
- c. Describe the construction of He - Ne laser and explain its working, with the help of suitable diagrams. (08 Marks)
- d. A pulse laser has an average power output 1.5mw per pulse and pulse duration is 20ns. The number of photons emitted per pulse is estimated to be  $1.047 \times 10^8$ . Find the wavelength of the emitted laser. (04 Marks)
- 6 a. Choose the correct answers for the following : (04 Marks)
- i) The superconductor behaves like a Perfect  
A) Paramagnet    B) Ferro magnet    C) Diamagnet    D) None of these
- ii) The critical temperature of mercury is  
A) 4.2 K            B) 2.4 K            C) 6.2 K            D) 7.8 K
- iii) The quantum of magnetic flux is given by  
A)  $\frac{2h}{e}$             B)  $\frac{h}{2e}$             C)  $\frac{h}{2\pi e}$             D)  $\frac{2\pi h}{e}$
- iv) The attenuation of a fiber - optic cable is expressed in  
A) ohm/km            B) watt/km            C) decibel/km            D) joule/km
- b. Define Super conductivity and explain Type - I and Type - II super conductors. (06 Marks)
- c. Describe different types of optical fibres, with neat diagrams. (06 Marks)
- d. The attenuation of light in an optical fiber is 3.6 dB/km. What fractional initial intensity remains after 1km? (04 Marks)
- 7 a. Choose the correct answers for the following : (04 Marks)
- i) The relation between atomic radius and lattice constant in FCC structure is  
A)  $a = 2r$             B)  $a = 2\sqrt{2} r$             C)  $a = \frac{\sqrt{3}r}{4}$             D)  $a = \frac{4r}{\sqrt{3}}$
- ii) Which of the following crystal structure is having the least coordination number?  
A) Simple cubic                                 B) Body centered cubic  
C) Face centered cubic                         D) None of these
- iii) The inter planar spacing in a crystal is  $1\text{Å}$  and the glancing angle is  $35^\circ$ . For the first order Bragg reflection to take place, the wavelength of X - rays is  
A)  $1.147\text{Å}$             B)  $0.573\text{Å}$             C)  $1.638\text{Å}$             D)  $0.819\text{Å}$
- iv) The inter atomic distance between the sodium and chlorine atoms in sodium crystal is  
A)  $5.51\text{Å}$             B)  $5.62\text{Å}$             C)  $6.62\text{Å}$             D)  $2.81\text{Å}$
- b. Derive Bragg's law for X - ray diffraction in crystals. (04 Marks)
- c. Define Coordination number and atomic packing factor. Calculate the packing factor for SC, BCC and FCC structures. (08 Marks)
- d. Copper has FCC structure and the atomic radius is 0.1278nm. Calculate the inter planar spacing for (111) and (321) planes. (04 Marks)





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- 8 a. Choose the correct answers for the following : (04 Marks)
- i) In a carbon nanotube, the bond between the carbon atom is  
A) metallic      B) ionic      C) hydrogen      D) covalent
  - ii) The Ultrasonic waves are sound waves having  
A) Velocity greater than  $330 \text{ ms}^{-1}$       B) Velocity less than  $330 \text{ ms}^{-1}$   
C) Frequency greater than 20 KHz      D) Frequency less than 20 KHz
  - iii) The ultrasonic waves are produced by  
A) Electromagnetic induction      B) Electric tuning fork  
C) piezo electric effect      D) Inverse piezo electric effect
  - iv) A constant testing of product without causing any damage is called  
A) minute testing      B) destructive testing  
C) non - destructive testing      D) random testing
- b. Explain Carbon nanotubes and its application by giving their physical properties. (08 Marks)
- c. Describe a method of measuring velocity of ultrasonic waves in liquids. (08 Marks)

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