P12A

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06PHY12/22

# First Semester B.E. Degree Examination, June/July 2011
## Engineering Physics

Time: 3 hrs. Max. Marks:100

**Note:** 1. *Answer any FIVE full questions, choosing at least two from each part.*
2. *Answer all objective type questions only in OMR sheet page 5 of the answer booklet.*
3. *Answer to objective type questions on sheets other than OMR will not be valued.*
4. *Physical constants : $h = 6.625 \times 10^{-34}$ J-Sec, $\epsilon_0 = 8.854 \times 10^{-12}$ Fards/mt, $m_e = 9.1 \times 10^{-31}$ kgs, $N_A = 6.025 \times 10^{26}$/k – mole, $c = 3 \times 10^8$ mn/Sec, $k = 1.38 \times 10^{-23}$ J/K.*



### PART – A

1 a. Choose your answers for the following :

i) Let $n_r$ and $n_b$ be the number of photons emitted by a red bulb and a blue bulb respectively having equal power. Then
A) $n_r = n_b$ B) $n_r < n_b$ C) $n_r > n_b$ D)The information is insufficient to get a relation between $n_r$ and $n_b$.

ii) An electron, neutron and a proton have the same de – Broglie wavelength which particle has grater velocity.
A ) Proton B) Neutron C) Electron D) All particles have same velocity.

iii) If a charged particle of mass m is accelerated through a potential difference of V volts, the de – Broglie wavelength is proportional to
A) V B) $V^{-1/2}$ C) $V^{1/2}$ D) $V^2$

iv) The wavelength of matter waves is independent of
A) Mass B) Charge C) Momentum D) velocity. **(04 Marks)**

b. Give an account of the attempts made through various laws to explain the black body spectrum. **(06 Marks)**

c. What is group velocity? Show that group velocity of de – Broglie wave length is equal to velocity of the particle with which the waves are associated. **(06 Marks)**

d. Calculate the kinetic energy of an electron whose de – Broglie wavelength is equal to that of a 10 keV photon. **(04 Marks)**

2 a. Choose your answers for the following :

i) If the uncertainty in the location of a particles is equal to its de – Broglie wavelength, the uncertainty in its velocity is of the order of
A) its velocity B) half its velocity C) twice its velocity D) Four times its velocity

ii) If an electron moves in a 1 – D box of length 2 nm, the normalization constant is
A) $(1\text{ nm})^{-1/2}$ B) $(2\text{ nm})^{-1}$ C) $\sqrt{2}(\text{nm})^{-1}$ D) 0

iii) A free particle can carry any amount of energy and hence its energy is
A) Discrete B) Continuous C) Degenerate D) Neither continuous nor discrete.

iv) The lowest possible energy for a particle in a potential well of infinite height is 2 eV. Its energy in the first excited state is
A) 4 eV B) 8 eV C) 16 eV D) 21 eV. **(04 Marks)**

b. Set up time independent Schrödinger's wave equation for free particle in one – dimensional **(06 Marks)**

c. What is the physical significance of the wave function? Also discuss the nature of eigen values and eigen functions. **(06 Marks)**

d. The velocity of an electron was measured to be $5 \times 10^5$ mts/sec with an uncertainty of 1%. What is the uncertainty involved in the measurement of its position? **(04 Marks)**

3 a. Choose your answers for the following :

i) The temperature dependence of classical expression for electrical resistivity of metal is

A) $\rho \alpha T^2$ B) $\rho \alpha \frac{1}{T^2}$ C) $\rho \alpha T^{1/2}$ D) $\rho \alpha \frac{1}{T}$

ii) If the Fermi –energy of a metal is 3 eV the Fermi temp of the metal is

A) $3.4 \times 10^4$ k B) $1.6 \times 10^2$ k C) $4.8 \times 10^3$ k D) $-10^{-12}$ k

iii) The quantum mechanical expression for electrical conductivity is

A) $\sigma = \frac{ne^2\lambda_F}{m^* v_F}$ B) $\sigma = \frac{m^* v_F}{\lambda_F ne^2}$ C) $\sigma = \frac{ne^2\lambda}{m^*}$ D) $\sigma = \frac{m^*}{ne^2\lambda_F}$

iv) If mobility of electrons in a metal increases, the resistivity

A) Decreases B) Increases C) Remains constant D) None of the above.

**(04 Marks)**

b. Derive an expression for density of states as per quantum free electron theory. **(08 Marks)**

c. Discuss effects of temperature and impurity on electrical resistivity of metals. **(04 Marks)**

d. Calculate the Fermi velocity and mean free path for conduction electrons in aluminium given that its Fermi energy is 91.63 eV and relaxation time for electron is $7.3 \times 10^{-15}$ sec. **(04 Marks)**

4 a. Choose your answers for the following :

i) Clausius – Mossotti equation with usual meaning of notations can be written as

A) $\frac{\epsilon_r + 2}{\epsilon_r - 1} = N\alpha_e$ B) $\frac{\epsilon_r + 1}{\epsilon_r - 2} = \frac{N\alpha_e}{3\varepsilon_0}$

C) $\frac{\epsilon_r - 1}{\epsilon_r + 2} = \frac{N\alpha_e}{3\varepsilon_0}$ D) $\frac{\epsilon_r + 2}{\epsilon_r - 1} = \frac{N\varepsilon_0}{3\alpha_e}$.

ii) Insertion of a di – electric material between the plates of a capacitor

A) Increases the capacitance B) Decreases the capacitance
C) Results no charge in capacitance D) None of above.

iii) For a given di – electrics the electronic polarizability $\alpha_e$,

A) increases with temperature
B) decreases with temperature
C) is not affected by temperature change
D) May increase decrease with temperature.

iv) The area of hysteresis loop of a ferromagnetic material gives

A) coercive force B) Remanent flux density
C) intensity of magnetization D) hysteresis loss. **(04 Marks)**

b. Derive Clacesius – Mossotti equation for a di – electric material. **(06 Marks)**

c. Explain magnetic hysteresis on the basis of domain theory. **(05 Marks)**

d. Sulphar is elemental solid di electric whose di – electric constant is 3.4. Calculate electronic polarisability if its density is $2.07 \times 10^3$ kg /mt$^3$ and atomic weight is 32.07. **(05 Marks)**

## PART – B

5 a. Choose your answers for the following :

i) In spontaneous emission the emitted photon can move
A) in the direction of field B) in a straight direction
C) in any random direction D) opposite to the direction of field.

ii) A laser requires mirrors because
A) they provide optical feed back
B) they invert the population inversion
C) they determine the wavelength at which lasing occurs
D) None of these

iii) Ratio of probabilities of spontaneous emission and stimulated emission is
A) Proportional to frequency $\gamma$ B) Independent of frequency $\gamma$
C) Proportional to $\gamma^2$ D) Proportional to $\gamma^3$

iv) The wavelength of He – Ne laser is
A) 6943 $A^0$ B) 6328 $A^0$
C) 6534 $A^0$ D) 6845 $A^0$. **(04 Marks)**

b. Explain the following terms
A) Stimulated emission
B) population inversion
C) Spontaneous emission. **(06 Marks)**

c. Write a note on measurements of pollutants in the atmosphere using laser. **(05 Marks)**

d. A pulsed laser has an average power output of 1.5 mW per pulse and pulse duration is 20 nS. The number of photons emitted per pulse is estimated to be $1.0472 \times 10^8$. Find the wavelength of the emitted laser. **(05 Marks)**

6 a. Choose your answers for the following :

i) In an optical fibre if $n_1$ is R. I of the core and $n_2$ that of cladding, then

A) $1-\frac{n_2}{n_1}>1$ B) $1-\frac{n_2}{n_1}=0$

C) $1-\frac{n_2}{n_1}<1$ D) $\frac{n_2-n_1}{n_1}=\infty$

ii) Which of the following is correct?
A) cladding is for providing greater mechanical strength
B) core has higher R,I than cladding
C) cladding has higher R.I. than the core
D) None of these.

iii) The relation between $T_c$ and $H_c$ for a super conductor is

A) $H_c = H_0 (1 + T^2)$ B) $H_c = T_c^2$

C) $H_c = H_0\left[1-\left(\frac{T}{T_c}\right)^2\right]$ D) $H_c = H_0\left[1+\left(\frac{T}{T_c}\right)^2\right]$

iv) Type – II superconductor has
A) only one critical magnetic field B) Two critical magnetic fields
C) Three critical magnetic fields D) All above are false. **(04 Marks)**

b. What are the different losses in optical fibres? Write a brief note on each. **(06 Marks)**

c. The numerical aperture of an optical fibre is 0.2 when surrounded by air. Determine the R. I. of core, given R. I. of cladding 1.59. Also find acceptance angle when the fibre is sunnounded by water. **(05 Marks)**

d. Discuss the Maglev vehicles. **(05 Marks)**

7 a. Choose your answers for the following :

i) The number of lattice points in a primitive cell are

A) 1 B) 1/2 C) 2 D) 3/2

ii) The Miller indices of the plane parallel the x and y axis are

A) (100) B) (010) C) (111) D) (001)

iii) The packing factor of the B.C.C structure is

A) 52% B) 68% C) 92% D) None of the above

iv) For a cubic system the inter planar spacing for (111) plane is

A) $\frac{a}{\sqrt{2}}$ B) $\frac{a}{\sqrt{3}}$ C) $\frac{a}{2}$ D) $\frac{a}{2\sqrt{2}}$. **(04 Marks)**

b. Define : i) Co-ordination number
ii) Packing factor. Calculate packing factor for B.C.C structure. **(06 Marks)**

c. Derive Bragg's law for x – ray diffraction. **(04 Marks)**

d. Draw the following plane in a simple cubic crystal
i) (132)
ii) (T 10)
iii) (010). **(06 Marks)**

8 a. Choose your answers for the following :

i) Ultrasonics are

A) Sound waves of frequencies > 20 Hz
B) Sound waves of frequency > 20 KHz
C) Transverse waves
D) None of the above

ii) Carbon nonotubes are made up of

A) Graphite sheet B) Plastic C) Glass D) All above

iii) Non destructive testing of materials can be carried out by

A) Ultrasonic method B) X- ray method C) Magnetic methods D) All the above

iv) The bulk material when reduced in three dimensions is known as

A) Quantum wire B) Quantum dot C) Film D) None of above. **(04 Marks)**

b. Give an account of carbon nanotubes. **(06 Marks)**

c. Describe in detail how a flow in solid material is detected by non destructive method using ultrasonics. **(10 Marks)**

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