SRN													

PES University, Bengaluru

(Established under Karnataka Act 16 of 2013) **UE18PH101**

END SEMESTER ASSESSMENT (ESA) B TECH. I SEMESTER MAY 2019

ENGINEERING PHYSICS

Time: 3 hours **Answer all questions** **Max marks: 100**

Useful constants:

$| m_e = 9.1x10^{-31}Kg$ | $h = 6.63x10^{-34}Js$ | $k_B = 1.38\,x\,10^{-23}\,JK^{-1}$

$| c = 3x10^8\,ms^{-1}$ | $N_A = 6.02x10^{23}\ per\ mol$ | $m_n = 1.67x10^{-27}\,Kg$

1 a)	Show that the electromagnetic waves have coupled electric and magnetic field components mutually perpendicular to each other and perpendicular to the direction of propagation of radiation.	6
b)	What is Compton Shift? At what angle, the shift in the wavelength is maximum? Will there be any Compton shift for the light in the visible range? Justify your answer.	4
c)	Compare the energy and momentum of photon and neutron when both are associated with De-Broglie wavelength of 1nm.	5
d)	Arrive at Heisenberg's uncertainty principle with the help of a simple thought experiment.	5
2 a)	The following are representative wave functions. Using the momentum operator $\hat{P} = i\hbar\left(\frac{d}{dx}\right)$ identify which of them are eigen functions (a) $\psi(x) = Asin(kx)$ (b) $\psi(x) = Asin(kx) - Acos(kx)$ (c) $\psi(x) = Acos(kx) + iA\,sin(kx)$ (d) $\psi(x) = Ae^{ik(x-a)}$.	5
b)	The wave function for a particle is given as $\psi(x) = Acos(kx) + B\,sin(kx)$. Show that it is a solution to the Schrodinger equation with $V(x) = 0$ and find the energy.	5
c)	A stream of particle of mass m and total energy E moves towards a potential step. If the energy of the electrons is greater than the step potential ($E > V_0$), by applying continuity conditions obtain the expression for reflection coefficient.	6
d)	Sketch the wave functions and probability densities for the first two quantum states of quantum harmonic oscillators.	4
3 a)	State the salient features of Drude model and show that the Drude's formula for conductivity can be expressed as $\sigma = \frac{ne^2\lambda}{(3mkT)^{1/2}}$.	5
b)	Write an expression for the probability of occupation of an energy level E by valence electrons in a metal. Prove that the probability of occupancy by an electron is zero if $E > E_f$ and unity if $E < E_f$ at T=0 K.	5
c)	What do you mean by Fermi temperature and Fermi velocity of valence electrons in a metal? Estimate the Fermi temperature and Fermi velocity of the electron. Fermi energy of metal is 2 eV.	5

d)	How does the potential energy of an electron vary in an infinite one dimensional crystal and how this potential is represented in Kronig –Penny model?	**5**
4 a)	Show that at thermal equilibrium the ratio of the coefficient of spontaneous emission to the coefficient of stimulated emission is proportional to ν^3.	**6**
b)	Bring out the difference between three level and four level lasers.	**4**
c)	With a neat energy level diagram discuss how lasing action is achieved in molecular laser.	**6**
d)	What is direct band semiconductor? If the band gap of direct band gap semiconductor is 0. 2 eV, estimate the wavelength of laser emitted from it. To which region of electromagnetic spectrum does it belong?	**4**
5 a)	Find the expression for orbital magnetic moment and hence estimate the magnetic moment of an electron that revolves around a nucleus in an orbit of $0.53A^0$ radius. If the frequency of revolution is 6.6×10^{15} Hz.	**5**
b)	Discuss graphically the variation of magnetic susceptibility of various types of magnetic materials as a function of temperature.	**5**
c)	What is meant by dielectric polarization? List the various kinds of polarization mechanisms that prevail in dielectric materials and how do those polarization mechanisms vary with temperature?	**5**
d)	Write a note on piezoelectric and pyroelectric materials	**5**

*** * ***