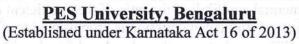
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END SEMESTER ASSESSMENT (ESA) B TECH. I SEMESTER MAY 2019

ENGINEERING PHYSICS

Answer all questions Max marks: 100

	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) $\psi(x) = A\sin(kx)$	5				
	(b) $\psi(x) = A\sin(kx) - A\cos(kx)$ (c) $\psi(x) = A\cos(kx) + iA\sin(kx)$ (d) $\psi(x) = Ae^{ik(x-a)}$.					
b)	The wave function for a particle is given as $\psi(x) = A\cos(kx) + B\sin(kx)$. Show that it is a solution to the Schrodinger equation with $V(x) = 0$ and find the energy.					
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.					
3 a)	State the salient features of Drude model and show that the Drude's formula for conductivity can be expressed as $\sigma = \frac{ne^2\lambda}{(3mkT)^{1/2}}$.					
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.					
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 v^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

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