Registration No: | | | | | | | | | | |

Total Number of Pages: 03 **B.Tech**

15BS1102

2nd Semester Regular Examination 2015-16
PHYSICS

Branch: ALL

Time: 3 Hours

Max Marks: 100

Q.CODE: W623

Answer Part-A which is compulsory and any four from Part-B.

The figures in the right hand margin indicate marks.

Part – A (Answer all the questions)

Q1 Select the correct answer of the followings. **(2 x 10)**

a) A particle is vibrating in simple harmonic motion with an amplitude of 4 cm. At what displacement from the equilibrium position is its energy half potential and half kinetic?
(i) 1 cm (ii)$\sqrt{2}$ cm (iii)2 cm (iv)$2\sqrt{2}$ cm

b) In a damped oscillator, the damping force is proportional to the velocity. Mention the position at which damping force vanishes?
(i)Extreme position (ii)Mean position (iii)Midway between mean position and extreme position (iv)Everywhere

c) Which of the following should be the path difference between two coherent waves of wave length such that there will be constructive interference?
(i)Nλ (ii)(2N + 1) λ (iii)(2N – 1)λ (iv)None of the above

d) In a plane diffraction grating, if the width of opaque space is twice the slit width, find the orders of missing spectra.
(i)3^{rd}, 6^{th}, 9^{th},. (ii) 2^{nd}, 4^{th}, 6^{th}, .(iii)4^{th} , 8^{th}, 12^{th}, . (iv)None of the above

e) Critical angle in certain substance is 30^0. What is the polarizing angle of the substance?
(i)$\tan^{-1} 2$ (ii)$\tan^{-1} 3$ (iii)$\tan^{-1} 0.2$ (iv)$\sin^{-1} 2$

f) The Stokes theorem connects
(i)Line integral to volume integral (ii)Surface integral to volume integral
(iii)Line integral to surface integral (iv)Volume integral to line integral.

g) Velocity of light in free space is given by C
(i)C=$\sqrt{\mu_0 \varepsilon_0}$ (ii)C=$\sqrt{\frac{\mu_0}{\varepsilon_0}}$ (iii)C=$\sqrt{\frac{\varepsilon_0}{\mu_0}}$ (iv)C=$\sqrt{\frac{1}{\mu_0 \varepsilon_0}}$

h) Which of the following electromagnetic radiations can cause Compton Effect?
(i)Visible radiation(ii)Gamma radiation(iii)X–rays(iv)Ultra-violet radiation

i) If the de Broglie wavelengths of an electron and a proton are λ_e and $\lambda_p$respectively when subjected to travel under the influence of a given potential V, then which of the following statements is correct.
(i) $\lambda_e < \lambda_p$ (ii) $\lambda_e > \lambda_p$ (iii) $\lambda_e = \lambda_p$ (iv) $\lambda_e \ll \lambda_p$

j) If the ground state energy of a particle trapped in an infinite deep potential well is E, what is its energy in the 2^{nd} excited state?
(i)9E (ii)4E (iii)Zero (iv)16E

Q2 Answer the following questions: ***Short answer type*** **(2 x 10)**

a) The natural frequency of a simple harmonic oscillator of mass 4 gram is 0.8 rad./s. It undergoes critically damped motion when taken to a viscous medium. Find the damping force on the oscillator when its speed is 0.4 cm/s.

b) What is the condition for observing circular and straight fringes in Young's double slit experiment.

c) The second order maximum for a wave length of 6360 A^0 in a transmission grating coincides with third order maximum of an unknown light. Determine the wave length of unknown light.

d) Quartz has refractive indices 1.55 and 1.54. Calculate the thickness of the quarter wave plate for sodium light of wavelength 5893A^0.

e) Distinguish between positive crystal and negative crystal.

f) Distinguish between displacement current and conduction current.

g) Express electric field and magnetic field in terms of vector potential and scalar potential.

h) Write Maxwell equation in Integral form.

i) Explain graphically the variation of stopping potential with frequency of incident light in case of photo-electric effect.

j) Write the time dependent and time independent Schrodinger equations for a free particle of mass 'm' moving along Y-axis.

<u>Part – B (Answer any four questions)</u>

Q3 **a)** A damped oscillator is subjected to a damping force proportional to its velocity. Set up the differential equation of the oscillator. Discuss the under-damped oscillation with necessary diagram. Explain logarithmic decrement. **(5)**

b) The amplitude of an under-damped oscillator falls to 1/10 of its initial value after 500 oscillations. If the period of oscillation is 0.1sec find (i) the damping coefficient (ii) logarithmic decrement (iii) Time during which energy falls to 1/10 of its original value. **(5)**

c) If amplitudes of a forced oscillator at frequencies $\omega_1 \& \omega_2$ are equal, find the value of resonant frequency. **(5)**

Q4 **a)** Prove with necessary diagram that the diameters of the dark rings, in Newton's ring experiment, as obtained by reflected light are proportional to square root of natural numbers**.** **(5)**

b) Twenty sinusoidal waves of equal amplitude superpose incoherently to produce a resultant wave of intensity 0.5 watt / m^2. What would be the resultant intensity if the waves superpose coherently? **(5)**

c) Prove that the radii of the zone plate are directly proportional to the square root of their natural numbers. **(5)**

Q5 **a)** In Fraunhofer diffraction due to single slit, obtain the conditions for principal maximum, secondary maxima and minima. Show the distribution of intensity graphically in this diffraction pattern. **(5)**

b) Give a comparison between convex lens and zone plate. **(5)**

c) A plane diffraction grating of width 2.5 cm has 12,500 rulings on it. What is maximum order of maxima in the grating spectrum that can be observed for incident light of wave length 5500 A^0? **(5)**

Q6 **a)** Explain the construction and working of a Nichol's prism with a suitable diagram. **(5)**

b) Give a distinction between O – ray and E – ray. **(5)**

c) Distinguish between unpolarized, plane polarized, circularly polarized and elliptically polarized light. **(5)**

Q7 **a)** What is steady state equation? Derive the steady state equation for electric and magnetic fields. **(7)**

b) Evaluate the surface integral for the vector function $\vec{F} = 6x\hat{\imath} - 4y^2\hat{\jmath} + 6yz\hat{k}$ over the surface S, where S is the surface of the unit cube bounded by x=0, x=1, y=0, y=1, z=0 & z=1 planes, using Gauss's divergence theorem. **(4)**

c) A parallel plate capacitor having circular plates of radius 6.5 cm is being charged. calculate the displacement current if the rate of change of electric field between the plates is 2.2×10^{10} V/ms. **(4)**

Q8 **a)** Derive electromagnetic wave equations in conducting medium and write the dissipative terms. From conducting medium extract the equation for non conducting medium. **(7)**

b) What is pair production? Explain why it cannot occur in vacuum. **(4)**

c) Write the Plank's formula for black body radiation. Explain how it follows Wein's formula and Raleigh Jeans formula. **(4)**

Q9 **a)** Set up the Schrodinger's wave equation for particles of mass m each crossing a potential step, **(7)**

$V(x) = 0$ for $x < 0$

$= V_0$ for $x \geq 0$ from left. Obtain the solution. Indicate the reflected and transmitted part in it and prove $R + T = 1$. (Consider the energy 'E' of the particle $> V_0$).

b) If the wave function of a moving particle $\Psi(x) = A_n \sin 2n\pi x / L$ is normalized in $0 \leq x \leq 1$, find the value of normalisation constant then write the normalised wave function. **(4)**

c) Using Heisenberg's uncertainty principle, prove the non-existence of electrons inside the nucleus. **(4)**