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

Total Number of Pages: 3 **B.TECH**

15BS1102

1st Semester Back Examination 2016-17

PHYSICS

BRANCH(S): ALL

Time: 3 Hours

Max Marks: 100

Q.CODE: Y764

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 **Answer the following questions:** **(2 x 10)**

a) A force field is given by $\vec{F} = grad\ V$. The curl of the force field is …..

b) At resonance, the phase of displacement of a forced oscillator lags behind the driving force by …..

c) In a plane diffraction grating, the grating element is twice that of the width of each slit. The initial two orders of missing spectra will be ……. and ……

d) In Fraunhoffer diffraction, the incident wavefront is ….[(a) plane (b) spherical (c) cylindrical.]

e) The refractive index of glass is 1.66. The polarizing angle for such a glass slab is ……

f) SI unit of Poynting vector is ……..

g) If an electromagnetic wave is propagating in vacuum along z direction with its electric field given by $E = \hat{j}\,25\cos(kx - 2\pi \times 10^8 t)$, then k = ___.

h) At θ = ___, the Compton shift is maximum?

i) The 1st excited energy eigen function for a particle trapped inside a one dimensional potential well of infinite depth and width of 2 units is ……

j) The de Broglie wavelength associated with a 15kV electron is ……..

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

a) Define Q-factor of oscillator. For a weak damping case, write the relationship between the Q-factor and the natural frequency of the oscillator.

b) 20 waves of equal amplitude superpose incoherently to produce an intensity of 10 units. How much intensity would have produced if they superpose coherently?

c) Write two similarities and two dissimilarities between a zone plate and a convex lens.

d) Two pendulums of mass 50g each are suspended by massless rigid rods of length 0.98m. The two masses are coupled by a massless spring of force constant k=150 dyne/cm. Determine the normal mode frequencies of the coupled oscillator.

e) What are positive crystal and negative crystal?

f) Evaluate the curl of position vector.

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

h) Draw a neat labeled diagram to show Compton effect.

i) Calculate the momentum eigen value along x axis, if the eigen function is e^{5ix}.

j) What is quantum mechanical tunneling?

Part – B (Answer any four questions)

Q3 **a)** Set up the differential equation of motion for a damped harmonic oscillator subjected to a damping force proportional to the speed of the oscillator and then discuss different cases of damping oscillations. **(10)**

b) A mass of 0.1 Kg hung from a spring of spring constant 100 N/m is oscillating under a damping force of damping constant 1 Ns/m. If it is subjected to a driving force $F = 2\cos 50t$ N calculate the amplitude of oscillation and phase relative to the driving force in the steady state. **(5)**

Q4 **a)** With a neat schematic diagram, describe the experimental set up to obtain Newton's ring for reflected light. Derive the expression for the diameter of dark rings. Explain in brief how the wavelength of light can be determined using Newton's rings. **(10)**

b) Light source emitting the light of wavelengths $\lambda_1 = 6.0 \times 10^{-7} m$ and $\lambda_2 = 4.8 \times 10^{-7} m$ is used to obtain Newton's rings in reflected light. It is found that the n^{th} dark ring of λ_1 coincides with $(n + 1)th$ dark ring of λ_2. If the radius of curvature of the curved surface of the lens is 1.0 m, calculate the diameter of $(n + 1)th$ dark ring of λ_2. **(5)**

Q5 **a)** Derive the expression of resultant intensity for diffraction due to single slit and obtain the angular positions for principal maximum, minima and secondary maxima. **(10)**

b) A zone plate has a principal focal length 50 cm for $\lambda = 6000\, A^0$. What would be its principal focal length for $\lambda = 5000\, A^0$? **(5)**

Q6 **a)** State and explain Brewster's law. Show that, the transmitted and reflected rays are mutually perpendicular to each other if a beam of light incidents at polarizing angle. **(5)**

b) Describe the construction and working of a Nicol prism. Discuss its uses as a polarizer and as an analyser. **(7)**

c) The refractive indices of quartz for ordinary and extra-ordinary rays are 1.5442 and 1.5533 respectively. Calculate the thickness of a quarter-wave plate of quartz for sodium light of wavelength 5893 A^0. **(3)**

Q7	**a)**	Write Maxwell's equations for a conducting medium in the absence of any additional charge source. Obtain electromagnetic wave equations for this medium.	**(7)**
	b)	How Ampere's law is modified by Maxwell?	**(3)**
	c)	The maximum value of electric field in an electromagnetic wave in vacuum is 800 V/m. Calculate the peak value of magnetic field intensity and the average value of Poynting vector.	**(5)**
Q8	**a)**	What is photo electric effect? Write the laws of photoelectric effect. Write Einstein's photoelectric equation by clearly defining the terms involved in it.	**(7)**
	b)	Write the characteristics of wave function in quantum mechanics.	**(4)**
	c)	Using Heisenberg's uncertainty principle, calculate the average energy of an electron if it exists inside a nucleus.	**(4)**
Q9	**a)**	Derive the expressions for the reflection and transmission coefficients for a particle encountering a one dimensional potential step with energy greater than the height of the potential barrier.	**(10)**
	b)	One million electrons with energy 15 eV incidented at a one dimensional potential step barrier of height 5 eV. Calculate the number of electrons reflected from the barrier.	**(5)**