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

Total Number of Pages : 03 **B.Tech.**
15BS1102

2nd Semester Back Examination 2017-18
PHYSICS
BRANCH : AEIE, AERO, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CSE, ECE, EEE, EIE, ELECTRICAL, ENV, ETC, FASHION, FAT, IEE, IT, ITE, MANUFAC, MANUTECH, MARINE, MECH, METTA, METTAMIN, MINERAL, MINING, MME, PE, PLASTIC, TEXTILE
Time : 3 Hours
Max Marks : 100
Q.CODE : C799

Answer Part-A which is compulsory and any four from Part-B.
The figures in the right hand margin indicate marks.
Answer all parts of a question at a place.

Part – A (Answer all the questions)

Q1 **Answer the following questions: *multiple type or dash fill up type*** **(2 x 10)**

a) Write the quantum mechanical operator form of velocity in three dimension.
a. $i\hbar\nabla$ b. $-i\frac{\hbar}{m}\nabla$ c. $-i\frac{\hbar^2}{m}\nabla$ d. $-i\frac{\hbar^2}{2m}\nabla^2$

b) Find the maximum velocity of a particle executing Simple Harmonic Motion (S.H.M) of a period 10π second and amplitude 5×12^{-2}m.
a. $1\text{x }10^{-2}$sec b. $2\text{x }10^{-2}$sec c. $3\text{x }10^{-2}$sec d. $4\text{x }10^{-2}$sec

c) X-rays with wave length λ = $1A^0$ are scattered from a carbon block. The scattered radiation is viewed at 90^0 to the incident beam. What is the Compton shift ∆λ?
a. $2.4\text{x}10^{-12}$ m b. $3.4\text{x}10^{-12}$ m c. $4\text{x}10^{-12}$ m d. none

d) Which of the following relation(s) can be used to determine de Broglie's wavelength associated with a particle of mass 'm' and having energy E?
a. $\frac{h}{\sqrt{2mqv}}$
b. $\frac{h}{\sqrt{3mkT}}$
c. $\frac{h}{\sqrt{2mE}}$
d. All of the above

e) Einstein's photoelectric equation is based on law of conservation of :
a. Momentum
b. angular momentum
c. energy
d. none of the above

f) Rayleigh-Jeans law is correct only in the
a. low wavelength region of black body radiation spectrum;
b. High wavelength region;
c. entire wavelength region;
d. None of these

g) Consider a diffraction grating of width 5 cm with slit width 0.0001 cm separated by a distance of 0.0002 cm. What are grating element and maximum order would be observable if $\lambda = 5.5\text{x}10^{-5}$ cm.
a. $5\text{x}10^{-4}$ cm and 6
b. $5\text{x}10^{-4}$ cm and 5
c. $3\text{x}10^{-4}$ cm and 5
d. $3\text{x}10^{-4}$ cm and 6

h) In Newton's ring set-up, the diameter of the fourth ring was found to be 0.4 cm and that of 24th ring was 0.8 cm. The radius of curvature of plano-convex lens is 100 cm. Calculate the wavelength of light source.

i) The resonant frequency of a forced oscillator of natural frequency ω_0 in a medium of damping coefficient γ is

a. $\omega_r = \omega_0$b.

b. $\omega_r = (\omega_0^2 - \gamma^2)^{\frac{1}{2}}$

c. $\omega_r = (\omega_0^2 - \gamma^2)^{\frac{1}{4}}$

d. $\omega_r = (\sqrt{\gamma^2} - \omega_0)$

j) If on rotating the analyzer the emergent light does not change in intensity ,then it is:

a. either plane polarized or partially polarized
b. either unpolarised or circularly polarized
c. either partially polarized or elliptically polarized
d. only circularly polarized.

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

a) What is damping? Does the principle of conservation of energy holds good in case of damped vibration? Explain.

b) A simple pendulum of one meter length is hang at one end. Considering the oscillations to be of small displacement, find the period of oscillation if the mass of the pendulum is 2.0 kg. (g = 9.8 m/s^2)

c) What is the physical significance of probability density?

d) Find the directional derivative of the scalar function $\phi = 2xz^4 - x^2y$ at the point (2, 1 -1).

e) What is the basic difference between classical and quantum mechanical measurements.

f) Differentiate between Fresnel and Fraunhofer's diffraction.

g) A particle is trapped in a one-dimensional box of length 'L' is described by the normalized wave function $\psi = ax$; what is the expectation value of position<x>?

h) If $\frac{1}{2}, \frac{1}{3}\ and \frac{1}{6}$ are the probabilities that the system be in three states represented by the eigen functions$\Psi_1, \Psi_2\ and\ \Psi_3$ and energy eigen values 2 eV, 3 eV and 6 eV respectively. Write down the eigen function of the system and find out the energy expectation value for the system.

i) What is pair production?

j) What do you mean by displacement current?

Part – B (Answer any four questions)

Q3 **a)** Give the theory of Newton's ring and how from their study the wavelength of monochromatic light can be determined? Explain why the central fringe is dark? How can it be made bright? **(10)**

b) If x is the displacement, ω is the angular frequency, A is the amplitude of an object executing SHM, then discuss about average kinetic and average potential energy of the system. Draw variation of kinetic energy and potential energy with displacement. **(5)**

Q4 **a)** State and interpret Heisenberg's uncertainty principle. Using uncertainty principle estimate the ground state energy of a linear harmonic oscillator. **(10)**

b) Normalize the wave function for given$\psi_n(x) = \begin{cases} A\sin\left(\frac{n\pi x}{a}\right) & 0 < x < a \\ 0 & otherwise \end{cases}$ **(5)**

Q5 **a)** State Poynting theorem. Explain how the pointing vector explains the enegy flow. **(8)**

b) Derive a relation between magnitudes of electric vector and magnetic vector. **(5)**

c) Magnetic vector potential for current network is given by$\vec{A} = \hat{\imath}xy^2 + \hat{\jmath}yz^2 + \hat{k}zx^2$, Find the magnetic induction at (1,1,1). **(2)**

Q6 **a)** Derive the conditions for constructive and destructive interference for two sources with constant phase difference. **(6)**

b) Mention the similarities and difference between a zone plate and a convex lens. **(5)**

c) A parallel beam of light is incident normally on a plane diffraction grating having 4300 lines/cm. A second order spectral line is found to be deviated through an angle of 30^0. Determine the wavelength of spectral line. **(4)**

Q7 **a)** Explain the phenomenon of double refraction in a calcite crystal. Give the construction and working of half wave plate and quarter wave plate. **(10)**

b) Two Nicol prisms are crossed to each other. Now one of them is rotated through 60^0.What percentage of incident unpolarised light will pass through the system. **(5)**

Q8 **a)** Writing the Einstein's photoelectric equation, mention the laws of photoelectric effect. How quantum mechanical approach overcome the limitations of classical physics. **(10)**

b) Write down the differential and Integral form of Maxwell's equations. **(5)**

Q9 **a)** Write down the equation of motion for a damped harmonic oscillator of mass 'm' and obtain its solution in different condition. **(10)**

b) If $\vec{E} = E_x\hat{\imath} + E_y\hat{\jmath} + E_z\hat{k}$, Prove that div(Curl$\vec{E}$) = 0, i.e.,$\vec{\nabla}.\left(\vec{\nabla} \times \vec{E}\right) = 0$ **(5)**