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

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

15BS1102

1st Semester Back Examination: 2017-18

Physics-I

BRANCH (s): , AEIE, BIOTECH, CHEM, CIVIL, CSE, ECE, EEE, EIE, ELECTRICAL, ETC, IEE, IT, MANUTECH, MECH, MINERAL, MINING, MME, PE, TEXTILE

Time: 3 Hours

Max Marks: 100

Q.CODE: B843

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 questions)

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

a) In simple harmonic motion kinetic energy is maximum at
(i)equilibrium position (ii) extreme position (iii) any position between extreme and minimum position (iv) none of the above

b) The maximum velocity of a particle executing SHM represented by $x=A\sin\omega t$ at time t occurs at (i) x=0; (ii) x=A; (iii) x=-A; (iv) x=A/2

c) What should be the path difference between two coherent waves of wavelength such that there will be constructive interference?
(i)$N\lambda$ (ii) $(2N+1)\lambda$ (iii) $(2N-1)\lambda$ (iv) none of the above

d) What is the phase difference between two waves originating from two consecutive Fresnel's half period zones?
(i)0 (ii) $\pi/2$ (iii) π (iv) 2π

e) What type of wavefront is incident in the case of Fresnel's diffraction?
(i)Plane (ii) Spherical (iii) cylindrical (iv) elliptical

f) The refractive index of certain glass is 1.5. What is the polarizing angle for this glass surface?
(i)55^o (ii) 56^o (iii) 57^o (iv) 58^o

g) The divergence of a position vector in XYZ plane is
(i)3 (ii) 9 (iii) 12 (iv) 15

h) Velocity of light in free space is given by c
(i)$c=\sqrt{\mu_o\varepsilon_o}$ (ii) $c=\sqrt{\mu_o}/\sqrt{\varepsilon_o}$ (iii) $c=\sqrt{\varepsilon_o}/\sqrt{\mu_o}$ (iv) $c=1/\sqrt{\mu_o\varepsilon_o}$

i) Through what potential difference should an electron be accelerated so that its de-broglie wavelength becomes 5500 A^o.
(i)4.98×10^{-6} V (ii) 4.98×10^{-5} V (iii) 4.98×10^{-4} V (iv) 4.98×10^{-3} V

j) Name a phenomenon where energy is converted into matter.
(i)Compton effect (ii) photoelectric effect (iii) pair production
(iv) Radioactive decay

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

a) What do you mean by critically damped harmonic oscillation? Write its applications.

b) Show graphically under damped, over damped and critically damped harmonic oscillations.

c) What are the conditions for sustained interference?
d) Write few differences between interference and diffraction.
e) Define optical rotation and write its unit.
f) State Gauss law in electrostatic field. Write its integral and differential form.
g) State Stoke's theorem.
h) Show that vector $\mathbf{A}=(x+3y)\mathbf{i} + (y+ az)\mathbf{j} +(x+az)\mathbf{k}$ is solenoidal.
i) What is the need of Quantum mechanics?
j) What is quantum mechanical tunneling?

Part-B (Answer any four questions)

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

b) The time period of simple harmonic oscillator is 4s. It is subjected to a damping force proportional to its speed with damping co-efficient 0.1/s. Find the time period and logarithmic decrement when subjected to damping forces. **(5)**

c) Differentiate between progressive and stationary wave. **(5)**

Q4 **a)** Give the theory of Newton's rings and how to determine the refractive index of transparent liquid using it. **(5)**

b) A source of light emitting two wavelengths λ_1=6000 A^o and λ_2=4500 A^o is used for Newton's rings. It is found that the n^{th} dark ring due to λ_1 coincides with $(n+1)^{th}$ dark ring for λ_2. If the radius of curvature of the convex surface is 100 cm, find the diameter of nth dark ring for λ_2. **(5)**

c) A slit illuminated by a monochromatic light is placed at a distance of 10 cm from a biprism of refractive index 1.5 and base angle 2^o. If the distance between two dark fringes is 0.18 mm, as observed on a screen placed at a distance of 1 m from the biprism. Find the wavelength of light. **(5)**

Q5 **a)** Write some similarities and dissimilarities between zone plate and convex lens. **(5)**

b) A plane diffraction grating of width 2.5 cm has 1500 rulings. Monochromatic light of wavelength 5893 A^o is incident normally on it. Find the angle at which second order principal maximum occurs. **(5)**

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

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

b) Distinguish between e-ray and o-ray. **(5)**

c) The refractive indices of a double refracting material for o-ray and e-rays for wavelength, 5500 A^o are 1.588 and 1.594 respectively. Calculate the required thickness of the material for, (i) half wave plate (ii) quarter wave plate. **(5)**

Q7 **a)** With the help of Gauss divergence theorem, show that the volume of a sphere is $\pi d^3/6$, where d is the diameter of the sphere. **(5)**

b) Derive electromagnetic wave equations in conducting medium and write the dissipative terms. **(5)**

c) Distinguish conduction current and displacement current. **(5)**

Q8 **a)** Define Poynting vector. Deduce Poynting theorem for the flow of energy in an electromagnetic field. **(5)**

b) State Heisenberg's uncertainty principle and using it show that electrons cannot reside inside a nucleus. **(5)**

c) Define group velocity and find a relation between group velocity and phase velocity. **(5)**

Q9 **a)** The probability that a system can be in the states represented by eigen functions ψ_1, ψ_2, ψ_3 are ½, 1/3, ¼ respectively. Write the wave function for the system. If the energy eigen values for the given states are 2 eV, 3 eV and 4 eV respectively, find the energy expectation value. **(5)**

b) Write the Schrodinger's equation for an infinitely deep one dimensional potential well and find expression for the wave function and energy of the particle. **(5)**

c) Calculate the expectation value of x-component of momentum of a free particle in a box of length l,
$\Psi=\sqrt{(2/l)}\ [\sin(n\pi x/l)]$