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

Total Number of Pages : 03 **B.Tech.**
PAP2A101

2nd Semester Regular / Back Examination 2017-18
APPLIED PHYSICS
BRANCH: AEIE, AERO, AUTO, BIOMED, BIOTECH, CHEM, CIVIL, CSE, ECE, EEE, EIE, ELECTRICAL, ENV, ETC, FAT, IEE, IT, MANUFAC, MANUTECH, MECH, METTA, MINERAL, MINING, MME, PE, PLASTIC, PT, TEXTILE
Time : 3 Hours
Max Marks : 100
Q.CODE : C803

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:** **(2 x 10)**

a) The photoelectric effect signifies the ……..
(i) Wave nature of light
(ii) particle nature of light
(iii) both(i)&(ii)
(iv) none of these

b) Condition for obtaining minima in Fraunhofer diffraction patterns due to a single slit is ……
(i) $d\cos\theta = \frac{1}{\lambda}$
(ii) $d\sin\theta = \frac{1}{\lambda}$
(iii) $d\sin\theta = \pm m\lambda$
(iv) $d\sin\theta = \frac{1}{\pm m\lambda}$

c) In a Bi prism experiment, 5mm wide fringes are obtained on a screen placed 1.0m away from coherent sources using a light of wavelength 5000A0. The separation between the two coherent resources is
(i) 1.0mm (ii) 0.1mm (iii) 0.01mm (iv) 0.05mm

d) The de Broglie wave length of a particle of mass m and kinetic energy E_k is given by……
(i) $\lambda = hc/\sqrt{[E_k(E_k + 2mc^2)]}$ (ii) $\lambda = hc/\sqrt{[2E_k(E_k + 2mc^2]}$
(iii) $\lambda = hc/\sqrt{[E_k(E_k + mc^2)]}$ (iv) $\lambda = hc/\sqrt{[2E_k(E_k + 2mc^2)]}$

e) For a simple cubic structure, packing fraction is ……
(i) 0.52 (ii) 0.74 (iii) 0.68 (iv) 0.51

f) The equation of continuity for charges explains
(i) Non-conservative nature of charge
(ii) conservation of charge for a static electric field
(iii) conservation of charge for a non-static electric field
(iv) non-destructive nature of charge

g) The wavelength of a HE-Ne LASER generating 3.147mW power is632.8 nm. When it is in operation, the number of photons emitted per minute is ……..
(i) 4.79×10^{14} (ii) 3.14×10^{-19} (iii) 0.5×10^{9} (iv) 6×10^{17}

h) A mathematical function can be considered as a quantum mechanical wave function if the probability density is
(i) positive and finite
(ii) negative and finite
(iii) positive and infinite
(iv) finite and either positive or negative

i) In a Compton scattering process, the wavelength of the incident beam changes from .5 nm to …… when scattered at an angle 45^0.
(i) 1.49nm (ii) 0.78nm (iii) 0.5nm (iv) none of these

j) For a high damping factor, the resonance ……..
(i) is very high
(ii) is unaffected
(iii) is flatter
(iv) varies linearly

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

a) Graphically show the variation of phase difference between the oscillator and driving force with frequency for two representative damping forces.

b) State de Alembert's principle.

c) The photoelectric threshold of tungsten is $2300A^0$.Determine the energy of the electron ejected from the surface by ultraviolet light of wavelength $1800A^0$.

d) Write two applications of LASER.

e) The refractive indices of for core and cladding for a step index fibre are 1.52 and 1.41 respectively. Calculate the numerical aperture of the fibre.

f) Write in SI unit system, the integral and differential forms of Gauss' law in electrostatics in a dielectric medium.

g) The wave function of a system is a linear combination of the eigen function $\varphi_1, \varphi_2, \varphi_3, \varphi_4 \; and \; \varphi_5$

$$= \frac{1}{\sqrt{3}}\varphi_1 + \frac{1}{\sqrt{3}}\varphi_2 + \frac{1}{\sqrt{6}}\varphi_3 + \frac{1}{\sqrt{24}}\varphi_4 + \frac{1}{\sqrt{8}}\varphi_5$$

h) A parallel plate capacitor having circular plates of radius 5.5 cm is being charged. Calculate the displacement current if the rate of change of electric field between the plates is $1.5x10^{10}$ V/m.s.

i) Mass of proton is approximately 1840 times of the mass of an electron. Calculate the ratio of the de Broglie wavelengths of electron and proton if both the particles move with same velocity.

j) State and explain Heisenberg's uncertainty principle.

Part – B (Answer any four questions)

Q3 **a)** What are normal coordinates? Set up the differential equations of motion of two pendulums of equal masses coupled together by a spring and hence find out the normal mode frequencies. Discuss the in phase mode and out of phase mode of oscillations. **(10)**

b) Apply Lagrange's equation of motion to obtain the differential equation for a one dimensional harmonic oscillator. **(5)**

Q4 **a)** Derive an expression for fringe spacing in a two source interference pattern. **(5)**

b) With neat diagrams, explain in detail, the determination of wavelength of light using Fresnel's Biprism. **(7)**

c) The diameter of the central zone of a zone plate is 2.3mm. If a point source of light of wavelength $\lambda = 5893\, A^0$ is placed at a distance of 6.0m from the zone plate, calculate the position of the first image. **(3)**

Q5 **a)** What is band theory of solids?Discuss the classification of materials on the basis of band theory of solids. **(8)**

b) State and explain Bragg's law. **(3)**

c) X-ray of wavelength $1.4\, A^0$ is found to be Bragg reflected from (111) plane of an fcc crystal structure. If the lattice parameter of the crystal is $5A^0$, find the angle at which the X-ray is incident on the (111) plane of the crystal. **(4)**

Q6 **a)** What does LASER stand for? Describe in detail, the components, principle of operation and working of a Ruby LASER. **(10)**

b) Write five differences between step-index and graded-index optical fibers. **(5)**

Q7 **a)** Define curl of a vector field. Write its physical significance. **(7)**
Find the curl of the vector field is given by $\vec{A} = -\frac{2z^2y}{x^3}\hat{\imath} + \frac{z^2}{x^2}\hat{\jmath} + \frac{2yz}{x^2}\hat{k}$.

b) State Ampere's circuital law. Write the integral and differential forms of Ampere's law in free space in SI unit. **(4)**

c) Distinguish between real current and displacement current. **(4)**

Q8 **a)** Derive the condition for obtaining minima and maxima for the diffraction pattern due to a single slit. **(6)**

b) Calculate the probability of finding a particle in the region $2 \leq x \leq 4$, if the wavefunction for the particle is given by $\psi = 0.25e^{2ix}$. **(4)**

c) Using the uncertainty principle derive the ground state energy of harmonic oscillator. **(5)**

Q9 **a)** With a neat labeled diagram, describe the construction of Michelson interferometer. **(5)**

b) What are Miller indices? Explain the steps to find out these indices of a crystal plane from the intercepts made by this plane along the three axes. **(4)**

c) What is expectation value of an observable? A particle is observed to have five quantum mechanical states $\psi_1, \psi_2, \psi_3, \psi_4$ and $\psi_5$with relative probabilities 0.2, 0.1, 0.3, 0.2 and 0.2 respectively. If the corresponding energy eigen values for these states are 2 eV, 3eV, 3 eV, 1eV, 1 eV then calculate the energy expectation value. **(3)**

d) Write some of the advantages of optical fibers over conventional wires. **(3)**