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Total Number of Pages:02

**B.Tech**  
**15BS1102**

**2<sup>nd</sup> Semester Regular / 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,**

**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.**

**Part – A (Answer all the questions)**

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

- A system of 2N particles having K number of constraints has degrees of freedom  $f = ?$
- Find the maximum velocity of a particle executing Simple Harmonic Motion (S.H.M) of a period  $10\pi$  second and amplitude  $5 \times 12^{-2}$  m.
- X-rays with wave length  $\lambda = 1 \text{ \AA}$  are scattered from a carbon block. The scattered radiation is viewed at  $90^\circ$  to the incident beam. What is the Compton shift  $\Delta\lambda$ ?
- What do you mean by Ultraviolet catastrophe?
- Mention two characteristics of photon.
- What is the physical significance of probability density?
- What do you mean by population inversion?
- State Gauss divergence theorem and write its mathematical form.
- What is the physical significance of  $\nabla \cdot B = 0$  and explain it.
- What do you mean by Miller indices?

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

- What is damping? On what factors damping depends?
- 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. ( $g = 9.8 \text{ m/s}^2$ )
- Find the eigen function for the operator:  $x + \frac{d}{dx}$
- The work function of Sodium metal is 2.3 eV. What is the longest wave length of light that causes photoelectric emission from Sodium?
- Prove that  $\nabla \cdot \vec{r} = 3$
- Find the unit vector perpendicular to the vectors,  $\vec{A} = 3\hat{i} - 2\hat{j} + 4\hat{k}$  and  $\vec{B} = \hat{i} + \hat{j} - 2\hat{k}$
- 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?
- 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  $\Psi_3$ . Write down the eigen function of the system.

- i) Find the inter-planer spacing for a (321) plane in a simple cubic lattice whose lattice constant is  $4.2 \times 10^{-8}$  cm.
- j) What do you mean by diffraction?

**Part – B (Answer any four questions)**

- Q3** a) Explain the working principle of Michelson's interferometer. How do you find out the wave length of an unknown light source using Michelson's interferometer? **(10)**
- b) Find out the differential equation of a Spring mass system, If 'm' is the mass of the object attached at one end and is free to move on frictionless surface. The spring constant is given by K. **(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  $\psi_n(x) = \begin{cases} A \sin\left(\frac{n\pi x}{a}\right) & 0 < x < a \\ 0 & \text{otherwise} \end{cases}$  **(5)**
- Q5** a) Explain the working principle of a He-Ne laser with energy level diagram. Write the characteristics of laser light. Why two level laser is not possible? **(10)**
- b) The refractive index of core and cladding for a step-index optical fibre are 1.54 and 1.42 respectively. Calculate the numerical aperture and acceptance angle of optical fibre. **(5)**
- Q6** a) Mention laws of Photo-electric effect. How classical mechanics fails to explain photo-electric effect and what was Einstein's explanation? **(10)**
- b) What is the maximum wavelength of light that will cause photoelectrons to be emitted from Sodium? What will be the maximum kinetic energy of the photoelectrons be if 200 nm light falls on the Sodium surface (work function = 3.9 eV) **(5)**
- Q7** a) What do you mean by Miller indices? Write down the general procedure to find out the Miller indices of a plane? **(7)**
- b) On the basis of band theory, distinguish between, conductors, semiconductors and insulators. **(5)**
- c) What do you mean by Brillouin zone? Draw the 1<sup>st</sup> and 2<sup>nd</sup> Brillouin zone of a two-dimensional square lattice. **(3)**
- Q8** a) Differentiate between Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein's statistics. **(7)**
- b) .what is the physical significance of Curl of a vector function? **(3)**
- c) 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) Obtain the equation of motion of a simple pendulum from its Lagrangian representation. **(5)**