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Name: Enr

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JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY, NOIDA

B. Tech. 1st year, EVEN SEMESTER (2011-12)

TEST – 3

Course Code : 10B11PH211/ 07B21PH102
Course Name : Physics –II
Course Credit: 4

Sem 2

Max. Time : 2 Hrs
Max. Marks: 35

Note: Answer all the questions.

1. a) Can a charge free region be associated with the electric potential $V = x^2+y^2+z^2$ Volt?
   b) Why a negative temperature at absolute scale is not possible?
   c) Show that the expectation values $\langle p_x x\rangle$ and $\langle x p_x\rangle$ are related by $\langle p_x x\rangle - \langle x p_x\rangle = \hbar/i$.
   d) Obtain $d_{100}:d_{110}:d_{111} = \sqrt{6}:\sqrt{3}:\sqrt{2}$ for a simple cubic lattice. **[4 x 2]**

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2. Find **D**, **B** and **H** for a given field $\mathbf{E} = E_0 \sin(\omega t - kz)\,\hat{\mathbf{j}}$ in free space. **[3]**

3. Establish the relation $v_g = v_p - \lambda(dv_p/d\lambda)$ where v_g and v_p are the group and phase velocities respectively. If $v_p = \sqrt{\frac{g\lambda}{2\pi}}$ for ocean waves then determine v_g. **[3]**

4. In a harmonic oscillator, the energy is given by $E = \frac{p^2}{2m} + \frac{1}{2}kx^2$. If the standard deviations in the position and momentum are $\Delta x = \frac{A}{\sqrt{2}}$ and $\Delta p = \frac{p_o}{\sqrt{2}}$ respectively, show that the minimum energy of a harmonic oscillator is $\frac{1}{2}h\nu$. **[3]**

5. The potential energy of two atoms is given by, $U(r) = -\frac{a}{r^2} + \frac{b}{r^{10}}$. Show that the binding energy in the state of stable configuration is $-\frac{4}{5}\left(\frac{a}{r_0^2}\right)$.

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[3]

6. Two Carnot engines A and B are operated in series. The first one A, receives heat at 727°C and rejects heat to reservoir at temperature T, the second engine B receives the heat rejected by the first engine and in turn rejects heat to the reservoir at -113°C. Calculate the temperature 'T' in each case (i) the work outputs of the two engines are equal (ii) the efficiencies of the two engines are equal. Also determine net change in the entropy of the system. **[5]**

7. Write down Schrödinger wave equation for one dimensional box, obtain the expressions for eigen function and eigen values. If the width of the box is 100Å, calculate the probability of finding the particle within an interval of 20 Å at the centre of the box when it is in the state of least energy. **[5]**

8. Determine c/a ratio in a hexagonal closed packed (hcp) structure. If the Zinc material has hcp structure with nearest neighbors distance 0.275nm and atomic weight 65. Calculate its mass and density. **[5]**

Constants: Avogadro number $N_A = 6.023\times10^{23}$, Planck's constant $h = 6.62 \times 10^{-34}$ J-s

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