Navrachana University

School of Liberal Studies and Education, B.Sc. Program

End Semester Examination May, 2017

First Year and Second Semester

Physics-II, PH-112

Date: 10/05/2017 **Total Marks- 40**

Duration: Two Hours (10.30 AM-12.30 PM)

Instructions:

- Answer all sections
- Use of non programmable scientific calculator is permitted.

A. Choose the correct answer **(1x10=10 Marks)**

1. If ΔE is the uncertainty in the measurement of energy of a particle and Δt is the time required for measurement, then the Heisenberg uncertainty relation is

   (a) $\Delta E\, \Delta t \leq (h/4\pi)$ (b) $\Delta E\, \Delta t \geq (h/4\pi)$ (c) $\Delta E\, \Delta t = 4\pi/h$

   (d) $\Delta E\, \Delta t \leq 4\pi/h$

2. Operator associated with x-component of linear momentum is

   (a) $i\left(\frac{h}{2\pi}\right)\partial/\partial t$ (b) $-i\left(\frac{h}{2\pi}\right)\partial/\partial t$ (c) $-i\left(\frac{h}{2\pi}\right)\partial/\partial x$

   (d) $i\left(\frac{h}{2\pi}\right)\partial/\partial x$

3. If $\Psi(x,t)$ represents wavefunction, then the probability density of finding a particle is given by

   (a) $|\Psi(x,t)|^2$ (b) $|\Psi(x,t)|^3$ (c) $|\Psi(x,t)|^{1/2}$

   (d) $|\Psi(x,t)|^{-1/2}$

4. An observer O' fixed with respect to an occurrence measures the interval Δt_o. An observer O moving with relativistic speed 'u' with respect to O' measures the time interval Δt for the same occurrence. The time dilation effect is represented by

   (a) $\Delta t = \Delta t_o / (1-u^2/c^2)^{1/2}$ (b) $\Delta t_o = \Delta t / (1-u^2/c^2)^{1/2}$ (c) $\Delta t = \Delta t_o$

   (d) $\Delta t = \Delta t_o / (1-u^2/c^2)$

   Where 'c' is the speed of light.

5. The curl of a vector function '**v**' is written mathematically as

(a) $\nabla . \mathbf{v}$ (b) $\nabla \times \mathbf{v}$ **(c) $\nabla \mathbf{v}$**

(d) $\nabla \times \nabla \mathbf{v}$

6. When the divergence of a vector field '**v**' is zero, then the vector field is regarded as

(a) solenoidal (b) irrotational (c) rotational

(d) complex

7. The atomic diameter of an BCC crystal (if a is lattice parameter) is

(a) a (b) a/2 (c)$a/(2/\sqrt{3})$ (d) $a/(4/\sqrt{2})$

8. Na and Mg crystallize in BCC and FCC type crystals respectively, then the number of atoms of Na and Mg present in the unit cell of their respective crystals is

(a) 4 and 2 (b) 9 and 14 (c) 4 and 9 (d) 2 and 4

9. The direction along the face diagonal of a unit cell of cubic crystal is denoted by

(a) [111] (b) [100] (c) [011] (d) [112]

10. Van der Waals bond is formed due to

(a) Coulomb interaction
(b) Sharing of electrons
(c) Electrons and ion cores interaction
(d) Dipole-dipole interaction

B. Answer <u>any seven</u> questions **(2x7=14 Marks)**

1. Show that group velocity of wave packets represents free particle velocity.
2. Write Einstein's postulates of special theory of relativity.
3. Find the gradient of the following scalar function

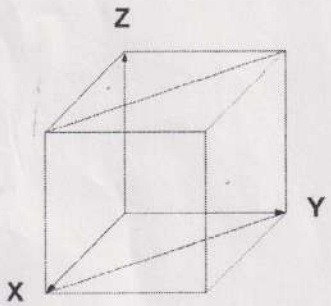
$$\Phi (x,y,z) = x^3 + y^3 + z^3$$

4. Write Ampere's law both in integral and differential forms.
5. Show that the work done by magnetic field is always zero.

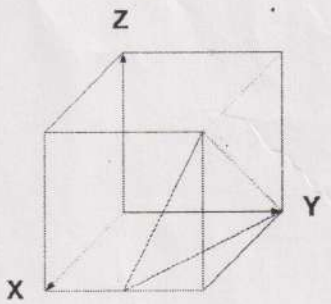
6. Why a face centered tetragonal unit cell is not included among Bravais lattices?
7. Write a short note on ABABA and ABCABC type of packing and give examples of each.
8. What is the difference between acoustic and optical phonons?
9. What is resolving power of an instrument? State Rayleigh criteria for resolution of two closely spaced objects.
10. What are conditions to form sustained interference of light waves?

C. Answer <u>any four</u> questions **(4x4=16 Marks)**

1. Write the experimental observations of photoelectric effect?
2. Derive an expression for time dilation effect.
3. An infinite plane carries uniform surface charge 'σ'. Find the electric field above and below the plane.
4. Draw the schematic of Newton's rings experiment. Write down conditions for constructive and destructive interference and hence derive expression for diameter of m^{th} dark ring.
5. Derive expression for lattice specific heat using classical theory. Plot the same as observed experimentally and comment why the classical theory is unable to explain the experimental results.
6. Calculate Miller indices for the following crystal planes in unit cubical lattice.



(a)



(b)

All the best