AUTUMN END SEMESTER EXAMINATION-2015

1st Semester B.Tech & B.Tech Dual Degree

PHYSICS (PH-1003)

(Regular-2015 Admitted Batch)

Full Marks: 60 **Time: 3 Hours**

Answer any SIX questions including Question No.1 which is compulsory.

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable and all parts of a question should be answered at one place only.

1. Answer all questions. [2 × 10

(a) Explain missing order spectra in plane diffraction grating.

(b) An "excited" atom gives up its excess energy by emitting a photon of characteristic frequency. The average period that elapses between the excitation of an atom and the time it radiates is $1.0 \times 10^{-8}\ sec$. Find the inherent uncertainty in the frequency of the photon.

(c) State Gauss's divergence theorem.

(d) A wire of length L and radius r is clamped rigidly at one end. When the other end of the wire is pulled by a force f, its length increases by l. Another wire of the same material of length $2L$ and radius $2r$, is pulled by a force $2f$. Find the increase in length of this wire.

(e) Calculate the change in entropy when 10gm of ice at 0 ^{0}C is converted to water at same temperature (Given latent heat of fusion of ice is 80 cal/gm).

(f) What is reversible process? Explain with an example.

(g) An electron and a proton have the same velocity. Compare the phase and group velocities of their de Broglie waves.

(h) Find the Atomic radius and Packing factor for BCC structure in cubic lattice.

(i) Represent isothermal and adiabatic process in a T-S diagram. Show that the area below the curve representing the isothermal process in T-S diagram is equal to the work done during the process.

(j) The spacing between the principal planes of NaCl crystal is 2.82 Å. It is found that the first order reflection of a beam of monochromatic X-rays occur at an angle of 10^0. What is the energy of X-ray photon in ev?

2. (a) With a neat suitable diagram, explain the principle, construction and working of a Ruby laser. [6

(b) Does the interference phenomenon violate energy conservation principle? Explain mathematically. [2

3. (a) Define the four thermodynamic potentials. Show that during a reversible isothermal and isobaric change, the Gibb's function remains constant. [4+2

(b) Starting from the expression of amplitude in steady state solution of forced harmonic oscillator, derive the expression for resonant frequency in amplitude resonance. [2

4. With a neat diagram, explain the formation of Newton's rings due to reflected light. Show that the radii of bright rings are proportional to square root of odd natural numbers [2+6

and the radii of dark rings are proportional to the square root of natural numbers.

5. (a) Derive the following relation: [4

$$\frac{9}{Y} = \frac{1}{K} + \frac{3}{\eta}$$

Where, K stands for Bulk modulus, Y stands for Young's modulus and η is the Rigidity modulus.

(b) Derive an expression for numerical aperture of a step index optical fiber. [4

6. (a) Set up the time independent Schrodinger equation for a particle in a one dimensional infinite potential box. Obtain the expression for energy values and wave functions. [6

(b) What do you mean by stationary state? Explain. [2

7. Distinguish between conduction current and displacement current. Establish Maxwell's electromagnetic equations in differential form. [2+6

8. Starting from the expression for the intensity distribution in Fraunhofer diffraction due to a plane transmission grating, obtain the conditions for principal maxima, secondary maxima and minima. Graphically show the intensity distribution in the grating spectra for different orders. [1+2+2+2+1

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