# COLLEGE OF ENGINEERING, PUNE

(An Autonomous Institute of Government of Maharashtra.)
SHIVAJI NAGAR, PUNE - 411 005

## END Semester Examination

### (AS101) Physics1 TH

Course: B.Tech

Branch: Applied Science

23 NOV 2014

Semester: Sem I

Max.Marks:60

Year: 2014-2015

Duration: 3 Hours Time:- 10am - 1pm

**Instructions:**

**MIS No.** | | | | | | | | | | |

1. Figures to the right indicate the full marks.
2. Mobile phones and programmable calculators are strictly prohibited.
3. Writing anything on question paper is not allowed.
4. Exchange/Sharing of anything like stationery, calculator is not allowed.
5. Assume suitable data if necessary.
6. Write your MIS Number on Question Paper
7. All questions compulsory

**Q.1.a)** Derive the condition for resultant intensity in case of multiple slit diffraction and find the conditions for principal maxima and minima. **5M**

**b).** i) Derive Q value of a nuclear reaction. **4M**

ii) Calculate Q value of the reaction: $_{7}N^{14} + {}_{2}He^{4} \longrightarrow {}_{1}P^{1} + {}_{8}O^{17}$

Mass of $_{2}He^{4}$ = 4.002603 amu, Mass of $_{7}N^{14}$ = 14.0031 amu
Mass of $_{1}P^{1}$ = 1.007825 amu, Mass of $_{8}O^{17}$ = 16.9994 amu

**c)** A three level laser emits laser light at a wavelength of 550 nm, if optical pumping mechanism is shut down what will be the ratio of population of upper level to that of lower level, ($T = 300^{O}K$). Given($k=8.62 \times 10^{-5}$ eV, $h=6.62\times10^{-34}$J–Sec) **3M**

OR

**c)** Calculate the angles at which the first dark band and the next bright band are formed in the fraunhoffer diffraction pattern of a slit width 0.3mm. (Assume $\lambda = 5890\ A^{0}$) **3M**

**Q.2.a)** The wave function of a certain particle is $\psi = A\cos^{2}x$ for $0 \le x \le \pi/2$. **6M**
(i) Find the value of A
(ii) Find the probability that the particle be found between x = 0 and $x = \pi/4$.

**b)** A particle propagating along +x direction and has a potential barrier defined as **4M**

| | |
|---|---|
| $V = 0$ | $x < 0$ |
| $V = V_0$ | $0 \le x \le a$ |
| $V = 0$ | $x > a$ |

Write the Schrödinger's wave equations and its solutions for all the three regions

**c)**The eigen function for momentum operator is $e^{ikx}$ Find the eigen value. **2M**

OR

**c)** Calculate the de-Broglie wavelength of an electron moving with speed $1/5^{th}$ of the velocity of light. (Given: mass of electron = $9.1 \times 10^{-31}$ kg and c = $3 \times 10^{8}$m/s). **2M**

**Q.3.a)** Obtain Schrodingers time independent equation from time dependent equation and show that time part of wavefunction is $\varphi(t) = e^{-i\omega t}$ **5M**

**b)** Explain the principle, construction and working of Semiconductor laser with energy level diagram. **4M**

**c)** Suppose a wedge shaped air film is made between two sheets of glass, with a piece of paper $7.618 \times 10^{-5}$m thick used as the spacer at their very ends. If light of wavelength 500nm comes down from directly above. Determine the number of fringes that will be seen across the wedge. **3M**

OR

**c)** Show that (coherent) light waves represented by equations **3M**
$E_1 = E_x \cos(\omega t - kz)$ and $E_2 = E_y \cos(\omega t - kz + \theta)$ give rise generally to an elliptically polarized wave.

**Q.4.a)** Show that the superposition of two oppositely circularly polarized waves of same frequency and amplitude result in plane polarized waves. **4M**

**b)** Explain principle, construction and working of G.M.Counter. **4M**

**c)** An electron is trapped in an infinitely deep potential well 3 $A^{O}$ in length, if the electron is in ground state, what is the probability of finding it within 1$A^{O}$ of the left hand wall? **4M**

**Q.5.a)** Explain in detail principle, construction and working of He-Ne laser. **5M**

**b)** In a certain Cyclotron, the maximum radius that the path of a deuteron may have before it is deflected out of the magnetic field is 20cm. (i) Calculate the velocity of the deuteron at this radius (ii) What is the energy of deuteron in MeV? (Given: Magnetic field = 1500 gauss, Mass of deuteron = $3.34 \times 10^{-27}$ kg, Charge of deuteron = $1.6 \times 10^{-19}$C ). **4M**

**c)** A plane polarized light is incident perpendicularly on a quartz plate cut with faces parallel to optic axis. Find the thickness of quartz plate, which introduces phase difference of $60^{0}$ between e-ray and o-rays. **3M**

**********