Institute of Engineering & Technology
BE I Year (ETC-A & Mech. Engg.)
Test III – 2APRC2 Applied Physics

Time : 60 Min.

Max. Marks : 20

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2. Explain the principle of LASER light with the description of Ruby laser. 8

Any one

LASER stands for "Light Amplification by Stimulated Emission of Radiation." The principle involves stimulating atoms or molecules to emit photons of light in a coherent and focused manner.

In a Ruby laser, the active medium is a synthetic ruby crystal, typically chromium-doped aluminum oxide. Here's a brief explanation of the process:

1. Pumping: Energy from a flashlamp or another light source is used to pump the ruby crystal. This energy excites the chromium ions within the crystal to a higher energy state.

2. Stimulated Emission: When the

chromium ions return to their lower energy state, they release photons. This process is called stimulated emission, where incoming photons trigger the emission of more identical photons.

3. Mirrors :The ruby crystal is placed between two mirrors—one fully reflective and the other partially reflective. The mirrors create an optical cavity that allows photons to bounce back and forth.

4. Amplification:As photons move back and forth between the mirrors, they stimulate further emissions, leading to the amplification of light. This coherent light builds up in intensity.

5. Output: The partially reflective mirror allows some light to escape, resulting in a highly collimated and coherent laser beam being emitted.

The Ruby laser typically emits red light due to the specific energy levels of the chromium ions in the crystal. This coherent and focused beam of light has various applications, including scientific research, medical procedures, and early laser experiments.

Any one

3. Copper has an f.c.c. structure with lattice constant a = 3.61 A⁰. Calculate the radius of copper atom.

$r_{\text{octahedral}} = 0.414R$ a = 3.61 A°

for FCC $4R = \sqrt{2}a$

$$R = \frac{\sqrt{2}a}{4}$$

$$r = \frac{0.414\sqrt{2}a}{4} = \frac{0.414\sqrt{2} \times 3.61}{4} = 0.53\text{Å}$$

4. Compute the de Broglie's wavelength of 10^{11} keV neutrons. Given mass of neutron = 1.675×10^{-27} Kg. 4

4

● **Explaination -**

Given -

$E = 10$ KeV $= 10 \times 10^3 \times 1.6 \times 10^{-19} = 1.6 \times 10^{-15}$ V

Solution -

de Broglie's wavelength of neutron is calculated by -

$$\lambda = h / \sqrt{(2mE)}$$

$$\lambda = 6.63 \times 10^{-34} / \sqrt{(2 \times 1.675 \times 10^{-27} \times 1.6 \times 10^{-15})}$$

$$\lambda = 6.63 \times 10^{-34} / 2.315 \times 10^{-21}$$

$$\boldsymbol{\lambda = 2.864 \times 10^{-13}\ \mathrm{m}}$$

Therefore, de Broglie wavelength would be 2.864×10^{-13} m.