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Total No. of Questions : 11 ]

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# **BPF-2236**

**M.Sc. (Final) Examination, 2022**

**PHYSICS**

Paper - VIII(a)

**(Physics of Lasers and Science and Technology of Solar  
Hydrogen)**

*Time : 3 Hours ]*

*[ Maximum Marks : 75*

**Section-A**

**(Marks : 2 × 10 = 20)**

*Note :-* Answer all *ten* questions (Answer limit **50** words). Each question carries **2** marks.

**Section-B**

**(Marks : 5 × 5 = 25)**

*Note :-* Answer all *five* questions. Each question has internal choice (Answer limit **200** words). Each question carries **5** marks.

**Section-C**

**(Marks : 10 × 3 = 30)**

*Note :-* Answer any *three* questions out of five (Answer limit **500** words). Each question carries **10** marks.

**Section-A**

1. (i) Draw the energy level diagram for a three level laser and mention types of transitions in it.

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- (ii) Draw the schematic for Kerr-lens mode locking. Give a brief description.
- (iii) Discuss the property of a laser beam which makes it useful for surgery.
- (iv) Why optical fibers are used in communication ?
- (v) Explain the photovoltaic effect with the help of a band level diagram.
- (vi) Why dye lasers are called Tunable ?
- (vii) Define fill factor and efficiency of a solar cell.
- (viii) Why amorphous silicon is mostly used in thin film solar cells ?
- (ix) Why special methods are needed for the storage of hydrogen fuel ?
- (x) "Hydrogen is a future of energy economy." Make a comment.

**Section-B**

2. Draw the stability graph for a two-mirror spherical resonator cavity and explain it.

*Or*

For a four-level laser, show that :

$$\frac{\Delta N}{N} \approx \frac{W_p}{W_p + T_{32}}$$

where  $\Delta N$  is the population inversion density.

3. (a) Draw a schematic diagram for the experimental demonstration of second harmonic generation.
- (b) Discuss the second harmonic power output.

*Or*

Write a note on 'Types of Optical fibers in Lightwave communication'.

4. How pulsed lasers with high peak power are generated ? Explain.

*Or*

Write brief notes on each of the following :

- (i) Semiconductor lasers
  - (ii) Excimer laser
5. Write brief notes on each of the following :
- (i) Thin film Tandem solar cell
  - (ii) Gallium Arsenide solar cell

*Or*

Write brief notes on each of the following :

- (i) Solar thermal energy
  - (ii) Ocean thermal energy
6. Draw a schematic diagram of solar green hydrogen. Explain it.

*Or*

Discuss solid state hydrogen storage materials.

### Section-C

7. (a) Using diffraction divergence of a Gaussian laser beam, show that its diffraction angle is given by :

$$\theta = \tan^{-1} \left( \frac{\lambda}{\pi w_0} \right)$$

where,  $w_0$  is the spot size of the beam. 5

- (b) Mention five properties of Gaussian mode which make it suitable for laser systems. 5
8. (a) Discuss the role of laser induced fluorescence spectroscopy in detection of purity of a sample. 4

- (b) Draw a schematic diagram for the experimental observation of stimulated Raman emission. 3
- (c) Discuss the importance of laser in the observation of Raman shift. 3
9. (a) On what factors does the absorption coefficient in direct and indirect transition semiconductors depends upon ? Explain. 6
- (b) Discuss the rate of radiative recombination in semiconductors. 4
10. Write a note on photoelectrochemical water splitting. 10
11. Write a note on 'Types of Solar Cells'. 10