

Roll No. : .....

Total No. of Questions : 11 ]

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# **BFMS-458**

**M.Sc. (Final) Examination, 2023**

**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.

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### Section–A

1. (i) Write the properties of Gaussian Beam.
- (ii) Define Pulse shortening in reference to Picosecond and Femtosecond operation.
- (iii) Write four applications of lasers.
- (iv) What do you mean by Raman Scattering ?
- (v) Write difference in between solid state laser and gas laser.
- (vi) Write applications of semiconductor lasers.
- (vii) What are the materials used in fabrication of a solar cell ?
- (viii) What do you mean by short circuit current and open-circuit voltage ?
- (ix) Write various factors relevant to safety in use of Hydrogen as fuel.
- (x) What do you mean by fuel cells ?

### Section–B

2. Explain the concept of longitudinal and transverse modes of laser cavity.

*Or*

An injection laser has active cavity losses of  $25 \text{ cm}^{-1}$  and the reflectivity of each laser facet is 30%. Determine the laser gain coefficient for the cavity it has a length of  $500 \mu\text{m}$ .

3. Describe ultra high resolution spectroscopy with lasers. On which factors this depend ? Explain its limitations and applications.

*Or*

Describe laser induced multiphoton processes and their applications.

4. Draw the construction and electronic energy levels diagrams showing the output wavelength/frequency of Nd : Yagi Lasers.

*Or*

Derive Inter-relationship between absorption coefficients and show band gap recombination of carriers.

5. For an uniformly doped PN-junction solar cell, draw the energy band diagram and explain the working principle. Explain the various characterising terms involved in solar cell study.

*Or*

Give a brief description on single crystal silicon and amorphous solar cells.

6. Write principle and relevance of Photo-electrochemical solar cell in relation to depletion of fossile fuels and environmental considerations.

*Or*

Describe Physics of material characteristics for production of Solar Hydrogen.

### **Section–C**

7. Describe different mode selection, spectral narrowing and stablization methods for laser.
8. Show construction of an optical fiber with diagram and its classification in detail. What does the numerical aperture signify ?
9. Describing optical properties of solids write fundamentals of photovoltaic materials and explain energy conservation.
10. Write a note on solid liquid junction solar cell and wind energy.
11. Describe elementary concept of air conditioners and hybride batteries with reference to hydrogen based devices.