

M.Sc. PHYSICS
THIRD SEMESTER
NONLINEAR & FIBER OPTICS-I
MSP - 303C
[USE OMR FOR OBJECTIVE PART]

**SET
A**

Duration: 1:30 hrs.

Full Marks: 35

Time: 15 mins.

(Objective)

Marks: 10

Choose the correct answer from the following:

1X10=10

- Linear refractive index of a medium relates to its linear susceptibility via
 - $n = 1 + \chi$
 - $n^2 = 1 - \chi$
 - $n = \sqrt{1 + \chi}$
 - $n^2 = \sqrt{1 - \chi}$
- In the first experiment on nonlinear optics, _____ was produced by the application of a Ruby laser.
 - an UV light
 - an X-ray
 - an IR light
 - a γ -ray
- The electric field strength of conventional light sources can go up to
 - $E \sim 10^3 \text{ V/cm}$
 - $E \sim 10^7 \text{ V/cm}$
 - $E \sim 10^{11} \text{ V/cm}$
 - $E \sim 10^{15} \text{ V/cm}$
- For efficient frequency doubling, the necessary phase matching condition is
 - $\Delta k_1 = 0$
 - $\Delta k_2 = 0$
 - $k_2 - 2k_1 = 0$
 - $k_1 - 2k_2 = 0$
- In pre-laser era, what is considered for the energy of a photon proportional to?
 - Its frequency
 - Its voltage
 - Its speed
 - Its amplitude
- Parametric amplification can be used to convert a _____ frequency to a _____ frequency optical pulse.
 - low, low
 - high, high
 - low, high
 - high, low
- If a two-photon process leads to second-harmonic generation (SHG) the refracting indices of the pumping and the secondary waves will be related by
 - $n_p(\omega) = 2n_s(2\omega)$
 - $n_p(\omega) = n_s(2\omega)$
 - $n_p(\omega) = \frac{n_s}{2}(2\omega)$
 - $n_p(\omega) = n_s^2(2\omega)$

8. Which among the following material is preferred for making the core of optical fiber?
 - a. Air
 - b. Diamond
 - c. Glass
 - d. Quartz
9. Which of the following loss occurs inside the fibre?
 - a. Radiative loss
 - b. Scattering
 - c. Absorption
 - d. Attenuation
10. Which among the following is described by the concept of numerical aperture in an optical fibre?
 - a. Light collection
 - b. Light scattering
 - c. Light dispersion
 - d. Light polarization

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(Descriptive)

Time : 1 hr. 15 mins.

Marks : 25

[Answer question no.1 & any two (2) from the rest]

1. What do you mean by multi-photon process? Show that in multi-quantum photoelectric effect the threshold frequency lowers by a factor of number of photons. 1+4=5

2. Discuss the sum frequency generation (SFG) and different frequency generation (DFG) processes. Give applications of the SFG and DFG process. 5+5=10

3. Explain self-focusing of light and derive the relation how nonlinear refractive index of a medium is related to intensity of light 2+8=10

4. Discuss briefly the three-photon process. Establish the 'wave synchronism' condition in terms of refractive indices n , for efficient transfer of light in second harmonic generation (SHG). 10

5.
 - a. What is the basic principle of optical fiber in the transmission of optical signals? 1+4+1+4
 - b. Show schematically the construction of optical fiber and discuss the parts. =10
 - c. What do you understand by Fiber Loss? A fiber of 100 m length has $P_{in} = 10 \mu W$ and $P_{out} = 9 \mu W$. Find the loss in dB/km.

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