

M.Sc. PHYSICS  
SECOND SEMESTER  
ATOMIC, MOLECULAR & LASER PHYSICS  
MSP – 204 [REPEAT] [OLD COURSE]  
[USE OMR FOR OBJECTIVE PART]

**SET  
A**

Duration : 3 hrs.

Full Marks : 70

**(Objective)**

Time : 30 min.

Marks : 20

Choose the correct answer from the following:

1X20=20

- During amplification of beam, .....
  - stimulated emission must predominate over spontaneous emission.
  - spontaneous emission must predominate over stimulated emission.
  - stimulated emission does not occur.
  - spontaneous emission does not occur.
- The concentration of energy in a laser beam, both spatially and ----- accounts for great intensity of lasers.
  - temporally
  - distinctly
  - spectrally
  - directly
- The difference between the adjacent frequencies in a resonator is always
  - constant
  - variable
  - 1
  - $2\pi\lambda$
- The major drawback of conventional holographic process is the requirement of coherent ----- in the image reconstruction.
  - absorption
  - distribution
  - variation
  - illumination
- For a typical laser, the beam divergence is ----- 0.01 milliradian.
  - equal to
  - more than
  - less than
  - none of these
- The real image obtained in holography is called ----- image.
  - pseudoscopic
  - inverted
  - lateral
  - all of the above
- Power Density (PD), or light concentration is measured in -----
  - W/cm
  - W/cm<sup>2</sup>
  - W/cm<sup>3</sup>
  - mW
- Laser means Light Amplification by Stimulated Emission of Radiation and was first theorized by
  - Maiman
  - Ali Javan
  - Hertz
  - Einstein





5. a. Write down the expression of interaction energy of an electron in a weak magnetic field. State the selection rule for transition in Zeeman levels. Show the Zeeman splitting of Sodium D<sub>1</sub> line. 2+2+3+  
3=10
- b. Calculate the Zeeman shift of a spectral line of wavelength 500 nm in a magnetic field of one (01) Tesla.
6. Give the Quantum theory of Raman effect. Why classical theory is not accepted for Raman spectroscopy? 3+1+4+  
2 =10
- b. Discuss the rotational Raman spectrum of oxygen molecule. Calculate the wavenumber of first Stokes line of  $^{14}N_2$  if the wavenumber of incident radiation is  $20487\text{ cm}^{-1}$ . (Rotational constant of  $^{14}N_2$  is  $2\text{ cm}^{-1}$ )
7. a. What do you mean by Orthohelium and Parahelium? Discuss important features of emission spectra of helium atom. 2+3+  
3+2=10
- b. Calculate the interaction energies in L-S coupling for a system of two electrons in sp configuration. Show the energy splitting in different states.
8. a. Write the expression of rotational energy as a non-rigid rotator. Calculate the value of rotational quantum number at which intensity of rotational spectral line is maximum. 2+3+1+  
3+1 =10
- b. Write the expression for the energy of a rotating vibrator. Calculate the frequencies of fundamental, first overtone and second overtone transition. What do you mean by hot band?

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