REV-01
MSP/13/18

2024/05

SET A

M.Sc. PHYSICS
FOURTH SEMESTER
NONLINEAR & FIBER OPTICS-II
MSP - 401C

[USE OMR FOR OBJECTIVE PART]

Duration: 3 hrs. **Full Marks: 70**

Objective

Time: 30 min. **Marks: 20**

Choose the correct answer from the following: ***1X20=20***

1. Which of the following are examples of elastic scattering?
   a. Rayleigh, Raman
   b. Mie, Compton
   c. Rayleigh, Mie
   d. Raman, Compton

2. The frequencies for molecular vibration ranges
   a. 10-10^2 Hz
   b. 10^3-10^4 Hz
   c. 10^4-10^{12} Hz
   d. 10^{14}-10^{18} Hz

3. Which of the following cannot be conserved during Raman scattering?
   a. Kinetic energy
   b. Potential energy
   c. Electric energy
   d. Total energy

4. Raman shift depends on
   a. incident wavelength
   b. incident intensity
   c. resolving power
   d. molecular energy

5. Tyndall effect appears due to which of the following properties of light?
   a. reflection
   b. refraction
   c. polarization
   d. scattering

6. Which of the following effect is responsible for the blue sky?
   a. Rayleigh scattering
   b. Raman Scattering
   c. Mie Scattering
   d. Compton Scattering

7. In Raman spectroscopy, the radiation lies in the _____.
   a. Microwave Region
   b. Visible Region
   c. UV Region
   d. X-ray Region

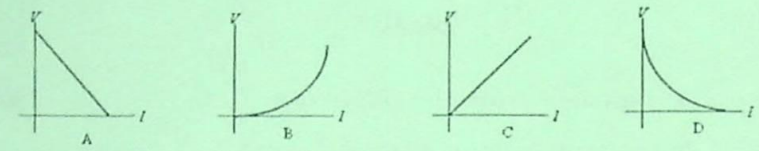
8. Which of the following lines are most intense?
   a. Stokes lines
   b. Rayleigh-scattered lines
   c. Anti-strokes lines
   d. All

9. Which among the following Maxwell's equations is correct for free space?
   a. $\nabla . E = \rho/\varepsilon_0$
   b. $\nabla . B = 0$
   c. $\nabla \times E = \partial B/\partial t$
   d. $\nabla \times B = \mu_0 J + \mu_0 \varepsilon_0 \partial B/\partial t$

10. On doping germanium metal, with a little amount of indium, what does one get?
    a. Intrinsic semiconductor
    b. Insulator
    c. n-type semiconductor
    d. p-type semiconductor

11. In n-type semiconductors, which one are the majority charge carriers?
    a. Holes
    b. Protons
    c. Neutrons
    d. Electrons

12. Which one of the following graphs represents the V-I characteristics for a semiconductor diode?



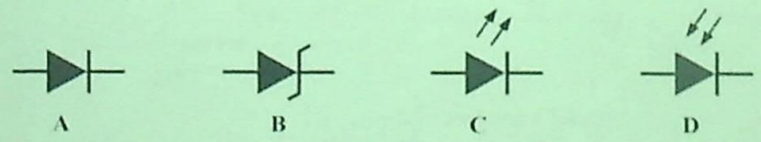
    a. A
    b. B
    c. C
    d. D

13. What will happen when a p-n junction diode is reversed-biased?
    a. No current flows
    b. The depletion region will increase
    c. The depletion region will reduce
    d. The height of the potential barrier will reduce

14. What will be the resistance measured by an ohmmeter, if a p-n diode is reverse biased?
    a. Zero
    b. Low
    c. High
    d. Infinite

15. _____ is used to detect the optical signals.
    a. Photodiode
    b. Zener diode
    c. PIN diode
    d. GUNN diode

16. Identify the LED from the following symbols



    a. A
    b. B
    c. C
    d. D

17. An LED made of GaAsP obtains an energy bandgap Eg = 1.90 eV. The wavelength of the emitted light is
    a. 240 nm
    b. 350 nm
    c. 653 nm
    d. 864 nm

18. The loss in the fiber is counted the minimum at wavelength _____.
    a. λ = 750 nm
    b. λ = 860 nm
    c. λ = 1300 nm
    d. λ = 1550 nm

19. Positive group velocity dispersion K">0 indicates
   a. Normal dispersion
   b. Anomalous dispersion
   c. Zero dispersion
   d. Waveguide dispersion

20. A(z,t)=Nsech(τ) indicates a
   a. Bright solition
   b. Dark soliton
   c. Gray soliton
   d. None of these

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Descriptive

Time : 2 hrs. 30 min. **Marks : 50**

[Answer question no.1 & any four (4) from the rest]

1. Explain the theory of elastic and inelastic collisions in Raman scattering? **10**

2. **a.** Using radiation of wavelength 4×10^3 Å, the first Stoke's line appears at a spacing 350 cm^{-1} from the Rayleigh line. Calculate the frequency of the first anti-stokes's line. **5+5=10**
   b. In a specified direction, the intensities of light scattered (Rayleigh) by a scattering substance from two beams are in a ratio of 256:81. Determine the ratio of the frequency of the first beam to that of the second beam.

3. Classify the low dimensional structures on the basis of confinement. Draw the density of electron states in those confined structures. **5+5=10**

4. **a.** When a particle of mass 'm' is confined in a semiconductor with hollow rectangular space of width 'a', then deduce its energy states. **5+5=10**
   b. A particle of mass $1.67 \times 10^{-27} kg$ is moving in a 1D potential well of width 10Å . Find the lowest energy level of the particle.

5.	a.	Define intrinsic and extrinsic semiconductors with diagrams.	5+5=10
	b.	Explain the basic principles of semiconductor diodes.	
6.	a.	What you understand by PN junction diode and how does its characteristic curve illustrate different biasing?	5+5=10
	b.	If an LED glows with wavelength 5493 Å, what is the energy band gap of the semiconductor material, that the LED made of?	
7.	a.	Distinguish between step and gradded indexed fibers.	4+3+3 =10
	b.	Define V-parameter and relative-index difference.	
	c.	Define normal and anomalous dispersion in fibers	
8.		Outline the fabrication process of a silica-based optical fiber, highlighting key steps and techniques involved.	10

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