



**ENGINEERING & MANAGEMENT EXAMINATIONS, JUNE - 2009**  
**OPTO ELECTRONICS & OPTICAL INST.**  
**SEMESTER - 6**

Time : 3 Hours ]

[ Full Marks : 70

**GROUP - A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for any *ten* of the following : 10 × 1 = 10

i) Band gap energy of a material is 1.24 eV, what is the wavelength of peak emission ?

a) 0.75  $\mu\text{m}$ b) 1.0  $\mu\text{m}$ c) 1.24  $\mu\text{m}$ d) 1.54  $\mu\text{m}$ . 

ii) Corpuscular theory of light was proposed by

a) Newton

b) Maxwell

c) Plank

d) Young. 

iii) The measurement of optical radiation by the principle of radiometry is possible over the frequency range of

a) visible range

b) only entire the infrared range

c) ultraviolet, visible and infrared range

d) none of these. 

iv) The near point of a normal eye is

a) 100 cm

b) 75 cm

c) 25 cm

d) 15 cm. **6727 (09/06)**



- v) In spherical aberration, the image is a
- a) ellipse along the axis
  - b) parabola along the axis
  - c) straight line along the axis
  - d) circle of varying diameter along the axis.
- vi) Population inversion in a laser occurs due to
- a) spontaneous emission of atoms
  - b) stimulated emission of atoms
  - c) both for the spontaneous emission and stimulated emission of atoms
  - d) spontaneous absorption of atoms.
- vii) Attenuation in optical fibre is represented in
- a) dB/km
  - b) dB/hr
  - c) kdB/hr
  - d) dB/m.
- viii) Hologram is the
- a) 3-D view of the object on a 2-D photo plate
  - b) 3-D view of the object on a 3-D photo plate
  - c) 2-D view of the object on a 2-D photo plate
  - d) 2-D view of the object on a 3-D photo plate.
- ix) Monochromator produces
- a) spectrum of light
  - b) monochromatic light
  - c) infrared radiation
  - d) ultraviolet radiation.



x) An atom stays in the excited state for a time of about

a)  $10^{-2}$  s

b)  $10^{-4}$  s

c)  $10^{-6}$  s

d)  $10^{-8}$  s.

xi) Laser is not used in

a) optical communications

b) entertainment electronics

c) illumination purposes

d) bloodless surgery.

xii) The dark current in the photo diode is actually

a) forward current through the junction

b) reverse saturation current

c) basically a output radiation

d) none of these.

### GROUP - B

#### ( Short Answer Type Questions )

Answer any three of the following questions.

3 × 5 = 15

2. Derive an expression for an all fibre Mach-Zehnder Interferometer ( MZI ) strain sensor for all phase change per unit length in the sensing arm due to change in strain. 5

3. Prove the relation for the Prism :

$$n = \frac{\sin \left[ (\delta_m + \alpha) / 2 \right]}{\sin \alpha / 2}$$

5

4. a) Discuss how population inversion is achieved in semiconductor laser. 4

b) What is the use of Q-switching ? 1



5. State Huygens' principle of wavefront. Explain the phenomenon of reflection and refraction on its basis. 2 + 3
6. What is the difference between spontaneous and stimulated emission ? How is the light amplified in the laser ? 3 + 2

### GROUP - C

#### ( Long Answer Type Questions )

Answer any *three* of the following questions.

$3 \times 15 = 45$

7. a) Give the construction and working principle of a refracting astronomical telescope. Show that in the case of an astronomical telescope the magnifying power is equal to the ratio of the diameter of the objective to the diameter of the exit pupil.
- b) If the objective lens of a microscope bears the designation "16 mm" and the eyepiece "12.5 X." By how much must the tube of the microscope be raised when changing from visual observation ( without accommodation ) to photography, assuming that the photographic film is 60 mm above the eyepiece ?  $( 5 + 4 ) + 6$
8. a) What are the vibrational modes in a CO<sub>2</sub> laser ? Describe its operating principle and pumping mechanism with the help of a energy level diagram.
- b) What is cavity oscillation and how does it influence laser operation ?
- c) What is Q-factor of a laser cavity ?  $( 2 + 7 ) + 4 + 2$
9. a) Explain detection process in the p-n photodiode. Compare this device with p-i-n photodiode.
- b) Define quantum efficiency & responsivity of a photodetector. Derive an expression for the responsivity of an intrinsic photodetector in terms of the quantum efficiency of the device & the wavelength of the incident radiation.



- c) A photodiode has a quantum efficiency of 70% when photon with energy  $2 \cdot 2 \times 10^{-19}$  J are incident on it.
- Calculate the incident power required to obtain a photo current of 2 mA.
  - Calculate the operating wavelength of the photo diode.  $3 + 3 + 2 + 3 + 4$
10. a) Discuss the advantages of optical fibre cable over the co-axial cable.
- b) What is meant by acceptance angle for an optical fibre ? Show how this is related to numerical aperture in case of a graded index fibre.
- c) What is the V-no. of a fibre ?
- d) A step index fibre in air has a numerical aperture ( N.A.) of 0.16, a core refractive index of 1.45 and a core diameter of 60  $\mu\text{m}$ . Determine the normalized frequency for the fibre, when light at a wavelength of 0.9  $\mu\text{m}$  is transmitted. Further estimate the no. of guided modes propagating in the fibre.  $3 + ( 2 + 4 ) + 2 + 4$
11. Write short notes on any *three* of the following :  $3 \times 5$
- Optical fibre sensor
  - Holography
  - Semiconductor laser
  - Opto coupler
  - Photo transistor.

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