

2021

ELECTRONICS — HONOURS

Paper : CC-14

(Photonics)

Full Marks : 50

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

Answer **question no. 1** and **any four** questions from the rest.

1. Answer **any ten** questions :

1×10

- (a) X-ray crystallography uses which characteristic of light?
- | | |
|-------------------|-------------------|
| (i) Polarization | (ii) Interference |
| (iii) Diffraction | (iv) Coherency. |
- (b) Interference of light is evidence that
- | |
|---|
| (i) the speed of light is very large. |
| (ii) light is a transverse wave. |
| (iii) light does not obey conservation of energy. |
| (iv) light is a wave phenomenon. |
- (c) A window which can transmit all the incident light without any reflection is called
- | | |
|-----------------------|-----------------------------|
| (i) Polarized Window | (ii) Malus Window |
| (iii) Brewster Window | (iv) Non-reflecting Window. |
- (d) Photo diode activity depends on
- | | |
|--------------------------|--------------------------|
| (i) photon absorption | (ii) electron absorption |
| (iii) neutron absorption | (iv) Both (i) and (ii). |
- (e) Suitable device for low level optical signal—
- | | |
|---------------------------|------------------------|
| (i) avalanche photo diode | (ii) p-i-n photo diode |
| (iii) solar cell | (iv) photo transistor. |
- (f) Doping for semiconductor LASER material is
- | | |
|------------|-----------------|
| (i) low | (ii) medium |
| (iii) high | (iv) very high. |

Please Turn Over

- (g) Charge coupled device is made by
- | | |
|------------------|-------------|
| (i) MOSFET | (ii) FET |
| (iii) transistor | (iv) diode. |
- (h) LED is made by
- | | |
|---------------------------------------|-----------------------------|
| (i) pure semiconductor | (ii) compound semiconductor |
| (iii) indirect band gap semiconductor | (iv) None of these. |
- (i) Attenuation and dispersion observe in optical fibre due to
- | | |
|------------------------------|----------------------------|
| (i) crystal structure defect | (ii) bending |
| (iii) Both (i) and (ii) | (iv) None of (i) and (ii). |
- (j) LASER light is
- | | |
|-------------------------|----------------------------|
| (i) coherent | (ii) non coherent |
| (iii) Both (i) and (ii) | (iv) None of (i) and (ii). |
- (k) The best performed optical fibre is
- | | |
|------------------------------------|---------------------------------|
| (i) single mode step index fibre | (ii) multimode step index fibre |
| (iii) multimode graded index fibre | (iv) Both (ii) and (iii). |
- (l) Bolometer is used to measure
- | | |
|---------------------------------|-----------------------|
| (i) frequency of light | (ii) speed of light |
| (iii) electromagnetic radiation | (iv) colour of light. |

2. (a) Derive the expression for the intensity distribution of the interference pattern in Young's double slit experimental arrangement.
- (b) Find the condition for the constructive and destructive interference.
- (c) Find the expression for fringe width.
- (d) Show by a sketch the intensity distribution. 5+3+1+1

3. (a) Explain the concept of temporal and spatial coherence. How does interference from thin film occurs?
- (b) Describe, in brief, the Newton's Ring Experiment. (2+2+2)+4

4. (a) State Malus law.
- (b) What is double refraction?
- (c) The X and Y component of electric field of an electromagnetic wave propagating in the Z-direction are given by
- $$E_x(z, t) = E_{0x} \cos(Kz - \omega t)$$
- $$E_y(z, t) = E_{0y} \cos(Kz - \omega t + \delta)$$

Find the state of polarization of the electromagnetic wave in the following cases :

- (i) $\delta = 0, E_{0x} \neq E_{0y}$
 (ii) $\delta = \pi/2, E_{0x} = E_{0y}$ and $\delta = -\pi/2, E_{0x} = E_{0y}$
 (iii) $\delta = -\pi/2, E_{0x} \neq E_{0y}$. 2+2+(2+2+2)

5. (a) What is population inversion?
 (b) Write the characteristics of LASER.
 (c) Derive the relation between Einstein's A and B coefficient. 2+3+5
6. (a) Why can light emitting diode emit light?
 (b) A LED material with bandgap energy ($E_g = 1.9\text{eV}$). Calculate the wavelength of emitted light from that LED.

$$h = 6.62 \times 10^{-32} \text{ JS}, c = 2 \times 10^{-8} \text{ m/s}, 1\text{eV} = 1.6 \times 10^{-19} \text{ J}$$

 (c) Why is photo-transistor more efficient than photo diode? 3+4+3
7. (a) What are the differences between step index and graded index fibre?
 (b) Write the advantages and disadvantages of step index single mode (mono mode) fibre.
 (c) Write the advantages of optical fibre. 3+3+4
8. (a) Write the name of common types of LCD panels.
 (b) How LCD display works?
 (c) What is Twisted Nematic display?
 (d) What are the advantages of LCD display over LED display? 2+3+3+2
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