

Note:

- (1) All questions are compulsory.
- (2) Figures to the right indicate maximum marks.
- (3) Use of non-programmable calculators is permitted.
- (4) Symbols used have their usual meaning.

Q1) A. Select the correct option:

[12M]

- (i) Diffraction effect can be observed in _____.
 (a) only sound wave (b) only light wave
 (c) only ultra-sonic waves (d) sound and light wave both
- (ii) In Fraunhofer diffraction due to a single slit, the screen is placed at a distance of 1m from the slit and the slit is illuminated by light of wavelength 5893\AA . If the separation between the central maximum and the first minimum is 0.5893cm , then the slit width is _____.
 (a) 10 cm (b) 10^{-3}cm (c) 2 mm (d) 10^{-2}m
- (iii) Liquid crystal devices are based on the phenomenon of _____.
 (a) Interference (b) Reflection (c) Polarization (d) Diffraction
- (iv) Huygen's explained the phenomenon of double refraction on the basis of _____.
 (a) Secondary wavelets (b) Dispersion (c) Scattering (d) Interference
- (v) The 2's complement form of 11001 is _____.
 a) 11011 b) 00110 c) 00111 d) 00110
- (vi) Flip-flop can be used to store _____.
 a) One byte data b) One bit data c) Two byte data d) Two byte data

B. Answer in one sentence:

[3M]

- (i) Why do we use lenses in Fraunhofer diffraction?
- (ii) What is a plane polarized light?
- (iii) Define Byte.

C. Fill in the blanks.

[5M]

- (i) An arrangement consisting of many equidistant narrow parallel rectangular slits of equal width separated by equal opaque portions is called a _____.
- (ii) Diffraction is due to the superposition of _____ wavelets originating from different parts of the same wave front.
- (iii) Superimposition of a linearly polarized and unpolarized light, results in the formation of _____ light.
- (iv) The decimal equivalent of $(1111.01)_2$ is _____.
- (v) The number of nibbles, which makes one byte is _____.

Q2) A. Attempt any one.

[8M]

- (i) Explain the diffraction due to a narrow wire. Obtain the expression for the interference band width formed in the geometrical shadow of the wire. Explain with relevant diagrams the intensity distribution in the shadow for the thin wire and for the thick wire.
- (ii) Explain the Fraunhofer diffraction a single slit. Derive an expression for the width of central maxima.

B. Attempt any one.

[8M]

- (i) Give an account of Fresnel's type diffraction effect produced by a narrow rectangular slit. Explain if a point is (a) Near the geometrical shadow (b) In the geometrical shadow
- (ii) In case of Fraunhofer diffraction due to a single slit, show that the intensity at any point on the screen is proportional to $(\frac{\sin\alpha}{\alpha})^2$ where α is the phase difference between the secondary

waves from the two ends of the slit. Draw the intensity distribution curve for this type of diffraction.

[4M]

C. Attempt any one.

- (i) Light of wavelength 6000 \AA illuminates a narrow rectangular slit placed at a distance of 0.2 m from a straight edge. Find the separation between the first and second bright band when observed on a screen at a distance of 0.5 m from the edge.
- (ii) A fabric with 600 threads/cm is illuminated by a light of wavelength 6000 \AA . Find the angle between the central image of a light and its first order diffracted image

[8M]

Q.3) A. Attempt any one.

- (i) Discuss theoretically the superposition of two linearly polarized lights at right angles to each other wave propagating in the same direction having the same frequency.
- (ii) Explain the concept of polarization by scattering & selective absorption.

[8M]

B. Attempt anyone.

- (i) Write a note on analysis of polarized light.
- (ii) Find the rate of polarization if components wave is represented by
- $E_x = E \sin(kz - \omega t)$ & $E_y = E \cos(kz - \omega t)$
 - $E_x = E \sin(kz - \omega t)$ & $E_y = E \sin(kz - \omega t)$

[4M]

C. Attempt any one.

- (i) At what angle the light should be incident on a plane glass plate so that reflected ray is plane polarized? (Given refractive index of glass = 1.5697)
- (ii) Determine the least thickness of a quarter-wave plate if a light of wavelength 5893 \AA passes through it; the refractive indices of ordinary ray is 1.54 and that extraordinary ray is 1.55 respectively.

Q4) A. Attempt any one.

[8M]

- (i) Perform $A+B$, $A-B$ & $-A-B$ using 2's complement method where $A=28$, $B=23$
- (ii) Convert the following 1) $(26.25)_{10} = (?)_{16} = (?)_2$ 2) $(11011.0011)_2 = (?)_{10} = (?)_{16}$

[8M]

B. Attempt any one.

- (i) Convert the following 1) $(2A.2F)_{16} = (?)_{10} = (?)_2$ 2) $(10101100.1)_2 = (?)_{16} = (?)_{10}$
- (ii) Draw & explain the working of RS flip flop using NOR gate with truth table.

[4M]

C) Attempt any one.

- (i) Distinguish between Latch and Flip-flop.
- (ii) What is half adder? Explain with the help of diagram and truth-table.

Q.5) Attempt any four

[20M]

- (i) Derive expression for the angular width of a principal maximum generated by a 5000 lines/cm in plane diffraction grating.
- (ii) Distinguish between Interference & diffraction.
- (iii) State the five applications of polarized light.
- (iv) Two Nicol are so oriented that maximum of light is transmitted. Find to what fraction of its maximum value is the intensity of transmitted light reduces when the analyser is rotated through 30° .
- (v) Explain the working of MSJK flip-flop with diagram.
- (vi) Perform binary Addition of following i) $110111 + 11001$ ii) $010101 + 001010$

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