Q.P.Code: 34640

[Time: 3 Hours] **[Marks: 100]**

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

Q 1 A **Select the correct option:** **12**

(i) A beam of parallel light of wavelength 5550Å is incident on a plane transmission grating which has 6000 lines per cm. The highest order spectrum that can be observed is

(a) 3 (b) 2 (c) 4 (d) 8

(ii) The bending of light into the geometrical shadow is commonly known as

(a) Interference (b) Diffraction (c) Polarization (d) none of these

(iii) Optic axis is

(a) an imaginary line inside the crystal (b) A real line inside the crystal
(c) A direction inside the crystal (d) None of the above.

(iv) Quarter wave plates produce

(a) path difference of $\lambda/4$ OR phase difference of $\pi/2$ radians between O and E – waves.
(b) path difference of $\lambda/4$ OR phase difference of π radians between O and E – waves.
(c) path difference of $\lambda/2$ OR phase difference of $\pi/2$ radians between O and E – waves.
(d) None of the above.

(v) JK flip-flop operates in a toggle mode when its J and K inputs are ___ and ___ respectively.

(a) 0 and 0 (b) 1 and 1 (c) 1 and 0 (d) 0 and 1

(vi) The decimal number 110 is represented in hexadecimal number system as

(a) 6E (b) 66 (c) E6 (d) 6F

Q 1 B **Answer in one sentence:** **(3)**

(i) Give one distinguishing point between Fraunhofer diffraction and Fresnel's diffraction.

(ii) State Malus' law.

(iii) What is asynchronous counter?

TURN OVER

Q 1 C **Fill in the blanks:** **(5)**

(i) Fresnel diffraction is due _____wave front.

(ii) In Fraunhofer's diffraction due to double slit, interference fringes of _____width are observed.

(iii) When unpolarized light passes through a _____, transmitted light is linearly polarized.

(iv) Transverse nature of light was confirmed by the phenomenon of _____ of light.

(v) In a D flip flop, output is 1 when D input is _____.

Q2 A **Attempt any one:** **8**

(i) Give the mathematical treatment of intensity distribution in the illuminated region for Fresnel's diffraction phenomenon due to straight edge. Draw relevant diagrams.

(ii) Give the theory of plane transmission grating. Draw the diagram of intensity distribution on the screen clearly indicating the positions of secondary maxima and secondary minima.

Q2 B **Attempt any one:** **8**

(i) In case of Fraunhofer diffraction due to a single slit, show that the intensity at any point on the screen is proportional to $\left(\frac{\sin\alpha}{\alpha}\right)^2$ 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 diffraction.

(ii) What are half-period zones? Show that the radii of half period zones are proportional to the square roots of natural numbers and the area of each half period zone is πbλ.

Q2 C **Attempt any one:** **4**

(i) A cylindrical wire of 0.01cm radius is placed in front of a slit illuminated by a monochromatic wavelength of 6328 Å . Find the width of the interference band on the screen at a distance of 150cm from the wire in the geometrical shadow.

(ii) A single slit diffraction produces a central maximum of width 0.5cm on a screen placed at 40 cm from the lens. Calculate the distance between the first dark and the next bright fringe on the screen. Wavelength of light used is 5890 Å

TURN OVER

Q3 A **Attempt any one:** **8**

(i) Discuss theoretically the superposition of two linearly polarized light wave propagating in the same direction having same frequency when the optical vectors are mutually perpendicular to each other for phase difference of odd and even multiple of $\pi/2$.

(ii) A right circularly polarized beam of wavelength 5893 Å is incident on a quartz crystal whose surface is cut parallel to the optic axis. If the thickness of the crystal is 0.025 mm, find the state of polarization of an emerging beam.
Given: μ_E =1.55336 and μ_o= 1.54425

Q3 B **Attempt any one:** **8**

(i) Describe in brief the following methods for producing plane polarized light
a) Polarization by scattering.
b) Polarization by selective absorption.

(ii) Describe the phenomenon of double refraction. Explain double refraction in calcite crystal.

Q3 C **Attempt any one:** **4**

(i) Find the degree of polarization when a beam of light passes through a pile of 10 plates such that at one critical angle of incidence the coefficient of amplitude reflection of glass plates is 2% for parallel vibrations and 8% for perpendicular vibrations. (Neglect absorption)

(ii) Ice is an example of positive uniaxial crystal with refractive indices of refraction 1.309 and 1.310. Determine the wavelength of light if ice acts like a quarter wave plate of thickness 0.15 mm.

Q4 A **Attempt any one:** **8**

(i) Draw a block symbol of RS flip-flop. Explain how RS flip-flop can be constructed using NAND gates. Write truth-table.

(ii) Describe three bit binary ripple counter with the help of relevant circuit diagram. Write truth-table. Draw also the waveforms.

Q4 B **Attempt any one:** **8**

(i) What is a shift register? Explain each of its type briefly using block symbol.

(ii) Using 2's complement arithmetic, find (–A+B) and (-A-B).
Given: A = 1001 and B = 0101

TURN OVER

Q4 C **Attempt any one:** **4**

(i) Convert decimal number 47.625 into binary number

(ii) a) Convert hexadecimal number D5 into decimal number.
b) A computer has 64 KB memories. How many numbers of bytes it can store?

Q 5 **Attempt any four:** **20**

(i) Derive an expression for the width of central maximum in case of single slit Fraunhofer diffraction.

(ii) A narrow slit illuminated by a light of wavelength 5890Å is located at a distance of 0.1m from a straight edge. If the measurement is made at a distance of 0.5m from the edge, calculate the distance between the first and the second dark band.

(iii) Explain the working of Quarter- Wave Plate.

(iv) State the five applications of polarized light.

(v) Write the logic symbol of JK flip flop and show how JK Master-Slave flip-flop can be constructed from JK flip flop. Write its truth table.

(vi) a) Using streamline method, convert binary number 1011011.01 into decimal number.
b) Draw the circuit diagram of mod 5 counter.

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