

Answer Key (SET -3)

- Q1 A **Select the correct option:** 12
- (i) (a) $(a+b) \sin \theta = n \lambda$ taking $\theta = 90$; $n = 3$
- (ii) (a) Diffraction
- (iii) (c) A direction inside the crystal
- (iv) (a) path difference of $\lambda/4$ OR phase difference of $\pi/2$ radians between O and E - waves.
- (v) 1 and 1
- (vi) 6E
- B **Answer in one sentence:** (3)
- (i) Fig 18.14 page 443 Text book of optics by Brijlal and Subhramanyam
- (ii) Malus law states that the transmitted intensity varies as the square of the cosine of the angle between the planes of transmission of analyser and the plain of transmission of polarizer
- (iii) Asynchronous counter is the counter in which output of one flip-flop acts as clock signal for the next flip-flop.
- C **Fill in the blanks:** (5)
- (i) Plane
- (ii) Unequal width
- (iii) polarizer.
- (iv) polarization.
- (v) 1
- Q2 A **Attempt any one:** 8
- (i) Figure with description.....(4 marks)
Positions of maximum and minimum intensity..... (4 marks)
Art17.10 ; Text book of optics by Brijlal and Subhramanyam
- (ii) Diagram with explanation(4 marks)
Secondary maxima and minima with intensity curve..... (4 marks)
Art18.7.1 ; Text book of optics by Brijlal and Subhramanyam
- B **Attempt any one:** 8
- (i) Derivation(6 marks)
intensity diagram.....(2 marks)
Page 427 Art18.2.1 ; Text book of optics by Brijlal and Subhramanyam
- (ii) Diagram with explanation.....(5 marks)
Derivation.....(3 marks)
Art 17.4 ; Text book of optics by Brijlal and Subhramanyam
- C **Attempt any one:** 4
- (i) $X = \lambda D / 2d$ (2marks)
Calculation (1mark)
Ans mm(1 mark)
- (ii) $a \sin \theta = n\lambda$; Also $\sin \theta = x_1 / f$ ($n=1$)
Hence $x_1 = \frac{f\lambda}{a} = \frac{0.4 \times 5890 \times 10^{-10}}{5 \times 10^{-3}} = \dots\dots\dots(2 \text{ marks})$
Similarly,
 $a \sin \theta = (2n+1)\lambda/2$ this gives $x_2 = \frac{3f\lambda}{2a} = \frac{3 \times 0.4 \times 5890 \times 10^{-10}}{2 \times 5 \times 10^{-3}} \dots\dots(1 \text{ mark})$
 $x_2 - x_1 = \dots\dots(1 \text{ mark})$
- Q3 A **Attempt any one:** 8
- (i) $E_x = a_1 \cos(kz - \omega t)$

$$E_y = a_2 \cos(kz - \omega t + \delta)$$

$$E_x = a_1 \cos \omega t$$

$$E_y = a_2 \cos(\omega t \pm \delta)$$

$$\frac{E_x}{a_1} + \frac{E_y}{a_2} = 1$$

$$E_x = a_0 \cos \omega t$$

$$E_y = a_0 \sin \omega t$$

$$E_x^2 + E_y^2 = a_0^2$$

$$(ii) \quad \delta = \frac{2\pi}{\lambda} [t(\mu_E - \mu_O)]$$

$$\delta = 0.77 \pi$$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{2xy}{ab} \cos \delta = \sin^2 \delta$$

amplitudes of two waves are same, $a=b$

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} - \frac{3xy}{2a^2} = 0.43$$

resultant is elliptically polarize

B

Attempt any one:

8

(i) Explanation with diagram

(ii) phenomenon of double refraction (2 mark)

Explanation of double refraction in calcite crystal + diagram ..(6 mark)

C

Attempt any one:

4

(i) $I_{\max} = a \times 0.98^{2\theta} = 0.667 a$ (1 mark)

$I_{\min} = a \times 0.92^{2\theta} = 0.180 a$ (1 mark)

Degree of polarization $= \frac{(I_{\max} - I_{\min})}{(I_{\max} + I_{\min})} = 0.873$ (2 mark)

$$(ii) \quad t = \frac{\lambda}{4(\mu_E - \mu_O)} \quad \dots\dots (1 \text{ mark})$$

Substitution and calculation (2 mark)

$\lambda = 600 \text{ nm}$ (1 mark)

Q4 A

Attempt any one:

8

(i) Block symbol of RS flip-flop(1 mark)

RS flip-flop using NAND gates: diagram(2 mark)

Working.....(3 mark)

Truth-table(2 mark)

(ii) 3 bit binary ripple counter : diagram.....(2 mark)

Working.....(4 mark)

Truth-table.....(2 mark)

B

Attempt any one:

8

(i) Shift register is a group flip-flops that stores binary data momentarily at the output of a decoder. brief description.....(2 mark)

Block symbols of four types of shift registers namely SISO, SIPO, PISO, PIPO and their brief explanation.....(6 mark)

(ii) a) $A = 1001$ and $B = 0101$

$(-A+B)$: 2's comp of A is $-A = 0111$ and $B = 0101$(2 mark)

$-A+B = 1100$, MSB is 1, so answer is negative.....(1 mark)

To find magnitude take 2's comp of 1100.

$0011 + 1 = 0100$ ie 4.....(1 mark)

$-A+B = 1100$ ie -4

b) $(-A-B)$: $-A = 0111$ and $-B = 1011$ (2's comp of B).....(2 mark)

$-A-B = 0111 + 1011 = 10010$, MSB is 1, so answer is negative..(1 mark)

To find magnitude take 2's comp of 10010

$01101 + 1 = 1110$ ie 14 $-A-B = 10010$ ie -14.....(1 mark)

C

Attempt any one:

- (i) a) 47.625 : use double dabble method to convert 47 into binary no.
 $(47)_{10} = (101111)_2$ (2 mark)
 $(0.625)_{10} = (0.101)_2$ use multiplication method to convert decimal fraction to binary fraction.....(2 mark)
- (ii) $(D5)_H = (13 \times 16) + (5 \times 1) = (213)_{10}$ (2 mark)
 b) 1KB = 1024 bytes.....(1 mark)
 64 KB = $64 \times 1024 = 65,536$ bytes.....(1 mark)

4

Q 5

Attempt any four:

- (i) To prove $w = 2f\lambda / a$
- (ii) ????????
- (iii) Ordinary ray-it is in the plane of incidence, obeys Snell's law, vibrations are perpendicular to the principle plane of the ordinary ray, same velocity and same μ in all directions through the crystal and spherical wavefront.
 Extra- Ordinary ray- it is not usually in the plane of incidence, does not obey Snell's law, vibrations are in the principle plane of the extraordinary ray, Different velocity and different μ in different directions through the crystal and ellipsoidal wave front. (5 mark)
- (iv) LCD, Laurents half shade polarimeter, Electro optics materials, civil and mechanical engineering practices and Anisotropy.... (5 mark)
- (v) JK flip flop logic symbol(1 mark)
 Master Slave flip-flop : diagram.....(2 mark)
 Truth table.....(2 mark)
- (vi) a) $(1011011.01)_2 = (91.25)_{10}$, use streamline method.....(2+1).. 3 mark
 b) Circuit diagram of mod 5 counter.....(2 mark)

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