Q1: (MCQ), Answer the following questions: (14 Marks)

1. In full wave rectification the average value of V_p =37.7 V is ....

A	24	B	32
C	44	D	56

2. A reverse biased *pn* junction has ....

A	Very narrow depletion layer	B	Almost no current
C	Very low resistance	D	Large current flow

3. Blue color of sky is due to...............

A	Scattering of light	B	Interference of light
C	Dispersion	D	Diffraction of light

4. In double slit interference, the distance between the two neighboring dark fringes is equal to............

A	$L\lambda/d$	B	$m\lambda$
C	$(m+1/2)\lambda$	D	$2m+1(\lambda/2)$

5. In double slit experiment we observe...............

A	Interference fringes only	B	Diffraction fringes only
C	Both interference and diffraction fringes	D	Polarized fringes

6. .... Phenomenon proves that nature of light is transverse

A	Interference	B	Diffraction
C	Scattering	D	Polarization

7. In n-type materials, the minority carriers are ....

A	Free electrons	B	Holes
C	Protons	D	Mesons

8. Type-II of superconductors are usually.................

A	Alloys	B	Semiconductors
C	Insulators	D	Paramagnetic

9. A distribution of electric charge at rest creates.................

A	Magnetic field	B	Electric field
C	Electromagnetic field	D	lines field

10. The magnetic force vector is............... to the magnetic field.

A	Perpendicular	B	Parallel
C	Helical	D	Intersect

11. Addition of pentavalent impurity to a semiconductor

A	Free electrons	B	Holes
C	Valence electrons	D	Bound electrons

12. Fringe width is inversely proportional to the..........

A	Separation between the two slits	B	Order of the fringe
C	Wavelength of light use	D	Distance between slits and screen

13. The width of depletion region of a diode

A	Increases under forward bias	B	Is independent of applied voltage
C	Increases under reverse bias	D	None of these

14. If the initial velocity of the charged particle has a component parallel to the magnetic field B, the resulting trajectory will be..........

A	A helical	B	parallel
C	A perpendicular	D	None of these

Q2: Complete the following questions: Write the steps of the solution (16 Marks)

1. A two-slit interference experiment in which the slits are **0.200 mm** apart and the screen is **1.00 m** from the slits. The m=3 bright fringe in the figure... is 9.49 mm from the central fringe. The wavelength (λ) of the light is...........

2. For diode circuit (**R_{limit} = 1 kΩ, V_{bias} = 10 V, r_d' = 10 Ω**), the forward voltage and forward current for each of the diode models (three models) are ....,............. and the voltage across the limiting resistor in each case is...............

3. The reflected ray in air is completely polarized when the angle of incidence is **48.0°**. The index of refraction of the reflecting material is............

4. A viewing screen is separated from a double slit by **4.80 m**. The distance between the two slits is **0.030 mm**. Monochromatic light is directed toward the double slit and forms an interference pattern on the screen. The first dark fringe (**m=0**) is 4.50 cm from the center line on the screen. The wavelength of the light is ...., while the distance between adjacent bright fringes is........

Q3:Answer the following questions: (30 Marks)

1. **Write short notes about:** Length contraction according to Special Theory of Relativity?
2. **Deduce:** the Magnetic Field Due to a Current in a Long Straight Wire?
3. **Explain:** Polarization by Absorption?
4. **Write short notes about**: Superconductivity and two types of superconductivity materials?

****End of Exam****
With My Best Wishes
Dr/ Walid Ismail

Q1

1 - (A)
2 - (B)
3 - (A)
4 - (A)
5 - (A)
6 - (D)
7 - (B)
8 - α
9 - (B)
10 - (A)
11 - (A)
12 - (A)
13 - (C)
14 - (A)

Q_2 1- $d = 0.2\times10^{-3}m$, $l = 1m$, $m = 3$, $Y_b = 9.49\times10^{-3}$

$\because Y = \frac{m\lambda l}{d} \rightarrow \therefore \lambda = \frac{Y \cdot d}{m \cdot l} = \frac{9.49\times10^{-3}\times0.2\times10^{-3}}{3}$

$\lambda = 6.326\times10^{-7}$

2 - $R_L = 10^3\Omega$, $V_B = 10V$, $r_d' = 10\Omega$

in ideal diode:

$I_F = \frac{V_B}{R_L} = \frac{10}{10^3} = 10^{-2}A$, $V_F = 0$, $V_{R_L} = I_F R_L = 10^{-2}\times10^3$
$= 10V$

in practical diode:

$I_F = \frac{V_B - 0.7}{R_L} = \frac{10 - 0.7}{10^3} = 9.3\times10^{-3}A$, $V_F = 0.7V$

$V_{R_L} = I_F R_L = 9.3\times10^{-3}\times10^3 = 9.3V$

in Complete diode :

$$I_F = \frac{V_B - 0.7}{R_L + r_d} = \frac{10 - 0.7}{10^3 + 10} \simeq 1\,A \quad , V_F = 0.7\,V$$

$$V_R = I_F R_L = 1 \times 10^3 = 10^3\,V$$

3. $\because \tan\theta_p = \frac{n_2}{n_1}$, $\because n_1 = 1$

$$\therefore n_2 = \tan 48^\circ = 1.11$$

4. $L = 4.8\,m$, $d = 0.03 \times 10^{-3}\,m$, $Y_d = 4.5 \times 10^{-2}\,m$

$$Y_d = \frac{(m + \frac{1}{2})\lambda L}{d} \longrightarrow \lambda = \frac{Y_d \cdot d}{(m + \frac{1}{2})L} = \frac{4.5 \times 10^{-2} \times 0.03 \times 10^{-3}}{2 \times 4}$$

$$= 5.625 \times 10^{-7}$$

$$\Delta y = \frac{\lambda L}{d} = \frac{5.625 \times 4.8}{0.03 \times 10^{-3}} = 0.09\,m$$

Q_3 :

1- We attach a light source to one end of a ruler and a mirror to the other end. The ruler at rest in reference frame S' and its length in this frame is L_0 Then the time Δt_0 required for a light pulse to make the round trip from source to mirror and back is

$$\Delta t = \frac{2L_0}{c}$$

in reference frame, the ruler is moving to the right with speed u, and the time required for light travel from the source to the mirror is Δt_1

and from the mirror to the light source is Δt_2

$d = d + u\Delta t_1$:

$d \rightarrow$ the length of the ruler

$u\Delta t_1 \longrightarrow$ the additional distance to the right.

2.

$$dB = \frac{\mu_0 I}{4\pi} \cdot \frac{ds \cdot \sin\theta}{r^2}$$

$$B = 2\int_0^\infty \frac{\mu_0 I}{2\pi} \int_0^\infty \frac{ds \cdot \sin\theta}{r^2} \qquad \because r = \sqrt{S^2+R^2}, \ \sin\theta = \frac{R}{\sqrt{S^2+R^2}}$$

$$B = \frac{\mu_0 I}{2\pi} \int_0^\infty \frac{R \cdot ds}{(S^2+R^2)^{3/2}}$$

$$B = \frac{\mu_0 I}{2\pi R} \left[\frac{S}{(S^2+R^2)^{1/2}} \right]_0^\infty$$

$$B = \frac{\mu_0 I}{2\pi R}$$

3 - The most Common ~~teqni~~technique in polarization we use a material such as Tourmaline, it absorbs the vibrations that are parallel to the Crystal axis and transmits vibrations that are parallel to the Transmission axis (perpendicular to the crystal axis)