Ministry of Higher Education		
Higher Institute for Engineering and Technology at Manzala		
First Semester		Date: 13/11/2023
Mid-term Exam		Level: 1
Department : Electronic Eng.		Time allowed: 60 mins.
Total mark : 10 Mark		Code: BS111
Course title : Physics 3		
Name :		Code:

Answer all of the following questions

Q1: a- A thin film with refractive index equal 1.32 is surrounded by air. What is the minimum thickness of thin film such that the reflection of normally incident light with wave length 500nm is maximized?

b- Explain the cases of **vector (M)** and the **emissivity (ε)** :

i- $\nabla . M > 0$, $\nabla . M < 0$ and $\nabla . M = 1$

ii- $\nabla \times M > 0$ and $\nabla \times M < 1$

iii- $\varepsilon = 1$, $\varepsilon < 1$ and $\varepsilon = 0$

Q2: a- In double silt experiment: **Proof** the relation of the intensity of the fringe then **calculate** the intensity of fringe at point at the screen if the path difference is 2λ and the incident intensity is 20 lux.

b- A disc A and B have radii 2cm and 3cm are coated with carbon black on their outer surfaces. The wavelengths corresponding to maximum intensity are 300 nm and 400nm. **Calculate** the ratio of the power radiated A **:** the power radiated B.

Q3: In a Michelson interferometer, if we placed a material with index of refraction ($n = 1.5$) and thickness(t) in the path of the light its wavelength 630nm traveling to the movable mirror. **Proof** the relation which can be used to calculate thickness of a material. Also, **calculate the** magnitude of the thickness if the shifted in fringes is 60 fringes.

The end of exam

Good luck

Dr. Ali Samir Awad

Q1 a)

$$2L = (\cancel{m}^{0} + \tfrac{1}{2})\frac{\lambda}{n}$$

$$L = \frac{\lambda}{4n}$$

$$L = \frac{500}{1.32 * 4} = 94.7 \text{ nm}$$

$n = 1.32$

$\lambda = 500$ nm

$m = 0$

$L = ?$

b)

i) $\nabla \cdot M > 0$, $\nabla \cdot M < 0$, $\nabla \cdot M = 0$

ii)

$\nabla \times M > 0$, $\nabla \times M < 0$

iii)

$\varepsilon = 1 \rightarrow$ For black body.

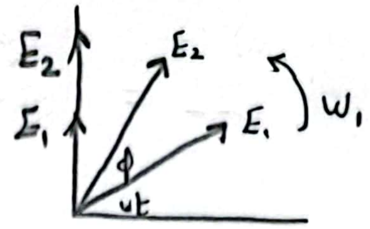
$\varepsilon = 0 \rightarrow$ at $0°K$ or $-273°C$.

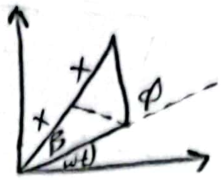
$\varepsilon < 1 \rightarrow$ For any body.

Q2)

a) ① $E_1 = E_0 \sin(\omega t)$

② $E_2 = E_0 \sin(\omega t + \varphi)$





$\varphi = \beta + \beta = 2\beta$

$\beta = \frac{1}{2}\varphi$

$\cos\beta = \frac{X}{E_0}$

$X = E_0 \cos\beta$

$\frac{1}{2}E = E_0 \cos\beta$

$E = 2E_0 \cos\beta$

$E^2 = 4E_0^2 \cos^2(\frac{1}{2}\varphi)$ بالتربيع

$\because I \propto E^2$

$\boxed{\therefore I = 4I_0 \cos^2 \frac{1}{2}\varphi}$ #

$\delta = 2\lambda$

$I_0 = 20$ lux

$\varphi = (\frac{2\pi}{\lambda})\delta = \frac{2\pi}{\lambda} \cdot 2\lambda \quad \therefore \boxed{\varphi = 4\pi}$

$\therefore I = 4(20)\cos^2(\frac{1}{2} \cdot 4\pi)$

$I = 79$ lux

b) $\frac{P_A}{P_B} = \frac{\cancel{\sigma}\cancel{\varepsilon} A_A T_A^4}{\cancel{\sigma}\cancel{\varepsilon} A_B T_B^4} = \frac{(\pi r^2)\lambda_B^4}{(\pi r^2)\lambda_A^4}$

A	B
$r = 2cm$	$r = 3cm$
$\lambda = 300nm$	$\lambda = 400nm$

$\varepsilon = 1$

$A = \pi r^2$

$= \frac{(2*10^{-2})^2 (400*10^{-9})^4}{(3*10^{-2})^2 (300*10^{-9})^4} = \frac{1024}{729} = 1.4$

$\boxed{P_A = 1.4 P_B}$

Q_3

$n = 1.5$

$\lambda = 630\ nm$

$N_m - N_n = 60$ fringe

$$N_m = \frac{2t}{\lambda_m} \quad , \quad \lambda_m = \frac{\lambda_a}{n}$$

$$N_m = \frac{2tn}{\lambda} \quad ①$$

$$N_{air} = \frac{2t}{\lambda_a} \quad ②$$

$$N_m - N_{air} = \frac{2tn}{\lambda_a} - \frac{2t}{\lambda_a}$$

$$\boxed{N_m - N_{air} = \frac{2t}{\lambda_a}(n-1)} \quad \#$$

بالتعويض

$$\therefore 60 = \frac{2t}{630 * 10^{-9}}(1.5-1)$$

$$t = \frac{60(630 * 10^{-9})}{2 * (1.5-1)}$$

$$\boxed{t = 3.78 * 10^{-5}\ m} \quad \#$$