EE552

Assignment 1

(a) (i) Recall

$E = \pi L$

$L = \frac{E}{\pi}$

Reflection factor = 85%

Brightness L = $\frac{\text{Illumination } E}{\pi} \times$ Reflection factor.

$L = \frac{E}{\pi} \times 85\%$

$L = \frac{44,000}{3.14159} \times \frac{85}{100} \Rightarrow 11.905 \times 10^3 \text{ Cd/m}^2$

(ii) when Illumination $E = 0.22$ lux

$L = \frac{0.22}{3.14159} \times \frac{85}{100} \Rightarrow 0.059 \text{ cd/m}^2$

$\approx 59.52 \times 10^{-3} \text{ cd/m}^2$

b Given Parameters

Luminous intensity $I = 120\ cp$

Globe diameter $= 22\ cm = 0.22\ m$

$I = \Phi / w$

$\Phi = I \times w$ Recall $w = 4\pi$

$\Phi = 120 \times 4\pi$

also 30% is absorbed by the globe

$\therefore$

$= 120 \times 4\pi \times 30/100 = 144\pi \Rightarrow 452.389$

flux emitted by globe = flux from the source − flux absorbed by globe

$\Rightarrow 120 \times 4\pi - 452.389 \Rightarrow$

$= 1507.964 - 452.389 = 1055.575$

$\text{Luminance} = \frac{\text{flux emitted}}{\text{Area}} \Rightarrow \frac{1055.575}{\pi \times 0.22^2} = 6942.1\ Lm/m^2$

(ii) Candle Power $CP = \frac{\text{Lumen}}{w} = \frac{1055.575}{4\pi}$

$\Rightarrow 83.9999 \approx 84\ Cd.$

22 cm 0.22 m

c Given Parameters. $\varepsilon_0 = 8.85\times10^{-12}$; $\varepsilon_r = 6.5$; $f = 2MHz$

Area $= 75cm^2$; Density $= 0.55 g/cm^3$; $\cos\phi = 0.04$

$t = 2cm$; $\theta_1 = 80$ $\theta_2 = 80$

Recall

Heat Required $= mc\Delta\theta$

$$\text{Density} = \frac{\text{mass}}{\text{Volume}}$$

~~Density~~

$$0.55 = \frac{\text{mass}}{75\times2}$$

mass $m = 0.55 \times 75 \times 2$

$m = 82.5$ grams.

2cm

$$C = \frac{\varepsilon_0 \varepsilon_r A}{t}$$

$A = 75cm^2 = 75\times10^{-4} m^2$

$$C = \frac{8.85\times10^{-12} \times 6.5 \times 75\times10^{-4}}{2\times10^{-2}}$$

$C = 2.1571875\times10^{-11}$

$C = 21.57\times10^{-12}$

$C = 21.57 pF$

$w = 2\pi f$

$w = 2\times\pi\times20\times10^6 = 125663706.1$ rad/s

$\cos\phi = 0.04$

$\cos^{-1} 0.04 = \phi$

$\phi = 87.7$

$\delta = 90 - \phi \Rightarrow 90 - 87.7 = 2.3$

Heat required $= mc\Delta\theta$

$= 82.5 \times 0.255 \times (80 - 30)$

$= 82.5 \times 0.255 \times 50$

$= 1051.8$ Cal.

Total heat required $= 1051.88 \times 85\%$

$= 1051.88 \times 85/100 = 894.098$ Cal

Recall

1 cal $= 4.186(W_s)$ J

$894.098 = ?$

$P_{in} = 894.098 \times 4.186$

$P_{in} = 3742.7 (W\text{-}S)$

$\text{Power} = \frac{\text{Energy}}{\text{time}} \Rightarrow \frac{3742.7}{8 \times 60} = 7.797 W$

$P_d = V^2 \omega C \tan\delta$

$7.797 = V^2 \times 125.664 \times 10^6 \times 21.52 \times 10^{-12} \times \tan 2.3$

$V^2 = 7.797 / 1.08868 \times 10^{-4} \Rightarrow \sqrt{7.797 / 1.08868 \times 10^{-4}}$

$V = 267.62 V$

$P = IV \cos\phi$

$I = \frac{7.797}{287.62 \times 0.04} = 0.728\,A$

or $728\,mA$