

EEE 552 Assignment.

a) i) From $E = \pi L = \frac{\pi}{\gamma^2}$

$$L = E / \pi$$

Consider reflection factor

$$L = E / \pi \times \text{reflection factor}$$

$$L = \frac{44,000}{\pi} \times \frac{85}{100}$$

$$= 11.905 \times 10^3 \text{ cd/m}^2$$

ii) $L = \frac{0.22}{\pi} \times \frac{85}{100}$

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

b) i) Flux emitted by source

$$\Phi = I \times \omega = 120 \times 4\pi \text{ lumens}$$

Flux absorbed = 1507.96 lumens
Flux ~~emitted~~ by globe (30% absorbed)

$$\Phi_g = 1507.96 \times \frac{30}{100} = 452.38 \text{ lumens}$$

Flux emitted by globe

$$\Phi_g = 1507.96 - 452.38 \\ = 1055.58 \text{ lumens.}$$

$$\text{Luminance} = \frac{\text{flux emitted}}{\text{Area}} = \frac{1055.58}{4\pi \times 0.11^2}$$

$$\text{Area of globe} = 4\pi r^2$$

$$r = \frac{22}{2} = 11 \text{ cm} = 0.11 \text{ m}$$

$$\text{Luminance} = \frac{1055.58}{4\pi \times 0.11^2} = 6942.18 \text{ lm/m}^2$$

$$\text{ii) Candle power} = \frac{\text{lumen}}{\omega} = \frac{1055.58}{4\pi} = 84 \text{ cp}$$

$$c) A = 75 \times 10^{-4} \text{ m}^2 = 75 \text{ cm}^2$$

$$t = 2 \times 10^{-2} \text{ m} = 2 \text{ cm}$$

$$\text{Heat required} = mC\Delta\theta$$

$$l = \frac{m}{V}, \quad m = l \times V = 0.55 \times 75 \times 2$$
$$= 82.5 \text{ g.}$$

$$C = \frac{\epsilon_0 \epsilon_r A}{t} = \frac{8.85 \times 10^{-12} \times 6.5 \times 75 \times 10^{-4}}{2 \times 10^{-2}}$$

$$= 21.57 \times 10^{-12} \text{ F}$$

$$\omega = 2\pi f = 2\pi \times 20 \times 10^6$$

$$= 125.664 \times 10^6 \text{ rad/s}$$

$$\cos \phi = 0.04, \quad \phi = \cos^{-1} 0.04 = 87.7^\circ$$

$$\delta = 90 - \phi = 90 - 87.7 = 2.3^\circ$$

$$\text{Heat required} = 82.5 \times 0.255 \times (80 - 30)$$
$$= 1051.88 \text{ cal}$$

$$1 \text{ cal} = 4.186 \text{ J}$$

$$1051.88 = 4403.17 \text{ J}$$

Total heat absorbed by slab

$$4403.17 \times \frac{85}{100}$$

$$= 3742.7 \text{ J}$$

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

$$= 7.797 \text{ W}$$

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

$$7.797 = V^2 \times 125.664 \times 10^6 \times 21.57 \times 10^{-12} \times \tan 2.3$$

$$V^2 = \frac{7.797}{1.08868 \times 10^{-4}} = 71618.84$$

$$V = 267.62 \text{ V}$$

$$P = IV \cos \phi, \quad I = \frac{P}{V \cos \phi}$$

$$I = \frac{7.797}{267.62 \times 0.04} = 0.7284 \text{ A}$$