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EEE 552 ASSIGNMENT

(a)(i) Recall $E = \pi L = \frac{I}{r^2}$

Therefore,

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

Considering reflection factor,

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

$$L = \frac{44000}{\pi} \times \frac{85}{100}$$

$$L = 11.905 \times 10^3 \text{ cd/m}^2 \text{ or } 1.19 \times 10^4 \text{ cd/m}^2$$

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

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

(b)(i) Flux emitted by source

$$\phi = I \times W = 120 \times 4\pi = 480\pi \text{ lumen}$$

Flux emitted by globe (30% is absorbed)

$$480\pi \times \frac{30}{100} = 144\pi \text{ lumen}$$

$\therefore$ Flux emitted by globe $= 480\pi - 144\pi = 336\pi$ lumen

$$\text{Luminance} = \frac{\text{Flux emitted}}{\text{Area}} = \frac{336\pi}{\pi \times 0.22^2} = 6942 \text{ lumen/m}^2$$

(ii) Candle power (CP) $= \frac{\text{Lumen}}{w}$

$= \frac{336\pi}{4\pi}$

$= 84\ cd$ //

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

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

Heat required $= mc\Delta\theta$

Density $= \frac{m}{V}$ [Recall $V = A \times t$]

$m = \text{Density} \times V$

$m = 0.55\ \frac{g}{cm^3} \times (75 \times 2)\ cm^3$

$m = 82.5\ g$

$C = \frac{\varepsilon_0 \varepsilon_r A}{t} = \frac{8.85 \times 10^{-12} \times 6.5 \times 75 \times 10^{-4}}{2 \times 10^{-2}}$

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

$w = 2\pi f = 2\pi \times 20 \times 10^6 = 125.664 \times 10^6\ rad/s$

Power factor $= \cos\phi = 0.04$

$\phi = \cos^{-1}(0.04) = 87.7°$

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

Heat required $= mc\Delta\theta$

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

$= 1051.88\ cal$

Total heat required = $1051.88 \times \frac{85}{100} = 894.098$ cal

1 cal = 4.186 (w-s) J

894.098 cal = x

Power input = $894.098 \times 4.186 = 3742.7$ (w-s)

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

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

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

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

$V = 267.62$ V //

$P = IV \cos\phi$

$I = \frac{7.797}{267.62 \times 0.04}$

$I = 0.7284$ A //