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15/ENG04/011

ELECT-ELECT ENGR

EEE 552 ASSIGNMENT SOLUTION

a) Recall E = π L ; $L = \frac{E}{\pi}$

Considering Reflection factor

L = $\frac{E}{\pi} * R$ where R = Reflection factor

(i) L = $\frac{44{,}000}{\pi} * 0.85 = 11.90 * 10^3\ cd/m^2$

(ii) L = $\frac{0.22}{\pi} * 0.85 = 5.952 * 10^{-2}\ cd/m^2$

b) Flux emitted by source is

Φ = I * W = 120 * 4π (lumen)

Flux emitted by globe (Recall 30% is absorbed)

120 * 4 π * $\frac{70}{100} = 336\pi$ (lumen)

(i) Luminance = $\frac{Flux\ emitted\ by\ globe}{Area} = \frac{336\pi}{\pi * 0.22^2} = 6942\ lm/m^2$

(ii) Candle power = $\frac{Lumen}{W} = \frac{336\pi}{4\pi} = 84cd$

c) A = 75c$m^2 = 75 * 10^{-4} m^2$

t = $2cm = 2 * 10^{-2} m$

Volume = $(75 * 2) = 150\ cm^3$

Density = $\frac{mass}{volume}$; $m = 0.55\frac{g}{cm^3} * 150cm^3 = 82.5g$

C = $\frac{\epsilon_0\, \epsilon_r\, A}{t} = \frac{8.85*10^{-12} * 6.5*75*10^{-4}}{2*10^{-2}} = 21.57 * 10^{-12}F$ = 21.57pF

W = 2 π F = 2 * π * 20*10^6 = 125.664 * $10^6\ rad/s$

Power factor = Cos Φ = 0.04

Φ = Cos^{-1} 0.04 = 87.7

δ= 90 − Φ = 90 − 87.7 = 2.3^0

Heat required = MC $\Delta\theta = 82.5 * 0.255 * (80 - 30)$

= 1051.88cal

Total heat required = $1051.88 * 0.85 = 894.098cal$

1cal = 4.186 (W-S)

Power delivered = 894.098 * 4.186 = 3742.7 (W-S)

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

$P_d = V^2 * WC * \tan\delta$

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

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

V = $\sqrt{\frac{7.797}{1.08868*10^{-4}}}$

V = 267.62v

To find current, recall P = IVcos Φ

I = $\frac{7.797}{267.62*0.04}$ = 0.7284A.