16/ENG04/065
EEE 552

1a) $L = ?$, $E = 44,000$, $\pi = 3.142$, $R.F. = 85\% = 0.95$

$$L = \frac{E}{\pi} \times R.F. = \frac{44,000}{3.142} \times 0.85 = 11,904.79 \text{ cd/m}^2$$

b i) $I = 120 \text{ cd}$, $\phi = ?$ luminous flux emitted by source, $w = 4\pi$, $\phi = I \times w$

$= 120 \times 4\pi = 1,507.96$ lumen

Since globe absorbs 20%

$$\frac{20}{100} \times 1,507.96 = 452.39 \text{ lumen}$$

Total flux emitted by globe $= 1,507.96 - 452.39 = 1,055.57$ lumen

Luminance $= \frac{\text{flux emitted}}{\text{Area}}$, Area $= \pi d^2 = \pi \times 0.22^2 = 0.152$

$$= \frac{1,055.57}{0.152} = 6,942.15 \text{ lumen/m}^2$$

ii) candle Power $= \frac{\text{lumen}}{w} = \frac{\phi}{w} = \frac{1055.57}{4\pi} = 84 \text{ cd}$

c) density $= 0.55 \text{ g/cm}^3 = \frac{\text{mass}}{?}$

Volume = Area x thickness $= 75 \times 2 = 150$

mass $= 0.55 \times 150 = 82.5 g$

$$C = \frac{\varepsilon_0 \varepsilon_r A}{\text{thickness}} = \frac{8.85 \times 10^{-12} \times 6.5 \times 75 \times 10^{-4}}{2 \times 10^{-2}} = 21.57 \times 10^{-12} \text{ F}$$

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

$\cos\phi = 0.04$, $\theta = 90 - 30 = 60°$

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

Heat required $= mc\theta$

$= 82.5 \times 0.255 \times 50$

$= 1051.88$ cal

If 15% of heat to slab is wasted

$1051.88 \times \frac{15}{100} = 157.78$ cal

Heat used $= 1051.88 - 157.78$

$= 894.094$ cal

cal to J

$= 894.094 \times 4.186 = 3,742.68$ J

Power $= \frac{\text{energy}}{\text{time}} = \frac{3742.68}{8 \times 60} = 7.80$ W

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

$7.8 = V^2 \times 125.664 \times 10^6 \times 21.57 \times 10^{-12} \times \tan 2.3$

$V^2 = \frac{7.8}{5,047,175.91 \times 21.57 \times 10^{-12}} = 71.615.12$

$V = 267.61$ V

$I = \frac{P}{V \cos\phi} = \frac{7.8}{267.61 \times 0.04} = 0.73$ A