EEE 552 Assignment

1. Distance between Stations $D = 1.5 \text{ km} = \underline{1500 \text{ m}}$

Schedule speed $= 36 \text{ km/h} = 36 \times \frac{1000}{3600} = \underline{10 \text{ m/s}}$

Braking retardation $\beta = 3 \text{ km/h/s} = \frac{3 \times 1000}{3600} = \underline{\frac{5}{6}} \text{ m/s}^2$

Schedule time of run ~~Tsch~~ $T_s = \frac{1500 \text{ m}}{10 \text{ m/s}} = \underline{150 \text{ s}}$.

$$T_s = T_{run} + T_{stop}$$

Actual run $T_{run} = T_s - T_{stop} = 150 - 25 = \underline{125 \text{ s}}$

$$\therefore \quad V_a = \frac{1500}{125} = 12 \text{ m/s}$$

ratio of $\frac{V_m}{V_a} \cancel{\alpha}$ 1.25 ; $V_m = 1.25 \times 12 = 15 \text{ m/s}$

Recall, $K = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{1500}{15^2}\left(\frac{15}{12} - 1\right) = \frac{5}{3}$

and $K = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$ $\left[\alpha \text{ Acceleration Unknown}\right]$

$$\frac{5}{3} = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{5/6}\right)$$

$$\frac{5}{3} \div \frac{1}{2} = \frac{1}{\alpha} + \frac{6}{5}$$

$$\frac{10}{3} = \frac{1}{\alpha} + \frac{6}{5} \quad \therefore \quad \frac{1}{\alpha} = \frac{32}{15}$$

$$\alpha = \frac{15}{32} = 0.469 \text{ m/s}^2$$

or

$$\underline{1.688 \text{ km/h/s}}$$ Ans

2. $V_a = 36\ km/h = 36 \times \frac{1000}{3600} = 10\ m/s$

$\alpha = 1.8\ km/h/s = 1.8 \times \frac{1000}{3600} = 0.5\ m/s^2$

$\beta = 3.6\ km/h/s = 3.6 \times \frac{1000}{3600} = 1\ m/s^2$

$D = 2\ km = 2000m$

recall; $V_a = \frac{D}{t}$ $\therefore$ $t = \frac{D}{V_a} = \frac{2000m}{10m/s} = 200s$

also, $K = \frac{\alpha + \beta}{2\alpha\beta} = \frac{0.5 + 1}{2(0.5 \times 1)} = 1.5$

$V_m = \frac{t - \sqrt{t^2 - 4KD}}{2K} = \frac{200 - \sqrt{200^2 - 4(1.5 \times 2000)}}{2 \times 1.5}$

$= 10.889\ m/s$ or $39.2\ km/h$ Ans

3. Total surface area = $6m^2$

Let L = side of tank so that Total surface area = $6L^2 = 6m^2$

$L = \frac{6}{6} = 1m^2$

$\therefore$ Volume = $L^3 = 1m^3$ (equivalent to 1000kg)

Volume to be heated six times daily = $6 \times \left(1 \times \frac{90}{100}\right) = 5.4m^3$

Mass to be heated daily = $5.4 \times 1000 = 5400kg$

Heat required to raise temp. of water

$= mc\Delta\theta = 5400 \times 4200 \times (65-20)$

$= 1020 \times 10^6 J = 1020MJ$

Since $1kWh = 3.6MJ$
$x = 1020MJ$

$\therefore = \frac{1020MJ}{3.6MJ} = 283.3kWh$

Daily loss per square meter per 1°C temp diff. is:

$6.3 \times 6 \times (65-20) \times \frac{24}{1000} = 40.8kWh$

Energy supplied per day = $283.3kWh + 40.8kWh = 324.1kWh$

Loading in kW = $\frac{324.1kWh}{24h} = \underline{13.5kW}$ Ans

Efficiency = $\frac{283.3}{324.1} \times 100 = \underline{87.41\%}$ Ans

(4) $P = IV\cos\phi$

Secondary current $I_2 = \dfrac{P}{V\cos\phi} = \dfrac{600\times10^3}{20\times0.6} = \underline{50\times10^3 A}$

Secondary voltage $V_2 = V(\cos\phi + j\sin\phi)$
$= 20(0.6 + j0.8) = (12 + j16)V$

$\therefore Z_2 = \dfrac{V_2}{I_2} = \dfrac{12+j16}{50\times10^3} = (2.4\times10^{-4} + j3.2\times10^{-4})\Omega$

When hearth is half full, resistance is double & reactance the same

$\therefore Z_2 = 2\times(2.4\times10^{-4} + j3.2\times10^{-4}) = (4.8\times10^{-4} + j3.2\times10^{-4})\Omega$

$I_2 = \dfrac{V_2}{Z_2} = \dfrac{20}{4.8\times10^{-4} + j3.2\times10^{-4}} = 28846.15 - j19230.8$

$= \sqrt{28846.15^2 + (-19230.8)^2} \angle \tan^{-1}\dfrac{-19230.8}{28846.15}$

$I_2 = 34668.78 \angle -33.69° \simeq (3.467\times10^4 \angle -33.7°)A$

$P.F = \cos -33.7 = 0.832$

Power absorbed $= I_2 V_2 \cos\phi$

$= 34668.78 \times 20 \times 0.832 = 576888.4992 W$

$\simeq 576.888\times10^3 W$

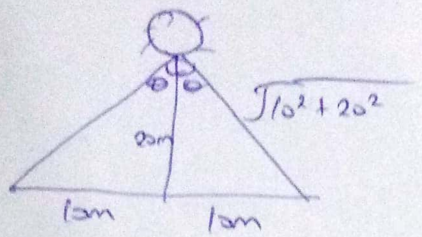
$\simeq \underline{580 kW}$ Ans

5. Without reflector

$$E = \frac{I}{h^2} \cos\theta$$

ⓐ $E = \frac{300}{20^2} \cos 0 = 0.75 \ lm/m^2$ Ans

ⓑ



$$\theta = \sin^{-1}\left(\frac{10}{\sqrt{10^2+20^2}}\right) = 26.56^\circ$$

at the Edge

$$E = \frac{300}{10^2+20^2} \times \cos 26.56^\circ = 0.537 \ lm/m^2$$ Ans

With reflector

$$I = \frac{\phi}{\omega} \quad \therefore \quad \phi = I \times \omega = 300 \times 4\pi \text{ lumen}$$

Total flux $\phi = 1200\pi$

flux directed by reflector $= \frac{50}{100} \times 1200\pi = 600\pi$ lumen

$$E = \frac{\phi}{A} = \frac{600\pi}{\pi \times 10^2} = 6 \ lm/m^2$$ Ans

The illumination is the same at every point on the disc while using the reflector.