EEE 552 Assignment

1) $D = 1500m$, Schedule speed $= 36 km/hr = 36 \times 5/18 = 10 m/s$

braking retardation $\beta = 3 \times 5/18 = 5/6 \, m/s^2$

$v = d/t \therefore t = d/v = 1500/10 = 150s$

Actual time of run $= 150 - 25 = 125s$

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

$V_{max} = 1.25 \times 12 = 15 m/s$

$K = \frac{D}{V_m^2}\left(\frac{V_m}{V_a} - 1\right) = \frac{1500}{15^2}(1.25 - 1)$

$= 5/3$

Recall $K = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

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

$\alpha = 0.4 m/s^2 = 0.47 \times 18/5$

$= 1.7 \, km/h/s$

$\therefore$ acceleration $\alpha = 1.7 \, km/h/s$

2. $V_a = 36 km/h = 36 \times 5/18 = 10 m/s$

$\alpha = 1.8 \, km/h/s = 1.8 \times 5/18 = 0.5 m/s^2$

$\beta = 3.6 \, km/h/s = 3.6 \times 5/18 = 1.0 m/s^2$

$t = \frac{2000}{10} = 200s$

$K = \frac{(\alpha + \beta)}{2\alpha\beta} = \frac{(0.5 + 1.0)}{2(0.5 \times 1.0)} = 1.5$

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

$= 11 m/s = 11 \times 18/5$

$= 39 km/h$

3) T.S.A of the tank = $6L^2$

$\therefore 6L^2 = 6$, $L = 6/6 = 1 m^2$

Volume of the tank = $L^3 = 1m^3$

Volume of water to be heated daily = $6 \times (1 \times 0.9) = 5.4 m^3$

Since $1m^3$ of water weighs 1000 kg,

Mass of water = $5.4 \times 1000 = 5400$ kg

Heat required to raise the temperature of water = $5400 \times 4200 \times (65-20)$

= 1020 MJ

If 1 kWh = 3.6 MJ

then 1020 MJ = 1020 / 3.6

= 283.3 kWh

Daily loss from the tank = $6.3 \times 6 \times (65-20) \times 24 / 1000$

= 40.8 kWh

Energy supplied per day = 283.3 + 40.8 = 324.1 kWh

Loading in kWh = 324.1 / 24

= 3.5 kW

Efficiency of the tank = $\frac{283.3 \times 100}{324.1}$

= 87.4%

4) Secondary current = $\frac{600 \times 10^3}{20 \times 0.6} = 5 \times 10^4$ A

If this current is taken as the reference quantity, then secondary voltage is $V_2 = 20(0.6 + j0.8) = (12 + j16)$ V

secondary Impedance $Z_2 = \frac{(12 + j16)}{(5 \times 10^4)}$

$= (2.4 + j3.2) \times 10^{-4}$ ohm

Now, if the secondary resistance is doubled while reactance remains constant, the impedance when neath is half-full becomes

$Z_2 = (4.8 + j3.2) \times 10^{-4}$ ohm.

Now secondary current $I_2 = \frac{20}{(4.8 + j3.2) \times 10^{-4}}$

$= 3.466 \angle -33.7^\circ \times 10^4 A$

Also, Power factor, $pf = \cos 33.4 = 0.832$

Hence, Power absorbed $= 20 \times 3.466 \times 10^4 \times 0.832 \times 10^4$

$= 580 kW$

5) Without Reflector,

(a) $E = \frac{300}{20^2} = 0.75 \, lm/m^2$

(b) $\theta = \tan^{-1}(10/20) = \tan^{-1}(0.5) = 26.6^\circ$

$\cos\theta = 0.89$, $x^2 = 10^2 + 20^2 = 500$

$\therefore E = \frac{300}{0.89 \times 500}$

$= 0.534 \, lm/m^2$

With Reflector,

Luminous output of the lamp $= 300 \times 4\pi$ lumen

Flux directed by the reflector $= 0.5 \times 1200\pi$

$= 600\pi \, lm$

Illumination Produced on the disc $= \frac{600\pi}{100\pi}$

$= 6 \, lm/m^2$

It is the same at every point on the disc.