15/ENG04/047

EEE 552 Assignment II

24th/May/2020

1

Distance = 1.5km = 1500m

Scheduled speed = $36 \times 5/18 = 10 m/s$

Breaking retardation $\beta = 3 km/h/s = 3 \times 5/18 = 0.833 m/s^2$

$$\text{Velocity} = \frac{\text{distance}}{\text{time}} = \frac{D}{t}$$

$$t = D/V = \frac{1500m}{10m/s} = 150s$$

Actual time of run $(t_a = t - 25$

$$= 150 - 25 = 125s$$

$$V_a = \text{actual velocity} = \frac{D}{t_a} = \frac{1500}{125} = 12m/s$$

V_{max} = maximum velocity = $1.25 \times V_a = 15m/s$

$$K = \frac{D}{V_m^2}\left[\frac{V_m}{V_a} - 1\right] = \frac{1500}{(15)^2}\left[\frac{15}{12} - 1\right]$$

$$K = \frac{20}{3}\left[1.25 - 1\right] = \frac{20}{3}\left[0.25\right] = \frac{5}{3}$$

Also $K = \frac{D}{V_m^2}\left[\frac{V_m}{V_a} - 1\right]$ $K = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{1}{\beta}\right]$

Also $\frac{5}{3} = \frac{1500}{(15)^2}$ $\frac{5}{3} = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{1}{0.8333}\right] = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{6}{5}\right]$

$\frac{5}{3} = \frac{1}{2\alpha} + \frac{1}{1.6666}$ $\frac{5}{3} = \frac{1}{2\alpha} + \frac{5}{12}$

$\frac{5}{3} - \frac{1}{1.6666} = \frac{1}{2\alpha}$ $\frac{5}{3} = \frac{6 + 1}{12\alpha} = \frac{7}{12\alpha}$

$2\alpha\left[\frac{5}{3} - \frac{1}{1}\right] =$ $\frac{5}{3} = \frac{7}{12\alpha}$ $= 60\alpha = 21$

$\frac{5}{3} = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{6}{5}\right]$

$\frac{5}{3} = \frac{1}{2\alpha} + \frac{6}{10}$

$\frac{1}{2\alpha} = \frac{5}{3} - \frac{6}{10} = \frac{50 - 18}{13} = \frac{32}{13}$

$1/2\alpha = 32/13$

$13 = 64\alpha$

$\alpha =$

$\frac{10}{3} = \frac{1}{\alpha} + \frac{6}{5}$

$1/\alpha = 10/3 - 6/5$

$\frac{1}{\alpha} = \frac{32}{15}$

$\alpha = \frac{15}{32}$

$\alpha = 0.47\ m/s^2 = 0.47 \times 18/5 = 1.7\ Km/h/s$

$\alpha = 1.7\ Km/h/s$

2.

$V_a = 36\ Km/h = 36 \times 5/18 = 10\ m/s$

$\alpha = 1.8\ Km/h/s = 1.8 \times 5/18 = 1/2\ m/s^2$

$D = 2\ Km = 2 \times 1000\ m = 2000\ m$

~~Retardation = 1.8 Km/h/s~~

~~Acceleration = 1.8 Km/h/s = 1.~~

Retardation $= 3.6\ Km/h/s = 3.6 \times 5/18 = 1.0\ m/s^2$

$V_{max} = ?$

$t = d/v = \frac{2000}{10} = 200\ s$

$K = \frac{(\alpha + \beta)}{2\alpha\beta} = \frac{(0.5 + 1.0)}{2(0.5 \times 1)} = 1.5$

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

$V_m = \frac{200 - \sqrt{200^2 - 12000}}{3} = 200$

$V_m = \frac{33}{3} = 11\ m/s$

$V_m = 11 \times 18/5 = 39\ Km/h$

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(3)

Total Surface area of tank = $6l^2 = 6$ $l^2 = 6/6 = 1$ $l = 1m^2$

β = Volume of tank = $1m^3$

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

$1m^3$ of water = 1000kg

Mass of water = 1000kg x Volume of water

$M = 1000 \times 5.4 = 5400kg$

Heat required to raise the temperature of water = $M \Delta T \times$ specific heat

$= 5400 \times 4200 \times (65-20)$

$= 1020 MJ = 1020/3.6$

$= 283.3$ kWh

Daily loss from the surface of 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 kW = $324.1/24 = 3.5$ kW

Efficiency of the tank = $28.3 \times 100 / 324.1 = 87.4\%$

(4) Secondary current $I_2 = P/V_2 \cos\phi$

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

$V_2 = (\cos\phi + j\sin\phi)$

Secondary current $V_2 = 20(0.6 + j0.8) = (12 + j16) V$

(if the current is taken as reference quantity)

$Z_2 = \frac{(12+j16)}{(5 \times 10^4)} = \frac{V_2}{I_2}$ – (

$Z_2 = (2.4 + j3.2) \times 10^{-4}$ ohm

if resistance is doubled, while reactance is constant

~~$Z_2 = 2(2.4 + j3.2) \times 10^{-4}$ ohm~~

~~$Z_2 = (4.8 + j6.4) \times 10^{-4}$~~

Now $I_2 = \frac{20}{(4.8\sim}$

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When Resistance is doubled

$Z_2 = 2(2.4\times10^{-4} + j13.2\times10^{-4}) = (4.8 + j3.2)\times10^{-4}$

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

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

$I_2 = 34668.78 \angle -33.69°$

(5.) ~~R.F~~ P.F = cos 33.7 = 0.832

(a) ~~without Reflector~~ Power absorbed $= I_2 V_2 \cos\phi$

~~$E = \frac{300}{20^2} = 0.75 lm$~~

$= 34668.78 \times 20 \times 0.832$

$= 576888.4992 W$

$= 576.888 kW$ ~~245~~

5. (a)

$E = \frac{I}{h^2}\cos\theta$ without Reflector $= \frac{300}{20^2}\cos\theta = 0.75 lm/m^2$

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

at Edge $E = \frac{300}{10^2+20^2} \times \cos 26.56° = 0.5371 lm/m^2$

With reflector

$I = \phi/\omega \therefore \phi = I\times\omega = 300\times4\pi$ lumen

Total flux $\phi = 1200\pi$

Flux directed by reflector $= 50/100 \times 1200\pi = 600\pi$ lumen

$E = \phi/A = \frac{600\pi}{\pi\times10^2} = 6 lm/m^2$

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