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16/ENG04/066

EEE 552 Assignment

1 Distance, D = 1.5Km = 1500m

schedule speed = 36 Km/h = $\frac{36 \times 1000}{3600}$ = 10m/s

braking retardation, β = 3 Km/h/s = $3 \times \frac{1000}{3600} = \frac{5}{6}$ m/s^2

schedule run time = $\frac{\text{Distance to be covered}}{\text{Scheduled speed}} = \frac{1500m}{10m/s}$ = 150s

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

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

since the ratio of maximum ~~Average~~ speed, V_a and Average ~~Maximum~~ speed, V_a equal to 1.25

$\frac{V_m}{V_a} = 1.25$, $V_m = 1.25 \times 12$

V_m = 15m/s

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

$K = \frac{5}{3}$

Let α = acceleration

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

α = 0.47m/s^2 = 0.47 × 18/5 = 1.7Km/h/s

2 Average speed, V_a = 36Km/h = $36 \times \frac{1000}{3600}$ = 10m/s

Distance, D = 2Km = 2000m

Acceleration, α = 1.8Km/h/s = $1.8 \times \frac{1000}{3600}$ = 0.5m/s^2

Retardation, β = 3.6Km/h/s = $3.6 \times \frac{1000}{3600}$ = 1.0m/s^2

total time used, t = $\frac{\text{Distance}}{\text{Average velocity}}$

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

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

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

$V_m = 11 m/s = 11 \times \frac{3600}{1000} = 39.6 km/h$

$V_m = 39.6 km/h$

3 let the size of the tank be h

T.S.A of the tank = $6h^2$

$6h^2 = 6$

$h = \sqrt{\frac{6}{6}} = 1$

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

Volume of water to be heated daily $= 6 \times (1 \times \frac{90}{100})$

$= 5.4m^3$

Since $1m^3$ of water weighs 1000kg, mass of water heated daily $= 5.4 \times 1000 = 5400 kg$

Heat required to raise temp of water $= mc\Delta\theta$

$c = 4,200 J/kg/°C$, $T_2 = 65°C$, $T_1 = 20°C$

$\Delta\theta = 65 - 20 = 45°C$

Heat required $= 5400 \times 4200 \times 45 = 1020 MJ$

Since 1 kWh = 3.6 MJ

Heat required $= \frac{1020}{3.6} = 283.3 kWh$

Daily loss from the surface of the tank

$= 6.3 \times 6 \times 45 \times \frac{24}{1000} = 40.8 kWh$

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

Loading in kW $= \frac{324.1}{24} = 3.5 kW$

Efficiency of the tank $= \frac{283.3}{324.1} \times 100 = 87.4\%$

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

secondary voltage, $V_2 = 20(0.6 + j0.8)V = (12 + j16)V$

So, secondary impedence, $Z_2 = \frac{(12+j16)}{5 \times 10^4} = (2.4 + j3.2) \times 10^{-4}\ \Omega$

If secondary resistence is doubled and secondary reactence is the same

total impedence when the hearth is half-full $= Z_2 = (4.8 + j3.2) \times 10^{-4}\ \Omega$

Secondary current $I_2 = \frac{20}{(4.8 + j3.2) \times 10^{-4}} = \frac{20}{5.77} \angle 33.7^\circ \times 10^4 A$

$I_2 = 3.466 \angle -33.7^\circ \times 10^4 A$

$p.f = \cos 33.7^\circ = 0.832$

Power absorbed $= 20 \times 3.466 \times 10^4 \times 0.832 \times 10^{-3}$

Power absorbed $= 580\ KW$

5 candle power = 300 lumen

diameter of disc = 20 m

distance from source = 20 m

Area illuminated $= 20 \times 20 = 400 m^2$.

without reflector

a illumination at the centre

$E = \frac{\text{candle power}}{\text{Area illuminated}} = \frac{300}{400} = 0.75\ lm/m^2$

b illumination at the edge

$\theta = \tan^{-1}(\frac{r}{h}) = \tan^{-1}(\frac{10}{20}) = 26.6^\circ$

$\cos\theta = 0.89$

$x^2 = 10^2 + 20^2 = 500$

$E = 300 \times \frac{0.89}{500} = 0.534\ lm/m^2$

with reflector

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

$= 1200\pi$

flux directed by the reflector $= 0.5 \times 1200\pi = 600\pi$ lumen

illumination produced on the disc $= \frac{600\pi}{100\pi} = 6\ lm/m^2$

b) illumination is the same at every point

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