DEPARTMENT OF MECHANICAL & INDUSTRIAL ENGINEERING

I SEMESTER B.TECH.

Mid-Term Exam

SUBJECT: BASIC MECHANICAL ENGINEERING (MIE 1071)

SCHEME OF EVALUATION

Time:8.30-10.00 AM   Date: 26.09.2024   MAX.MARKS: 30

Type: DES

A6:

$$x = 0.5 - - - -(\boldsymbol{0.5\ mark})$$

$$Heat\ supplied\ in\ the\ boiler = \ h_Q - h_P$$

$$h_P = 125.61\ kJ/kg - - - -(\boldsymbol{0.5\ mark})$$

$$h_Q = 1825.1\ kJ/kg - - - -(\boldsymbol{0.5\ mark})$$

$$Heat\ supplied\ in\ the\ boiler = \ h_Q - h_P = 1825.1 - 125.61 = 1699.49\ kJ/kg - - - -(\boldsymbol{0.5\ mark})$$

$$Condition\ of\ steam\ at\ exit\ of\ pipeline:$$

$$h_{Exit} = 0.8h_R$$

$$h_R = 3016.7\ kJ/kg - - - -(\boldsymbol{0.5\ mark})$$

$$h_{Exit} = 2413.36\ kJ/kg - - - -(\boldsymbol{0.5\ mark})$$

$$Since\ h_{Exit} > h_f\ and\ h_{Exit} < \ h_g, the\ steam\ is\ wet. - - - - (\boldsymbol{0.5\ mark})$$

$$x\ at\ exit = 0.804\ - - - -(\boldsymbol{0.5\ mark})$$

A7:

$$\theta = 3.2\ radian - - - (\boldsymbol{0.5\ mark})$$

$$\frac{T_1}{T_2} = 2.61 - - - (\boldsymbol{0.5\ mark})$$

$$T_1 + T_2 = 1600N - - - (\boldsymbol{0.5\ mark})$$

$$T_1 = 1156.79N - - - (\boldsymbol{0.5\ mark})$$

$$T_2 = 443.21N - - - (\boldsymbol{0.5\ mark})$$

$$Power\ Transmitted = 1.87\ kW - - -(\boldsymbol{0.5\ mark})$$

A8:

Length of open belt, $L = \Pi (r_1 + r_2) + [(r_1 - r_2)^2 / X] + 2 X$

$5.571 = \Pi D + 0 + 2*2; D = 0.5$ m or $r_1 = r_2 = 0.25$m (**0.5 mark**)

Ratio of Tensions $= T_1 / T_2 = e^{\mu\Theta} = e^{0.3 \times 180 \times \pi/180} = 2.57$ (**0.5 mark**)

$$T_1 + T_2 = 1000\ N$$

$T_2 = 280.1$ N (**0.5 mark**)

and $T_1 = 719.9$ N (**0. 5 mark**)

Power Transmitted = 26.39 kW (**01 mark**)

A9:

$$p = 2.7 \, bar, T_{sat} = 130°C, x = 0.85, \; h_f = 546.2 \, \frac{kJ}{kg}, h_{fg} = 2173.7 \frac{kJ}{kg}, h_g = 2719.9 \frac{kJ}{kg}, Q =$$

$$500 \frac{kg}{day}, T_1 = 25°C, GCV_{fuel-1} = 25000 \frac{kJ}{kg}, GCV_{fuel-2} = 30000 \frac{kJ}{kg}, \eta = 75\%$$

$$h_w = 104.68 \frac{kJ}{kg} - - - - - (\mathbf{0.5 \, marks})$$
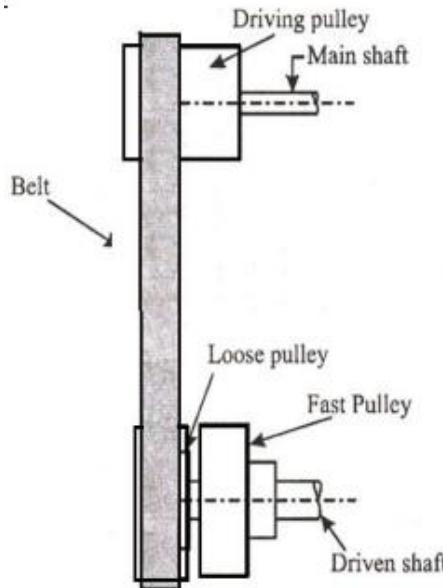
$$h_s = 2285.16 \, kJ/kg - - - - - (\mathbf{0.5 \, marks})$$

$$m_{fuel-1} = 58.15 \, kg - - - - - (\mathbf{01 \, marks})$$

$$m_{fuel-2} = 48.45 \, kg - - - - - (\mathbf{01 \, marks})$$

A10:

Identification of the pulley as Fast and Loose Pulley (**01 mark**)

Sketch (**1. 5 mark**)

• Deduct 0.5 mark if the sketch fails to depict a wider driving pulley

• Deduct 0.5 mark if the sketch shows too much gap between the fast and loose

pulleys.

Explanation (**0. 5 mark**)

A11:

$$Given \; Q = 4000 \frac{kg}{h}, T_{sat} = 188°C, T_w = 30°C, m_f = 2000 \frac{kg}{h}, CV_{fuel} = 25000 \frac{kJ}{kg}$$

$$At \; 12 \, bar, h_f = 798.4 \frac{kJ}{kg}, h_{fg} = 1984.3 \frac{kJ}{kg}; \; h_g = 2782.7 \, kJ/kg$$

Efficiency of boiler without accessory:

$$h_s = 2584.27 \ kJ/kg - - - - - (\mathbf{0.5 \ marks})$$

$$h_w = 125.61 \frac{kJ}{kg} - - - - - (\mathbf{0.5 \ marks})$$

$$\eta = 19.67\% - - - - - (\mathbf{0.5 \ marks})$$

Efficiency of boiler with economiser:

$$\therefore h_w = 355.895 \frac{kJ}{kg} - - - - - (\mathbf{0.5 \ marks})$$

$$Mass \ of \ caol \ consumption = 1760 \ kJ/kg - - - - - (\mathbf{0.5 \ marks})$$

$$\eta = 20.25\% - - - - - (\mathbf{0.5 \ marks})$$

A12:

Suggesting the boiler type as a Fire Tube Boiler$- - - - -(\mathbf{01 \ mark})$

    Justification (*Any one point* $- - - - - \mathbf{01 \ mark}$)

- Fire tube boilers donot require water treatment
- Fire tube boilers are suitable for locomotives with in-built furnace

A13:

a) Boiler mountings are required for safe operation of the boilers. They are mounted directly on the boiler drum and hence form an integral part of the boiler. $- - - - -(\mathbf{01 \ mark})$
b) To prevent reverseflow of water from the boiler drum to the reservoir due to difference in pressure when the feed pump fails/stops functioning. $- - - - -(\mathbf{01 \ mark})$

A14:

Friction in belt drives ensure that there is no slipping of belt from the pulley surface ensuring minimum loss of power during its transmission. $- - - - -(\mathbf{01 \ marks})$

Explnation to slip $- - - - -(\mathbf{01 \ marks})$