

2nd SEMESTER B.TECH FIRST SESSIONAL FEB-2020

SUBJECT: BASIC MECHANICAL ENGINEERING [MME 1051]

SCHEME OF VALUATION

Time: 1Hours

MAX. MARKS: 15

Instructions to Candidates:

- ❖ Answer **ALL** the questions.
- ❖ Missing data if any may be suitably assumed.
- ❖ Use of Steam Tables is permitted

Type: MCQ

Q1. The enthalpy of 1 kg of steam at a pressure of 2 bar is 2800 kJ. The condition of the steam is:

1. Wet steam
2. Dry steam
3. ******Superheated Steam
4. None of these

Q2. For all values of pressure below critical point, the latent heat of steam is found to:

1. ****** Increase
2. Decrease
3. Remain constant
4. Increase and then decrease

Q3. The quantity of heat supplied to water below saturation temperature is called:

1. Latent heat
2. Enthalpy
3. ******Sensible heat
4. None of These

Q4. When dry saturated steam is cooled at constant pressure, its dryness fraction

1. ******decreases
2. increases
3. remains same
4. None of these.

Q 5. In a Steam Boiler

1. The major axis of the lid is shorter than the major axis of the manhole.
2. ******The major axis of the lid is longer than the major axis of the manhole.
3. The minor axis of the lid is longer than the major axis of the manhole.
4. None of These

Q 6. Boiler mountings are:

1. ******Necessary devices for the safety of boiler
2. Necessary devices for efficiency enhancement purpose
3. Necessary devices for both safety and efficiency enhancement purpose
4. None of the above

Q 7 . Chain drive is a

1. ******Positive type
2. Non-positive type
3. Overdrive
4. None of these

Q 8. Steam trap is used to,

1. Generate super-heated steam
2. ******Drain off the water in the pipeline without allowing the escape of steam
3. Separate steam and water in the boiler shell
4. None of these

Q.9 In a crossed belt drive, if velocity ratio=1 then angle of lap is"

1. π radians
2. ****** greater than π radians
3. less than π radians
4. none of these

Q 10. In an open belt drive when the diameter of driven pulley is more than driver pulley the speed reduction ratio is:

1. Equal to one
2. Less than one
3. ******Greater than one
4. None of these

Type: DES

Q11. Justify why belt drive is not a positive drive. (2)

Slip mainly occurs when the difference between tensions in the tight and the slack side is very large or when the coefficient of friction between the belt and the pulley surface decreases owing to stretching of the belt or when the smoothness of the pulley surface is more or due to a layer of air trapped between the pulley rim and the belt. ----- 01 mark

Creep:- In a belt drive the belt is alternatively subjected to higher and lower tensions. The portion of the belt between the driving and driven pulley has lower tension and the portion of the belt between the driven and driving pulley has higher tension. Thus the belt undergoes alternate stretching and contraction. While passing from slack side to tight side the belt extends and while passing from tight side to slack side the belt contracts. Due to this alternate stretching and contraction over a period of time the length of the belt increases leading to relative motion between the belt and the pulley surface. This relative motion is called creep which results in loss of power and decreases the velocity ratio. ----- 01 mark

Q12. Water enters a steam boiler at 30°C and generates steam having an enthalpy of 3000kJ/kg. The superheated steam is then passed through the pipeline to a steam turbine. It is found that the steam loses 293.7 kJ/kg of heat at constant pressure in the pipeline and becomes saturated before it enters the steam turbine. Determine the pressure at which steam is generated. What is the temperature of the superheated steam from the boiler? Assume specific heat of superheated steam as 2.25 KJ/kgK. (2)

Ans:- Enthalpy of steam before it enters the turbine= 3000 – 293.7 = 2706.3 kJ/kg.

Hence enthalpy of dry steam = 2706.3 kJ/kg.

Therefore, pressure from steam table is 2 bar at h_g ----- 01 mark

$$h_{\text{sup}} = h_g + C_p (T_{\text{sup}} - T_{\text{sat}})$$

$$3000 = 2706.3 + 2.25 (T_{\text{sup}} - 120.2) \quad \text{for 2 bar, } T_{\text{sat}} = 120.2 \text{ } ^\circ\text{C}$$

$$\text{Hence } T_{\text{sup}} = 250.76 \text{ } ^\circ\text{C} \quad \text{---- 01 Mark}$$

Q13. Explain the functions of fusible plug and safety valve in steam boiler? (2)

Fusible Plug: Fusible plug is a safety device which is used to extinguish the fire in the boiler furnace when the water level in the boiler falls too much below the normal level. It is fitted on the bottom most portion of the boiler drum just above the combustion zone. The plug has an annulus of fusible metal having low melting point. Normally the plug is covered by water inside the boiler drum which keeps the temperature of the plug below its melting point. As the water level falls below the minimum level the plug is uncovered and the fusible metal melts as it gets exposed to steam space instead of water, which is not able to keep it cool. The plug drops down and the steam present in the boiler drum rushes out into the combustion zone and puts out the fire. ---- 01 Mark

Safety Valves: The function of the safety valve is to prevent the steam pressure in a boiler from exceeding certain predetermined value. A boiler is designed to operate at a certain rated pressure called design pressure. However the operating pressure in a boiler is generally maintained below the

design pressure. When the boiler is in operation either due to sudden reduced flow of steam out of the boiler or due to sudden increased rate of steam generation which may be due to low water levels or increased rate of combustion there will be a increase in steam pressure which poses danger to the safety of the boiler. This excess steam must be instantly released from the boiler to reduce the steam pressure. ---- **01 Mark**

Q14. Determine the enthalpy of 1 kg of wet steam at a pressure of 10 bar containing 0.1 kg of water particles in it. (2)

$$m_w = 0.1 \text{ kg}, m_m = 1 \text{ kg},$$

$$m_v = m_m - m_w = 0.9 \text{ kg} \dots \text{0.5 mark}$$

$$\text{At 10 bar, } h_f = 762 \text{ kJ/kg, } h_{fg} = 2013 \text{ kJ/kg} \dots \text{0.5 mark}$$

$$X = m_v / m_m = 0.9 \text{ kg} / 1 \text{ kg} = 0.9 \dots \text{0.5 mark}$$

$$h_{\text{wet steam}} = h_f + X h_{fg} = 2573.7 \text{ kJ/kg} \dots \text{0.5 mark}$$

Q15. Power is transmitted between two shafts, 4m apart using two pulleys both rotating in counter clockwise direction with a velocity ratio of unity. The length of belt is 11.142m and coefficient of friction is 0.3. Determine the size of two pulleys and the slack side tension of belt drive if the tight side tension is 1080 N. (2)

Ans:- Since both the shafts are rotating in counter clockwise direction the drive is an open drive:-

$$X = 4 \text{ m}, L = 11.142 \text{ m}, \mu = 0.3, T_1 = 1080 \text{ N}$$

$$\text{Length of open drive belt} = L = \pi(r_1 + r_2) + \frac{(r_1 - r_2)^2}{X} + 2X$$

$$11.142 = \pi * D + 0 + 2 * 4$$

$$D = 1 \text{ m} = r_1 = r_2 \quad \text{----- 1 Mark}$$

Since $r_1 = r_2$, Angle of lap ($\theta = 180^\circ$)

$$\text{Ratio of Tensions} = T_1 / T_2 = e^{\mu \theta} = 1080 / T_2 = e^{0.3 * 180 * \pi / 180}$$

$$T_1 = 2.57 T_2$$

$$T_2 = 1080 / 2.57 = 420 \text{ N} \quad \text{----- 1 Mark}$$