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MANIPAL ACADEMY OF HIGHER EDUCATION

II Semester B.Tech Mid-term Examination
BASIC MECHANICAL ENGINEERING SCIENCE [MIE 1072-PHY]

Marks: 30   **Duration: 90 mins.**

MCQ

Answer all the questions.   Section Duration: 20 mins

Answer all the questions.

1)   Match the following

A.	Baffle plates	I.	Furnace
B.	Stoker	II.	Boiler drum
C.	T-tube	III.	Flue gases
D.	Safety valve	IV.	Superheater

(1)

A-I; B-III; C-II; D-IV   A-III; B-I; C-IV; D-II   A-III; B-IV; C-II; D-I   A-I; B-II; C-III; D-IV

2)   Identify the correct statement from the following:

| The dryness fraction of the saturated steam depends on the pressure at which the water is boiling. | The boiling point of water always coincides with the critical temperature of water for any given pressure. | Water always exists in a liquid state at all temperatures above the critical temperature for any given pressure. | The amount of heat required to vaporize saturated water to saturated steam at lower pressure is greater than that required at higher pressure. |

(1)

3)   Determine the dryness fraction of steam if there is a mixture of 12 kg of liquid and 65 kg of vapour.

(1)

0.79   0.84   0.55   0.98

4)   The sum of diameters of two pulleys is 1000 mm and the pulleys are connected by belt. If the pulleys rotate at 600 rpm and 1800 rpm, determine the diameters of each pulley.

(1)

D1 = 750 mm; D2 = 250 mm   D1 = 700 mm; D2 = 300 mm   D1 = 800 mm; D2 = 200 mm   D1 = 650 mm; D2 = 350 mm

5)   Idler gears in a simple gear train _____

| do not influence the velocity ratio and do not influence the direction of rotation of the driven shaft | Influences the velocity ratio and the direction of rotation of the driven shaft | Influences the velocity ratio but does not influence the direction of rotation of the driven shaft | do not influence the velocity ratio but influence the direction of rotation of the output shaft |

(1)

DESCRIPTIVE

Answer all the questions.

Answer all the questions.

6)   A boiler generates 225 kg of 15% wet steam at a temperature of 230 ºC. This steam is subsequently heated in a superheater to achieve a degree of superheat of 85 ºC. Prior to entering the superheater, the steam loses approximately 15% of its heat. The superheated steam is then used to run a turbine, during which it loses 353.15 MJ of heat.

a) Total heat supplied to feed water in the boiler

b) Dryness fraction of steam at the entry of super heater

c) Total heat supplied in the super heater   (5)

d) Quality of the steam at the exit of the turbine.

The temperature of the feedwater entering the boiler is found to be 28 ºC.

7)   A manufacturing company is considering the installation of a coal-fired boiler for its process heating requirements, constrained by investment limits. The required steam generation capacity is 4000 kg/h at a pressure of 0.64 MPa and a temperature of 250 ºC. The feed water is sourced from a nearby river at an average temperature of 25 ºC. The coal consumption is 800 kg/h, with a calorific value of 24 MJ/kg. Evaluate the enhancement in boiler efficiency when the following accessories are implemented:

i) an economizer that increases the feed water temperature to 65 ºC and reduces coal consumption by 15%.   (5)

ii) an air preheater that reduces coal consumption by 18%.

iii) both air preheater and economizer, resulting in a combined effect of reducing coal consumption by 24% and preheating the feed water temperature by 30 ºC.

8)   A large industrial fan, used for ventilation in a manufacturing facility, is driven by a motor running at 1800 rpm. To achieve the desired airflow, the fan operates with a speed reduction ratio of 2.5. The motor and fan are connected by a belt drive, with the larger pulley measuring 500 mm in diameter, causing the pulleys to rotate in opposite directions. The system is designed to transmit 40 kW of power, with a coefficient of friction of 0.28 between the belt and pulley surface. The center distance between the pulleys is fixed at 1.8 m. Considering that the permissible tension in the belt is limited to 27 N/mm of belt width, determine the belt specifications required for this   (5) system. Additionally, calculate the initial tension needed when the drive is stationary.

9)   A gear box for a machine tool is to be designed, the motor of which runs at 4000 rpm. Following are the gears available as tabulated below. Build a compound gear train and calculate the least possible speed for the machine spindle in such a way that the driver and driven shafts are parallel to each other. The entire gear train consists of five shafts. Sketch the arrangement and list the criteria for building the gear train.

Gear	Type	Module (mm)	No. of teeth
A	Spur	2	92
B	Spur	2	40
C	Helical	2	104
D	Helical	2	40
E	Bevel	2	116
F	Bevel	2	30
G	Spur	3	30
H	Spur	3	75
I	Helical	3	72
J	Helical	3	30
K	Bevel	3	20
L	Bevel	3	68

(4)

10)   Give reasons for the following:

1. Generating "super-heated steam" in a boiler is practically not possible

2. Belt drives are known as "non positive drive"   (3)

3. It is not recommended to use a gear train for power transmission from the engine to the rear wheel in a motorcycle.

11)   Machines in group drive need to be stopped and started at will. Suggest the type of pulley for the said requirement and hence explain its construction and working with a simple schematic representation.   (3)