[Total No. of Questions : 6] [Total No. of Pages : 3]

Pune Institute of Engineering & Technology, Pune

(Formerly Government College of Engineering, Pune)

F.Y. B.Tech

(ME 101)

BASIC THERMODYNAMICS

[Time : 3 Hours] [Max. Marks : 60]

Instructions to candidates:

1) Answer **all** questions.
2) Neat Diagrams must be drawn wherever necessary.
3) Assume suitable data, if necessary.
4) Figures to the right indicate full marks.
5) Use of only non-programmable calculator is allowed.
6) Start answers of each question on new page.

Q. No.1.

a) Draw a neat diagram of steam power plant and state functions of each component. [5]

b) Explain the working of a window air conditioner with the help of suitable diagram. [5]

Q. No. 2

a) Compare four stroke and two stroke cycle engines. Bring out clearly their merits and demerits. [4]

b) Give a detailed classification of pumps and mention their engineering applications. [3]

c) State the advantages and drawbacks of solar energy. [3]

Q. No. 3

a) What is a quasi-state process? What is its characteristic feature? [2]

b) What is a constant volume gas thermometer ? Why is it preferred to a constant pressure gas thermometer ? [3]

c) The pressure of a steam flowing in a pipe line is measured with a mercury manometer. One limb is connected to the pipe & other is open to atmosphere. Some steam condenses in to water (condensate) in a limb connected to the pipe, whose height is 30 mm. The level of mercury in open limb is 50 cm. Take density of mercury as 13.6×10^3 kg/m^3, the barometer reads 76.1 cm of Hg and take g = 9.806 m/s^2. Estimate the steam pressure in kPa. [5]

Q. No. 4

a) Desire a steady flow energy equation on time basis and hence show that for throttling device, enthalpy before throttling is equal to enthalpy after throttling. [5]

b] A fluid system undergoes a non-flow frictionless process following the pressure - volume relation as

$$P = \left(\frac{4.5}{V}\right) + 3,$$

where P is in bar and V is in m^3. During the process, the volume changes from 0.15 m^3 to 0.03 m^3 and the system rejects 52 kJ of heat. Determine the change in internal energy and enthalpy. [5]

Q. No. 5

a) All spontaneous processes are irreversible. Explain. [2]

b) Can you use the same plant as a heat pump in winter and as a refrigerator in summer ? Explain. [3]

c) A reversible heat engine operates between two reservoirs at temperatures of 700^{0}c and 35^{0}c. The engine drives a reversible

refrigerator which operates between reservoirs at temperatures of 35^0c and -25^0c. The heat transfer to the engine is 2500 kJ and the net work output of the combined engine - refrigerator plant is 410 kJ.

Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 35^0c [5]

Q. No. 6

a) What is the critical state ? Explain the terms critical pressure, critical temperature and critical volume of water. [4]

b) A 150mm steam pipe has inside diamer of 130 mm and outside diameter of 170 mm. It is insulated at the outside with asbestos. The steam temperature is 180^0c and the air temperature is 22^0c. Heat transfer coefficient-steam side is 110 w/m^2-k, air side 30 w/m^2-k, thermal conductivity of asbestos = 0.75 w/m-k and for steel 45 w/m-k.

What should be the thickness of asbestos, in order to limit the heat losses to 2.5 kw/ m^2 ? [6]

OR

b] A closed vessel of 0.8 m^3 capacity contains dry saturated steam at 360 KN/m^2. The vessel is cooled until the pressure is reduced to 200 KN/m^2. Calculate -

i) mass of steam in a vessel

ii) the final dryness of the steam

iii) the amount of heat transferred during the cooling process. [6]