No. of Printed Pages : 5

**BME-019**

# B.Tech. MECHANICAL ENGINEERING (COMPUTER INTEGRATED MANUFACTURING) / BTMEVI

## Term-End Examination

00192

## December, 2017

## BME-019 : ENGINEERING THERMODYNAMICS

*Time : 3 hours* *Maximum Marks : 70*

***Note :*** *Answer any* ***seven*** *questions. All questions carry equal marks. Use of calculator, steam table and Mollier chart is permitted.*

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**1.** (a) Explain and differentiate between Extensive and Intensive properties with the help of examples. *5*

(b) Define Thermodynamic System. Explain different types of thermodynamic systems with the help of examples. *5*

**2.** (a) What is the concept of Continuum ? How will you define density and pressure using this concept ? *5*

(b) When the valve of the evacuated bottle (Figure 1) is opened, atmospheric air rushes into it. If the atmospheric pressure is 101·325 kPa, and 0·6 $m^3$ of air (measured at atmospheric conditions) enters into the bottle, calculate the work done by air. 5

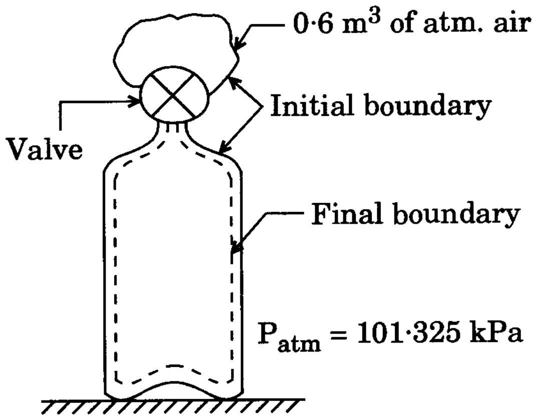



*Figure 1*

3. (a) A stationary mass of gas is compressed without friction from an initial state of 0·3 $m^3$ and 0·105 MPa to a final state of 0·15 $m^3$ and 0·105 MPa, the pressure remains constant during the process. How much does the initial energy of the gas change ? 5

(b) Show that Internal Energy is the property of a system. 5

4. A fluid is confined in a cylinder by a spring-loaded, frictionless piston so that the pressure in the fluid is a linear function of the volume ($P = a + bV$). The internal energy of the fluid is given by the following relation : $u = 34 + 3{\cdot}15\ pV$; where u is in kJ, p in kPa and V in $m^3$.

If the fluid changes from an initial state of 170 kPa, $0{\cdot}03\ m^3$ to a final state of 400 kPa, $0{\cdot}06\ m^3$, with no work other than that done on the piston, find the direction and magnitude of the work and heat transfer. *10*

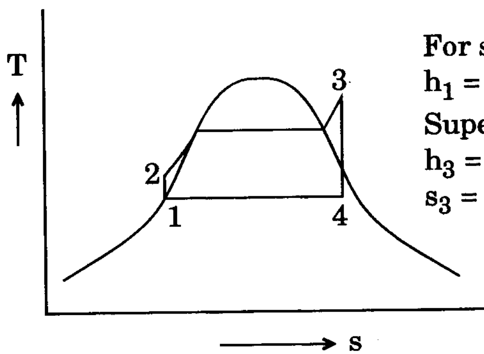
5. (a) Which is the more effective way to increase the efficiency of a Carnot engine to increase $T_1$, keeping $T_2$ constant or to decrease $T_2$, keeping $T_1$ constant ? *5*

(b) A domestic food freezer maintains a temperature of $-15°C$. The ambient air temperature is $30°C$. If heat leaks into the freezer at a continuous rate of $1{\cdot}75$ kJ/sec, what is the least power necessary to pump this heat out continuously ? *5*

6. Two identical bodies of constant heat capacity are at the same initial temperature $T_i$. A refrigerator operates between these two bodies until one body is cooled to temperature $T_2$. If the bodies remain at constant pressure and undergo no change of phase, show that the minimum amount of work needed to do this is

$$W_{(min)} = C_p\left(\frac{T_i^2}{T_2} + T_2 - 2T_i\right).$$ *10*

7. A steam power plant is proposed to operate between the pressures of 10 kPa and 2 MPa with a maximum temperature of 400°C, as shown in the figure. Determine the maximum efficiency possible from the power cycle. *10*




For sat. liquid
$h_1 = h_f = 191{\cdot}8$ kJ/kg
Superheat
$h_3 = 3248$ kJ/kg
$s_3 = 7{\cdot}1279$ kJ/kg-K

*Figure 2*

8. (a) What is refrigeration ? How is (i) ice, and (ii) dry ice used for the purpose of refrigeration ? *5*

(b) Show that

$$(COP)_{\text{Heat Pump}} = (COP)_{\text{Refrigerator}} + 1. \quad 5$$

9. A steam power station uses the following cycle :

Steam at boiler outlet – 150 bar, 550°C

Reheat at 40 bar to 550°C

Condenser at 0·1 bar

Using the Mollier chart and assuming ideal process, find the *10*

(a) Quality at turbine exhaust

(b) Cycle efficiency

(c) Steam rate