[Total No. of Questions - 9] [Total No. of Printed Pa[illegible] - 4]
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16095(D) 10 DEC 2016

**B. Tech 3rd Semester Examination**

**Engineering Thermodynamics (CBS)**

**ME-303**

**Time : 3 Hours** **Max. Marks : 60**

*The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.*

**Note :** This question paper carries five sections. Attempt any five questions selecting at least one question each from section A, B, C & D. Section E is compulsory.

## SECTION - A

1. (a) Explain the Zeroth law of thermodynamics. Why it is so called? (5)

   (b) One kg of air at a pressure of 7 bar and a temperature of 360 K undergoes a reversible polytropic process which may be represented by $pV^{1.1}$=constant. If the final pressure is 1.4 bar, evaluate (a) final specific volume and temperature, (b) work done and heat transfer. How the work and heat interaction would be affected if the process is irreversible and 15 kJ of work is lost due to internal friction? Take R= 287 J/kg K and $\gamma$=1.4. (7)

2. (a) What is the essence of first law of thermodynamics? Write down expressions for the first law applied to (i) a cycle (ii) a process. (6)

   (b) An artificial satellite of mass 500 kg is moving towards the moon. Make calculations for the kinetic and potential energies, (i) Relative to the earth when 50 km from launching and travelling at 2500 km/hr. Take earth's



gravitational field equal to 7.9 m/s$^2$, (ii) Relative to the moon when travelling at the same velocity and 50 km from its destination where 1 kg mass has a weight of 3N. (6)

## SECTION - B

3. A heat pump is to be used to heat a house in winter and then reversed to cool the house in summer. The interior temperature is to be maintained at 20°C. Heat transfer through the walls and roof is estimated to be 2400 kJ per hour per degree temperature difference between the inside and outside. Determine the minimum power required to drive the heat pump, if the outside temperature in winter is 0°C. If the power input is the same as that in part, what is the maximum outside temperature for which the inside can be maintained at 20°C? (12)

4. (a) Entropy is defined in terms of a reversible process. How can then it be evaluated for an irreversible process? (5)

   (b) 0.04 m$^3$ of nitrogen contained in a cylinder behind a piston is initially at 1.05 bar and 15°C. The gas is compressed isothermally and reversibly until the pressure is 4.8 bar. Calculate: (i) The change of entropy, (ii) The heat flow and (iii) The work done. Sketch the process on a p-v and T-s diagram. Assume nitrogen to act as a perfect gas. Molecular weight of nitrogen = 28. (7)

## SECTION - C

5. Show that for a perfect gas, the difference between the specific heats ($c_p$-$c_v$) can be expressed as $c_p - c_v = [p + \left(\frac{du}{dv}\right)_T]\left(\frac{dv}{dT}\right)_p = pv\beta + v\beta\left(\frac{du}{dv}\right)_T$ where $\beta$ is the coefficient of volume expansion. (12)