# B.Tech. Civil (Construction Management) / B.Tech. Civil (Water Resources Engineering) B.Tech. (Aerospace Engineering)

01852

## Term-End Examination

## June, 2011

## ET-201(B) : ENGINEERING THERMODYNAMICS

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

***Note :*** *Answer **any seven** questions. All questions carry **equal** marks. Use of steam tables and calculator is permitted.*

**1.** (a) (i) What is meant by thermodynamic equilibrium ? **2+3**

(ii) Explain with simple sketches. Thermodynamic systems - closed, open, isolated.

(b) A pressure gauge fitted on a steam boiler records a pressure of 30 bar. The vacuum gauge on the condenser indicates the vacuum of 0.95 bar. If the atmospheric pressure is 1 bar, calculate. **5**

(i) absolute pressure in the steam boiler.

(ii) absolute pressure in the condenser.

**2.** (a) Define pressure. Explain with the help of a diagram showing relation between gauge pressure, vacuum pressure, and atmospheric pressure. **5+5**

(b) A closed system undergoes a thermodynamic cycle ABCDA. The heat transfer per minute during processes AB, BC and CD are $-500$ kJ, 10,000 kJ, and $-1000$ kJ respectively. The work transfers per second during processes AB, BC, CD, and DA are $-10{,}000$, zero, 17,000 and $-1000$ kJ respectively. Find the heat transfer during the process DA and net rate of work input in kW.

3. (a) Explain the following terms relating to steam formation : 5+5

(i) Sensible heat of water

(ii) Latent heat of steam,

(iii) Dryness fraction of steam

(iv) Enthalpy of wet steam, and

(v) Super heated steam

(b) Determine the total work done by a gas system following an expansion process as shown in Figure - 1.

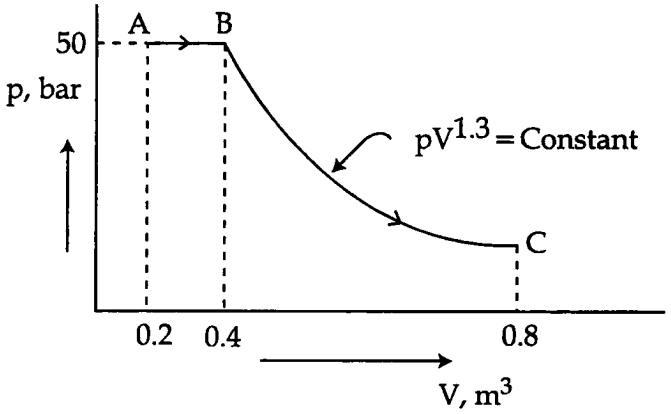


Figure - 1

4. (a) What do you mean by "Perpetual motion machine of first kind PMM 1" ? 5+5

(b) A reversible power cycle is used to drive a reversible heat pump cycle. The power cycle take in $Q_1$ heat units at $T_1$ and rejects $Q_2$ at $T_2$. The heat pump abstracts $Q_4$ from the sink at $T_4$ and discharges $Q_3$ at $T_3$. Develop an expression for the ratio $\frac{Q_4}{Q_1}$ in terms of the four temperatures.

5. (a) Explain in brief the Clausius statement of second law of thermodynamics. 5+5

(b) A carnot cycle operates between source and sink temperature of 250°C and −15°C. If the system receives 90 kJ from the source, find :

(i) Efficiency of the system

(ii) The net work transfer

(iii) Heat rejected to sink.

6. (a) Define heat engine, refrigerator and heat pump. 5+5

(b) A heat engine receives heat at the rate of 1500 kJ/min and gives an output of 8.2 kW. Determine :

(i) The thermal efficiency

(ii) The rate of heat rejection

7. (a) What do you mean by the term "Entropy" ? Prove that entropy is a property of a system. 5+5

(b) Two carnot engines combined in series operate between temperatures of 906 K and 586 K. What should be the intermediate temperature so that both the engines produce equal work.

8. (a) An inventor claims to have developed a cyclic engine which exchanges heat with reservoirs at 130°C and −40°C. It receives only 2,100 kJ/min of heat and develops 17.66 kW. Is his claim feasible ? 5+5

(b) Steam initially at 1.5 MPa, 300°C expands reversibly and adiabatically in a steam turbine to 40°C. Determine the ideal work output of the turbine per kg of steam.

9. (a) The co-efficient of performance of a carnot refrigerator, when it extracts 8350 kJ/min from a heat source is 5. Find the power required to run the compressor. 5+5

(b) Explain in brief the simple vapour absorption refrigeration system.

10. (a) Describe in brief the various non-conventional energy sources. 5+5

(b) The temperature in a refrigerator coil is 267 K and that in the condenser coil is 295 K. Assuming that the machine operates on the reversed carnot cycle, calculate.

(i) $COP_{(ref.)}$

(ii) The refrigerating effect per kW of input work

(iii) The heat rejected to the condenser