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

Term-End Examination 00031

December, 2012

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) Classify the properties as either intensive or extensive. 4+6

   (i) Volume

   (ii) Weight

   (iii) Pressure

   (iv) Temperature

   (v) Density

   (vi) Velocity

   (vii) Elevation

   (viii) Kinetic Energy

   (b) Discuss the concept of thermodynamic equilibrium with examples.

2. (a) The energy generated in the engine of a car is rejected to the air by the radiator through the circulating water. Should the radiator be analysed as a closed system or as an open system ? Explain. **4+6**

(b) (i) Define the isothermal, isobaric and isochoric processes.

(ii) What is the difference between gauge pressure and absolute pressure ?

3. (a) During expansion and compression processes of a gas, pressure and volume taken are often related by $PV^n=C$, where n and C are constants. Develop a general expression for the work done for the above case. **4+6**

(b) (i) What is the zeroth law of thermodynamics ?

(ii) What is triple point ? Explain using a suitable diagram.

4. (a) A can of soft drink at room temperature is put into the refrigerator so that it will cool. Would you model the can of soft drink as a closed system or as an open system ? Explain. **4+6**

(b) (i) A burning candle can be viewed as an energy transfer. What are the energy transformations involved during this process ?

(ii) State the first law of thermodynamics for a closed system undergoing a cycle.

5. (a) Two kg of a gas is passed through an insulated duct. A valve is opened and its pressure falls from 20 bar abs. to 1.5 bar abs. In the process the internal energy reduces by 0.16 kJ. If the initial volume of the gas is 0.44 m^3. Find the final specific volume. 5

(b) A heat engine operates between a source at 600°C and a sink at 20°C. Determine the least rate of heat rejection per kW net output of the engine. 5

6. A 30cm diameter cylinder fitted with a frictionless leak-proof piston contains 0.02 kg of steam at a pressure of 8 bar and a temperature of 200°C. As the piston moves steadily outwards through a distance of 25cm, the steam pressure P and volume V are related by PV^n = constant. Final pressure of steam is 1.4 bar. Determine 10

(a) Value of 'n'

(b) Work done by steam.

7. (a) A mass of a gas is compressed in a fully resisted process from 90 kPa and 0.12m^3 to 0.45 MPa and 0.03m^3. Assuming that pressure and volume are related to PV^n=Constant. Determine the work done by gas system. 5+5=10

(b) The bore and stroke of an engine cylinder are 18cm and 32cm respectively. The clearance volume is $0.00254m^3$. If the engine works on Otto cycle, find the compression ratio and the air standard efficiency.

8. (a) (i) What is the significance of energy for national economy development ? **3+3=6**

(ii) What are the environmental aspects of energy use ?

(b) The temperature of 3.5kg of gas in a rigid container is increased from 22°C to 39°C by heating it. The heat transfered during the heating process is 25kJ The specific heat ratio and the molar mass of the gas are 1.4 and 28 respectively. Calculate the work done and the change in internal energy for the gas, treating the gas to be a perfect gas. **4**

9. (a) 10kg of nitrogen is cooled in a rigid tank from 350°C to 37°C. The initial pressure is 35 bar. Calculate the change in entropy, internal energy and enthalpy. Assume nitrogen to be an ideal gas with C_p=1.042 kJ/kgK and C_v=0.745 kJ/kgK. **4**

(b) (i) Saturated steam has an entropy of 6.6596 kJ/kgK. Find its pressure, temperature and enthalpy. **6**

(ii) What is the internal energy of saturated water vapour at 133.54°C ?

10. Write short notes on **any four** of the following : **4x2½=10**

(a) Waste heat recovery and utilisation.

(b) Renewable resources

(c) Entropy

(d) Energy Audit

(e) Heat exchanger.

(f) Steam jet refrigeration system.