

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

Term-End Examination

June, 2013

ET-201(B) : ENGINEERING THERMODYNAMICS

Time : 3 hours

Maximum Marks : 70

Note : Answer seven questions in all . Question no 1 is compulsory. Steam tables and scientific calculator are allowed. All questions carry equal marks.

1. Choose the correct answer from the given four alternatives for these objective type questions.

10x1=10

- (a) Which one of the following is the characteristic feature of a quasi-static process ?

- (i) Infinite slowness
- (ii) Rapidity
- (iii) Stability
- (iv) Stationary existence

- (b) Which one of the following is not a point function ?
- (i) Temperature
 - (ii) Pressure
 - (iii) Energy
 - (iv) Power
- (c) Which of the following may be used for measuring high temperature beyond 1063°C ?
- (i) Platinum - platinum/ Rhodium Thermocouple
 - (ii) Electric resistance thermometer
 - (iii) Optical method using Planck's law of thermal radiation
 - (iv) Constant pressure gas thermometer.
- (d) Which one of the following does not change during a throttling process :
- (i) Enthalpy
 - (ii) Entropy
 - (iii) Volume
 - (iv) Pressure

- (e) The efficiency of a reversible cycle depends upon the :
- (i) nature of the working substance
 - (ii) amount of the working substance
 - (iii) temperature of the two reservoirs between which the cycle operates.
 - (iv) type of cycle followed.
- (f) For an ideal gas, which one of the following is a function of temperature only :
- (i) Specific heat at constant volume
 - (ii) Specific heat at constant temperature
 - (iii) Internal energy
 - (iv) Entropy
- (g) Which of the following gas has the maximum value of specific heat ratio (γ) ?
- (i) Oxygen
 - (ii) Helium
 - (iii) Methane
 - (iv) Carbon dioxide
- (h) The more effective way of increasing the efficiency of a Carnot engine is to :
- (i) increase higher temperature
 - (ii) increase lower temperature
 - (iii) decrease lower temperature
 - (iv) decrease higher temperature

- (i) Which of the following is an intensive property of a thermodynamic system ?
- (i) Volume
 - (ii) Temperature
 - (iii) Mass
 - (iv) Energy
- (j) Which of the following is correct statement ?
- (i) Absolute pressure = gauge pressure + atmospheric pressure
 - (ii) Gauge pressure = absolute pressure + atmospheric pressure
 - (iii) Atmospheric pressure = absolute pressure + gauge pressure
 - (iv) None of the above
2. (a) What is the difference between a closed system and an open system ? Define an isolated system. **2x5=10**
- (b) A pump discharges a liquid into a drum at the rate of $0.032 \text{ m}^3/\text{s}$. The drum, 1.50m in diameter and 4.20m in length can hold 3000 kg of the liquid. Find the density of the liquid and the mass flow rate of the liquid handled by the pump.

3. (a) A mass of 1.5 kg of air is compressed in a quasi-static process from 0.1 MPa to 0.7 MPa for which $Pv = \text{constant}$. **2x5=10**
 The initial density of air is 1.16 kg/m^3 . Find the work done by the piston to compress the air.
- (b) Determine the total workdone by a gas system following an expansion as shown in figure 1.

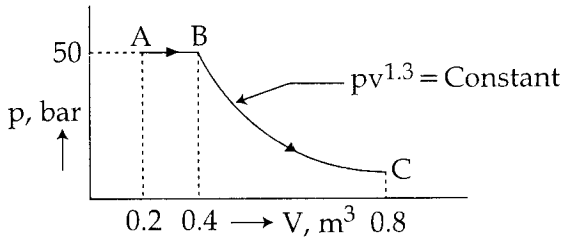


Figure - 1

4. (a) A gas expands from an initial state with $P_1 = 340 \text{ kPa}$ and $V_1 = 0.0425 \text{ m}^3$ to a final state where $P_2 = 136 \text{ kPa}$. If the pressure - volume relationship during the process is $Pv^2 = \text{constant}$, determine the work in kJ. **2x5=10**
- (b) During one cycle the working fluid in an engine engages in two work interactions : 15 kJ to the fluid and 44 kJ from the fluid, and three heat interactions, two of which are known : 75 kJ to the fluid and 40 kJ from the fluid. Evaluate the magnitude and direction of the third heat transfer.

5. (a) What is a Perpetual Motion Machine of the first kind ? Why is it impossible ? $2 \times 5 = 10$
- (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 the continuous rate of 1.75 kJ/sec , what is the lowest power necessary to pump this heat out continuously ?
6. (a) Give the Clausius 'Statement of the second law of thermodynamics. $2 \times 5 = 10$
- (b) Explain the operation of vapour compression refrigeration system with the help of a block diagram.
7. (a) What is a carnot cycle ? What are the four processes which constitute the cycle ? $2 \times 5 = 10$
- (b) A heat engine receives half of its heat supply at 1000 k and half at 500 k while rejecting heat to a sink at 300 k . What is the maximum thermal efficiency of the heat engine ?
8. (a) What do you understand by high grade energy and low grade energy ? Also explain what is available energy and unavailable energy ? $2 \times 5 = 10$
- (b) Find the saturation temperature, the changes in specific volume and entropy during evaporation, and the latent heat of vaporization of steam at 1 MPa .

9. (a) Find the enthalpy and entropy of stream when the pressure is 2 MPa and the specific volume is $0.09 \text{ m}^3/\text{kg}$. **2x5=10**
- (b) A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C . The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, and the enthalpy.
10. (a) Steam expands isentropically in a nozzle from 1 MPa, 250°C to 10 kPa. The steam flow rate is 1 kg/sec. Neglecting the KE of steam at inlet to the nozzle, find the velocity of steam at exit from the nozzle and the exit area of the nozzle. **2x5=10**
- (b) What are the different sources of renewable energy ? Explain the role of energy manager. Also explain the energy audit.
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