



RM-6569

**B. E. - II (Sem. IV) (Mechanical) Examination**  
**May / June - 2010**  
**Thermodynamics - I**

Time : 3 Hours]

[Total Marks : 400

**Instructions :**

(1)

नीचे दृष्टावेक निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - 2 (Sem. 4) (Mechanical)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Thermodynamics - I"/>	<input type="text"/>
Subject Code No. : <input type="text" value="6"/> <input type="text" value="5"/> <input type="text" value="6"/> <input type="text" value="9"/>	<input type="text"/>
Section No. (1, 2,.....): <input type="text" value="1&amp;2"/>	<input type="text"/>
	Student's Signature

- (2) Attempt **all** questions.
- (3) Figures to the right indicate full marks.
- (4) Assume suitable data if necessary.
- (5) Use of steam tables and mollier chart is permitted.

**SECTION - I**

- 1 (a) Answer the following : 10
- (i) A closed vessel contains  $0.1 \text{ m}^3$  of saturated liquid and  $0.9 \text{ m}^3$  of saturated vapor at  $30^\circ\text{C}$ . Determine the percentage vapor on mass basis.
  - (ii) What is Thermodynamics?
  - (iii) Define pure substance. Is a mixture of liquid air and gaseous air a pure substance?
  - (iv) Is it possible to have water vapor at  $-10^\circ\text{C}$ ? Explain.
  - (v) What is critical point?
  - (vi) A room is heated as a result of solar radiation coming in through the windows. Is this heat or work interaction? Justify.
  - (vii) Draw the P-v diagram of a substance that contracts on freezing including all the three phases.

- (viii) What is microscopic and macroscopic forms of energy.
- (ix) What is total energy? Identify the different forms of energy that contribute total energy.
- (x) What is critical point?
- (b) A ski lift has a one way length of 1 km and a vertical rise of 200 m. The chairs are placed 20 m apart and each chair can sit three people. The lift is operating at a steady speed of 10 km per hour. Neglecting friction and air drag and assuming the average mass of each loaded chair is 250 kg, determine the power required to operate this ski lift. Also estimate the power required to accelerate this ski-lift in 5 seconds to its operating speed when it is turned on. **10**
- 2** (a) Derive Generalized Steady Flow Energy Equation giving necessary assumptions. From that derive Steady Flow Energy Equation for Nozzles. **10**
- OR**
- (a) A sluice gate dam has water stored up to a height of 5m. There is a small hole at the bottom of the gate so liquid water at 20°C comes out of a 1 cm diameter hole. Neglect any changes in internal energy and find the exit velocity and mass flow rate.
- (b) Explain energy as a property of the system. **5**
- 3** (a) Sketch the T-v property diagram for water and explain what is critical point. **5**
- (b) Answer any **two** of the following : **10**
- (i) Consider the simple steam power plant cycle. Identify all the energy transfers for each of the component considering each component as a control volume.
- (ii) A sealed rigid vessel has volume of  $1\text{m}^3$  and contains 2 kg of water at 100°C. The vessel is now heated. If a safety pressure valve is installed, at what pressure should the valve be set to have a maximum temperature of 200°C?
- (iii) What is PMM1?\

## SECTION - II

- 4 Attempt the following : 18
- (a) An ice plant working on a reversed carnot cycle heat pump produces 15 tonnes of ice per day. The ice is formed from water at  $0^{\circ}\text{C}$ . and the formed ice is Maintained at  $0^{\circ}\text{C}$  The heat is rejected to atmosphere at  $25^{\circ}\text{C}$ . The heat pump used to run the ice plant coupled to carnot engine which absorbs heat from a source which is maintained at  $220^{\circ}\text{C}$  by burning liquid fuel of 44500 kJ of calorific value and rejects heat to the atmosphere calculate
- (i) Power developed by engine
- (ii) Fuel consumption per hour
- (b) Derive an expression for entropy change for a closed system for heating gas at constant volume.
- (c) In an air turbine the air expands from 7 bar and  $460^{\circ}\text{C}$  to 0.012 bar and  $160^{\circ}\text{C}$ . The heat loss from turbine can be assumed negligible. Show that the process is irreversible. Calculate change of entropy per kg of air.
- 5 Attempt any two : 16
- (a) Explain following terms - Volumetric analysis of gas mixture, Gibb's dalton law, adiabatic mixing of perfect gas.
- (b) Given that air contains 21% oxygen, 79% nitrogen by volume, determine
- (i) Moles of Nitrogen per mole of oxygen
- (ii) Partial pressure of oxygen and nitrogen if total pressure is atmospheric.
- (iii) Kg of nitrogen per kg of mixture.

(c) Explain following terms :

(i) PPM-2

(ii) Kelvin planck statement

(iii) Claussis statements

**6** Attempt any **two** :

**16**

(a) With neat sketch explain construction and working of Sonker's gas calorimeter.

(b) How are fules classified? Compare liquid fuels and gaseous fuels.

(c) Explain any **one** corollary pertaining to second law of thermodynamics.

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