

**INDIAN MARITIME UNIVERSITY**  
**(A Central University, Government of India)**

**B.Tech. (Marine Engineering) - Semester – I**  
**December 2015 End Semester Examinations**

**Basic Thermodynamics**  
**Subject Code: UG11T2103/UG11T1103**

Time: 3 Hours  
Date: 16.12.2015

Max Marks: 100  
Pass Marks: 50

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**NOTE: Use of Steam table and Mollier charts are permitted.**

**PART-A**

Answer the compulsory question (10 × 3=30 Marks)

- 1.a) Define perpetual motion machine of first kind.
- b) Define internal energy of a thermodynamic system.
- c) Define isolated system.
- d) Define “triple point “ of a pure substance.
- e) What is meant by ideal gas?
- f) What is the function of economizer in boilers.
- g) Define boiler thermal efficiency.
- h) What is the effect of condenser leakage in boilers.
- i) Define indicated power of an engine.
- j) Define compression ratio in ideal gas cycles.

**PART-B**

ANSWER ANY FIVE OF THE FOLLOWING SEVEN QUESTIONS (5 x14=70 Marks)

2. Derive the Steady flow energy equation.

Explain the significance of the each term involved in it. (14 marks)

3. a) Derive the relation between the specific heat constants  $C_p$  and  $C_v$ . (7 marks)
- b) A vessel of volume  $0.3 \text{ m}^3$  contains 15 kg of air at 303 K. Determine the pressure exerted by the air using (i) perfect gas equation (ii) vanderwaals equation.

Take critical temperature of air is 132.8 K, critical pressure of air is 37.7 bar. Take R for air is 0.287 (7 marks)

4. a) 0.25 kg of air at a pressure of 1 bar occupies a volume of  $0.3 \text{ m}^3$ .if this air expands isothermally to a volume of  $0.9 \text{ m}^3$ .find a)initial temperature b)final temperature c)external work done d)heat absorbed by the air e)change in internal energy. assume  $R=0.29$ . (8 marks)
- b) Find the specific volume and enthalpy of steam at 9 bar when the condition of steam is a)wet with dryness fraction of 0.98 b)dry saturated c)super heated, the temperature of steam  $240^\circ\text{C}$ . (6 marks)
5. a) 2 kg of steam is initially at 5 bar and 0.6 dry is heated at constant pressure until the temperature becomes  $350^\circ\text{C}$ .find the change in entropy and internal energy. (4 marks)
- b) Explain Mollier diagram with a neat sketch and explain it. (6 marks)
- c) Steam at 15 bar and  $300^\circ\text{C}$  is expanded hyperbolically to a pressure of 5 bar.calculate the change in internal energy and work done during the process. (4 marks)
6. a)What are the effects of impure feed in boilers. (4 marks)
- b) The following observations were made in a boiler plant calorific value of a coal= $30,000 \text{ kJ/kg}$   
 Mass of coal used = 300 kg. Mass of water evaporated = $2200 \text{ kg}$ . Steam pressure = 12 bar  
 Dryness fraction = 0.95. Feed water temperature =  $34^\circ\text{C}$   
 Calculate the equivalent evaporation from and at  $100^\circ\text{C}$  per kg of coal and the efficiency of the boiler. (10 marks)
7. An engine working on constant volume cycle has the following data.  
 Clearance volume =  $0.04 \text{ m}^3$ . Swept volume = $0.13 \text{ m}^3$   
 Pressure and temperature at the beginning of the cycle are 1.15 bar and  $120^\circ\text{C}$ .maximum pressure of the cycle is limited to 23 bar. calculate air standard efficiency, maximum temperature of the cycle and mean effective pressure. (14 marks)
8. a) Explain with a neat diagram, the working of four stroke diesel engine. (10 marks)
- b) An engine working on otto cycle has cylinder diameter and stroke length are 110 mm and 140 mm respectively. The clearance volume is 0.25 litre. Find the air standard efficiency of the cycle. (4 marks)

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