COLLEGE OF ENGINEERING PUNE

Second Year Mechanical
Autumn Term (2011/12)
Engineering Thermodynamics (ME-201)

Date- 23/11/2011
Academic Year: 2010-11

Timing: 3 hrs
Max. Marks: 50

Instructions:
1) Attempt all questions
2) Figures to right indicate full marks.
3) Assume suitable data if necessary. Use of Mollier chart, Steam table, and Compressibility chart is allowed.

Q.1 Attempt **FIVE** of the following.

a What are the limitations of first law of thermodynamics **10**

b Differentiate between pv work and $\int pdv$ work

c Prove that slope of constant volume line is greater than slope of constant pressure line

d A heat engine operates on a Carnot cycle between source and sink temperature of 337°C and 57°C, respectively. If the engine receives 400kJ of heat from the source, find the net work done and heat rejected to the sink.

e Find the heat required to produce 10 kg of steam at a pressure of 10 bar and initial temperature is 5°C. When the condition of steam is
i) 0.85 dry
ii) superheated steam with degree of superheat being 50°C
The specific heat of superheated steam is 2.01 kJ/kgK

f What is the available energy and unavailable energy?

Q.2 a A vessel having a volume of 0.4 m^3 contains 2.0 kg of a liquid water and water vapour mixture in equilibrium at a pressure of 600 kPa.Calculate **5**
i) The volume and mass of liquid.
ii) Volume and mass of vapour.

b Determine the specific volume of R_{12} at 1 MPa and 50°C,using **5**
i) The ideal gas equation of state
ii) The generalized compressibility chart
Compare the values obtained to the actual value of 0.019 m^3/kg and determine error involved in each case.

OR

b Exhaust steam at 50kPa, 150°C enters a subsonic diffuser with velocity of 180 m/s. The inlet area at the diffuser inlet is 1000cm^2.During passage of steam through the diffuser, its velocity decreases to 90m/s, and pressure increase to 1 bar. Also 120 kW of heat is lost to the surroundings from the diffuser. Determine the area at diffuser **5**

Q.3 a Derive expression for entropy change of an ideal gas in term of pressure and volume. Apply it for polytropic process. 5

b What is the difference between the entropy and entropy generation
1 kg of water at 0°Cis brought in contact with a heat reservoir at 90°C.When water has reached 90°C,find 5
i) Entropy change of water,
ii) Entropy change of the reservoir,
iii) Entropy change of universe.
State the way of heating water, produces no change in entropy of the universe

OR

b What is the difference between diffuser and nozzle? 5

The flight speed of a turbojet engine is 270m/s. Ambient air temperature is -15°C.Gas temperature at outlet of nozzle is 600°C.Corresponding enthalpy values for air and gas are respectively 260 and912 kJ/kg. Fuel air ratio is 0.0190.Chemical energy in fuel is 44.5MJ/kg. Heat loss from the engine is 21 kJ/kg of air. Calculate the velocity of the exhaust jet.

Q.4 a Prove that availability for open system is- 5
$a = (h_1 - T_0 S_1) - (h_2 - T_0 S_2)$
Write equation of second law efficiency for refrigerator and heat pump.

b Gas flows through a gas turbine unit from its initial pressure and temperature of 600kPa and 1300 K, respectively and exhausts at a pressure of 102 kPa and a temperature of 600 K. The atmospheric pressure and temperature are 100kPa and 298K.Calculate availability at the entrance and exit of gas turbine. Take c_p of gas as 1.005kJ/kg and R=0.287kJ/kg K 5

OR

b Prove that COP of heat pump is greater than COP of refrigerator by unity. 5
The efficiency of Carnot engine is 20%.The efficiency gets doubled, when sink temperature is reduced by60°C.Estimate the source and sink temperature. With this source and sink temperature what is coefficient of performance of heat pump.

Q.5 a Represent the basic ideal, ideal reheat and ideal regenerative Rankine vapour power cycle on *T-s* diagram. Draw flow diagrams for it. 5

b Draw P-V diagram of the substance which contracts on freezing showing three phases of pure substance and critical point. 5
Calculate amount of heat energy required to convert 10 kg of water at 20°C into steam at 300°C and 10 bars.

OR

b Represent Rankine cycle on *p-v* and *h-s* diagram. 5
A steam power plant has boiler and condenser pressure of 60 bar and 0.1 bar respectively. Steam coming out of boiler is dry and saturated. The plant operates on Rankine cycle. Calculate thermal efficiency.

College of Engineering, Pune

(An Autonomous Institute of Government of Maharashtra)

END SEMESTER EXAMINATION

(MT202) PRINCIPLES OF PHYSICAL METALLURGY

Semester – I

Year: S.Y.B-Tech
Academic Year: 2011-12
Duration: 3 hrs.

Branch: Metallurgy
Date: November 23, 2011
Max. Marks: 50

Instruction to candidates:

1. **All questions are compulsory.**
2. Neat Diagrams must be drawn wherever necessary.
3. Assume suitable data, if necessary.

Q.1 a. **Draw the steel portion of iron –iron carbide phase diagram and show the following heat treatment temperatures on it:** [2]

1. Normalising
2. Recrystallization annealing
3. Spherodising annealing
4. hardening

b. **What is isothermal annealing? What are its advantages over full annealing process?** [3]

c. **State the applications of equilibrium diagram.**
Draw a typical equilibrium diagram for two elements which are completely soluble in liquid state and completely insoluble in solid state. Explain the slow cooling of any one alloy from the above system. [5]

Q.2 a. **With the help of Bain model, explain the mechanism of matensitic transformation. State the characteristics of martensitic transformation.** [5]

b. **Thin pieces of 0.5 mm thick strips of AISI 1080 steel are heated for 1 hour at 850^0C and then given the heat treatments shown in the following list. Using isothermal transformation (IT) diagram ,determine the microstructures of the samples after each heat treatment:** [5]

i. **Water quench to room temperature**
ii. **Quench in molten salt bath at 690^0C and hold for 3 hours and water quench**
iii. **Quench to 580^0C hold for 20 minutes and then water quench.**
iv. **Quench to 450^0C and hold for 5 hr and water quench.**

Also define the term CCR.

Q.3 a. **"Hardening of steel is always followed by tempering". Is it true or false? If true give reasons.** [5]
Draw a flowchart which shows product of tempering treatment at different tempering temperature.

b. **Explain the mechanism of quenching. Describe at least four requirements of a quenching medium for effective cooling of the heated part.** [5]

Q.4 a. Explain in detail the factors affecting the microstructures of cast irons. [5]

b. Suggest suitable material for following applications and justify your answer [5]

1. lathe bed
2. cutting tool
3. road roller surfaces
4. table fan blade
5. beams used in construction

Q.5 a. What is season cracking? How can it be minimized? [2]

b. Why is white metal (babbit) suitable for bearing applications? [2]

c. Which bronze shows cored type of structure? Why? [2]

d. Which methods are used for manufacturing of 60:40 brasses and 70:30 brasses? Justify your answer. [2]

e Which type of nonferrous alloy is used for brazing application? Give its chemical composition. [2]
Why brazed joint shows high value of strength?

****