

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November - December 2016

B. Tech Mechanical Engineering, Semester III

COURSE CODE: ME 301

COURSE TITLE: Engineering Thermodynamics

Roll No.....

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
4. Use compressibility charts and steam table.
5. Universal gas constant = $8.314 \text{ kJ/kg mole-K}$

Q.1 Objective type multiple choice questions

10

- i. Properties are:
 - a. State function
 - b. Path function
 - c. State and path function
 - d. None of the above
- ii. Heat transfer is:
 - a. Path function
 - b. State function
 - c. State and path function
 - d. All of the above
- iii. Work is a:
 - a. Path function
 - b. State function
 - c. Depends upon working fluid
 - d. None of the above
- iv. Internal energy can be measured :
 - a. Thermometer
 - b. Pressure gauge
 - c. all of the above
 - d. None of the above
- v. Turbine Expansion for work is:
 - a. isentropic process
 - b. isenthalpic process
 - c. polytropic process
 - d. constant volume process
- vi. Steam can be assumed as ideal gas :
 - a. At saturation pressure
 - b. At saturation temperature
 - c. At low pressure superheated conditions

- d. None of the above
- vii Air balloon analysis can be assumed as:
 - a. Closed system
 - b. Open system
 - c. Isolated system
 - d. None of the above
- viii Steady flow open system assumes:
 - a. No change of property with time
 - b. Change of property with time
 - c. Accumulation of material in the system
 - d. All of the above
- ix Reversible process is:
 - a. State dependent
 - b. Path dependent
 - c. State and path dependent
 - d. All of the above
- x Availability is a measure of :
 - a. Total energy of the system
 - b. Maximum energy which can be converted to required
 - c. Minimum energy which can be converted
 - d. None of the above

- Q.2 a. Most of the energy generated in the engine of car is rejected to the air by the radiator through the circulating water. Should the radiator be analyzed as a closed system? Explain 5
- b. A person is cooking vegetable soup for his family in a pan which is (a) uncovered, (b) covered with a light lid and (c) covered with a heavy lid. For which case will the cooking time be the shortest? Why 5
- Q.3 Using the ideal gas equation of state verify: 10
- a. Cyclic relation
- b. Reciprocating relation at constant P
- Q.4 A 0.1 m³ rigid tank contains steam initially at 500 kPa and 200°C. The steam is now allowed to cool until its temperature drops to 50°C. Determine the amount of heat transfer during the process and the final pressure in the tank. 25
- OR
- Q.4 A piston cylinder device contains 25 gm of saturated water which is maintained at a constant pressure of 300 kPa. A resistance heater within the cylinder is turned on and passes a current of 0.2 A for 5 minutes from a 10V source. At the same time, a heat loss of 3.7 kJ occurs. 25
- a. Show that for a closed system the boundary work W_b and the change in internal energy ΔU in first law relation can be combined into one term, ΔH , for a constant temperature process.
- b. Determine the final temperature of steam.

- a. A Carnot heat engine is operating with steam receives 500 kJ heat per cycle from a high temperature source of 600°C and rejects heat to a low temperature sink at 30°C. Determine: 15
- a. Thermal efficiency of this Carnot engine b. Amount of heat rejected to the sink per cycle.
- What happens when we use air in place of steam? Calculate a. Thermal efficiency of Carnot cycle with air b. Calculate heat rejected to the sink per cycle
- b. Using a Clapeyron equation, estimate the value of enthalpy of vaporization of steam at 150°C. Compare it with tabulated value. 10
- OR
- Q.5a. Estimate saturation pressure of water at 50°C. 10
- b. Verify the validity of following Maxwell relations: 15
- $$(\partial S / \partial P)_T = (\partial V / \partial T)_P$$
- For Steam at 250°C and 300 kPa.
- Q.6 Steam flows steadily through an adiabatic turbine. The inlet conditions of the steam are 10 MPa, 450°C and 80 m/s, and the exit conditions are 10 kPa, 92% quality and 50 m/s. The mass flow rate of the steam is 12 kg/s. Determine: 20
- a. The change in kinetic energy
- b. The power output
- c. The turbine inlet area