

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Special), Jan. 2016
B. Tech. in Mechanical Engineering, Semester III

Roll No.....

ME 301: ENGINEERING THERMODYNAMICS

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. Steam table and H-S chart are permitted.
5. Scientific Calculator without programming of any type is allowed.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. A practical example of an open thermodynamic system is; (a) a manual ice-cream freezer (b) a centrifugal pump delivering water to a boiler (c) a pressure cooker with steam shut-off (d) automobile storage battery.
- ii. The zeroth law forms the basis of measuring; (a) temperature (b) volume (c) pressure (d) heat (e) work (f) none of the above.
- iii. Heat is supplied to air taken in a cylinder and enclosed by a frictionless piston held under a constant load. The expansion of the gas will be; (a) isobaric (b) isochoric (c) isothermal (d) adiabatic
- iv. For an isochoric process; (a) there occurs no transfer of mass and energy across the system boundary (b) the product of pressure and volume remains essentially constant (c) free expansion takes place (d) work output from the system is zero.
- v. A system plus its environment constitutes; (a) an adiabatic system (b) a closed system (c) an isolated system (d) a segregated system (e) a homogenous system
- vi. The change in entropy for any natural process would be; (a) zero (b) negative (c) positive (d) infinite
- vii. If the temperature of the source is increased, the efficiency of the Carnot engine; (a) decreases (b) increases (c) does not change (d) depends on other factors
- viii. In a reversible cycle, the entropy of the system; (a) increases (b) decreases (c) does not change (d) first increases and then decreases
- ix. In a throttling calorimeter, throttling of wet steam is carried out to convert the steam into a; (a) sub-cooled liquid (b) dry saturated vapour (c) condensate (d) superheated steam
- x. The work done by steam in a steam turbine is the change of; (a) enthalpy of the steam at the inlet and outlet conditions (b) entropy of the steam at the inlet and outlet conditions (c) internal energy of the steam at the inlet and outlet conditions (d) none of the above

Q.2 Short answer type questions (4 questions @ 2.5 marks)

10

- i. State the limitations of the first law of thermodynamics.

- ii. Define specific heat at constant volume and specific heat at constant pressure.
 - iii. Write down the zeroth law of thermodynamics?
 - iv. What do you understand by the terms "degree of superheat" and "degree of subcooling"?
- Q.3A State the Kelvin-Planck and Clausius statements of the second law of thermodynamics. 05
- Q.3B Discuss the salient features of a free expansion process. 05
- Q.4A Show that COP of a heat pump is greater than COP of a refrigerator by unity. 05
- Q.4B Explain the throttling process. 05
- Q.5A What is a heat pump? How does it differ from a refrigerator? 05
- Q.5B Explain the perpetual motion machine of first kind. 05
- Q.6A What are Helmholtz function and Gibb's function? 05
- Q.6B Define quality and dryness fraction of steam. 05
- OR
- Q.6B What is the difficulty in constructing an engine working on Carnot cycle? 05
- Q.7A Derive an expression for the efficiency of a Carnot cycle. 05
- Q.7B What do you understand by exergy and anergy? 05
- OR
- Q.7B Establish the inequality of Clausius. 05
- Q.8 An inventor claims to have developed an engine that operates between a source at 450 K and a sink at 280 K, and is capable of delivering 0.15 kWh of work for every 1200 kJ of heat received. As a patent officer, would you issue a patent for such an engine? 10
- Q.9 Steam at an absolute pressure of 10 bar and 250° C expands isentropically in a steam turbine till the pressure drops to 1 bar. Estimate the quality of steam leaving the turbine and work developed by turbine per kg of steam. If the actual drop is 90% of isentropic drop and steam flow rate through the turbine is 500 kg/min, determine the power developed by the turbine. Use Mollier chart. 10
- Q.10 Derive the expression for the "availability of a non-flow or closed system". 10
- OR
- Q.10 A steam turbine operates under steady flow conditions receiving steam at the following state: pressure 15 bar; internal energy 2700 kJ/kg; specific volume 0.17 m³/kg and velocity 100 m/s. The exhaust of steam from the turbine is at 0.1 bar with internal energy 2175 kJ/kg, specific volume 15 m³/kg and velocity 300 m/s. The intake is 2.5 meters above the exhaust. The turbine develops 30 kW and heat loss over the surface of turbine is 25 kJ/kg. Determine the steam flow rate through the turbine. 10

-----ALL THE BEST-----