

Roll No.

OLE-3060

B. Tech. 3rd Semester (ME) Examination – April, 2021

THERMODYNAMICS

Paper : PCC-ME-213-G

Time : Three Hours]

[Maximum Marks : 75

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Attempt *five* questions in all, selecting *one* question from each Unit. Question No. 1 is *compulsory*. All questions carry equal marks.

1. Explain Following :

- (a) Zeroth Law
- (b) Continuum
- (c) Saturation Temperature
- (d) Steady Flow Process
- (e) Lost Work
- (f) Absolute Temperature Scale $2.5 \times 6 = 15$

UNIT – I

- 2.** (a) Determine the power transmitted through the shaft of a car when the torque applied is 200 Nm and the shaft rotates at a rate of 4000 revolutions per minute (rpm). 8
- (b) What is a quasi-equilibrium process? What is its importance in engineering ? 7
- 3.** (a) A rigid tank contains a hot fluid that is cooled while being stirred by a paddle wheel. Initially, the internal energy of the fluid is 800 kJ. During the cooling process, the fluid loses 500 kJ of heat, and the paddle wheel does 100 kJ of work on the fluid. Determine the final internal energy of the fluid. Neglect the energy stored in the paddle wheel. 8
- (b) What are the different mechanisms for transferring energy to or from a control volume ? 7

UNIT – II

- 4.** (a) What is the physical significance of h_{fg} ? Can it be obtained from knowledge of h_f and h_g ? How ? 8
- (b) What is the difference between the critical point and the triple point ? 7
- 5.** (a) Which process requires more energy: completely vaporizing 1 kg of saturated liquid water at 1 atm

pressure or completely vaporizing 1 kg of saturated liquid water at 8 atm pressure ? 8

- (b) How does the boiling process at supercritical pressures differ from the boiling process at subcritical pressures ? 7

UNIT – III

- 6.** (a) Heat is transferred to a heat engine from a furnace at a rate of 80 MW. If the rate of waste heat rejection to a nearby river is 50 MW, determine the net power output and the thermal efficiency for this heat engine. 8

- (b) What is a thermal energy reservoir ? Give some examples. 7

- 7.** (a) What is the Kelvin-Planck expression of the second law of thermodynamics ? 8

- (b) A heat pump is used to meet the heating requirements of a house and maintain it at 20°C. On a day when the outdoor air temperature drops to -2°C, the house is estimated to lose heat at a rate of 80,000 kJ/h. If the heat pump under these conditions has a COP of 2.5, determine
(i) the power consumed by the heat pump and
(ii) the rate at which heat is absorbed from the cold outdoor air. 7

UNIT – IV

- 8.** (a) A piston-cylinder device contains a liquid-vapor mixture of water at 300 K. During a constant-pressure process, 750 kJ of heat is transferred to the water. As a result, part of the liquid in the cylinder vaporizes. Determine the entropy change of the water during this process. 8
- (b) How does useful work differ from actual work ?
For what kind of systems are these two identical ? 7
- 9.** (a) A heat source at 800 K loses 2000 kJ of heat to a sink at (i) 500 K and (ii) 750 K. Determine which heat transfer process is more irreversible. 8
- (b) Compare Rankine cycle and Carnot cycle on T-5 diagram. 7
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