

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, December, 2021

Engineering Thermodynamics

B. Tech. in Mechanical Engineering, Semester III

Roll No.....

Course Code : ME1102

Time: 3 hours

Max. Marks: 50

Instructions to students:

Do not write anything other than your roll number on question paper.

Assume suitable data wherever required and mention it clearly.

Students can use **Steam Tables**.

Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

- Q.1 You are making rice porridge at home. Rice in milk boil at 110°C . How heavy a lid should you put on the 20-cm-diameter pot when $P_{\text{atm}} = 101 \text{ kPa}$? 5
Lo 1,2
- Q.2 A mass of 8 kg gas expands within a flexible container so that the $p-v$ relationship is of the form $pv^{1.2} = \text{constant}$. The initial pressure is 1000 kPa and the initial volume is 1m^3 . The final pressure is 5 kPa. If specific internal energy of the gas decreases by 40 kJ/kg, find the heat transfer in magnitude and direction 5
Lo 1,2
- Q.3 A nozzle is a device for increasing the velocity of a steadily flowing stream. At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3000 kJ/kg and the velocity is 60 m/s. At the discharge end, the enthalpy is 2762 kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. 10
Lo 3,4
- (a) Find the velocity at exists from the nozzle.
(b) If the inlet area is 0.1 m^2 and the specific volume at inlet is $0.187 \text{ m}^3/\text{kg}$, find the mass flow rate.
(c) If the specific volume at the nozzle exit is $0.498 \text{ m}^3/\text{kg}$, find the exit area of the nozzle.
- Q.4 A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C . The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C . The reversible heat engine also drives a machine that absorbs 30 kW. If the heat pump extracts 17 kJ/s from the 5°C reservoir, determine 10
Lo 4,5
- (a) The rate of heat supply from the 840°C source
(b) The rate of heat rejection to the 60°C sink.
- Q.5 An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 100 kPa and 178°C , and 800 kJ/kg of heat is transferred to air during the constant-volume heat-addition process. Accounting for the variation of specific heats of air with temperature, determine (a) the maximum temperature and pressure that occur during the cycle, (b) the net work output, (c) the thermal efficiency, and (d) the mean effective pressure for the cycle. 10
Lo 5