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(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS

2021/2022 ACADEMIC YEAR

SECOND SEMESTER MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND COMMUNICATION (2ND YEAR)

COURSE CODE: MIE 274: COURSE TITLE: THERMODYNAMICS I

DATE: 29-04-2022 TIME: 15:00-17:00

INSTRUCTIONS:

1. **This paper contains FOUR questions**
2. **QUESTION ONE IS COMPULSORY**
3. **Attempt any TWO questions from the remaining.**
4. **Question ONE carries 30 marks and the REST 20 marks each.**
5. **Examination duration is 2 (TWO) HOURS**

MMUST observes ZERO tolerance to examination cheating

This Paper Consists of 3 Printed Pages. Please Turn Over.

QUESTION ONE (30Marks)

a) State and discuss five gas laws you are aware of in reference to thermodynamics **(10 Marks)**

b) 10Kg of fluid per minute goes through a reversible steady flow process. The properties of the fluid at the inlet are: Pressure, P_1= 1.5 bar; density, ρ_1= 26Kg/m^3; velocity, C_1 = 110m/s and internal energy, u_1= 910KJ/Kg and at exit are: Pressure, P_2= 5.5 bars; density, ρ_2= 5.5Kg/m^3; velocity, C_2 = 190m/s and internal energy, u_2= 710KJ/Kg. During the passage, the fluid rejects 55KJ/s and rises through 55 metres. Take gravitational force, g = 9.80 m/s^2. Determine:

(i) The change in enthalpy**(4 Marks)**

(ii) Work done during the process. **(6 Marks)**

c) A 2200-kg automobile traveling at 25 m/s hits the rear of a stationary, 1000-kg automobile. After the collision the large automobile slows to 13.89 m/s and the smaller vehicle has a speed of 24.44 m/s. What has been the increase in internal energy, taking both vehicles as the system? **(10 Marks)**

QUESTION TWO (20Marks)

a) An insulated vessel of 0.5 m^3 capacity is divided by a rigid conducting diaphragm into two chambers A and B, each having a capacity of 0.25 m^3. Chamber A contains air at 1.4 bar pressure and 290 K temperature and the corresponding parameters for air in chamber B are 4.2 bar and 440 K. Calculate:

(i) Final equilibrium temperature, **(8 Marks)**

(ii) Final pressure on each side of the diaphragm **(2 Marks).**

For air take c_v = 0.715 kJ/kg K and R = 0.287 kJ/kg K.

b) 1 Kg of steam initially dry saturated at 1.1 Mpa expands in a cylinder following the law $PV^{1.13} = C$. The pressure at the end of expansion is 0.1 Mpa. Determine:

i. The final volume **(2 Marks).**
ii. Final dryness fraction **(2 Marks).**
iii. Work done **(2 Marks).**
iv. The change in internal energy **(3 Marks).**
v. The heat transferred **(1 Marks).**

QUESTION THREE (20Marks)

a) A heat engine receives heat at the rate of 1,500KJ/s and gives an output of 8.2KW. Determine:

(i) The thermal efficiency**(2Marks)**

(ii) The rate of heat rejection **(2Marks)**

b) What amount of heat would be required to produce 4.4Kg of steam at a pressure of 6 bar and temperature of 250^0C from water at 30^0C? Take specific heat for water as 4.18 kJ/kg K and superheated steam as 2.2KJ/KgK. **(10 Marks)**

c) Define the following terms in reference to Thermodynamics. **(6 Marks)**

(i) Mass Density

(ii) Specific Weight

(iii) Specific Volume

QUESTION FOUR (20Marks)

a) Steam at a 6.87 bar, 205°C, enters in an insulated nozzle with a velocity of 50 m/s. It leaves at a pressure of 1.37 bar and a velocity of 500 m/s. Determine the final enthalpy of steam **(8 Marks).**

b) State the rules governing non-flow systems in thermodynamics **(3 Marks).**

c) Air at 1.02 bar, 22°C, initially occupying a cylinder volume of 0.015 m^3, is compressed reversibly and adiabatically by a piston to a pressure of 6.8 bar. Calculate:

i. The final temperature **(3 Marks)**

ii. The final volume **(3 Marks)**

iii. The work done on the mass of air in the cylinder **(3 Marks)**