Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University, Manipal – 576 104

III SEM. B.TECH (MECHANICAL ENGG.) END SEMESTER (MAKE UP) EXAMINATIONS, DEC 2015/JAN 2016

SUBJECT: THERMODYNAMICS - I (MME 2101)

REVISED CREDIT SYSTEM

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:
- Answer **all the** questions.
- Missing data if any, may be suitable assumed
- Use of Thermodynamic data hand book/steam tables is permitted.

1A State the first law of thermodynamics as applied to a closed system which undergoes change state. 2

1B Distinguish between:
(i) Macroscopic and microscopic point of views.
(ii) Intensive and extensive properties.
(iii) Point and path functions.
(iv) System boundary and Control surface 4

1C At the inlet to a certain nozzle, the enthalpy of the fluid is 3325kJ/kg and the velocity of 60m/s. At the exit the enthalpy of the fluid is 2790kJ/kg. The nozzle is of 5m length, 350mm diameter at inlet, inclined at 30^0 to horizontal and the fluid flow is upward. 100kW of heat is lost to surroundings from the lateral surface of the nozzle during the flow from inlet to outlet. Calculate the velocity of the fluid at nozzle exit and the mass flow rate of the fluid if the fluid density is 5kg/m^3. 4

2A Define entropy and show that it is a property of the system 3

2B Write the Kelvin Plank and Clausius statements of second law of thermodynamics. 3

2C Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ of heat removed from the cold body by the refrigerator?
If the system is used as a heat pump how many MJ of heat would be available for heating for each MJ of heat input to the engine?
Assume that heat engine, refrigerator and heat pumps are reversible. 4

3A	Define the terms: Critical point, saturated liquid, saturated vapor and triple point as referred to pure substance.	2
3B	Write the SFEE with usual notations and reduce the same under ideal conditions for the following cases (i) Condenser (ii) throttle valve	4
3C	A copper block of mass 0.6kg and Cp= 150J/kgK at 100^0C initially is placed in a lake with water at 8^0C. Calculate the change in entropy of the (i) Copper (ii) Lake (iii) Universe	4
4A	Define (i) Gas constant (ii) Universal gas constant	2
4B	Derive an expression for change in entropy of an ideal gas in terms of specific heat ratio, pressure ratio, gas constant and temperature ratio.	4
4C	A gas having a value of adiabatic index 1.66 is expanded from the same initial state (i) isothermally and (ii) adiabatically such that the pressure ratio is 5 in each case. Calculate the ratio of isothermal work done to adiabatic work done	4
5A	Define (i) Mole fraction (ii) Mass fraction (iii) Partial pressure (iv) Partial volume.	2
5B	Define Daltons law of partial pressure and show that volume fraction is equal to mole fraction	3
5C	A closed adiabatic cylinder $1m^3$ is divided by a partition into two compartments. First compartment contains Methane and has a volume of 0.6 m^3 at a pressure of 0.4 MPa, 40^0C, while second compartment has a volume of 0.4 m^3 and contains Propane at 0.4MPa, 40^0C. The partition is removed and the gases are allowed to mix. The resulting mixture is compressed reversibly and adiabatically to 1.2MPa. Compute (a) Molecular weight and adiabatic index for the mixture (b) Final temperature of the mixture (c) work transfer for the mixture. Take C_p of methane and propane as 35.72 and 74.56 kJ/kg-mol K respectively.	5