Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – OCT. / NOV. 2017

SUBJECT: THERMO-FLUIDS (MET 231)

(BRANCH: MECHATRONICS)

Friday, 10 November 2017

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer ANY FIVE full Questions.**
- ✓ **Missing data, if any, may be suitably assumed**

1A. Sketch and explain two examples for open and closed system.

1B. Define the following terms.

a. Thermodynamic system and surrounding.
b. Microscopic and Macroscopic viewpoint
c. Intensive and Extensive properties
d. Homogeneous and heterogeneous system.
e. Boundary and isolated system.

1C. Sketch and explain Quasi-static process **(5+10+5)**

2A. Derive a work done equation for Isothermal, Isochoric, Isobaric and Polytrophic process.

2B. On a hot day in manipal, a temperature of 97^0F is reported. What is the temperature in units of ^{0}C, K and R?

2C. Define zeroth law, first law and second law of thermodynamics. **(10+6+4)**

3A. Define absolute, gauge, vacuum and atmospheric pressure.

3B. A vertical cylinder of cross-sectional area 0.25m^2 fitted with leak proof piston containing 0.3kg of air. Initially, the volume is 0.5m^3 and temperature 500^o C. The air is cooled and the piston descends until it hits 2 stops on the inside of the cylinder and the volume of air is then 0.25m^3. The cooling process is continued until temperature of air becomes 20^{o}C. Calculate

i) Initial Pressure of air.
ii) Temperature of air when piston hits the stops.

Pressure of the air and force on the stops when temperature is 20^{o}C.
Assume that air is an ideal gas with a gas constant of 0.287kJ/kg K.

3C. With an example sketch and explain different types of work transfer. **(4+8+8)**

4A. Derive an equation for Steady Flow Energy Equation (SFEE) for an open system.

4B. A gas of mass 1.5kg undergoes a quasi-static expansion which follows a relationship P=a+bv. Where P is in kPa, v is in m^3/kg, a & b are constants. The initial and final pressure are 1000kPa and 200kPa respectively and the corresponding volumes are 0.2m^3/kg and 1.2m^3/kg. The specific internal energy of the gas is given by the relationship U=1.5pv-85 kJ/kg. Where P is in kPa, v is in m^3/kg. Calculate the net heat transfer and the maximum internal energy of the gas during expansion. **(12+8)**

5A. Explain the Kelvin-Planck and Clausius statement of second law.

5B. What is a Carnot cycle? Explain with a P-V diagram.

5C. A reversible heat engine operates between two reservoirs at temperature of 600^0C and 40^0C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40^0C and -20^0C. The heat transfer to the heat engine is 2000KJ and the net work output of the combined engine refrigerator plant is 360KJ.

a) Evaluate the heat transfer to the refrigerant and net heat transfer to the reservoir at 40^0C. **(4+6+10)**

Reconsider (a) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum values.

6A. Prove that Carnot engine is the most efficient engine.

6B. A cyclic heat engine operates between a source temperature of 800^0C and a sink temperature of 30^0C. What is the least rate of heat rejection per KW net output of engine?

6C. A reversible engine operates between temperature limits of T_1 and T. Where T_1 is the higher temperature. The heat rejected by this engine is received by a second reversible engine at the same temperature T which in turn rejects heat to a sink at temperature T_2. **(7+5+8)**

a. If the two engines have equal efficiencies, Show that $T=\sqrt{T_1 T_2}$

b. If the two engines have equal work output, Show that $T = (T_1+T_2)/2$

7A. Explain viscosity and variation of viscosity of fluids with temperature.

7B. Briefly explain types of fluids and represent in graph.

7C. Derive Darcy Weisbach's equation to determine the loss of head due to friction in pipes.

7D. One litre of crude oil weighs 9.6N. Calculate its specific weight, density and specific gravity. **(4+4+8+4)**

8A. Sketch and explain simple U tube, inverted U-tube and U-tube differential manometers

8B. Derive Euler's equation of motion.

8C. A pipe through which water is flowing is having diameter 20cm and 10cm at cross-section 1 and 2 respectively. Velocity of water at section 1 is given 4m/s. Find velocity head at 1 and 2 and also rate of discharge. **(10+6+4)**