Reg.No.									

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION – APRIL / MAY 2017

SUBJECT: THERMODYNAMICS AND FLUID MECHANICS (ME 241)

(BRANCH: CIVIL)

Tuesday, 2 May 2017

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

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

1A. Differentiate between Heat and work, path function and point function and Intensive and Extensive properties with suitable examples.

1B. Prove that energy is a property of the system.

1C. In an engine the charge is at 105 kPa and 310 K at the beginning of compression. It reaches 2.5 MPa after compression by following the law $PV^{1.4}$ = c. Calculate the temperature at the end of compression and work done.

(6+6+8)

2A. Show that the COP of a heat pump is greater than the COP of a refrigerator.

2B. With help of P-V diagram, derive an expression for work in the following cases.

a. Constant volume process
b. constant pressure process
c. Isothermal process
d. Adiabatic process

2C. In a rotary compressor air flow steadily at a rate of 1.5 kg/s. The air enters with a velocity of 80 m/s and leaves at 4.5 m/s. The specific volume at inlet is 0.9m^3/kg and at the exit is 0.4m^3/kg. As the air passes through the compressor, the specific enthalpy of air is increased by 110 kJ/kg and losses heat of 20 kJ/kg. Determine a) The inlet and exit areas of the compressor and b) The power required to drive the compressor in kW.

(4+8+8)

3A. Derive an expression of co-efficient of performance of a reversible Carnot heat pump cycle.

3B. Explain the working of vapour compression refrigeration cycle.

3C. A gas occupies 0.3 m^3 at 2 bar. It executes a cycle consisting of processes.

(i)1-2 constant pressure process with work interaction of 12 kJ.
(ii) 2-3 compression process which follows the law PV = constant and $U_3 = U_2$
(iii) 3-1, constant volume and change in internal energy $U_1 - U_3$ is -40 kJ.

Neglect changes in kinetic and potential energy, draw P-V diagram for the following processes and determine network transfer for the cycle. Also show that first law is obeyed by the cycle

(6+6+8)

4A. State statements of the second law of thermodynamics and show that violation of one equally violates the other.

4B. Derive an expression of thermal efficiency of a reversible Carnot cycle.

4C. A reversible heat engine extracts heat from three reservoirs at 1000 k, 810 k and 595 k. The engine delivers 10^4 J/s of network and rejects 400 kJ/min of heat to a sink at 298 k. If the heat supplied to the reservoir at 1000 k is 55% of the heat supplied by the reservoir at 595 k. Determine quantity of heat absorbed by each reservoir.

(6+6+8)

5A. Define & explain following properties of fluids.

i) Specific weight ii) Viscosity iii) Specific gravity

iv) Capillary v) Newtonian fluid vi) Surface tension.

5B. Explain surface tension and capillarity action of liquid and derive the expression for capillary rise of a liquid surface in a small tube.

5C. Calculate the capillary effect in millimeter in a glass tube of 4 mm diameter, when immersed in (i) water, and (ii) mercury. The temperature of the liquid is 20^0 C and the values of the surface tension of water and mercury at 20^0 C in contact with air are 0.073575 N/m and 0.51 respectively. The angle of contact for water is zero and for mercury 130^0. Take density of water at 20^0 C as equal to 988 kg/m^3. Take specific gravity of mercury 13.6 **(6+6+8)**

6A. Define pascal's law and show that the intensity of pressure is same all directions.

6B. Explain the following states of flow

a.Uniform and non-uniform flow, b. Compressible and in-compressible flow c..Laminar and turbulent flow

6C. A 0.3 m diameter pipe conveying water branches into two pipes of a diameters 0.2 m and 0.15 m respectively. If the average velocity in the 0.3 m diameter pipe is 2.5 m/s, find the discharge in this pipe. Also determine the velocity in 0.15 m pipe If the average velocity in 0.2 m diameter pipe is 2 m/s. **(6+6+8)**

7A. Derive Euler's equation of motion and then find Bernoulli's energy equation for incompressible steady flow.

7B. Explain various minor losses of energy in flow through pipes.

7C. An oil of specific gravity 0.7 is flowing through a pipe of diameter 300 mm at the rate of 500 litres/s. Find the head loss due to friction and the power required to maintain the flow for a length of 1000 m. Take γ = 0.29 stokes. **(6+6+8)**

8A. Derive Darcy Weisbatch's equation to determine the loss of head due to friction in pipes.

8B. State Buckingham's π- theorem. The pressure difference Δp in a pipe of diameter D and length l due to viscous flow depends on the velocity V, viscosity д and density ρ using Buckingham's π- theorem. Obtain expression for Δp.

8C. Derive continuity equation in three dimensions and simplify the expression for the various types of flow.

(6+8+6)