Reg.No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

IV SEMESTER B.S. DEGREE EXAMINATION - OCT. / NOV. 2017

SUBJECT: THERMODYNAMICS & FLUID MECHANICS (ME 241)

(BRANCH: CIVIL)

Thursday, 09 November 2017

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

✓ **Answer ANY FIVE full Questions.**

1A) Define the following terms:
- i) Cycle
- ii) Quasistatic process
- iii) Thermometric property
- iv) Mean effective pressure
- v) Compression ratio
- vi) Diathermic wall

1B) Obtain the expression for displacement work done for a isothermal process.

1C) A cylinder contains one kg of certain fluid at an initial pressure of 25 bar. The fluid is allowed to expand reversibly behind a piston according the law PV^2=Constant until the volume is doubled. The fluid is then cooled reversibly at constant pressure until the piston regains its original position; heat is then supplied reversibly with the piston firmly held in this position until the pressure rises to 25 bar. Calculate the net work done by the fluid for an initial volume of $1m^3$. **(6+6+8)**

2A) Explain Joules experiment and show that energy is a property of the system.

2B) Derive the expression for work output of an insulated turbine with the application of SFEE.

2C) A gas with a mass of 1.5kg undergoes a quasi-static process p = a + bV, where a and b are constants. The initial and final pressures are 1000kPa and 200kPa respectively and corresponding volumes are $0.2m^3$ and $1.2\ m^3$. The specific internal energy of the gas is given by the relation u = 1.5pv – 68 kJ/kg where p is in kPa and v is in m^3/kg. Calculate the net heat transfer. **(8+4+8)**

3A) State and prove Carnot theorem.

3B) Two reversible engines operate in series between a high temperature T_1 and low temperature T_2 reservoirs. Engine A rejects heat to Engine B, which in-turn rejects heat to the low temperature reservoir. The high temperature reservoir supplied heat to engine A. Let T_1=1000K and T_2= 400K and the engine thermal efficiencies are equal. The heat received by engine A is 500kJ. Determine (i) Temperature of heat rejection by engine A, (ii) work output of engine A and B, (iii) heat rejected by engine B.

3C) Explain the working principle of vapor compression refrigeration with neat sketch. **(8+7+5)**

4A) Explain Clausius inequality.

4B) A 30kg steel ball at 427°C is dropped into 150kg of oil at 27°C, the specific heat of steel and oil are 0.5kJ/kg K and 2.5kJ/kg K. Determine the entropy change of steel, oil and that of system containing oil and steel.

4C) At the inlet to a certain nozzle, the enthalpy of the fluid passing is 3200kJ/kg and the velocity is 50m/s. At the discharge end, the enthalpy is 2800kJ/kg. The nozzle is horizontal and there is negligible heat loss from it. Find a) the velocity at the exit from the nozzle, b) If the inlet area is $0.2m^2$ and the specific volume at the inlet is $0.19m^3/kg$, find the mass flow rate. **(6+8+6)**

5A) State and prove Hydrostatic law.

5B) Explain differential U tube manometer with a neat sketch.

5C) A piezometer tube is fitted to a tank containing water at a point 600 mm above the bottom of the tank. The liquid in the manometer is carbon disulphide having a specific gravity 1.9. Find the height of the free water surface above the bottom of the tank if the piezometer reading is 700 mm. Find also the pressure intensity at the bottom of the tank. **(8+6+6)**

6A) Derive Bernoulli's equation.

6B) Obtain the expression for discharge through a venturimeter.

6C) Water flows over a rectangular notch 1m wide at a depth of 150mm and afterwards passes through a right angled triangular notch. Taking Cd for the rectangular and triangular notch as 0.62 and 0.59 respectively, find the depth over the triangular notch. **(8+8+4)**

7A) Derive Darcy formula for the loss of head due to friction in the pipe flow.

7B) Determine the rate of flow of water through a pipe of diameter 20cm and length 50m when one end of the pipe is connected to a tank and the other end of the pipe is open to the atmosphere. The pipe is horizontal and the height of water in the tank is 4m above the center of the pipe. Consider all minor losses and take f = 0.009. **(10+10)**

8A) The resisting force F of a plane during flight can be considered as dependent upon the length of air craft L, velocity V, air viscosity μ, air density ρ and bulk modulus of air K. Express the functional relationship between these variables with resisting force by using Buckingham's π theorem.

8B) What is meant by geometric, kinematic and dynamic similarity?

8C) What is a dimensionally homogeneous equation? Give example. Write the dimension of force, power and viscosity. **(10+6+4)**