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INTERNATIONAL CENTRE FOR APPLIED SCIENCES
(MAHE, MANIPAL)
III SEMESTER B.S. DEGREE EXAMINATION – APRIL / MAY 2018
SUBJECT: THERMO FLUIDS (MET 231)
(BRANCH: IP)
Friday, 11 May 2018

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

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

1A) Derive an equation for Steady Flow Energy Equation (SFEE) for an open system. **(12)**

1B) A piston cylinder device operates 1kg of fluid at 20atm pressure. The initial volume is 0.04m^3. The fluid is allowed to expand reversibly following a process $PV^{1.45}$=C. So that volume becomes double. The fluid is then cooled at constant pressure until the position comes back to the original position, Keeping the piston unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle. **(08)**

2A) With an example, explain thermodynamic properties. Discuss homogeneous and heterogeneous systems. **(06)**

2B) A gas undergoes a thermodynamic cycle consisting of 3 processes beginning at an initial state where P_1=1 bar, V_1 =1.5m^3 and U_1 = 512kJ. The processes are as follows: **(08)**

- Process 1-2: compression with PV=C to P_2=2 bar, U_2=690kJ.
- Process 2-3: W_{2-3}=0, Q_{2-3}=-150kJ and
- Process 3-1: W_{3-1}= 50kJ.

Neglecting K.E and potential energy changes, determine the heat interaction Q_{12} and Q_{31}.

2C) Show that internal energy is a property of a system. **(06)**

3A) In a steam power station, steam flows steadily through a 0.2m dia pipeline from the boiler to the turbine. At the other end, the steam conditions are found to be P=4Mpa, t=400^{0}C, h=3213.6 kJ/kg and v=0.073m^3/kg. At the turbine end, conditions are found to be P=3.5MPa, t=392^{0}C, h=3202.6 kJ/kg, v=0.84 m^3/kg. There is a heat loss of 8.5kJ/kg from the pipeline. Calculate the steam flow rate. **(06)**

3B) Air flows steadily at a rate of 0.5 kg/s through an air compressor entering at 7m/s velocity, 100kPa pressure and 0.95 m^3/kg volume and leaving at 5 m/s , 700kPa and 0.19 m^3/kg. The internal energy of air leaving is 90J/kg greater than that of air entering. Cooling water absorbs heat from the air at a rate of 58kW. **(06)**

a) Compute a rate of shaft work input to the air in kW.
b) Find the ratio of inlet pipe diameter to output pipe diameter

3C) With an example sketch and explain different types of work transfer. **(08)**

4A) Establish the equivalence of Kelvin-Planck and Clausius statements. **(08)**

4B) Prove that Carnot engine is the most efficient engine. **(06)**

4C) A domestic food freezer maintains a temperature of -15^0C. The ambient air temperature is 30^0C. If the heat leaks into the freezer at the continuous rate of 1.75kJ/s. What is the least power necessary to pump the heat out continuously? **(06)**

5A) Draw the pressure-volume diagram of an constant pressure cycle and explain its working **(08)**

5B) Sketch and explain the terminologies of an internal combustion engine. **(06)**

5C) Explain the principle and functions of a refrigeration. **(06)**

6A) Sketch and explain simple U tube, inverted U-tube differential manometer and U-tube differential manometers **(10)**

6B) Sketch and explain Venturimeter. List some important point about Venturimeter. **(05)**

6C) The inlet and throat of a horizontal Venturimeter are 30cm and 10cm respectively. The liquid flowing through the meter is water. Pressure intensity at inlet is 13.734N/cm^2 while the vacuum pressure head at the throat is 37cm of mercury. Find rate of flow. Assume that 4% of differential head is lost between inlet and throat. Find also value of C_d for Venturimeter. **(05)**

7A) Derive an equation for discharge through Orifice meter. **(08)**

7B) List advantages and disadvantages of Venturimeter. **(06)**

7C) In a vertical pipe conveying oil of specific gravity 0.8, two pressure gauges have been installed at A and B where the diameters are 16cm and 8cm respectively. A is 2m above B. Pressure gauge recordings have shown that pressure at B is greater than that at A by 0.981N/cm^2 neglecting all losses, Calculate flow rate. If the pressure gauge is at A and B are replaced by tubes filled with same liquid and connected to a U-tube containing mercury. Calculate the difference of mercury in the two limbs. **(06)**

8A) Define Pascal's law and show that the intensity of pressure is same all directions. **(06)**

8B) A 15cm diameter pipe is attached to a 10cm diameter pipe by means of a flange in such a manner that axis of the two are in straight line. Water flows through the arrangement at a rate of 2m^3/min. The pressure lost at the transition is indicted by differential gauge length water mercury manometer connected between two pipes equals 8cm. Calculate the heat lost and coefficient of contraction. **(06)**

8C) Derive Darcy Weisbach's equation to determine the loss of head due to friction in pipes **(08)**