Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

III SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER MAKE-UP EXAMINATIONS, DEC 2016/JAN 2017

SUBJECT: ENGINEERING THERMODYNAMICS AND HEAT TRANSFER [MTE 2103]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Data not provided may be suitably assumed.

1A. What is Quasi static process? Explain the following terms: (i) State, (ii) Process, and (iii) Cycle. **(5)**

1B. Find out the amount of heat transferred through an iron fin of length 50 mm, width 100 mm, and thickness 5 mm. Assume k=210 W/m˚C and h= 42 W/m^2˚C and temperature at base of fin is 80˚C. Also determine the temperature at the tip of the fin if the atmospheric temperature is 20˚C **(5)**

2A. A double pipe shell and tube heat exchanger is constructed from stainless steel (k= 15.1 W/mK), inner tube of diameter 1.5cm and outer diameter 1.9 cm and an outer shell of inner diameter 3.2 cm. The convection heat transfer coefficient is given to be h_i = 800 W/m^{2}K on the inner surface of the tube and h_o =1200 W/m^{2}K on the outer surface. Calculate the thermal resistance of the heat exchanger per unit length. **(4)**

2B. Consider a large plane wall of thickness 0.2 m, k= 1.2 W/mK, surface area of 15 m^2. The 2 sides of the wall are maintained at constant temperatures of 120 ˚C and 50˚C respectively. **(4)**

a. Determine the variation of temperature within the wall and value of temperature at 0.1m
b. Rate of heat conduction through wall under steady conditions.

2C. What is fouling in heat exchangers? What is the cause for fouling? **(2)**

3A. Draw the thermal resistance network for the composite wall shown in fig Q3A. Also write the expression for individual resistances in terms of given parameters. **(3)**

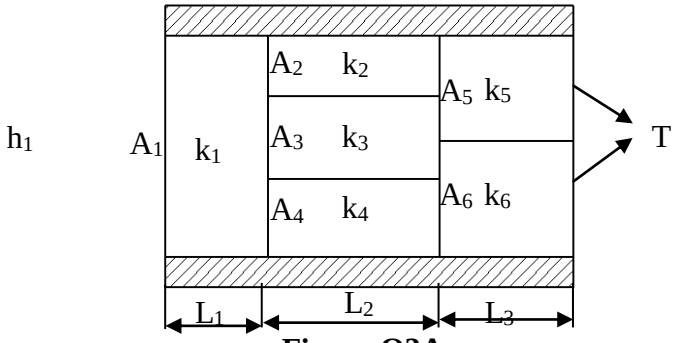

Figure Q3A

3B. A Carnot cycle operates between source and sink temperatures of 250°C and – 15°C. If the system receives 90 kJ from the source, find : **(3)**
(i) Efficiency of the system (ii) The net work transfer ;
(iii) Heat rejected to sink.

3C. State Kelvin Plank's statement and Claussius's statement for the second law of thermodynamics. **(4)**

4A. Write a note on heat transfer through a PCB. **(3)**

4B. A vacuum recorded in the condenser of a steam power plant is 740 mm of Hg. Find the absolute pressure in the condenser in Pa. The barometric reading is 760 mm of Hg. **(2)**

4C. A glass window is 0.8m high, 1.5 m wide and 8 mm thick with a thermal conductivity of k=0.78 W/mK. Determine the steady rate of heat transfer through this window if room temperature is 20˚C and outdoor temperature is -10˚C. Take indoor heat transfer coefficient as 10 W/m^2K and outdoor heat transfer coefficient as 40 W/m^2K. **(5)**

5A. A tank containing air is stirred by a paddle wheel. The work input to the paddle wheel is 9000 kJ and the heat transferred to the surroundings from the tank is 3000 kJ. **(4)**
Determine : (i) Work done by the system;
(ii) Change in internal energy of the system.

5B. Write down the general energy equation for steady flow system and simplify when applied for the following systems : **(3)**
(i) Compressor (ii) Turbine

5C. Define heat engine, refrigerator and heat pump and express their efficiencies and COP in terms of Higher and lower temperature reservoirs. **(3)**