Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

A Constituent Institute of Manipal University, Manipal

III SEMESTER B.TECH (IP ENGG.) END SEMESTER MAKE-UP EXAMINATIONS, DEC 2017

SUBJECT: THERMAL ENGINEERING [MME 2113]

REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitably assumed.
- Use of Thermodynamics data hand book is permitted

1A. A fluid system undergoes a non-flow frictionless process from initial volume of $6m^3$ to a final volume of $2m^3$. The pressure - volume relation during the process is given by $p = 150V+2$ where p is the pressure in bar and V is the volume in m^3. Determine the work done during the process. **3**

1B. Derive the expression for work done for the following process with respective p-V diagrams **3**

i) Isothermal
ii) Polytropic

1C. In an air compressor air flows steadily at the rate of 0.5kg/s. It enters the compressor at 6m/s and 1 bar with a specific volume of $0.85m^3/kg$ and leaves at 5m/s and 7 bar with a specific volume of $0.16m^3/kg$. The internal energy of air leaving is 90 kJ/kg greater than that of air entering the compressor. The heat lost to atmosphere is 60kJ/s. calculate: **4**

i) Power required to drive the compressor
ii) Inlet and outlet pipe cross sectional areas.

2A. Explain the equivalence of kelvin Planck and Clausius statements. **3**

2B. Explain Carnot cycle with a neat sketch. **3**

2C. The COP of heat pump is 6 when the power supplied is 40kW, The heat transfer from the heat pump is used to heat the water flowing through the radiator of a building, **4**

i) Evaluate the magnitude of heat transfer rate to and from the working fluid.
ii) Evaluate the mass flow rate of heated water given that the temperature increases from 500^oC to 700^oC. Assume that water velocity to be negligible.

3A. Explain Otto cycle with the help of a p-V diagram and derive the expression for thermal efficiency for the same. **4**

3B. With the help of a T-S diagram explain Rankine cycle and Rankine cycle with Reheat. **3**

3C. In a Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 20 bar and the exhaust pressure is 0.5 bar. Determine : **3**

i) Pump work and Turbine work
ii) Dryness fraction at the end of expansion
iii) Rankine efficiency

4A. What are the assumptions made for the analysis of an air standard cycle? **2**

4B. A single stage double acting compressor is required to deliver $14m^3$ of air per minute measured at 1.013 bar and 15^oC. The delivery pressure is 7 bar and the speed is 300 rpm. The clearance volume is 5% of the swept volume and the compression and expansion index being 1.3. Calculate **4**

i) Swept volume
ii) Delivery temperature
iii) Indicated power

4C. Sketch and explain multistage compression with the help of a p-V diagram. **4**

5A. Explain Vapor Absorption refrigeration system with a neat diagram. **4**

5B. Derive the expression for heat transfer in a composite wall with a neat sketch. **4**

5C. State Stefan Boltzmann's law and define Emissivity? **2**