Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

III SEMESTER B.TECH. (AERONAUTICAL/AUTOMOBILE ENGINEERING)
END SEMESTER EXAMINATIONS, NOV/DEC 2018

SUBJECT: THERMODYNAMICS [AAE 2104]

REVISED CREDIT SYSTEM

(29/11/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **ALL** the questions.
- Missing data may be suitable assumed.
- USE OF THERMODYNAMIC DATA HAND BOOK IS PERMITTED

1A. Explain different types of thermodynamic system with examples and neat sketches. **(03)**

1B. Differentiate between intensive and extensive properties. Give examples **(02)**

1C. Determine the total work done by the gas following expansion processes
Process 1-2: constant pressure expansion at 50bar from $0.2m^3$ to $0.4m^3$
Process 2-3: expansion as per $PV^{1.3}$=constant till volume reaches $0.8m^3$
Show the processes on P-V diagram. **(05)**

2A. State first law of thermodynamics. Write the equation describing it to a process, a cycle, and steady flow process. **(02)**

2B. A domestic refrigerator is loaded with food and the door is closed. During certain period, the machine consumes 1kWh of energy and the internal energy of the system (food) drops by 5000kJ. Find the net heat transfer for the system. (1kWh is equivalent to 3600kJ). **(03)**

2C. Air flows steadily at a rate of 0.5kg/s through an air compressor, entering at 7 m/s velocity, 100kPa pressure and $0.95m^3$/kg specific volume and leaving at 5 m/s velocity, 700kPa pressure and $0.19m^3$/kg specific volume. The internal energy of the air leaving is 90kJ/kg greater than that of air entering. Cooling water in the compressor jackets absorbs heat from air at a rate of 58kW. Compute the rate of work input in kW. Also, find the ratio of inlet pipe diameter to outlet pipe diameter. **(05)**

3A. State two statements of second law of thermodynamics and show that both are equivalent. **(03)**

3B. To maintain a room at 20ºC temperature when the outside temperature is 0ºC, the rate of heat to be supplied is 10kW. If an ideal heat pump is used to supply this heat, what is the rate of work input needed to the run this heat pump? What is the minimum rate of work needed if direct resistance heating instead of heat pump? **(03)**

3C. A household refrigerator is maintained at a temperature of 2ºC. Every time the door is opened an average of 420kJ heat is introduced to inside. The door is opened 20 times a day and the refrigerator operates at 15% of the ideal COP. The cost of energy input is 32 paisa per kWh. What is the monthly bill of the refrigerator? Atmosphere is at 30ºC. **(04)**

4A. One kg of steam initially at 10bar pressure and 46% quality undergoes two processes.
Process 1-2:Heating at constant volume till pressure reaches 30bar
Process 2-3: Isothermal expansion until 10 bar.
Find the change of enthalpy, entropy, internal energy and specific volume in each process. **(04)**

4B. Explain compressibility chart and its usefulness. **(02)**

4C. Humid air at 101.3kPa, 39ºC dry bulb temperature and 50% relative humidity is cooled at constant pressure to a temperature, which is 10º below its Dewpoint temperature. Show the process on psychrometric chart. **(04)**
a) What is the amount of heat removed from the air?
b) For 100kW cooling rate, what is the volume flow rate of the inlet air in m^3/s?

5A. In an air standard Otto cycle, compression ratio is 7 and compression begins at 35ºC and 0.1MPa. Maximum temperature of the cycle is 1100ºC. Find the temperature and pressure at all the states of the cycle, heat supplied per kg of air, work done per kg, efficiency of the cycle and mean effective pressure of the cycle. **(04)**

5B. An air standard limited pressure cycle has compression ratio of 15 and compression begins at 0.1MPa and 40ºC. Maximum pressure is limited to 6MPa and heat added is 1.675MJ/kg. Find the heat added in constant volume process, heat added in constant pressure process, work done, cycle efficiency, temperature at the end of constant volume heating process, cut-off ratio and mean effective pressure of the cycle. **(04)**

5C. Explain the effect of intercooling and reheating in Brayton cycle with neat sketch, P-V and T-s diagram. **(02)**