Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
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III SEM. B.E. (INDUSTRIAL & PRODUCTION ENGG.) DEGREE END SEMESTER (MAKE-UP) EXAMINATION JAN. 2007

SUBJECT : APPLIED THERMODYNAMICS (IPE-201)
REVISED CREDIT SYSTEM
(05/01/2007)

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:
- Answer **ANY FIVE FULL** questions.
- Use of thermodynamics data hand book is permitted.
- Any missing data may be suitable assumed

1A. Differentiate the following terms with suitable examples.

1. Open system and closed system 2.Heat and Work 3. Statistical thermodynamics and applied thermodynamics 4. Intensive and Extensive properties -4-

1B.A certain mass of air is initially at 270^0 C and 8 bar of pressure occupies 0.2 m^3. The air is expanded at constant pressure such that the volume becomes 3 times the initial volume. A polytropic expansion process with index 1.3 is then carried following by an isothermal compression process to complete the cycle. Considering all the processes to be reversible, find 1. Heat transfer during each process 2. Network done during the cycle. Sketch the cycle on P-V and T-s diagram. -6-

2A.Explain the first law of thermodynamics applied to a closed system executing a cyclic process and an open system executing a process. Also prove that the energy of a system is a property. -4-

2B.Air flows steadily at the rate of 0.8 kg/s through an air compressor, entering at 5 m/s velocity, 100 kPa pressure and 0.9 m^3/kg volume and leaving at 8 m/s, 900 kPa, and 0.19 m^3/kg. the internal energy of the air leaving is 100 kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 60 kW. Compute a) The rate of shaft work input to the air in kW b) Find the ratio of the inlet pipe diameter to outlet pipe diameter. -6-

3A. Define the two parallel statements of second law of thermodynamics and show that violation of one equally violates the other. -4-

3B. Two reversible heat engines A and B are arranged in series. A rejecting heat directly to B. Engine A receives 200 kJ at a temperature of 420 ^{0} C from a hot source, while engine B is in contact with a cold sink at 4 ^{0} C. If the work output of A is twice that of B, find, i) The intermediate temperature between A and B ii) The efficiency of each engine and iii) The heat rejected to the cold sink. -6-

4A. With the help of flow and T-S diagram explain the working of Binary vapour cycle and also derive an expression for the efficiency of the cycle considering the pump work. -5-

4B. Steam is supplied to a two-stage turbine at 30 bar and 400^{o}C. It expands in the first stage turbine up to 10 bar, with an isentropic efficiency of 85%. Then it is reheated to 400^{o}C and expands through the second stage turbine with an isentropic efficiency of 80% up to condenser pressure of 0.05 bar. Find the cycle efficiency, steam rate and power output for a flow rate of 25 kg/min. -5-

5A.Obtain an expression for the air standard efficiency of a Dual cycle. -4-

5B.An engine working on dual cycle has cylinder diameter of 20 cm and stroke 24cm. It operates with a compression ratio of 10. The pressure and temperature of air at the beginning of compression is 1 bar and 30^{o}C. The maximum pressure is limited to 40 bar. The heat addition at constant pressure is 5% of the stroke. Calculate 1.The thermal efficiency 2. Mean effective pressure 3.Percentage of Clearance. -6-

6A. Derive an expression for intermediate pressure for minimum work of compression in a two-stage reciprocating air compressor with an imperfect inter cooling. -6-

6B. A double acting compressor is required to deliver air at 60 bar from an induction pressure of 1 bar at the ratio of 3 m^3/min measured at free air conditions of 1.013 bar and 15^{o}C. The temperature at the end of induction stroke is 30^{o}C. Calculate the indicated power required if the compression is according to $PV^{1.3}$ =C in two stages with perfect inter cooling. What is the saving in power over single stage compression. If the clearance is 4% of swept volume in each cylinder, calculate the swept volumes of the cylinders if the speed of the compressor is 800 rpm. -4-