Reg.No.										

MANIPAL INSTITUTE OF TECHNOLOGY
(A Constituent Institute of MAHE –Deemed University)
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III SEM. B.E. (MANUFACTURING ENGG.) DEGREE (MAKE-UP) EXAMINATION JAN. 2007

SUBJECT : ENGINEERING THERMODYNAMICS (MME-221)
REVISED CREDIT SYSTEM
(05/01/2007)

Time: 3 Hours. MAX.MARKS: 50

Instructions to Candidates:
- Answer **ANY FIVE FULL** questions.
- Use of Thermodynamic data hand book/steam tables is permitted.

1A) State the first law of Thermodynamics applied to a
i) Cycle
ii) Non flow process
iii) Flow process. (03)

1B) Prove that entropy is a property of a system. (02)

1C) The heat capacity at constant pressure of a certain system is a function of temperature only and may be expressed as

$$C_p = \frac{41.87}{(t+100)} \text{ J/°C.}$$

Where t is the temperature of the system in °C. The system is heated while it is maintained at a pressure of 1 atmosphere until its volume increases from 2000 cm^3 to 2400 cm^3 and its temperature increases from 0°C to 100°C. Find
i) The magnitude of the heat interaction.
ii) Change in internal energy of the system. (05)

2A) State and prove claussius Inequality. (03)

2B) A heat engine operating between two reservoirs at 1000 K and 300 K is used to drive a heat pump which extracts heat from the reservoir at 300 K at a rate twice that at which the engine rejects heat to it. If the efficiency of the engine is 40% of the maximum possible and the C.O.P. of the heat pump is 50% of the maximum possible, find

i) Temperature of the reservoir to which the heat pump rejects heat.
ii) Rate of heat rejection from the heat pump if the rate of heat supply to the heat engine is 50 KW. (07)

3A) Obtain an expression for the minimum work of compression for a two stage reciprocating air compressor with perfect intercooler. (04)

3B) At the inlet to a certain nozzle, the enthalpy of the fluid is 3000 KJ/Kg, velocity is 60 m/s. At the discharge end, the enthalpy is 2762 KJ/Kg. The nozzle is horizontal and there is negligible heat loss from it. Find

i) The velocity at exit of the nozzle.
ii) The mass flow rate if the inlet area is 0.1 m^2 and the specific volume at inlet is 0.187 m^3/Kg.
iii) The exit area of the nozzle if the specific volume at the nozzle exit is 0.498 m^3/Kg. (06)

4A) With usual notations, obtain an expression for the air standard efficiency of a diesel cycle in terms of compression ratio, cut-off ratio and ratio of specific heats. State the assumptions made for deriving this expression. (05)

4B) In an air standard Otto cycle, the compression ratio is 7. The compression begins at 35°C, 0.1 MPa. The maximum temperature of the cycle is 1100°C. Find

i) The temperature and pressure at the cardinal points of the cycle.
ii) The heat supplied per Kg of air.
iii) The work done per Kg of air.
iv) The cycle efficiency.
v) The mean effective pressure of the cycle. (05)

5A) Critically evaluate the merits and demerits of the different refrigerants used in vapour compression refrigeration system. (03)

5B) A Freon -12 refrigerator producing a cooling effect of 20 KW operates on a simple vapour compression cycle with pressure limits of 1.509 bar and 9.607 bar. The vapour leaves the evaporator dry saturated and there is no under cooling. Determine the power required by the machine. If the compressor operates at 3000 rpm and has a clearance volume of 3% of stroke volume, determine the piston displacement of the compressor. For compressor assume that the compressor follows the law $pv^{1.3}$ = constant. Find also the bore & stroke of the compressor if the bore to stroke ratio is 0.95. Show the process on a T-S diagram. (07)

6A) Derive expressions for temperature distribution, under one dimensional steady state heat conduction for the following systems.
i) Composite wall ii) Sphere. (06)

6B) A 150 m steel steam pipe has inside diameter of 120mm and outside diameter of 160mm. It is insulated at the outside with asbestos. The steam temperature is 150°C and the air temperature is 20°C. The heat transfer coefficient for steam is 100 W/m^2°C and for air is 30 W/m^2°C. The thermal conductivity of steel is 42 W/m°C & that of asbestos is 0.8 W/m°C. If the heat loss is to be limited to 2.1 KW/m^2, find the thickness of the asbestos insulation required. (04)