

**VIT**Vellore Institute of Technology
(Established as Vellore Institute of Technology in 1984)

School of Mechanical Engineering

Continuous Assessment Test – I, January 2020, Winter Semester 2019-20

B.Tech Mechanical with spl in Automotive Engineering (BME, BMA, BEM)

Course Code	: MEE2038	Duration	: 90 minutes
Course Name	: Thermal and Heat Transfer	Max. Marks	: 50
Slot / Batch	: A1 + TA1	Faculty	: Prof. T. Vijayakumar

- Assume suitable data if required
- Avoid irrelevant answers
- Make your sketches neatly with pencil
- Answer all the questions
- Use of steam table book is permitted

Part A

(5 x 2 = 10 Marks)

1. What is the need for a multi-stage compression in a reciprocating air compressor?
2. A compressor delivers $2.5 \text{ m}^3/\text{min}$ at a suction pressure of 0.78 bar and a temperature of 35°C . What will the free air delivered by the compressor when measured at the STP conditions?
3. Steam at a pressure of 10 bar and 250°C is supplied to an adiabatic convergent divergent nozzle. The exit pressure is 2 bar. Find the throat pressure.
4. A Carnot refrigerator extracts 400 kJ of heat per minute from a cold room which is maintained at -15°C and it is discharged to atmosphere which is at 30°C . Find the ideal I.P. required to run the unit.
5. A refrigeration system is able to extract 1260 kJ of heat per minute. What is the capacity of the system?

Part B

6. A two stage single acting air compressor delivers air at 20 bar. The pressure and temperature of the air before the compression in L.P. cylinder are 1 bar and 27°C . The discharge pressure of L.P. cylinder is 4.7 bar. The pressure of air leaving the inter-cooler is 4.5 bar and the air is cooled to 27°C . The diameter and stroke of L.P. cylinder are 40 cm and 50 cm respectively. The clearance volume is 4% of stroke in both cylinders. The speed of the compressor is 200 rpm. Assuming the index of compression and re-expansion in both cylinders is 1.3 find (a) the I.P. required to run the compressor. (b) The heat rejected in inter-cooler per minute. (c) the diameter of the H.P. Cylinder (15)
7. A dense air refrigeration machine operating on Bell-Coleman cycle operates between 3.4 bar and 17 bar. The temperature of air after the cooler is 15°C and after the refrigerator is 6°C . For a refrigeration capacity of 6 tons, find (a) Work of compressor and expander, (b) Theoretical COP and (c) Rate of water circulation required in the cooler in kg/min, if the rise in temperature is limited to 30°C (10)
8. Steam at 15 bar and 0.97 dry is discharged through a convergent-divergent nozzle to a back pressure of 0.2 bar. The flow rate is 9 kg/kWh. If the power developed is 220 kW, determine: (a) Throat Pressure (b) No of nozzles required, if each nozzle throat area is 32 mm^2 (c) if 12% of overall isentropic enthalpy drop reheats the steam by friction in divergent part only then find out cross-sectional area at the exit of the nozzle. (15)