BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

CLASS: BTECH **SEMESTER : III**
BRANCH: MECH **SESSION : MO/2022**

SUBJECT: ME201 THERMODYNAMICS

TIME: 3:00 Hours **FULL MARKS: 50**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

Q.1(a) Indicate which of the following properties are intensive and which are extensive [2]
i) Density ii) Potential Energy iii) Enthalpy iv) Pressure

Q.1(b) A 1 m^3 rigid tank has air at 100 kPa, 300 K is connected by a valve to another tank of 0.5 m^3 with air at 250 kPa, 400 K. The valve is opened and the two tanks come to a uniform state at 315 K. Determine the final pressure? [3]

Q.1(c) A constant pressure piston/cylinder assembly contains 0.2 kg of steam at 400 kPa, 220 ^oC. It is cooled so that the volume reduces to half of the original volume. Estimate the work done in the process. [5]

Q.2(a) State the first law of thermodynamics applied to (i) a process and (ii) a cycle [2]

Q.2(b) One kg of air at 7 bar, 90 ^oC undergoes a polytropic process which is represented by $pv^{1.1}$ = constant, till the pressure falls to 1.4 bar. Determine (i) the final temperature, (ii) the final volume and (iii) the heat transferred. [3]

Q.2(c) Steam enters a nozzle with a negligible velocity at 3 MPa, 320 ^oC and leaves the nozzle at 1.6 MPa with a velocity of 550 m/s. The rate of flow of steam is 0.5 kg/s. Determine the condition of steam at the nozzle exit and nozzle exit area. [5]

Q.3(a) State the difference between refrigerator and heat pump. [2]

Q.3(b) State and explain Carnot theorem. [3]

Q.3(c) An ice plant working on revered Carnot cycle refrigerator produces 20 tonnes of ice per day. The ice is formed from the water at 0 ^oC and is maintained at 0 ^oC. The heat is rejected to the atmosphere at 27 ^oC. The heat pump used to run the ice plant is coupled to a Carnot engine which absorbs heat from a source which is maintained 227 ^oC and rejects heat to the atmosphere at 27 ^oC. Compute the heat supplied to the engine. (Take the enthalpy of fusion of ice is 334.5 kJ/kg) [5]

Q.4(a) Show that entropy is the property of a system. [2]

Q.4(b) Explain entropy principle. [3]

Q.4(c) Estimate the change in entropy of the universe as a result of following processes (i) A copper block 600 gm mass and Cp of 150 J/K at 100 ^oC is placed in a lake at 8 ^oC, (ii) Two such blocks one at 100 ^oC and 0 ^oC are joined together. [5]

Q.5(a) Derive an expression for the ideal efficiency of an air standard diesel cycle. [5]

Q.5(b) An engine working on Otto cycle has a volume 0.5 m^3, pressure 1 bar and temperature 27 ^oC at the commencement compression stroke. At the end of compression stroke the pressure is 10 bar. Heat is added during constant volume process is 200 kJ. Determine the (a) percentage clearance volume (b) air standard efficiency and (c) mean effective pressure. [5]

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