Code No: R21032 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, Oct/Nov- 2017
THERMODYNAMICS
(Com. to ME, AE, AME, MM)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
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Note: Steam Tables are allowed

1\. a) What is concept of continuum? How will you define density and pressure using this concept. (6M)

b) The piston of an oil engine, of area 0.0045 m^2, moves downwards 75 mm, drawing in 0.00028 m^3 of fresh air from the atmosphere. The pressure in the cylinder is uniform during the process at 80 kPa, while the atmospheric pressure is 101.325 kPa, the difference being due to the flow resistance in the induction pipe and the inlet valve. Estimate the displacement work done by the air finally in the cylinder. (9M)

2\. a) Two streams of air, one at 1 bar , 27^0C and velocity of 30m/s and the other at 5 bar, 227^0C and 50m/s velocity, mix in equal proportion in a chamber from which heat at the rate of 100kJ/kg is removed. The mixture is then passed through an adiabatic nozzle. Find the velocity of the stream issuing out of the nozzle. The temperature of air leaving the nozzle is 27^0C, and its c_p=1.005kJ/kg K. (9M)

b) On a hot summer day, a student turns his fan on in his cubicle, then closes the door and windows – all wooden – before he departs in the morning. By evening he returns. Will his cubicle be warmer or cooler than the neighboring rooms? Substantiate your answer with proper reasoning. (6M)

3\. a) Why is the entropy increase of an isolated system a measure of the extent of irreversibility of the process undergone by the system? (6M)

b) A heat pump is to be used to heat a house in winter and then reversed to cool the house in summer. The interior temperature is to be maintained at 20^0C. Heat transfer through the walls and roof is estimated to be 0.525 kJ/s per degree temperature difference between the inside and outside. If the outside temperature in winter is 5^0C, what is the minimum power required to drive the heat pump? (9M)

4\. a) Write short notes on Mollier chart. (6M)

b) A 280mm diameter cylinder fitted with a frictionless leak proof piston contains 0.02 kg of steam at a pressure of 0.6 MPa and a temperature of 200^0C. as the piston moves slowly outwards through a distance of 305 mm, the steam undergoes a fully-resisted expansion during which the steam pressure p and the steam volume V are related by pV^n=constant, where n is a constant. The final pressure of the steam is 0.12 MPa. Determine (i) the value of n,(ii) the work done by the steam, and (iii) the magnitude and sign of heat transfer. (9M)
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Code No: R21032 **R10** SET - 2

5. a) What is the physical significance of the two constants that appear in the van der Waals equation of state? (6M)

   b) A rigid pipe (ID 25 mm; length 10 m) is pressurized with dry air. After the pressurization is over, the pressure gauge and temperature indicator fitted to the pipe show 6 bar and 40°C readings. Sometime later, the corresponding readings are 5 bar and 30°C. Does this indicate any air leakage? If so, how much it is? (9M)

6. a) Show that the enthalpy of an ideal gas is a function of temperature only. (6M)

   b) An air sample (t = 22°C/ at 760 mmHg of barometer pressure) registers an RH of 30%. Calculate its (i) vapour pressure, (ii) humidity ratio, (iii) vapour density and (iv) specific enthalpy. (9M)

7. a) Determine the air standard efficiency of a diesel engine operating with a compression ratio of 14 while the cut-off takes place at 6% of the stroke. (9M)

   b) For the same compression ratio and hear rejection, which cycle is most efficient: Otto, Diesel or Dual? Explain with $p-v$ and $T-s$ diagrams. (6M)

8. a) Explain the vapour compression cycle with the help of flow, $T-s$ and $p-h$ diagrams. Can this cycle be reversible? If not, why? (6M)

   b) A gas refrigerating system using air as a refrigerant is to work between -12°C and 27°C using an ideal reversed Brayton cycle of pressure ratio 5 and minimum pressure 1 atm, and to maintain a load of 10 tonnes, find (i) the COP,(ii) the air flow rate in kg/s,(iii) the volume flow rate entering the compressor in m^3/s, and (iv) the maximum and minimum temperatures of the cycle. (9M)