## Code: 9D17101

# M.Tech I Semester Supplementary Examinations August 2016 <br> ADVANCED THERMODYNAMICS 

(Refrigeration \& Air Conditioning)
(For students admitted in 2012, 2013, 2014 \& 2015 only)
Time: 3 hours
Max. Marks: 60

## Answer any FIVE questions

All questions carry equal marks
1 A piston-cylinder device contains 0.15 kg of air initially at 2 MPa and $350^{\circ} \mathrm{C}$. The air is first expanded isothermally to 500 kPa , then compressed polytropically with a polytropic exponent of 1.2 to the initial pressure and finally compressed at the constant pressure to the initial state. Determine the boundary work for each process and the net work of the cycle.

2 (a) Explain the equation of state for real gases and suggest a suitable method for calculation of constants in the Vander Waal's equation. Describe briefly about generalized compressibility charts along with its importance.
(b) Determine the pressure of saturated steam at $40^{\circ} \mathrm{C}$ if at $35^{\circ} \mathrm{C}$ the pressure is 5.628 kPa , the enthalpy of vaporization is $2418.6 \mathrm{~kJ} / \mathrm{kg}$ and the specific volume is $25.22 \mathrm{~m}^{3} / \mathrm{kg}$. The enthalpy of vaporization is essentially constant over this temperature range.

3 A rigid tank contains 2 kmol of $\mathrm{N}_{2}$ and 6 kmol of $\mathrm{CO}_{2}$ gases at 300 K and 15 MPa . Estimate the volume of the tank on the basis of:
(a) The ideal-gas equation of state.
(b) Kay's rule.
(c) Compressibility factors and Amagat's law.
(d) Compressibility factors and Dalton's law.

6 Draw and explain the Rankine cycle with reheat and compare the Rankine and Carnot cycles with T-S diagram.
$7 \quad$ An air standard Otto cycle is to be designed according to the following specifications:
Pressure at the start of the compression process $=101 \mathrm{kPa}$.
Temperature at the start of compression process $=300 \mathrm{~K}$.
Compression ratio $=8$.
Maximum pressure in the cycle $=8.0 \mathrm{MPa}$.
Find:
(a) The network output per unit mass of air.
(b) Cycle efficiency.
(c) MEP.

