SECTION – D

6. (a) Steam initially at 0.3 MPa, 250° C is cooled at constant volume : 15

(i) At what temperature will the steam become saturated vapour ?

(ii) What is the quality at 80°C ? What is the heat transferred per kg of steam in cooling from 250°C to 80°C ?

(b) Draw and explain the phase equilibrium diagram for a pure substance on p-T coordinates. 5

7. (a) Derive Vander Waal's Equation of State for Real Gases and calculate the value of constants in terms of properties. 14

(b) Define Dalton's Law of Partial Pressure. 6

SECTION – E

8. (a) Derive Clausius-Clapeyron equation. 8

(b) Define Joule Thomson coefficient and its application. Also define Inversion curve and Inversion temperature. 12

9. Write short notes on following : $4 \times 5 = 20$

(a) Carnot Cycle

(b) Otto Cycle

(c) Diesel Cycle

(d) Brayton Cycle

Roll No. ....

24046

B. Tech. 3rd Semester (MAE)

Examination – December, 2018

THERMODYNAMICS

Paper : ME-201-F

Time : Three Hours] *[Maximum Marks : 100*

Before answering the questions, candidates should ensure that they have been supplied the correct and complete question paper. No complaint in this regard, will be entertained after examination.

Note : Section **A** is ***compulsory.*** Attempt ***five*** questions in all including ***compulsory*** question. Select at least ***one*** question from each Section. Provide Steam Tables. Assume suitable values for missing parameters if any.

SECTION – A

1. (a) State the differences between Heat & Thermodynamic work. 4

(b) Write Maxwell Relations and discuss their significance. 4

(c) Explain the concept of 'Entropy'. 4

(d) Explain the method of measuring dryness fraction of steam using throttling calorimeter. 4

(e) Define the triple point and critical point of pure substance. 4

SECTION – B

2. (a) Explain the different types of work transfer possible for a thermodynamic system. Why free expansion have zero work transfer ? 8

(b) A piston-cylinder device operates 1 kg of fluid at 20 atm pressure. The initial volume is $0.04\,m^3$. The fluid is allowed to expand reversibly following a process $pV^{1.45}$ = constant so that the volume becomes double. The fluid is then cooled at constant pressure until the piston cames back to the original position. Keeping the position unaltered, heat is added reversibly to restore it to the initial pressure. Calculate the work done in the cycle and plot the cycle on p-v chart. 12

3. (a) Explain the different forms in which energy is stored in a thermodynamic system. 8

(b) Air at temperature of $15^{\circ}C$ passes through a heat exchanger at a velocity of 30 m/s where its temperature is raised to 800°C. It then enters a turbine with velocity 30 m/s and expands until the temperature falls to $650^{\circ}C$. Then air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature has fallen to $500^{\circ}C$. If the air flow rate is 2 kg/s. Calculate :

(i) Rate of heat transfer to the air in Heat exchanger.

(ii) The power output from the turbine.

(iii) The velocity at exit from the nozzle, assuming no heat loss. 12

SECTION – C

4. (a) Explain Kelvin-Planck and clausius statements of second law of thermodynamic and prove their equivalence. 12

(b) A Carnot engine absorbs 200 J of heat from a reservoir at the temperature of the boiling point of water and rejects heat to a reservoir at the temperature of triple point of water. Find the heat rejected, the work done by the engine and thermal efficiency. 8

5. (a) Discuss causes of Irreversibities in a thermodynamic system. 5

(b) One kg of ice at –5°C is exposed to the atmosphere which is at 20°C. The ice melts and comes into thermal equilibrium with the atmosphere. : 15

(i) Determine the entropy increase of the universe.

(ii) What is the minimum amount of work necessary to convert the water back into ice at –5°C ? C_p of ice 2.093 KJ/Kg K and latent heat of fusion of ice is 333.33 KJ/Kg.