Roll No													

PRESIDENCY UNIVERSITY
BENGALURU

SCHOOL OF ENGINEERING

SUMMER TERM / MAKE UP END TERM EXAMIANTION

Semester: Summer Term 2019
Course Code: ME A 106
Course Name: Thermodynamics
Program & Sem: B.Tech & I Sem (2016 Batch)

Date: 27 July 2019
Time: 3 Hours
Max Marks: 100
Weightage: 40%

Instructions:

i. *Read the question properly and answer accordingly.*
ii. *Question paper consists of 3 parts*
iii. *Scientific and Non-programmable calculators are permitted.*

Part A

Answer **all** the Questions. **Each** question carries **five** marks. (6Qx5M=30M)

1. Explain about thermodynamic system and different types of thermodynamic system with examples.
2. State Zeroth law of thermodynamics and also state macroscopic and microscopic approach of thermodynamics
3. Define the following processes a) Isobaric process b) Isothermal process c) Adiabatic process d) Isochoric process
4. Define Pressure, Absolute Pressure and Gauge pressure with graphical representation. Also write steady flow energy equation with usual symbols
5. Define Sensible heat, Latent heat, Latent heat of fusion and Latent heat of vaporization. Also plot on temperature verses heat diagram
6. State Kelvin plank statement and Clausius statement of second law of thermodynamics. Also mention what was outcome of Kelvin plank statement and Clausius statement of second law of thermodynamics

Part B

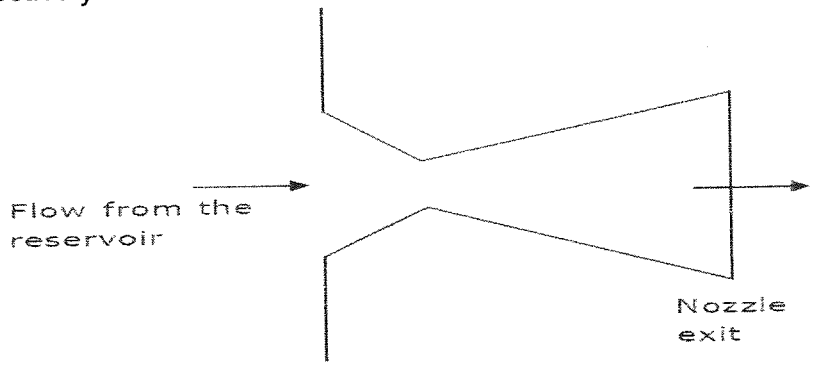
Answer **all** the Questions. **Each** question carries **ten** marks. (5Qx10M=50M)

7. An imaginary engine receives heat and performs work on a slowly moving piston at such a rate that this cycle of operation of 1 kg of working fluid can be represented as a circle of 10 cm diameter on P-V diagram. The scale is 1 cm = 300 kPa and 1 cm = 0.1 m^3 Find net work done in kilo joule

8. Air flows steadily through an adiabatic diffuser (C_p=1.005 kJ/kg-K). The inlet condition are P_1=100 kPa, T_1=500 K, Velocity(V_1)=150 m/s.
The exit temperature is 510 K. Neglect changes in kinetic energy and potential energy.
Find exit velocity of air from diffuser in m/s.

9. Air at a temperature of 15°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 the same velocity of 30 m/s and expands until the temperature falls to 650°C. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature has fallen to 500°C. If the air flow rate is 2 kg/s, calculate
(1) The rate of heat transfer to the air in the heat exchanger
(2) The power output from the turbine assuming no heat losses
(3) The velocity at exit from the nozzle, assuming no heat loss.

10. The temperature and pressure of air in a large reservoir are 400K and 3 bar respectively. A nozzle of exit area 0.005 m^2 is fitted to the wall of the reservoir as shown in the figure . The static pressure of air at the exit section for adiabatic flow through the nozzle is 50 kPa. The characteristic gas constant and the ratio of specific heats of air are 0.287kJ/kgK and 1.4 respectively.



Find the density of air at exit of nozzle in kg/m3 and mass flow rate of air through nozzle in m/s.

11. A reversible heat engine operates between 600°C and 40°C. This engine drives a reversible refrigerator operating between 40°C and -18°C, Still there is a net work-output of 370 kJ. The heat received by engine is 2100 kJ. Draw appropriate diagram and find cooling effect (desired effect) of refrigerator in kilo joule.

Part C

Answer **both** the Question. Question carries **ten** marks. (2Q×10M=20M)

12. A closed system executes a reversible cycle 1-2-3-4-5-6-1 consisting of six processes. Process 1-2 the system receives 1000 kJ of heat at a constant temperature of 500 K. Process 2-3 is adiabatic expansion during which temperature decreases from 500 K to 400 K. Process 3-4 is isothermal heat addition during which 800 kJ of heat is added at a Constant temperature of 400 K. Process 4-5 is adiabatic expansion during which temperature decreases from 400 K to 300 K. Process 5-6 is constant temperature heat rejection at 300 K. Process 6-1 is adiabatic compression.
Plot the cycle on T-S diagram(Temperature Entropy diagram) and find net work done And efficiency of cycle.

13. Temperature of Nitrogen gas in a vessel of volume 2 m3 is 288 K. A U tube manometer connected to a vessel shows a reading of 70 cm of mercury(level higher in the end open to atmosphere). The universal gas constant is 8314 J/k-mol K, atmospheric pressure is 1.01325 bar, acceleration due to gravity is 9.81 m/s^2, density of mercury is 13600 kg/m^3. Find the mass of nitrogen (in kg) in vessel.