*Ex/Prod/T/124/2017*

# B. E. PRODUCTION ENGG. 1ST YEAR 2nd SEMESTER EXAMINATION, 2017

## THERMODYNAMICS

**Time: Three Hours** **Full Marks: 100**

All parts of a question (*a, b, c* etc) should be answered at one place.
Assume any missing data with proper justification.

Answer any **FIVE** questions.

1.a) What is a thermodynamic system? Mention the various types of thermodynamic system with suitable examples. 2+3

b) Why dose free expansion have zero work transfer?-Explain. 5

c) The initial volume of a closed system is 0.2 $m^3$. The initial pressure and temperature are 50kPa and 90° C respectively. The air is compressed to a final volume of 0.02 $m^3$ and the final pressure became 2000 kPa. Estimate the work transfer and heat transfer during the process. Take R= 0.287 kJ/kg-K and $c_v$= 0.718 kJ/kg-K for air. 10

2.a) Mention the difference between steady flow and unsteady flow systems. 4

b) State the first law of thermodynamics for a closed system operating on a non-cyclic process as well as cyclic process. 4

c) The temperature of air at 15° C is raised to 800° C when it passes through a heat exchanger with a velocity of 30 m/s. Then its temperature falls to 650° C when it enters a turbine with same velocity of 30 m/s and expands. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle where it expands further and leaves the nozzle with a velocity of 550 m/s. If the air flow rate is 2 kg/s calculate (i) the rate of heat transfer to the air in the heat exchanger, (ii) the power output from the turbine and (iii) the temperature at exit from nozzle. Take $c_p$ = 1.005 kJ/kg-K for air. Assume no heat loss. 12

3.a) State the third law of thermodynamics. 2

b) Show that Clausius statement and Kelvin-Plank Statement are two consequence of second law of thermodynamics. 8

c) It is desired to produce a temperature of -35° C by refrigeration. High temperature heat reservoir and surroundings are at 210° C and 35° C respectively. Work is obtained from a heat engine operating between source and the surroundings and used to drive the refrigerator. Determine the ratio of heat transferred from the high temperature reservoir to the heat transferred from the cold chamber assuming that the Carnot cycle is used for both heat engine and refrigeration. 10

4.a) Show that entropy is a property of system. 5

b) Prove that PMM II is impossible to construct. 5

c) How can you predict that whether a process is reversible or irreversible? 3

d) With the help of entropy principle shows that the mixing of two non-reactive fluids is an irreversible process. 7