Roll No. .....

# 24046

## B. Tech. 3rd Sem. (ME)

## Examination – December, 2015

### 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 :* Attempt *five* questions. All questions carry equal Marks. The students have to attempt *first* common question, which is *compulsory,* and *one* question from each of the *four* sections. Use steam table.

1. (a) Differentiate between Throttling Process and Free Expansion Process.

   (b) Differentiate between Otto cycle and Diesel cycle.

   (c) Explain law of corresponding states.

   (d) Explain first law of Thermodynamics and Zeroth law.

(e) Explain adiabatic process and polytrophic process.

(f) Explain Characteristic Gas Equation.

(g) Describe Brayton cycle.

(h) Describe Equivalence of Kelvin-Planck and Clausius Statements.

(i) Describe Throttling calorimeter.

(j) Explain Irreversibility. $2 \times 10 = 20$

## SECTION - I

**2.** Define mean effective pressure. Air is compressed adiabatically from 0.92 $m^3$ to 0.29 $m^3$ in a piston cylinder arrangement. Taking its initial pressure and temperature as 103 kPa and 300 k respectively, find the work done. Also find the final temperature. 20

**3.** A working substance flows at a rate of 5 kg/s into a steady flow system at 6 bar, 2000 kJ/kg of internal energy and 0.4 $m^3$/kg specific volume with a velocity of 300 m/s. It leaves at 10 bar, 1600 kJ/kg internal energy, 1.2 $m^3$/kg specific volume with a velocity of 150 m/s. The inlet is 10 m above the outlet. The work transfer to the surroundings in 3 MW. Estimate the heat transfer and indicate the direction. 20

## SECTION - II

**4.** Describe different causes of Irreversibility. Derive the expression for change in entropy during Adiabatic and Polytropic processes. 20



**5.** Explain The Clausius Inequality. A Carnot engine operated between 4°C and 280°C. If the engine produces 300 kJ of work, determine the entropy change during heat addition and heat rejection. 20

## SECTION - III

**6.** Describe working of Separating and Throttling calorimeter. In a steam power plant 1.0 MW is added at 700°C in the boiler, 0.58 MW is taken at out at 40°C in the condenser, and the pump work is 0.02 MW. Find the plant thermal efficiency. 20

**7.** State Phase rule of Pure substances. A steam power plant operates on the Rankine cycle. If the isentropic efficiency of the turbine is 87 percent and the isentropic efficiency of the pump is 85 percent, determine (a) the thermal efficiency of the cycle and (b) the net power output of the plant for a mass flow rate of 15 kg/s. 20

## SECTION - IV

**8.** Explain Joule-Thomson coefficient. Show that the internal energy of (a) an ideal gas and (b) an incompressible substance is a function of temperature only, $u = u(T)$. 20

**9.** Explain the Clapeyron equation. Derive expressions for (*a*) $\Delta u$, (*b*) $\Delta h$, and (*c*) $\Delta s$ for a gas whose equation of state is $P(v - a) = RT$ for an isothermal process. 20