29th November, 2013
3.00 pm to 6.00 pm

Con. 7882-13.

GX-12068

(3 Hours)

[Total Marks : 80

N.B. : (1) Question No. **1** is **compulsory**.
(2) Attempt any **three** questions out of remaining **five** questions.
(3) Use of steam tabels is permitted.

1. Explain any **four** of the following :- **20**
   (a) State and explain Maxwell relations.
   (b) Claussius inequality.
   (c) Adiabatic flame temperature.
   (d) Second law of thermodynamics.
   (e) Joule's experiment.
   (f) Second law efficiency.

2. (a) Show that the conversion of work into heat is complete and contineous. **4**
   (b) Steam flows into a turbine, at a flow rate of 5000 kg/hr. The turbine develops a power of 550 KW. The heat loss from the casing of the turbine and the bearings is negligible. **12**
      (i) Find the change in enthalpy across the turbine, if the inlet velocity is negligible and exit velocity is 360 m/s and the change in potential energy is negligible.
      (ii) Find the change in enthalpy across the turbine, if the velocity at entry is 66 m/s and the inlet pipe is 3 m above the exit pipe.
   (c) Show that entropy is a property of system. **4**

3. (a) Heat flows through a wall at a rate of 3×10^5 KJ/hr. The temperatures of two faces of the wall are 327°C and 207°C. If the surroundings are at 27°C, What is the loss in available energy? **12**
   (b) State and prove carnot theorm. **8**

4. (a) A carnot heat engine which operates between temperature levels of 927°C and 33°C rejects 30 KJ to the low temperature sink. The heat pump receives 270 KJ of heat from a low temperature reservoir and rejects it to the surroundings at 33°C. Determine the temperature in °C of the low temperature for the heat pump. **12**
   (b) Derive an expression for an air-standard efficiency for otto cycle. **8**

5. (a) Steam at 500 kPa having a quality of 0.9 expands adiabatically and reversibly to a final pressure of 100 kPa. Determine its final condition. **10**

(b) The ultimate analysis of a solid fuel is as follows :- **10**

$C = 78\%$, $O_2 = 3\%$, $H_2 = 3\%$, $S = 1\%$, moisture $= 5\%$ and ash content $= 10\%$

Calculate the mass of air supplied. Also calculate individual and total mass of products of combustion per kg of fuel if 30% of excess air is supplied for combustion.

6. (a) In an air-standard dual cycle, the pressure and temperature are 0.1 mPa and 27°C. The compression ratio is 18. The pressure ratio for the constant volume part of heating process is 1.5 and the volume ratio for the constant pressure part of heating is 1.2. Determine :- **12**

(i) thermal efficiency.

(ii) mean effective pressure in M Pa.

(b) State the Clausius clapeyron equation. **4**

(c) Draw a simple schematic of thermal plant with one reheater. Also represent it on T-S-diagram. **4**