## S.E. (Mechanical/Automobile/Mechanical Sandwich)
## (First Semester) EXAMINATION, 2015
## THERMODYNAMICS
## (2012 PATTERN)

**Time : Two Hours　　　　　　　　　　　Maximum Marks : 50**

**N.B. :—** (i) Solve Q. No. **1** or Q. No. **2**, Q. No. **3** or Q. No. **4**, Q. No. **5** or Q. No. **6** and Q. No. **7** or Q. No. **8**.

(ii) All *four* questions are to be solved in one answer book.

(iii) Neat diagrams must be drawn wherever necessary.

(iv) Figures to the right indicate full marks.

(v) Use of Mollier charts, electronic pocket calculator and steam tables are allowed.

(vi) Assume suitable data, if necessary.

1. (a) Explain the following concepts of thermodynamics : [6]
   (i) Thermodynamics cycle
   (ii) Flow work
   (iii) P-dV work.

   (b) Find the change in entropy of universe when 1 kg of ice at –5°C is exposed to atmosphere which is at 30°C, ice melts and comes in thermal equilibrium with atmosphere. Consider specific heat of ice 2.1 kJ/kgK, latent heat of fusion of ice 330 kJ/kg. [6]

*Or*

2. (a) What are the Kelvin-Planck and Clausius statements of second law of thermodynamic ? Also establish their equivalence.[6]

   (b) Air is initially at 1 bar and 27°C is compressed reversibly and adiabatically in a reciprocating engine to final pressure of 25 bar. Find work done, change in enthalpy and change in entropy per kg of air. Assume $C_p$ and $C_v$ of air 1.005 kJ/kgK and 0.717 kJ/kgK respectively. [6]

**3.** (*a*) Draw P-V and T-S diagram of Otto cycle and derive an expression to find its thermal efficiency. [6]

(*b*) A sample of steam generated in a boiler at a pressure of 12 bar is passed through separating and throttling calorimeter to measure its dryness fraction. The following observations were recorded during the test : [6]

(*i*) Pressure of steam after throttling—1.2 bar,

(*ii*) Temperature of steam after throttling—120°C

(*iii*) Mass of steam collected after throttling—1 kg

(*iv*) Mass of water collected through separating calorimeter–15 gm.

Find the quality of steam generated by boiler.

Assume $C_p$ of superheated steam 2.1 kJ/kgK.

*Or*

**4.** (*a*) Prove that when heat is transfer through finite temperature difference it causes loss of available energy. [6]

(*b*) A thermal power plant works on Rankine Cycle has a boiler pressure of 120 bar and condenser pressure of 5 kPa. Steam is superheated in the superheater to 400°C. Find per kg of steam generated by boiler : [6]

(*i*) Net work output

(*ii*) Rankine efficiency

(*iii*) Specific steam consumption.

**5.** (*a*) With the help of suitable diagram explain the construction and working of Cochron boiler. [6]

(*b*) Determine the air-fuel ratio for an oil fired steam generator with the following data : [7]

Chimney height—32 m,

Chimney draught—12 mm of water column,

Flue gas temperature through chimney—297°C

Ambient air temperature—27°C

Also calculate the velocity of flue gas through chimney neglecting losses in the flow of flue gas through chimney.

*Or*

**6.** (*a*) Write the function and locations of the following boiler mountings : [6]

(*i*) Blow off cock

(*ii*) Fusible plug

(*iii*) Steam safety valve.

(*b*) The following readings were recorded during boiler trial of 6 hour duration : [7]

Pressure of steam generated—12 bar,

Mass of steam generated—40000 kg

Dryness fraction of steam generated—0.85

Feed water temperature—30°C,

Coal used—4000 kg.

Calorific value of coal—33400 kJ/kg,

Find :

(*i*) Factor of equivalent evaporation

(*ii*) Equivalent evaporation from and at 100°C

(*iii*) Efficiency of boiler.

**7.** (*a*) Write the complete combustion equations for $C_8H_{18}$ and $C_{12}H_{26}$. Also find theoretical air required for complete combustion of 1 kg of these fuels. [6]

(*b*) If 30% excess air is supplied for the combustion of dry anthracite of the following compositions by mass : Carbon—88%, Hydrogen— 4%, Oxygen—3.5%, Sulphur—0.5%, Ash—3% and Nitrogen—1%, determine : [7]

(*i*) Air-fuel ratio

(*ii*) Dry analysis of product of combustion by volume.

*Or*

**8.** (*a*)   With the help of suitable diagram explain, how Junker gas calorimeter is used to measure Calorific value of gases fuel ?   [6]

(*b*)   Diesel fuel ($C_{12}H_{26}$) reacts with 80% thoretical air. Determine the product of combustion on percentage of volume basis. Considering complete combustion of hydrogen of fuel.   [7]