USN | | | | | | | | | | 10ME/AU43

Fourth Semester B.E. Degree Examination, June/July 2013
Applied Thermodynamics

Time: 3 hrs.   Max. Marks:100

PART – A

1 a. Explain the following:
    i) Enthalpy of formation   ii) Combustion efficiency   iii) Enthalpy of combustion
    iv) Complete combustion   v) Incomplete combustion   **(10 Marks)**
   b. The products of combustion of hydrocarbon fuel of unknown composition have the
      following composition on dry basis:
      $CO_2 = 8.0\%$, $CO = 0.9\%$, $O_2 = 8.8\%$, $N_2 = 82.3\%$
      Calculate: i)   Airfuel ratio   ii) Composition of fuel on mass basis.
                  iii) The percentage of theoretical air on mass basis.   **(10 Marks)**

2 a. Derive an expression of air standard efficiency of a dual cycle, stating the assumptions
      made.   **(10 Marks)**
   b. A diesel engine operating on an air standard diesel cycle has 20 mm bore and 30 mm stroke.
      The clearance volume is 4.2×10^{-4} m³. The fuel is injected for constant pressure for 5% of
      the stroke, calculate the air standard efficiency. If the cut-off is delayed from 5% to 8%,
      what will be the effect on efficiency?   **(10 Marks)**

3 a. Explain the following: i) Motoring test method   ii) Willian's line method. **(08 Marks)**
   b. A two stroke diesel engine was motored when meter reading was 1.5 kW. Test on engine
      was carried for one hour and data observed were as follows: Brake torque = 120 N-m;
      C_P(gas) = 1.05 kJ/kg-K,   Speed = 600 rpm,   Room temperature = 27°C,
      Fuel used = 2.5 kg,   A : F ratio = 32 : 1,   Calorific value = 40.3 MJ/kg,
      Cooling water = 818 kg,   Rise in temperature of cooling water = 10°C,
      Exhaust gas temperature = 347°C.
      Determine brake power, indicated power, brake thermal efficiency. And draw the heat
      balance sheet on minute basis.   **(12 Marks)**

4 a. Sketch the flow diagram and corresponding T-S diagram of a reheat vapour cycle and derive
      an expression for the reheat cycle efficiency. What are the advantages gained by reheating
      the steam in between stages?   **(10 Marks)**
   b. A steam power station uses the following cycle: steam boiler outlet : 150 bar, 550°C
      Reheat at 0.1 bar, using the Mollier diagram and assuming the ideal process find,
      i) Quality of steam at turbine exhaust.
      ii) Cycle efficiency.   **(10 Marks)**

PART – B

5 a. Derive an expression for minimum work I/P by two stage compressor with intercooler.

(10 Marks)

   b. The following data refer to a single stage double acting air compressor in which air is drawn at 1 bar and compressor in which air is drawn at 1 bar and compressed to 16 bar, according to the law $PV^{1.25} = C$. Input to compressor is 50 kW. The speed of the compressor is 300 rpm. The piston speed is 180 m/min. The volumetric efficiency is 80%. Calculate the diameter and stroke of the cylinder.

(10 Marks)

6 a. With neat sketches, explain turbojet and ramjet propulsions.

(10 Marks)

   b. A gas turbine receives air at 100 kPa and 300 K and compresses it to 620 kPa. With compressor efficiency of 88%. The fuel has a heating value of 44180 kJ/kg and fuel air ratio is 0.017 kg of fuel per kg of air. The turbine efficiency is 90%. Calculate the compressor work, turbine work and thermal efficiency.

(10 Marks)

7 a. Explain the effect of super heating and sub-cooling with the aid of T-S and P-H diagrams.

(06 Marks)

   b. Explain steam jet refrigeration.

(04 Marks)

   c. A vapour compression refrigeration uses Freon-12, has its temperature - 10°C and 30°C. The vapour enters the compressor dry and under cooled by 5°C in the condenser. For the capacity of 15 TO R, find
      i) COP
      ii) Mass of Freon
      iii) Power required C_P (vapour) = 0.56 kJ/kg-K and C_P (liquid) = 1.003 kJ/kg-K

(10 Marks)

8 a. Define the following:
      i)   Wet bulb temperature
      ii) Dew point temperature
      iii) Relative humidity
      iv) Specific humidity
      v)   Degree of saturation.

(10 Marks)

   b. A sling thermometer reads 40°C DBT and 28°C WBT. Find the following:
      i)   Specific humidity   ii) Relative humidity
      iii) Dew point temperature   iv) Vapour density

(10 Marks)

* * * * *