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10ME/AU43

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

Time: 3 hrs.　　　　　　　　　　　　　　　　　　　　　　　　　　Max. Marks:100

Note:1. *Answer FIVE full questions, selecting*
at least TWO questions from each part.
2. *Use of thermodynamic data hand book is permitted.*

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 $4.2 \times 10^{-4}\,m^3$. 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)**

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