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06ME43

Fourth Semester B.E. Degree Examination, June/July 2011

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 steam table and psychrometric chart is permitted.

PART – A

1 a. Explain the following with reference to combustion process :
i) Percent excess air
ii) Enthalpy of formation
iii) Adiabetic flame temperature
iv) Enthalpy of combustion. **(10 Marks)**

b. Calculate the air-fuel ratio for burning of propane (C_3H_8) with 130 percent theoretical air. **(10 Marks)**

2 a. Compare the Otto, diesel and dual cycles on P-V diagram and T-S diagrams, when heat supplied to each cycle is same. **(10 Marks)**

b. An engine of 250 mm bore and 375 mm stroke works on constant volume cycle. The clearance volume is 0.00263 m^3. The initial pressure and temperature are 1 bar and 50°C. If maximum pressure is 25 bar, find :
i) Air standard efficiency of cycle
ii) Mean effective pressure. **(10 Marks)**

3 a. Explain with a neat sketch, the difference between open and closed cycle gas turbine. **(10 Marks)**

b. The air enters the compressor of an open cycle constant pressure gas turbine at a pressure of 1 bar and temperature 20°C. The pressure of the air after compression is 4 bar. The isentropic efficiencies of compressor and turbine are 80% and 85% respectively. The air-fuel ratio used is 90 : 1. The flow rate of air is 3 kg/s. Find :
i) Power developed ii) Thermal efficiency of the cycle. **(10 Marks)**

4 a. Derive an expression for the efficiency of a Rankine cycle with the help of neat sketches. State the advantages and disadvantages of reheating and regeneration over a simple Rankine cycle. **(12 Marks)**

b. In a steam power cycle, the steam supply is at 15 bar and dry saturated. The condenser pressure is 0.4 bar. Calculate the Carnot and Rankine efficiencies of the cycle. Neglect pump work. **(08 Marks)**

PART – B

5 a. Obtain an expression for volumetric efficiency of a single stage air compressor in terms of pressure ratio, the clearance ratio, and the index of expansion, and explain the effect of clearance on the volumetric efficiency. **(12 Marks)**

b. In a 2-stage air compressor, the work out-put is found to be 350 kJ/kg of air. It is used to compress 1kg of free air from 1 bar pressure and 32°C initial temperature. The value of n = 1.3 and R = 0.287 kJ/kg°K. Find the intermediate pressure. **(08 Marks)**

6 a. What do you mean by refrigerant, refrigeration and refrigerator? Explain with a neat sketch, working principle of vapour absorption refrigeration system. **(10 Marks)**

b. Find the least power of a perfect reversed heat engine that makes 400 kg of ice per hour at $-8^{\circ}C$ from feed water at $18^{\circ}C$. Assume specific heat of ice as 2.09 kJ/kg$^{\circ}$K and latent heat as 334 kJ/kg. **(10 Marks)**

7 a. Define and deduce an expression for the following terms :

i) Specific humidity
ii) Degree of saturation
iii) Relative humidity
iv) Enthalpy of moist air. **(10 Marks**

b. A sling psychrometer reads $40^{\circ}C$ D.B.T and $28^{\circ}C$ W.B.T. Calculate the following :

i) Specific humidity
ii) Relative humidity
iii) Vapour density in air
iv) Dew point temperature
v) Enthalpy of mixture per kg of dry air. **(10 Marks)**

8 a. Explain briefly the following frictional power determination methods:

i) William's line method
ii) Morse test method **(10 Marks)**

b. A rope brake was used to measure the brake power of a single cylinder, 4-stroke cycle petrol engine. It was found that the torque due to brake load is 175 N-m and the engine makes 500 rpm. Determine the brake power developed by the engine in horse power unit. **(05 Marks)**

c. Define following terms :

i) Indicated power
ii) Brake power
iii) Mechanical efficiency
iv) Specific fuel consumption
v) Frictional power. **(05 Marks)**

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