CBCS SCHEME

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17AU33

Third Semester B.E. Degree Examination, Aug./Sept.2020
Engineering Thermodynamics

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
2. ***Use of Thermodynamic data handbook, steam tables and psychrometric charts are permitted.***
3. ***Assume C_p and γ for air as 1.005 kJ/kgK and 1.4.***

Module-1

1 a. Distinguish between:
(i) Macroscopic and microscopic approaches.
(ii) Intensive and extensive properties
(iii) Thermal equilibrium and mechanical equilibrium
(iv) Cyclic and non cyclic process
(v) Diathermic and adiabatic walls **(10 Marks)**

b. The temperature 't' on a certain scale is defines interms of the thermometry property 'X' by the relation $t = a\ln x + b$ where a and b are constants. On this scale the temperature of ice and steam points are 0°C and 100°C respectively. Experiments reveal that X_i = 1.86 and X_s = 6.81. Find the temperature for an 'X' value of 3.2 on this thermometer. **(10 Marks)**

OR

2 a. Specify the most widely used sign convention for work and heat interaction. And also list the similarities between heat and work. **(10 Marks)**

b. A piston and cylinder machine containing a fluid system has a stirring device in the cylinder as shown in Fig.Q2(b). The piston is frictionless, and it is held down against the fluid due to the atmospheric pressure of 101.325 kPa. The stirring device is turned 10,000 revolutions with an average torque against the fluid of 1.275 MN. Mean while the piston of 0.6 m diameter moves out 0.8 m. Find the net work transfer for the system.

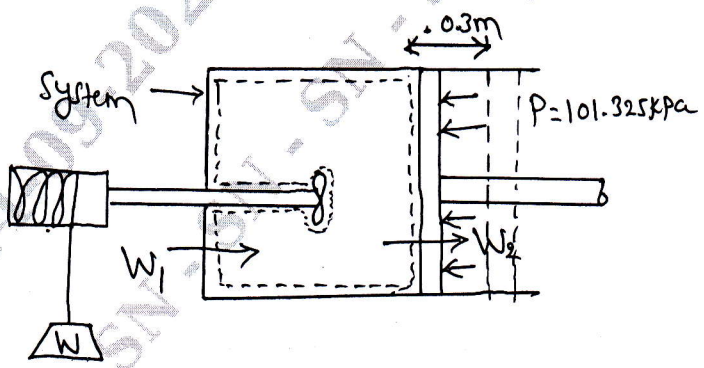

Fig.Q2(b) **(10 Marks)**

Module-2

3 a. With a neat sketch, explain the Joules experiments. **(10 Marks)**

b. Derive the steady flow energy equation for a single stream of fluid entering and a single stream of fluid leaving the control volume. **(10 Marks)**

OR

4 a. Define entropy. Show that entropy is a property. **(10 Marks)**

b. A lump of steel of mass 10 kg at 627°C is dropped 100 kg of oil at 30°C. The specific heats of steel and oil are 0.5 kJ/kgK and 3.5 kJ/kgK respectively. Calculate the entropy change of steel, the oil and the universe. **(10 Marks)**

Module-3

5 a. With a neat sketch, explain the analysis of exhaust gases by orsat apparatus. **(10 Marks)**

b. With the help of P-V and T-S diagrams. Derive an expression for the air standard efficiency of an Otto cycle. **(10 Marks)**

OR

6 a. Explain the following as applied to I.C. engines:
(i) Morse test (ii) Heat balance sheet **(10 Marks)**

b. The following observations were made during a test on a two-stroke cycle oil engine. Bore = 200 mm, stroke = 250 mm, speed = 350 rpm, brake drum dia = 1.2 m, net brake load = 450 N. Mean effective pressure = 2.8 bar, oil consumption = 3.6 kg/hr, calorific value of oil = 41868 kJ/kg. Determine:
(i) Indicated Power (I.P) (ii) Brake Power (B.P)
(iii) Mechanical efficiency (η_{mech}) (iv) Indicated thermal efficiency (η_{ith})
(v) Brake thermal efficiency (η_{bth}) **(10 Marks)**

Module-4

7 a. With a neat sketch, explain the vapour absorption refrigeration system. **(10 Marks)**

b. With a schematic diagram, explain the working of steam jet refrigeration. **(10 Marks)**

OR

8 a. List the properties of refrigerant. **(04 Marks)**

b. Define the following:
(i) Wet bulb temperature (ii) Dry bulb temperature (iii) Relative humidity
(iv) Specific humidity (v) Dew point temperature **(10 Marks)**

c. With a neat sketch, explain the psychrometric chart. **(06 Marks)**

Module-5

9 a. With a neat sketch, explain the principle and operation of a single reciprocating compressor. Also draw P-V diagram. **(10 Marks)**

b. Define: (i) Isothermal efficiency (ii) Adiabatic efficiency (iii) Mechanical efficiency **(06 Marks)**

c. List the advantages of multistage compressor. **(04 Marks)**

OR

10 a. With a neat sketch, explain the open cycle gas turbine cycle. **(05 Marks)**

b. Explain the working principle of rocket propulsion. **(05 Marks)**

c. In an open cycle gas turbine plant, air enters the compressor at 1 bar and 27°C. The pressure after the compression is 4 bar. The isentropic efficiencies of the turbine and compressor are 85% and 80%, respectively. Air fuel ratio is 80:1. Calorific value of the fuel used is 42,000 kJ/kg and mass flow rate of air is 2.5 kg/sec. Determine the power output from the plant and the cycle efficiency. Assume Cp and γ to be same for both air and products of combustion. **(10 Marks)**

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