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10MT71

Seventh Semester B.E. Degree Examination, July/August 2022
Thermodynamics and Heat Transfer

Time: 3 hrs. Max. Marks: 100

Note: **1.** ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of Issue of Thermodynamics/Heat Transfer data books is permitted.***

PART – A

1 a. Define:
(i) Intensive property
(ii) Extensive property
(iii) Thermodynamic state
(iv) Cyclic process
(v) Zeroth law of thermodynamics **(10 Marks)**

b. Explain the concept of temperature measurement using following methods:
(i) Electrical resistance thermometer
(ii) Thermocouple **(10 Marks)**

2 a. Define:
(i) Thermodynamic work
(ii) Path function
(iii) Point function
(iv) Free expansion
(v) Heat **(10 Marks)**

b. A piston and cylinder machine containing a fluid system has a stirring device in the cylinder. The piston is frictionless, and it is held down against the fluid due to the atmospheric pressure of 101.32 kPa. The stirring device is turned 10,000 revolutions with an average torque against the fluid of 1.275 Nm. Meanwhile the piston of 0.6 m diameter moves out 0.8 m. Find the network transfer for the system. **(10 Marks)**

3 a. Explain Joule's experiment with suitable diagram. **(08 Marks)**

b. Explain perpectual motion machine of the first kind (PMM1). **(04 Marks)**

c. In a steady flow apparatus, 135 kJ of work is done by each kg of fluid. The specific volume of the fluid, pressure and velocity at the inlet are 0.37 m^3/kg, 600 kPa and 16 m/s. The inlet is 32 m above the floor, and the discharge pipe is at floor level. The discharge conditions are 0.62 m^3/kg, 100 kPa and 270 m/s. The total head loss between the inlet and the discharge is 9 kJ/kg of fluid. In flowing through this apparatus, does the specific internal energy increases or decreases, and by how much? **(08 Marks)**

4 a. Explain:
(i) Kelvin-Planck's law
(ii) Clausius law and Carnot principles **(12 Marks)**

b. A domestic food freezer maintains a temperature −15°C. The ambient air temperature is 30°C. If heat leaks into the freezer at the continuous rate of 1.75 kJ/s, what is the least power necessary to pump this heat out continuously? **(08 Marks)**

PART – B

5 a. Write a short note on following:

(i) Thermal conductivity

(ii) Convective heat transfer coefficient

(iii) Combined heat transfer mechanism (12 Marks)

b. An iron plate of thickness L with thermal conductivity 'K' is subjected to a constant, uniform heat flux q_0 W/m^2 at the boundary surface at X = 0. From other boundary surface at X = L, heat is dissipated by convection into a fluid at temperature T_∞ with a heat transfer coefficient h. Develop expression for the determination of the surface temperature T_1 at the surfaces X = 0 and X = L respectively. (08 Marks)

6 a. Explain critical thickness of insulation by considering cylinder and sphere. (12 Marks)

b. Derive one dimensional fin equation for fins of uniform cross section and provide a general solution. (08 Marks)

7 a. Define:

(i) Drag coefficient

(ii) Nusselt number

(iii) Hydrodynamic entrance length

(iv) Hydrodynamically developed flow (08 Marks)

b. A vertical plate L = 5 m high and W = 1.5 m wide has one of its surfaces insulated; the other surface, maintained at a uniform temperature T_w = 400 K, is exposed to quiescent atmospheric air at $T\infty$ = 300 K. Calculate the total rate of heat loss from the plate. (12 Marks)

8 Explain:

a. Stefan-Boltzmann law

b. Kirchhoff's law

c. Plank's law

d. Wein's displacement law

e. Lambert's law (20 Marks)

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