Question Paper

Exam Date & Time: 03-Dec-2018 (09:30 AM - 12:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
IV SEMESTER B.S. ENGG. END SEMESTER EXAMINATION - NOV./ DEC. 2018
Thermodynamics and Fluid Mechanics [ME 241]

Marks: 100 **Duration: 180 mins.**

Answer 5 out of 8 questions.

1) A) With help of the suitable examples define the following terms: (5)
i)System and Surrounding
ii) Open and closed system
iii) Statistical thermodynamics and applied thermodynamics
iv) Intensive and Extensive properties
v) Point and path function.

B) Explain the state of thermodynamic equilibrium of a system. (5)

C) Consider gas contained in a cylinder as a system, the initial pressure is being 210 kPa and the corresponding volume is 0.04 m^3. Calculate the work done when the volume of gas increases to 0.15 m^3, (i) By heating at constant pressure and (ii) By heating such that pressure varies inversely with volume. (10)

2) A) With the help of P-v diagram explain Joule's experiment of I^{st} law of thermodynamics applied to a closed system. (6)

B) Apply the steady flow energy equation for the following systems:
(i) Boiler (ii) Nozzle (iii) Centrifugal pump (iv) Heat exchanger v) Compressor. (6)

C) In a steady flow device, the work done by each kg of fluid is 150 kJ. At the entry, the fluid properties are v_1 =0.40 m^3/kg, P_1= 550 kPa and V_1 = 15 m/s and v_2 = 0.65 m^3/kg, P_2 = 105 kPa and V_2 = 275 m/s are the fluid properties at (8)

the exit. The inlet is 30 m above the floor and exit section is at the floor level. The heat loss from the fluid is 10^4 J/kg. Calculate change in internal energy of fluid through the device.

3) A) Explain and derive the expression for the work transfer for the following processes with help of P-v diagrams: i) Polytropic ii) Isothermal iii) Adiabatic. (6)

B) With the help of P-v diagram explain the first law of thermodynamics applied to a closed system executing a cyclic process and an open system executing a process. (6)

C) A cylinder contains 0.12 $m^3$of air at a bar and temperature 90^0 C. It is compressed to 0.013 m^3, the final pressure being 6 bar. Find the index of compression, increase in internal energy and heat transferred. Take R = 287 J/kg.K and C_v = 0.717 kJ/kg.K. (8)

4) A) Define the two parallel statements of second law of thermodynamics and show that violation of one of the statements equally violates the other. (6)

B) Explain working of the vapour compression refrigeration system. (4)

C) A reversible heat engine takes 900 kJ of heat from a source at 700 K. The engine develops 350 kJ of net work and rejects heat to two low temperature sinks at 600 K and 500 K. Determine engine thermal efficiency and heat rejected to each low temperature sinks. (10)

5) A) Explain various properties of fluids and Newton's law of viscosity. (5)

B) Explain surface tension and capillarity action of liquid and derive the expression for capillary fall of a liquid surface in a small tube dripped in mercury. (5)

C) The dynamic viscosity of an oil used for lubrication between a shaft and sleeve is 0.6 N-s/m^2. The shaft is of diameter 0.4 m and rotates at 190 rpm. Calculate the power lost in the bearing for a sleeve length of 90 mm. The thickness of the oil film is 1.5 mm. (10)

6) (6)

A) Define Pascal's law and show that the intensity of pressure is same all directions.

B) The right limb of a simple U-tube manometer containing mercury is open to the atmosphere while the left limb is connected to a pipe in which a fluid of specific gravity 0.9 is flowing. The center of the pipe is 12 cm below the level of mercury in the right limb. Find the pressure of fluid in the pipe if the difference of mercury level in the two limbs is 20 cm. (8)

C) Differentiate between the following states of flow: (6)
a. Uniform and non-uniform flow
b. Compressible and in-compressible flow
c. Laminar and turbulent flow

7) A) Derive Euler's equation of motion and then find Bernoulli's energy equation for incompressible steady flow. (6)

B) Water is flowing through a pipe having diameter 300 mm and 200 mm at the bottom and upper end respectively. The intensity of pressure at the bottom end is 24.525 N/cm^2 and the pressure at the upper end is 9.81 N/cm^2. Determine the difference in datum head if the rate of flow through pipe is 40 lit/s. (8)

C) Derive continuity equation in three dimensional flows. (6)

8) A) Derive Darcy Weisbatch's equation for loss of head due to friction in pipes. (6)

B) Derive the expression for the discharge through a Rectangular notch. (4)

C) The pressure difference $\triangle p$ in a pipe of diameter D and length L due to turbulent flow depends on the velocity V, viscosity μ, density ρ and roughness k. Using Buckingham's Π-theorem obtain an expression for $\triangle p$. (10)

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