

FULL LENGTH MODEL PAPER

WBUT 2nd SEMESTER

ENGINEERING THERMODYNAMICS & FLUID MECHANICS

ME 201

GROUP A (Multiple Choice Type Questions)

1. Choose the correct alternatives for the following :

(i) During throttling process -

- (a) internal energy does not change
- (b) pressure does not change
- (c) entropy does not change
- (d) enthalpy does not change
- (e) volume does not change

(ii) A thermal power plant works on -

- (a) Carnot Cycle
- (b) Joule Cycle
- (c) Rankine Cycle
- (d) Otto Cycle

(iii) Dynamic viscosity has dimension of

- (a) MLT^{-2}
- (b) $ML^{-1}T^{-2}$
- (c) $ML^{-1}T^{-1}$
- (d) $M^{-1}L^{-1}T^{-1}$

(iv) Which of the following is an intensive thermodynamics property?

- (a) Volume
- (b) Temperature
- (c) Mass
- (d) Energy

(v) The latent heat of vaporisation at critical point is

- (a) less than zero
- (b) greater than zero
- (c) equal to zero
- (d) all of these

(vi) An open system is one in which -

- (a) heat and work cross the boundary of the system, but the mass of the working substance does not
- (b) mass of the working substance crosses the boundary of the system, but heat and work do not
- (c) both the heat and work as well as mass of the working substances cross the boundary of the system
- (d) neither the heat and work nor mass of the working substance crosses the boundary of a system

(vii) If a heat engine attains 100% efficiency, it violates -

- (a) zeroth law of thermodynamics
- (b) first law of thermodynamics
- (c) second law of thermodynamics
- (d) law of conservation of energy

(vii) The continuity equation (at two section 1 and 2) for an incompressible fluid is given as -

- (a) $\rho_1 A_1 V_1^2 = \rho_2 A_2 V_2^2$
- (b) $\rho_1 A_1 V_1 = \rho_2 A_2 V_2$
- (c) $A_1 V_1 = A_2 V_2$
- (d) $\rho_1^2 A_1 V_1 = \rho_2^2 A_2 V_2$

(viii) For pipes, turbulent flow occurs when the Reynolds number is -

- (a) less than 2000
- (b) between 2000 and 4000
- (c) more than 4000
- (d) less than 4000

(ix) Bernoulli's theorem deals with the law of conservation of

- (a) mass
- (b) momentum
- (c) energy
- (d) work

(x) Carnot cycle operates between temperature of 100 K and 500 K. Then the efficiency of the cycle is

- (a) 50 %
- (b) more than 50 %
- (c) less than 50 %
- (d) none of these

GROUP B (Short Answer Type Questions)

Answer any three questions

2. (a) State the first law of thermodynamics.
(b) Explain thermodynamic equilibrium.
3. State and prove Pascal's law of pressure at a point.
4. A pilot static tube issued to measure the viscosity of water in a pipe. The stagnation pressure head is 8 m, the static pressure head is 6 m. Calculate the velocity of flow assuming the co-efficient of tube equal to 0.98. Determine the formula you have used.
5. (a) What is steady flow process?
(b) Write the steady flow energy equation for a single stream entering and a single stream leaving a control volume and explain the various terms in it.
6. (a) What is Carnot heat engine?
(b) A Carnot cycle has an efficiency of 32%. Assuming that the lower temperature is kept constant, determine the percentage increase of the upper temperature of the cycle if the cycle efficiency is raised to 48%.

GROUP C (Long Answer Type Question)

Answer any three of the following

7. (a) State Newton's law of viscosity.
(b) What is Bulk Modulus of elasticity?
(c) The space between two large flat and parallel walls, 25 mm apart, is filled with a liquid of viscosity μ . A plate of length 1 m is towed at a velocity of 150 mm/s at a distance of 6 mm from one wall, the plate and its movement being parallel to the walls. Assuming linear variations of velocity between the plates and the walls, determine the force exerted by the liquid on the plate.
8. (a) What is a pure substance?
(b) What is "critical point"? State the values of critical pressure and critical temperature of water.
(c) What are the four basic components of a steam power plant? Show by a block diagram.
(d) Why is Carnot cycle not practicable for a steam power plant?
(e) In an air-standard Diesel cycle, the pressure and temperature at the intake are 1.03 bar and 27°C respectively. The maximum pressure in the cycle is 47 bar and heat supplied during the cycle is 545 kJ/kg. Determine the
(i) Compression ratio
(ii) temperature at the end of the compression
(iii) temperature at the end of the combustion
(iv) air standard efficiency
9. (a) Write a Bernoulli's equation and describe the various terms in it.
(b) What are the assumptions involved in derivation of Bernoulli's equation?
(c) A vertical pipe of 1 m diameter and 20 m length has a pressure head of 5.5 m of water at the upper end. When the water flows through the pipe at an average velocity of 4.5 m/s, the head loss due to friction is 1 m of water column. Find the pressure head at the lower end of the pipe, when the flow is (i) upward (ii) downward.
10. A turbine operates under steady flow conditions, receiving steam at the following state: Pressure = 1.2 MPa, temperature = 188°C, enthalpy = 2785 kJ/kg, velocity = 33.3 m/s and elevation = 3m. The steam leaves the turbine at the following state: Pressure = 20 kPa, enthalpy = 2512 kJ/kg. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?
11. A heat pump working on the Carnot cycle takes in heat from a reservoir at 5°C and delivers heat to a reservoir at 60°C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840°C and rejects heat to a reservoir at 60°C. The reversible heat engine also drives a machine that absorbs 30kW. If the heat pump extracts 17 kJ/s from the 5°C reservoir, determine (i) the rate of heat supply from the 840°C source, and (ii) the rate of heat ejection to 60°C sink.

12. Write short notes on any three of the following

- (a) Pitot tube
- (b) Orifice meter
- (c) Rankine Cycle
- (d) Point function and path function
- (e) Newton's Law of Viscosity

- This model paper has been prepared for reference of students and should not be referred as Original WBUT paper.

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