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B.E. / B.Tech. DEGREE EXAMINATION, MAY 2016

Fourth Semester

Electronics and Instrumentation Engineering

14UME421 - THERMODYNAMICS AND FLUID MECHANICS

(Common to Instrumentation and Control Engineering)

(Regulation 2014)

Duration: Three hours   Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 1 = 10 Marks)

1. A closed system is one in which

   (a) Mass does not cross the boundaries of the system, though energy may do so
   (b) Mass crosses the boundary but not the energy
   (c) Neither mass nor energy crosses the boundaries of the system
   (d) Both energy and mass cross the boundaries of the system

2. According to the First law of thermodynamics

   (a) Mass and energy are mutually convertible
   (b) Carnot engine is more efficient
   (c) Heat and work are mutually convertible
   (d) Mass and light are mutually convertible

3. Otto cycle consist of following 4 processes

   (a) 2 isothermal and 2 isentropic
   (b) 2 isentropic and 2 constant volume cycles
   (c) 2 isentropic , 1 constant volume and 1 constant pressure
   (d) 2 isentropic and 2 constant pressures

4. Steam power plants using coal work closely on known which of the following cycle?

      (a) Otto cycle   (b) Binary vapour cycle

      (c) Brayton cycle   (d) Rankine cycle

5. In reciprocating compressor, the compression work per *kg* of air

      (a) increases as clearance volume increases

      (b) decreases as clearance volume increases

      (c) increases as clearance volume decreases

      (d) is independent of clearance volume

6. The COP of a vapour compression refrigeration in comparison with vapour absorption refrigeration is

      (a) more   (b) less

      (c) same   (d) depending upon size of plant

7. Mercury does not wet glass. This is due to the property of liquid known as

      (a) adhesion   (b) cohesion   (c) surface tension   (d) viscosity

8. Which of the following manometer has highest sensitivity?

      (a) U tube with water   (b) U tube with mercury

      (c) Inclined U tube with mercury   (d) Micro-manometer with water

9. The flow is laminar when Reynolds number is

      (a) Less than 4000   (b) More than 4000

      (c) Less than 2000   (d) More than 2000

10. Bernoulli's equation deals with the law of conservation of energy

      (a) Mass   (b) Momentum   (c) Energy   (d) Force

PART - B (5 x 2 = 10 Marks)

11. Define thermodynamic system. What are the different types of systems?

12. Illustrate the P-V and T-S diagram of Otto cycle.

13. Define ton of refrigeration.

14. Define Capillarity

15. Write down Darcy- Weisbach equation.

41477

PART - C (5 x 16 = 80 Marks)

16. (a) Derive the steady flow energy equation. (16)

Or

(b) A heat engine of 30% efficiency drives a heat pump of *COP* = 5. The heat is transferred from both the engine and the heat pump to circulate water for heating building in winter. Find the ratio of heat transfer to the circulating water from the heat pump to the heat transfer to the circulating water from the heat engine. (16)

17. (a) The minimum pressure and temperature in an Otto cycle are 100 *kPa* and 27°C. The amount of heat added to the air per cycle is 1500 *kJ/kg*

(i) Calculate the pressures and temperatures at all points of the air standard Otto cycle.

(ii) Also calculate the specific work and thermal efficiency of the cycle for a compression ratio of 8:1.

Take for air C_v =0.72 *kJ/kg* and γ = 1.4. (16)

Or

(b) With the help of a neat layout explain the working principle of a steam power plant. (16)

18. (a) A single acting reciprocating compressor compresses air from 1*bar* to 7 *bar*. The clearance volume is 2 *litres*. The compression and expansion follows the law $pv^{1.3} = C$. If the volumetric efficiency of a compressor is 85%, find the stroke volume and cylinder dimensions. Assume diameter of piston is equal to stroke. (16)

Or

(b) With the help of a neat sketch, explain the working principle of vapour compression refrigeration system. (16)

19. (a) Explain the following properties of the fluid

(i) Specific gravity

(ii) Specific weight

(iii) Viscosity

(iv) Compressibility

(v) Surface tension

(vi) Pascal's law (16)

41477

Or

(b) A U-Tube manometer is used to measure the pressure of water in a pipe line, which is in excess of atmospheric pressure. The right limb of the manometer contains mercury and is open to atmosphere. The contact between water and mercury is in the left limb. Determine the pressure of water in the main line, if the difference in level of mercury in the limbs of U- tube is 10 *cm* and the free surface of mercury is in level with the centre of the pipe. (16)

20. (a) Derive the Darcy – Weisbach equation. (16)

Or

(b) The rate of flow of water through a horizontal pipe is 0.$25m^3/s$. The diameter of the pipe which is 200 *mm* is suddenly enlarged to 400 *mm.* The pressure intensity in the smaller pipe is 11.772 *N/cm²*. Determine

    (i) Loss of head due to sudden enlargement

    (ii) Pressure intensity in the large pipe

    (iii) Power lost due to enlargement (16)

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41477