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Question Paper Code: 41373

B.E. / B.Tech. DEGREE EXAMINATION, NOVEMBER 2015

Third Semester

Mechanical Engineering

14UME303 – ENGINEERING THERMODYNAMICS

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Use of Steam table and Psychrometric chart are permitted)

PART A - (10 x 1 = 10 Marks)

1. As differentials, heat and work would be described mathematically as

   (a) inexact (b) exact (c) discontinuity (d) point function

2. The characteristic gas equation $pv = mRT$ is essentially valid for a

   (a) real gas (b) ideal gas (c) monoatomic gas (d) mixture of gas

3. The efficiency of Carnot cycle engine depends on

   (a) speed of the engine (b) working fluid
   (c) operating temperature limits (d) all of the above

4. The relation $ds = dQ/T$ for entropy change a process is valid for

   (a) all real processes (b) only for reversible process
   (c) only for irreversible process (d) all of the above

5. The heat absorbed by water at its saturation temperature to get converted into dry steam at the same temperature is called

(a) sensible heat (b) specific heat (c) total heat (d) latent heat

6. Name the parameter that decreases with increase in steam pressure

(a) sensible heat (b) specific entropy
(c) boiling point (d) latent heat of vaporization

7. The difference of specific heats for the ideal gases is

(a) Joule - Thomson coefficient (b) Characteristics gas constant
(c) Molecular mass (d) None

8. Joule – Thomson coefficient for ideal gas

(a) zero (b) one (c) γ (d) none

9. In sensible heating process ---------- remains constant

(a) sensible heat (b) dry bulb temperature
(c) wet bulb temperature (d) specific humidity

10. On psychrometric chart, the constant wet bulb temperature line coincide with lines of constant

(a) relative humidity (b) dry bulb temperature
(c) specific enthalpy (d) specific humidity

PART - B (5 x 2 = 10 Marks)

11. What is PMM-I?

12. What is irreversibility?

13. What is the difference between saturated vapour and superheated vapour?

14. What is the value of the Clapeyron equation in thermodynamics?

15. What is evaporative cooling?

PART - C (5 x 16 = 80 Marks)

16. (a) Air goes through a polytropic process from 125 *kPa* and 325 *K* to 300 *kP*a and 500 *K*. Find the polytropic exponent and the specific work in the process. (16)

Or

(b) The compressor of a large gas turbine receives air from the ambient surrounding at 95 *kPa* and 20° *C* with a low velocity. At the compressor discharge, air exits at 1.52 *MPa* and 430° *C* with celocity of 90 *m/s*. The power input to the compressor is 5000 *kW*. Determine the mass flow rate of air through the unit. (16)

17. (a) A combination of a heat engine driving a heat pump takes waste energy at 50° *C* as a source to the heat engine rejected heat at 30° *C*. The reminder goes into the heat pump that delivers at 150° *C*. If the total waste energy is 5 *MW*, find the rate of energy delivered at high temperature. (16)

Or

(b) A heat engine receives 5 *kW* at 800 *K* and 10 *kW* at 1000 *K*, rejecting energy by heat transfer at 600 *K*. Assume it is reversible and find the power output. How much power could be produced if it could reject energy at T_o = 298 *K*. (16)

18. (a) A piston-cylinder arrangement of initial volume 0.025 m^3 contains saturated water vapor at 180° *C*. The steam now expands in a polytropic process with exponent n = 1 to a final pressure of 200 *kPa* while it does work against the piston. Determine the heat transfer for this process. (16)

Or

(b) A steam turbine has an inlet of 2 *kg/s* water at 1000 *kPa* and 350° *C* with velocity of 15 *m/s*. The exit is at 100 *kPa*, x = 1 and very low velocity. Find the specific work and power produced. (16)

19. (a) (i) A 2 *kg* mixture of 25% N_2, 50% O_2 and 25% CO_2 by mass is at 150 *kPa* and 300 *K*. Find the mixture gas constant and the total volume. (8)

(ii) Deduce Clapeyron equation from Maxwell's relation. (8)

Or

(b) Weighing of mass gives a mixture at 60° *C* 225 *kPa* with 0.5 *kg* O_2, 1.5 *kg* N_2 and 0.5 *kg* CH_4. Find the partial pressures of each component, the mixture specific volume, mixture molecular weight and the total volume. (16)

20. (a) Two moist air streams with 85% relative humidity, both flowing at a rate of 0.1 *kg/s* of dry sir, are mixed in a steady flow setup. One inlet stream is at 32.5° *C* and the other at 16° *C*. Find the exit relative humidity. (16)

Or

(b) A flow of moist air at 100 *kPa* 40° *C* and 40% relative humidity is cooled to 15° *C* in a constant pressure device. Find the humidity radio of inlet and the exit flow and the heat transfer in the device per *kg* of dry air. (16)