Reg. No. : | | | | | | | | | | |

Question Paper Code: 41733

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

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 measurement of thermodynamic property known as temperature is based on

   (a) Zeroth law of thermodynamics (b) First law of thermodynamics
   (c) Second law of thermodynamics (d) None of these

3. The efficiency of Carnot cycle engine depends on

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

4. Carnot cycle has a maximum efficiency for

   (a) Petrol engine (b) diesel engine
   (c) reversible engine (d) irreversible engine

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. For a given set of operating pressure limits of a Rankine cycle the highest efficiency occurs for

(a) Saturated cycle (b) Superheated cycle
(c) Reheat cycle (d) Regenerative cycle

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

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

8. When heat is supplied at constant volume of a gas it

(a) Increases the internal energy (b) Increase the temperature
(c) Does some external work (d) All the above

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

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

10. The relation between relative humidity (Φ) and degree of saturation (μ) is given by

(a) $\mu = \frac{(P_b - P_v)}{(P_b - P_s)} \Phi$ (b) $\mu = \frac{(P_b - P_s)}{(P_b - P_v)} \Phi$ (c) $\mu = \frac{P_v}{(P_b - P_s)} \Phi$ (d) $\mu = \frac{(P_b + P_s)}{(P_b - P_v)} \Phi$

PART - B (5 x 2 =10 Marks)

11. What is the difference between classical and the statistical approaches to thermodynamics?

12. What is irreversibility?

13. What do you understand by triple point?

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

15. What is a psychrometer?

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 heat pump working on a Carnot cycle takes in heat from a reservoir at 5^0C and delivers heat to a reservoir at 60^0C. The heat pump is driven by a reversible heat engine which takes in heat from a reservoir at 840^0C and rejects heat to a reservoir at 60^0C. The reversible heat engine also drives a machine that absorbs 30 *kW*. If the heat pump extracts 17 *kJ/s* from the 5^0C reservoir, determine (a) the rate of heat supply from the 840^0C source, and (b) the rate of heat rejection to the 60^0C sink. (16)

Or

(b) State and prove Clausius' theorem. (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) Derive Clausius-Clapeyron equation and present the procedure to estimate the latent heat for vapourisation, Vapour pressure of any liquid, and latent heat for sublimation. (16)

Or

(b) (i) Derive Maxwell equations from Helmohtz function and Gibbs function. (8)

(ii) Derive the TdS equation taking T and v as independent variables. (8)

20. (a) An industrial process requires an atmosphere having a *RH* of 88.4% at 22 ^{0}C, and involves a flow rate of 2000 m^3/h. The external conditions are 44.4% *RH*, 15^{0}C. The air intake is heated and then humidified by water spray at 20^{0}C. Determine the mass flow rate of spray water and the power required for heating, if the pressure throughout is 1 bar. (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)