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Question Paper Code: 43073

B.E. / B.Tech. DEGREE EXAMINATION, NOV 2017

Third Semester

Mechanical Engineering

14UME303 – ENGINEERING THERMODYNAMICS

(Regulation 2014)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

(Smith chart may be permitted)

PART A - (10 x 1 = 10 Marks)

1. 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 the above

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

(a) Inexact (b) Exact (c) Discontinuity (d) Point function

3. No engine which gives higher efficiency other than Carnot engine when working at same temperature limits is called

(a) Kelvin statement (b) Clausius statement
(c) Carnot theorem (d) Clausius inequality

4. The heat flows from a cold body to a hot body with the aid of an external source. This statement is given by

(a) Kelvin (b) Joule (c) Clausius (d) Gay-Lussac

5. 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

6. The latent heat is the heat required to

(a) Rise the temperature of the substance
(b) Change the phase of the substance
(c) Both (a) and (b)
(d) None of these

7. Air flows steadily through a compressor. It is compressed reversibly from 0.1 *MPa* and 30^{o} *C* to 0.9 *MPa*, then the non flow isothermal specific work of compression is

(a) -265.8 *kJ/kg* (b) -189.9 *kJ/kg* (c) -190.7 *kJ/kg* (d) zero

8. For a given mass of gas at constant pressure, its volume is directly proportional to the absolute temperature. It belongs to which law

(a) Gay Lussa's law
(b) Charle's law
(c) Joule's law
(d) Boyle's law

9. 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) $\mu = \frac{(P_b + P_s)}{(P_b - P_v)} \Phi$

10. The temperature at which the water vapor starts condensing is called

(a) Degree of saturation
(b) Dry bulb temperature
(c) Wet bulb temperature
(d) Dew point temperature

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. State Gibb's phase rule and mention the terms.
14. Define Dalton's law of partial pressure.
15. What is a psychrometer?

PART - C (5 x 16 = 80 Marks)

16. (a) Air at a temperature of 15^0C passes through a heat exchanger at a velocity of 30 *m/s* where its temperature is raised to 800^0C. It then enters a turbine with the same velocity of 30 *m/s* and expands until the temperature falls to 650^0C. On leaving the turbine, the air is taken at a velocity of 60 *m/s* to a nozzle where it expands until the temperature has fallen to 500^0C. If the air flow rate is 2 *kg/s*, calculate (a) the rate of heat transfer to the air in the heat exchanger, (b) the power output from the turbine assuming no heat loss and (c) the velocity at exit from the nozzle, assuming no heat loss. Take the enthalpy of air as $h = c_p t$, where c_p is the specific heat equal to 1.005 *kJ/kg K* and *t* is the temperature. (16)

Or

(b) 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)

17.(a) A series combination of two Carnot engines operates between the temperature of *T1* and *T2*. Calculate the intermediate temperature *T3*, if the engines produce

(i) Equal amount of work and

(ii) Equal efficiency. (16)

Or

(b) Two heat engines operating in series are giving out equal amount of work. The total work is 50 kJ/cycle. If the reservoirs are at 1000 K and 250 K, find the intermediate temperature and the efficiency of each engine. Also find the heat extracted from the source. (16)

18. (a) Explain steam formation with relevant sketch and label all salient points and explain every point in detail. (16)

Or

(b) Steam at 0.8 *MPa*, 250^0C and flowing at the rate of 1 *kg/s* passes into a pipe carrying wet steam at 0.8 *MPa*, 0.95 dry. After adiabatic mixing the flow rate is 2.3 *kg/s*. Determine the condition of steam after mixing. The mixture is now expanded in a frictionless nozzle isentropically to a pressure of 0.4 *MPa*. Determine the velocity of the steam leaving the nozzle. Neglect the velocity of steam in the pipeline. (16)

19. (a) Derive Maxwell equations from Helmohtz function and Gibbs function. (16)

Or

(b) 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)

20. (a) 1 *k*g of air at $24^{o}C$ and a *RH* of 70*%* is to be mixed adiabatically in a steady state, steady flow device with 1 *kg* of air at $16^{o}C$ and a RH of 10*%*. Assuming that the mixing is carried out at a constant pressure of 1 *atm*, determine the temperature and *RH* of the leaving stream. (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)