B.E. DEGREE EXAMINATIONS: APRIL / MAY 2009

Fourth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U07ME406 Applied Thermodynamics

Time: Three hours   **Maximum Marks: 100**

(Use of approved Thermodynamic property tables and charts permitted)

Answer ALL the Questions:-

PART A (20 x 1 = 20 Marks)

1. Which one of the following is intensive property of a thermodynamic system?

    (a) Mass   (b) Total Volume   (c) Total internal energy   (d) Density

2. A cycle is made up of a combination of _____

    (a) Properties   (b) States   (c) Processes   (d) Surroundings

3. Zeroth law of thermodynamics ststes that when two bodies of different temperatures come into contact, after some time, they will reach _____

    (a) same temperature   (b) different temperature

    (c) subzero temperature   (d) any one temperature

4. Entropy is defined as _____

    (a) $dQ = \dfrac{T}{ds}$ (b) $ds = \dfrac{dQ}{T}$ (c) $ds = \dfrac{T}{dQ}$ (d) $ds.dQ = T$

5. One cycle of operation in a four-stroke IC engine is completed in _____ revolution of the crank shaft.

    (a) one   (b) two   (c) three   (d) four

6. spark plug is used in _____

    (a) Diesel engine   (b) petrol engine

    (c) two-stroke engine   (d) four-stroke engine

7. Gas turbine works on _____

    (a) Otto cycle   (b) Diesel cycle   (c) Dual cycle   (d) Brayton cycle

8. The critical temperature of water is _____

    (a) 221.2°C   (b) 374.15°C   (c) 347.15°C   (d) 212.2°C

9. In water tube boilers

    (a) water passes through the tubes   (b) the tubes are surrounded by hot gas

    (c) forced circulation of water takes place   (d) all

10. Reheating in Rankine cycle _____

    (a) improves dryness fraction of steam at turbine outlet   (b) improves efficiency

    (c) increase turbine output   (d) all

11. The steam in an impulse turbine is expanded _____

    (a) in nozzles and moving blades   (b) in moving blades only

    (c) in nozzle only   (d) all

12. A device used in a boiler for the prevention of explosions due to excessive internal pres of steam is called _____

    (a) stop valve   (b) water level indicator   (c) pressure gauges   (d) safety val

13. In a reciprocating air compressor, the compression work is maximum during _____

    (a) isothermal compression   (b) isentropic compression

    (c) polytropic compression   (d) adiabatic compression

14. Multi-stage compression with perfect inter-cooling in between stages _____

    (a) improves volumetric efficiency   (b) reduces work done

    (c) reduces temperature of air delivered   (d) all

15. Sub-cooling in vapour compression refrigeration cycle _____

    a) reduces enthalpy of liquid refrigerant below saturation level

    b) increases refrigeration effect for same power consumption

    c) increases COP always

    d) all

16. In split air conditioning system _____

    (a) condenser is inside the room   (b) only evaporator is inside the room

    (c) compressor is inside the room   (d) all

17. In general, the thermal conductivity of a substance is

    (a) independent of temperature   (b) a strong function of pressure

    (c) strongly temperature dependent   (d) independent of pressure

18. Heat is transferred by all the three modes, viz, conduction, convection and radiation in

    (a) refrigerator freezer coils   (b) melting of ice   (c) boiler tubes   (d) steam condens

19. Reynolds analogy is true only when

    (a) flow is laminar   (b) flow is turbulent

    (c) flow is partially turbulent   (d) Prandtl number is near about 1

20. Every substance in the universe radiates

    (a) at all temperatures above 0 K   (b) at all temperature above 0°C

    (c) only above room temperature   (d) depending on the environment temperatu

21. (a). (i). Derive the Steady flow energy equation? (8)

(ii). A turbine operates under steady flow conditions receiving steam at the following state: Pressure $=1.2$MPa, Temperature $= 188^0$C, Enthalpy $= 2785$kJ/kg, Velocity $= 33.3$m/s and elevation $= 3$m. The steam leaves the turbine at the following state: Pressure $=20$ KPa, enthalpy $=2512$kJ/kg, Velocity $= 100$ m/s and elevation $= 0$ m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of turbine in KW? (8)

(OR)

(b). A reversible heat engine operating between reservoirs at 900K and 300K drives a reversible refrigerator operating between reservoirs at 300K and 250K. The heat engine receives 1800kJ heat from 900 K reservoir. The net output from the combined engine refrigerator is 360kJ. Find the heat transferred to the refrigerator and the net heat rejected to the reservoir at 300K.

22. (a).(i). Describe working of four stroke C.I engine with neat sketches? (10)

(ii). Explain the knocking phenomena in S.I. and C.I. engine? (6)

(OR)

(b).(i). Draw the *PV & TS* diagram of Brayton cycle with inter cooler. (4)

(ii). A gas turbine unit has a pressure ratio 5/1 and a maximum cycle temperature 900°K. The compression takes place in two stages of equal pressure ratio with intercooling back to initial temperature of 15°C. The isentropic efficiencies of turbine and compressor are 0.86 and 0.89 respectively. Determine the efficiency of the unit when it is fitted with a heat exchanger of 70% effectiveness. (12)

23. (a). Explain the construction and working principle of Babcock and Wilcox boiler?

(OR)

(b). Describe Velocity compounding and Pressure compounding of steam turbines with sketch and list out the advantages?

24. (a). A vapour compression refrigerator capacity of 12TR and the liquid evaporates in the evaporator at -15°C. The temperature of this refrigerant at the delivery from the compressor is 15°C when the vapour is condensed at 10°C. The vapour enters the compressor as wet. Find the co-efficient of performance and power if (i). There is no under cooling. (ii). Liquid is sub cooled by 5°C before expansion by throttling. Take C_p (Super heated vapour) $=0.64$Kj/kgK, C_p (liquid) $= 0.94$KJ/kgK. Use the following data for R-12

Saturation	Enthalpy kJ/kg		Entropy kJ/kgK	
Temperature °C	Liquid	Vapour	Liquid	Vapour
-15	22.3	180.88	0.0904	0.7051
10	45.4	191.76	0.1750	0.6921

(OR)

(b). (i). Determine the work required and heat rejected in each inter cooler compressor perfect inter cooling with a suction pressure of 1×10^5 Pascal and 30°C and the pressure is 70×10^5 Pascal. The mass of air is 1 kg and the compression follows the $pv^{1.2} = C$. Take Cp=1.005kJ/Kg.K. (8)

(ii).Explain the working principal of a Centrifugal compressor? (8)

25. (a).Two circular discs of diameter 0.3m each are placed parallel to each other at a distance 0.2m. One disc is maintained at a temperature of 750°C and the other at 350^0 C and corresponding emissivities are 0.3 and 0.6. Calculate heat exchange between the discs.

(OR)

(b). Water at 30°C, 20m/s flows through a straight tube of 60mm diameter. The tube surface is maintained at 70°C and outlet temperature of water is 50°C. Find the heat transfer coefficient from the tube surface to the water, heat transferred and the tube length.

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