

B.E. DEGREE EXAMINATIONS: APRIL / MAY 2010

Fourth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

U07EI405: Applied Thermodynamics

Time: Three Hours

Maximum Marks: 100

(Use of Approved Data Book and Tables are Permitted)

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. The maximum efficiency of a cyclic operation as per first law of thermodynamics is
 - a) 50%
 - b) 0%
 - c) 90%
 - d) 100%
2. The change in entropy when heat is rejected by the gas is
 - a) Positive
 - b) Negative
 - c) No change
 - d) Both positive and negative
3. Air standard efficiency of an Otto cycle is given by
 - a) $\eta = 1 + 1/(r)^{\gamma+1}$
 - b) $\eta = 1 - 1/(r)^{\gamma-1}$
 - c) $\eta = 1 - 1/(r)^{\gamma+1}$
 - d) $\eta = 2 - 1/(r)^{\gamma-1}$
4. In a constant pressure closed cycle gas turbine the compression and expansion are assumed to be
 - a) Isentropic
 - b) Constant volume
 - c) Constant temperature
 - d) Constant pressure
5. Steam turbines are governed by the following method
 - a) Throttle governing
 - b) Nozzle control governing
 - c) By- pass governing
 - d) All the above
6. Efficiency ratio is the ratio of the thermal efficiency to the corresponding
 - a) Rankine efficiency
 - b) Adiabatic efficiency
 - c) Carnot efficiency
 - d) Isothermal efficiency
7. In a centrifugal air compressor the pressure developed depends on
 - a) Impeller tip velocity
 - b) Inlet temperature
 - c) Compression index
 - d) All the above
8. C.O.P for a Carnot refrigerator is
 - a) Less than that of Carnot heat pump
 - b) More than that of Carnot heat pump
 - c) Equal to Carnot heat pump
 - d) Zero
9. A body which absorbs all the radiation falling on it is called
 - a) Black body
 - b) Grey body
 - c) White body
 - d) Transparent body

10. The rate of heat transfer from a solid surface to a fluid is obtained from
- a) Newton's law of cooling
 - b) Fourier law
 - c) Kirchhoff's law
 - d) Stephen's law

PART B (10 x 2 = 20 Marks)

- 11. Define point function and path function.
- 12. State Kelvin Planks statement.
- 13. Write any four merits of closed cycle gas turbine over open cycle gas turbine.
- 14. Distinguish between two stroke and four stroke cycle engine.
- 15. What is compounding of turbine?
- 16. What is meant by fire tube and water tube boilers?
- 17. Define volumetric efficiency in an air compressor.
- 18. Name any four commonly used refrigerants.
- 19. State the Fourier law of conduction.
- 20. Write the factors affecting the radiation between two surfaces.

PART C (5 x 14 = 70 Marks)

21. (a) (i) Steam at a 6.87 bar, 205⁰ C, enters in an insulated Nozzle with a velocity of 50 m/s. It leaves at a Pressure of 1.37 bar and a velocity of 500 m/s. Determine the final enthalpy of the steam. (9)
- (ii) Discuss reversible and irreversible processes. State examples. (5)

(OR)

- (b) A reversible heat engine operates between two reservoirs at temperatures 700⁰C and 50⁰C. The engine drives a reversible refrigerator which operates between reservoirs at temperatures of 50⁰C and -25⁰C. The heat transfer to the engine is 2500 kJ and the net work output of the combined engine refrigerator plant is 400kJ.
- (i) Determine the heat transfer to the refrigerant and the net heat transfer to the reservoir at 50⁰C.
 - (ii) reconsider (i) given that the efficiency of the heat engine and the C.O.P of the Refrigerator are each 45% of their maximum possible values

22. (a) Explain with neat sketch the principle of operation of a four stroke cycle Compression ignition engine.

(OR)

(b) Explain with neat sketch and T-S diagram, any two methods for improvement of thermal efficiency of an open cycle gas turbine plant.

23. (a) A simple Rankine cycle works between pressure 28 bar and 0.06 bar, the initial condition of steam being dry saturated, calculate the cycle efficiency, work ratio and specific steam consumption.

(OR)

(b) Explain the working principle of steam power plant with a neat sketch.

24. (a) A four cylinder double acting compressor is required to compress $30\text{m}^3/\text{min}$ of air at 1 bar and 27°C to a pressure of 16 bar. Determine the power of the motor required and cylinder dimensions if the following data is given

i) Speed of the compressor= 320 rpm

ii) Clearance Volume= 4%

iii) Stroke to bore ratio= 1.2

iv) Mechanical efficiency= 82%

v) Value of index= 1.32

Assume no pressure change in suction valves and air gets heated by 12°C during suction stroke.

(OR)

(b) An air vapour mixture at 0.1 MPa , 30°C , 80% RH has a volume of 50m^3 . Calculate the specific humidity, dew point temperature, wet bulb temperature, mass of dry air and mass of water vapour.

25. (a) A furnace wall is made of 20cm of magnesite brick and 20cm of common brick. The magnesite brick is exposed to hot gas at 1355°C and common brick outer surface is exposed to 45°C . The convection and radiation heat transfer coefficients towards gas side are 16.5 and $17.5 \text{ W/m}^2 \text{ }^{\circ}\text{C}$. The convection and radiation heat transfer coefficients towards out side are 12.5 and $6.5 \text{ W/m}^2 \text{ }^{\circ}\text{C}$ respectively. Thermal conductivities of magnesite and common brick are 4 and $0.65 \text{ W/m }^{\circ}\text{C}$ respectively. Determine

- i) Heat loss per sq.metre area of the furnace wall
- ii) Maximum temperature to which common brick is subjected

(OR)

(b) (i) Explain the concept of black body. (6)

(ii) A very long 25mm diameter copper ($k=380 \text{ W/m.K}$) rod extends from a surface at 120°C . The temperature of the surrounding air is 25°C and the heat transfer coefficient over the rod is $10 \text{ W/m}^2 \text{ K}$. calculate:

- i) Heat loss from the rod
- ii) How long the rod should be in order to be considered infinite. (8)
