

B.E., DEGREE EXAMINATIONS: MAY/JUNE 2013

Fourth Semester

ELECTRONICS AND INSTRUMENTATION ENGINEERING

MEC231:Applied Thermodynamics

(Steam Table and HMT Data book is permitted)

Time: Three Hours

Maximum Marks: 100

Answer all the Questions

PART A (10 x 1 = 10 Marks)

1. Heat and work mutually convertible but since energy can neither be created nor destroyed the total energy associated with an energy conversion remains constant. It specifies
 - a) Zeroth law of thermodynamics
 - b) First law of thermodynamics
 - c) Second law of thermodynamics
 - d) Third law of thermodynamics
2. Which one of the following expression for COP of a heat pump?
 - a) Heat rejected / work input
 - b) Heat supplied / heat rejected
 - c) Heat supplied / work input
 - d) Heat rejected / heat supplied
3. In a four-stroke cycle engine, the operations namely suction, compression, expansion and exhaust are completed in the number of revolutions of crankshaft equal to
 - a) Four
 - b) Three
 - c) Two
 - d) One
4. The air standard efficiency of closed gas turbine cycle is given by (r_p =pressure ratio for turbine)
 - a) $\eta = 1 - \left(\frac{1}{r_p}\right)^{\frac{\gamma-1}{\gamma}}$
 - b) $\eta = 1 - (r_p)^{\gamma-1}$
 - c) $\eta = 1 - \frac{1}{(r_p)^{\gamma-1}}$
 - d) $\eta = (r_p)^{\frac{\gamma-1}{\gamma}} - 1$
5. Which one of the following is called as boiler mounting?
 - a) Economizer
 - b) Air pre-heater
 - c) Steam trap
 - d) Water level indicator
6. The pressure on the two sides of the impulse wheel of a steam turbine
 - a) is same
 - b) is different
 - c) increases from one side to the other side
 - d) decreases from one side to other side
7. The clearance volume in reciprocating air compressors is provided to
 - a) to reduce the work done per kg of air delivered
 - b) to increase the volumetric efficiency of the compressor
 - c) to accommodate valves in the head of the compressor
 - d) to create turbulence in the air to be delivered

8. Air refrigeration cycle is used in
 - a) Commercial refrigerators
 - b) Domestic refrigerators
 - c) Gas liquefaction
 - d) Air conditioning
9. Which one of the following is the unit of thermal conductivity?
 - a) W/m K
 - b) W/m²K
 - c) W/m²
 - d) Wm/sec
10. The heat transfer equation $Q = \sigma AT^4$ is known as
 - a) Fourier law of heat conduction
 - b) Stefan Boltzmann equation
 - c) Newton's law of cooling
 - d) Wien's displacement law

PART B (10 x 2 = 20 Marks)

11. What is meant by point and path function?
12. State Carnot's theorem.
13. List out the various processes of the Otto cycle.
14. Sketch the schematic arrangement of open cycle gas turbine plant and name the components.
15. What is the difference between water tube and fire tube boiler?
16. What is meant by compounding of turbine?
17. Specify the important applications of compressed air.
18. Define dew point temperature.
19. State Fourier's law of heat conduction.
20. What is meant by radiation shape factor?

PART C (5 x 14 = 70 Marks)

21. a) Air flows steadily at the rate of 0.5 kg/s through an air compressor, entering at 7 m/s velocity, 100kPa pressure, and 0.95 m³/kg volume, and leaving at 5m/s, 700kPa, and 0.19m³/kg. The internal energy of the air leaving is 90kJ/kg greater than that of the air entering. Cooling water in the compressor jackets absorbs heat from the air at the rate of 58kW. (a) Compute the rate of shaft work input to the air in kW. (b) Find the ratio of the inlet pipe diameter to outlet pipe diameter.

(OR)

- b) A reversible heat engine operates between two reservoirs at temperatures of 600°C and 40°C. The engine drives a reversible refrigerator which operates between reservoirs at temperature of 40°C and -20°C. The heat transfer to the heat engine is 2000kJ and the net work output of the combined engine refrigerator plant is 360kJ. (a) Evaluate the heat transfer to the refrigerator and the net heat transfer to the reservoir at 40°C. (b) Reconsider (a) given that the efficiency of the heat engine and the COP of the refrigerator are each 40% of their maximum possible values.

22. a) Briefly explain about the working principle of four stroke compression ignition engine with neat sketch.

(OR)

b) What is the effect of regeneration on brayton cycle efficiency? Define the effectiveness of a regenerator.

23. a) A vessel of volume 0.04 m^3 contains a mixture of saturated water and saturated steam at a temperature of 250°C . The mass of the liquid present is 9 kg. Find the pressure, the mass, the specific volume, the enthalpy, the entropy, and the internal energy.

(OR)

b) (i) Differentiate between impulse and reaction turbines. (6)

(ii) What is governing of turbines? Explain nozzle control governing. (8)

24. a) Explain the working of a multistage air compressor with inter cooling. State its advantages?

(OR)

b) Explain vapour compression cycle with p-h and T-S diagram

25. a) Derive heat transfer equation for conduction of heat through a plane wall

(OR)

b) Water flows inside a tube of 20mm diameter and 3m long at a velocity of 0.03m/s . The water gets heated from 40°C to 120°C while passing through the tube. The tube wall is maintained of 160°C . Find the heat transfer.
