

**B.E DEGREE EXAMINATIONS: NOV/DEC 2014**

(Regulation 2009)

Fourth Semester

**ELECTRONICS AND INSTRUMENTATION ENGINEERING**

**MEC231: Applied Thermodynamics**

*(Steam tables and Heat and mass transfer tables are permitted for use)*

**Time: Three Hours**

**Maximum Marks: 100**

**Answer all the Questions:-**

**PART A (10 x 1 = 10 Marks)**

1. First law of thermodynamics deals with
  - a) Conservation of mass
  - b) Conservation of momentum
  - c) Conservation of energy
  - d) Conservation of volume
2. For an Isentropic process, which of the following statement is correct
  - a) Entropy constant
  - b) Change in entropy zero
  - c) Heat transfer is zero
  - d) Change in enthalpy is zero
3. Compression ratio for the Otto cycle is kept less than diesel cycle because of
  - a) calorific value of petrol is more than the diesel
  - b) to prevent the auto ignition
  - c) pressure during combustion is less
  - d) Temperature during combustion is less
4. For the same maximum pressure and peak temperature, which cycle will be most efficient?
  - a) Diesel
  - b) Otto
  - c) Dual
  - d) Brayton
5. Which of the following are the boiler accessories?
  - a) safety valve
  - b) Stop valve
  - c) Economizer
  - d) Blow off cock
6. In an impulse turbine, steam expands
  - a) fully in nozzle
  - b) fully in blades
  - c) partly in nozzle and partly in blades
  - d) After the blades

7. Intercooling in multistage compressors is done
  - a) To cool the air at delivery
  - b) To cool the air during compression
  - c) To minimise the work of compression
  - d) To reduce the friction
8. In a Vapour compression refrigeration system, the condition of the refrigerant before entering the expansion device is
  - a) high pressure saturated liquid
  - b) wet vapour
  - c) dry vapour
  - d) low pressure saturated liquid
9. The predominant mode of heat transfer in electrical transmission lines is
  - a) conduction
  - b) natural convection
  - c) forced convection
  - d) radiation
10. \_\_\_\_\_ number gives an indication of the ratio of internal ( conduction ) resistance to the surface ( convection ) resistance
  - a) Stanton
  - b) Biot
  - c) Nusselt
  - d) Fourier

**PART B (10 x 2 = 20 Marks)**

11. State zeroth law of thermodynamics.
12. Define Intensive property with an example.
13. Draw P-V Diagram of diesel cycle and list out the process.
14. List down any two differences between Petrol and Diesel engine.
15. Name few boiler mountings.
16. Give the need in compounding of steam turbines.
17. What are the advantages of multi- stage compressor over the single stage air Compressor?
18. Write the basic difference between refrigeration and air-conditioning.
19. State the Fourier law of heat conduction.
20. Define radiation shape factor.

**PART C (5 x 14 = 70 Marks)**

21. a) One kg of air at 1 bar and 300 K is compressed adiabatically till its pressure becomes 5 times the original pressure. Then it is expanded at constant pressure and finally cooled at constant volume to return to its original conditions. Calculate 1) heat transfer 2) work transfer and 3) internal energy for each process and for the cycle. Represent the process on P-V diagram.

**(OR)**

- b) (i) Develop the steady flow energy equation with engineering applications. (6)

(ii) Fluid with an enthalpy of 3100 kJ/kg and the velocity of 60 m/s enters a convergent –divergent nozzle. The fluid leaves the nozzle with an enthalpy of 2759 kJ/kg. Determine the exit velocity of the fluid and also find the mass flow rate through the nozzle if the inlet area is 1000 cm<sup>2</sup> and specific volume at inlet is 0.2m<sup>3</sup>/kg. (8)

22. a) (i) An engine works on Otto cycle. The initial pressure and temperature of the air are 1bar and 40 °C, 825kJ of heat is supplied per kg of air at the end of compression. Find the efficiency and mean effective pressure for the cycle if compression ratio 6. (10)

(ii) Compare four stroke and two stroke engines. (4)

**(OR)**

b) (i) A gas turbine works on an air standard brayton cycle. The initial condition of the air is 25 °C and 1 bar. The maximum pressure and temperature are limited to 3 bar and 650 °C. Determine the work output per kg of air and exhaust temperature. (6)

(ii) Explain the principle of operation of a four stroke petrol engine with a neat sketch. (8)

23. a) (i) A simple Rankine cycle steam power plant operates between 40 bar and 0.05 bar. If the steam supplied is dry saturated find the cycle efficiency and Specific steam consumption. (7)

(ii) Sketch and describe the working of Benson boiler. Give the advantages of Benson boiler over the other types. (7)

**(OR)**

b) (i) Draw the layout of a steam power plant and explain its principle of operation. (8)

(ii) Illustrate the different methods of compounding of steam turbine stages. List the advantages and limitations of each type. (6)

24. a) (i) 2 kg/s of air enters the L.P cylinder of a two stage, reciprocating air compressor. The overall pressure ratio is 9. The air at inlet to the compressor is at 100kPa and 35 °C. The index of compression in each cylinder is 1.3. Find the intercooler pressure for perfect intercooling. Also, find the minimum power required for compression, and percentage saving over single stage compression. (8)

- (ii) Demonstrate with a neat sketch, the principle of operation of centrifugal compressor. (6)

(OR)

- b) (i) With the help of neat sketch and p-h diagram explain the vapour compression refrigeration cycle. (8)

- (ii) Summarize briefly about summer air-conditioning system. (6)

25. a) (i) An exterior wall of a house consists of a 10.16 cm layer of common brick having thermal conductivity of  $0.7 \text{ W/mK}$ . What thickness of loosely packed rockwool insulation ( $k=0.065 \text{ W/mK}$ ) should be added to reduce the heat loss through the wall by 80%. (8)

- (ii) Relate briefly about critical thickness of insulation. (6)

(OR)

- b) (i) Air stream at  $27^\circ\text{C}$  is moving at  $0.3 \text{ m/s}$  across a  $100 \text{ W}$  electric bulb at  $127^\circ\text{C}$ . If the bulb is approximated by a  $60 \text{ mm}$  diameter sphere, estimate the heat transfer rate and the percentage of power lost due to convection. (8)

- (ii) Discuss briefly about black body and grey body. (6)

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