

B.E. DEGREE EXAMINATIONS: NOVEMBER 2009

Fourth Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

U07ME406: Applied Thermodynamics

(Use of steam tables and psychometrics tables are permitted)

Time: Three Hours

Maximum Marks: 100

Answer ALL the Questions:-

PART A (10 x 1 = 10 Marks)

1. In which process the change in internal energy is zero
a) Iso-choric process b) Isobaric process c) Iso-thermal process d) Isentropic process
2. Carnot cycle efficiency is maximum when the initial temperature is
a) 0 K b) 273 K c) 100 K d) -273 K
3. Doping is the process of adding small amount of
a) Lead b) Tetraethyl lead c) Ethylnitrate d) Nitrate
4. The factor that affect air standard efficiency of diesel cycle is
a) Expansion ratio b) knocking c) Compression ratio d) Volumetric ratio
5. The water level indicator in the boiler is generally..... in numbers
a) Two b) Three c) One d) Four
6. The efficiency of a velocity-compounded steam turbine as compare to pressure compounded Turbine is
a) Equal b) Not equal c) Greater d) Less
7. Volume of air sucked by the compressor during its suction stroke is known as
a) Compressor capacity b) Swept volume c) Free air delivery d) Initial volume
8. Power requirement of a refrigerator is
a) Inversely proportional to COP b) Directly proportional to COP
c) Equal to COP d) Greater than COP
9. The heat transfer equation $Q = \sigma AT^4$ is known as
a) Fourier law of conduction b) Newton's law of cooling
c) Stefan-Boltzman equation d) Reynolds Number
10. A body which do not transmits any radiation is called as
a) Black body b) Gray body c) White body d) Opaque body

PART B (10 x 2 = 20 Marks)

11. What is meant by “Perpetual Motion Machine of First kind”?
12. What do you mean by “Calusius inequality”?
13. What are the assumptions made for air standard cycle analysis?
14. How we increase the efficiency of Brayton cycle?
15. Define dryness fraction of steam.
16. Differentiate between impulse and reaction turbines.
17. What is meant by free air delivered?
18. What is meant by sub cooling?
19. What is meant by radiation shape factor?
20. What are the dimension less parameters used in forced convection?

PART C (5 x 14 = 70 Marks)

21. a) i) 5 Kg of air at 40°C and 1 bar is heated in a reversible non-flow constant pressure until the volume is doubled. Find a) change in volume b) work done c) change in internal energy and d) change in enthalpy. (7)
- ii) Derive the equation for Steady Flow Energy Equation. (7)

(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 900K 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) Explain the working principle of two stroke C.I engine.

(OR)

- b) In a gas turbine plant working on the Brayton cycle the air at the inlet is at 23°C , 0.1Mpa. The pressure ratio is 6.75 and the maximum temperature is 750°C . The turbine expansion is divided into two stages with reheat to 750°C . The efficiency of compressor and two turbines are 82% respectively. Determine the maximum power that can be obtained from this plant, if the mass rate of air is 5 kg/sec.

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

(OR)

- b) Explain the various methods of steam governing.

24. a) A single acting single stage- reciprocating compressor takes 1m^3 of air per minute at 1.013bar and 17°C and delivers it at 7bar. The law of compression is $pv^{1.35} = \text{constant}$. Clearance is neglected. Compressor runs at 300 rpm. Stroke to bore ratio is 1.5. Mechanically efficiency compressor is 85% and motor transmission efficiency is 90%. Calculate mass of air delivered per minute, indicated power, bore and stroke, and motor power.

(OR)

b) A refrigeration system operates with condensing and evaporating temperature of 30°C and -5°C . There is no sub cooling and refrigerant is dry saturated at the end of compression. Sketch the cycle on T-S and p-h diagrams and find the theoretical COP.

25. a) A pipe of inner diameter 100mm and outer diameter 120mm carries steam at 110°C . The thermal conductivity of pipe material is $185\text{W}/\text{m}^\circ\text{C}$. The pipe is located in a room where the ambient temperature is 30°C and the convective heat transfer coefficient between pipe and air is $15\text{W}/\text{m}^2^\circ\text{C}$. Determine heat transfer rate per unit length of pipe. If the pipe is covered with 50mm thick insulation of thermal conductivity $0.2\text{W}/\text{m}^\circ\text{C}$ find the heat transfer rate per unit length of pipe.

(OR)

b) Two black discs of diameter 62cm are arranged directly opposite to each other and separated by a distance of 125cm. The temperature of the discs are 1150K and 620K. Calculate the heat flow by radiation between the discs for the following cases.

1. When no other surfaces are present.
2. When the discs are connected by non – conducting surface.
