KATHMANDU UNIVERSITY
End Semester Examination [C]
January, 2018

Marks scored:

Level: B.E.
Year : II

Course : MEEG 207
Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No. :

Date JAN 1 1 2018

SECTION "A"
[20 Q. × 1 = 20 marks]

Tick the most appropriate answer.

1. A thermodynamic system is referred to be an isolated system when there is transfer of .....across the system boundaries.
[ ] only mass [ ] only energy
[ ] both mass and energy [ ] neither mass nor energy

2. Choose the open thermodynamic system
[ ] ice cream freezer [ ] centrifugal pump [ ] pressure cooker [ ] storage battery

3. If a gas is heated against pressure keeping the volume constant, then work done will be
[ ] positive [ ] negative [ ] zero [ ] maximum

4. All of the following are intensive properties of a system, except
[ ] viscosity [ ] temperature [ ] density [ ] potential energy

5. If value of n is infinitely large in a polytropic process $PV^n = C$, then the process is constant
[ ] volume [ ] pressure [ ] temperature [ ] enthalpy

6. As differentials, heat and work would be described mathematically as
[ ] inexact [ ] exact [ ] discontinuity [ ] point function

7. Change in enthalpy of a system is the heat supplied at
[ ] constant pressure [ ] constant temperature [ ] constant volume [ ] constant entropy

8. First law of thermodynamics refers to conservation of
[ ] mass [ ] momentum [ ] energy [ ] force

9. In a general compression process, 1 kJ of mechanical work is supplied to 2 kg of fluid and 400 J of heat is rejected to the cooling jacket. The change in specific internal energy would be
[ ] 700 J [ ] 350 J [ ] 300 J [ ] 600 J

10. Which of the following parameter changes during an isothermal process
[ ] pressure [ ] temperature
[ ] internal energy [ ] pressure and internal energy

11. Which one of the following gases will have maximum value of gas constant
[ ] Nitrogen [ ] Carbon dioxide [ ] Sulphur dioxide [ ] Oxygen

12. For which of the following substances, the gas laws can be used with minimum error
[ ] dry steam [ ] wet steam [ ] saturated steam [ ] superheated steam

13. Total heat of a substance is also known as
[ ] internal energy [ ] entropy [ ] thermal capacity [ ] enthalpy

14. At critical point, the enthalpy of vaporization is
[ ] zero [ ] maximum
[ ] minimum [ ] depends on temperature only

15. In a Carnot cycle, the rejection of heat is at
[ ] Constant pressure [ ] Constant volume
[ ] Constant temperature [ ] None

16. If thermal efficiency of a Carnot heat engine is 40%, then coefficient of performance of a refrigerator working within the same temperature limits would be
[ ] 1.5 [ ] 2.5 [ ] 3.5 [ ] 4.5

17. For any natural process, the net entropy change would be
[ ] zero [ ] positive [ ] negative [ ] unpredictable

18. A heat engine is supplied heat at the rate of 30,000 J/s and gives an output of 9 kW. The thermal efficiency of engine will be
[ ] 20% [ ] 30% [ ] 40% [ ] 50%

19. The gas turbine works on the
[ ] Rankine cycle [ ] Carnot Cycle [ ] Brayton Cycle [ ] Dual Cycle

20. Cycle used to analyze thermal power plant is
[ ] Carnot [ ] Reversed Carnot [ ] Rankine [ ] Brayton

KATHMANDU UNIVERSITY
End Semester Examination [C]
January, 2018

Marks scored:

JAN 1 1 2018

Level : B.E.
Year : II
Time : 2 hrs. 30 mins.

Course : MEEG 207
Semester : II
F. M. : 55

SECTION "B"
[55 marks]

Attempt *ALL* questions. Assume suitable data if necessary. Steam tables are allowed.

Q.N.1

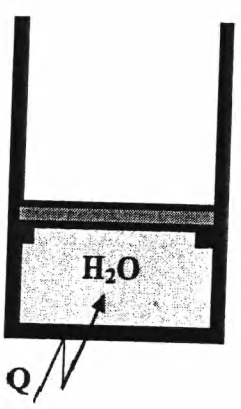
a. Define a) open system b) closed system and c) isolated system. [3]
b. A computer cooled by a constant-speed fan operate satisfactorily at sea level but overheat at high altitude. Why? Give reasons. [3]
c. A vacuum gauge mounted on a condenser reads 0.66 m of Hg. What is the absolute pressure in the condenser in kPa when atmospheric pressure is 101.3 kPa? ($\rho_{mercury}$ = 13600 kg/m^3) [3]

Q.N.2

a. Differentiate between heat and work transfer. [1]
b. Derive an expression for workdone during and isothermal process. [3]
c. A piston cylinder assembly contains 0.9 kg of air at a temperature of 300 K and pressure of 1 bar. The air is compressed to a state where the temperature is 470 K and the pressure is 6 bars. During the compression, there is a heat transfer from the air to the surrounding equal to 20 kJ. Using the ideal gas model for air, determine the work during the process in kJ. [4]

Q.N.3

a. Derive an expression for specific volume of a two phased mixture in terms of quality. ($v = v_l + x\, v_{lg}$) [3]
b. A piston cylinder arrangement contains 2 kg of water initially at a pressure of 200 kPa and a quality of 20%. Heat is added until the total volume is 1.5 m^3. It takes a pressure of 600 kPa to lift the piston. Sketch the process on P-v and T-v diagrams and determine the final temperature and work transfer. [5]



Q.N.4

a. Write down the general expression for conservation of energy of a control volume applying first law of thermodynamics. Apply it for steady flow devices: turbine, nozzle and throttling valve with appropriate assumptions. [4]

b. Air flows at a rate of 1.2 kg/s through a compressor, entering at 100 kPa, 25°C, with a velocity of 60 m/s and leaving at 500 kPa, 150°C with a velocity of 120 m/s. Heat lost by the compressor to the surrounding is estimated to be 20 kJ/kg. Calculate the power required to drive the compressor and diameters of inlet and exhaust pipes. [5]

Q.N.5

a. If a window air conditioner were placed on a table in a room and operated, would the room temperature increase, decrease, or remain the same. Explain? [2]

b. Using first T'ds equation derive an expression for change in entropy for solids. [3]

c. 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 temperatures of 40°C and - 20°C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine refrigerator plant is 360 kJ. Evaluate the heat transfer to the refrigerant and the net heat transfer to the reservoir at 40°C. [6]

Q.N.6

a. Write down four most important air standard assumptions for analysis of air standard cycles. [4]

b. Superheated steam at 8 MPa and 500°C enters into turbine of a steam power plant working on a Rankine Cycle. The steam leaves the condenser as saturated liquid at 10 kPa. The turbine and compressor have isentropic efficiencies of 0.9 and 0.8 respectively. Determine [2+2+2]

i) net work per kg of steam
ii) heat supplied into the boiler per kg of steam
iii) thermal efficiency