

KATHMANDU UNIVERSITY
End Semester Examination
June/July, 2023

Marks Scored:

Level : B.E./B.Tech.

Course : MEEG 207

Year : II

Semester : II

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date 1: 0 JUL 2023

SECTION "A"

[20 Q. × 1 = 20 marks]

Mark [X] in the most appropriate option.

- Which one of the following is not an intensive property?
 volume temperature pressure density
- Which one is the open thermodynamic system?
 ice cream freezer centrifugal pump
 pressure cooker storage battery
- In a new temperature scale say $^{\circ}X$, the boiling and freezing points of water at one atmosphere are $100^{\circ}X$ and $300^{\circ}X$ respectively. The reading of $0^{\circ}X$ in centigrade scale is
 $0^{\circ}C$ $50^{\circ}C$ $100^{\circ}C$ $150^{\circ}C$
- Workdone in free expansion is
 positive negative zero maximum
- The locus of saturated liquid line and saturated vapour line meets at
 boiling point critical point ice point Triple point
- As differentials, heat and work would be described mathematically as
 inexact exact discontinuity point function
- The cyclic integral of $(\delta Q - \delta W)$ for a process is
 positive zero negative depends on process
- Which of the following refers to stored energy?
 heat work internal energy none
- According to Joule's experiment
 heat can be completely converted into work
 work can be completely converted into heat
 both heat and work are completely interchangeable
 all of the above
- Change in enthalpy in a closed system is equal to the heat transferred, if the reversible process takes place at constant
 temperature internal energy pressure entropy

11. Which one of the following gases will have maximum value of gas constant?
 Nitrogen Carbon dioxide Sulphur dioxide Oxygen
12. According to first law of thermodynamics
 Total internal energy of a system during a process remains constant
 Total energy of a system remains constant
 work done by a system is equal to the heat transferred by the system
 All of above
13. A heat engine is supplied with 250 KJ/s of heat at a constant fixed temperature of 227°C. The heat is rejected at 27°C. The cycle is reversible, if the amount of heat rejected is
 273 kJ/s 200 kJ/s 180 kJ/s 150 kJ/s
14. 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
15. A Carnot engine operates between 27°C and 327°C. If the engine produces 300 kJ of Work, What is the entropy change during heat addition?
 0.5 kJ/K 1 kJ/K 1.5 kJ/K 2 kJ/K
16. The gas turbine works on the principle of
 Rankine cycle Carnot Cycle Brayton Cycle Dual Cycle
17. Increase in entropy of a system represents
 increase in availability of energy increase in temperature
 decrease in pressure degradation of energy
18. Which one of the following statements is correct when saturation pressure of a vapour increases?
 saturation temperature decreases enthalpy of evaporation decreases
 enthalpy of evaporation increases specific volume change of phase increases
19. A fluid flowing along a pipe line undergoes a throttling process from 10 bar to 1 bar in passing through a partially open valve. Before throttling, the specific volume of the fluid is 0.5 m³ /kg and after throttling is 2.0 m³ /kg. What is the Change in specific internal energy during the throttling process?
 0 100 kJ/kg 200 kJ/kg 300 kJ/kg
20. Which of the following statements are **CORRECT**?
a. First law of thermodynamics deals with law of conservation of energy
b. A closed system does not exchange work and heat with its surroundings
c. Second law of thermodynamics deals with law of conservation of entropy
d. Perpetual machine of the first kind converts energy into equivalent work
 a and c are correct a, c and d are correct
 a and d are correct all are correct

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End Semester Examination
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10 JUL 2023

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

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

SECTION "B"
[5Q × 11 = 55 marks]

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

1.

- a. Water circulates between a storage tank and a solar collector. Heated water from the tank is used for domestic purposes. Considering the solar collector and storage tank as two separate systems, identify locations on the system boundary where these systems interact with surrounding and describe events that occur within the system. [5]

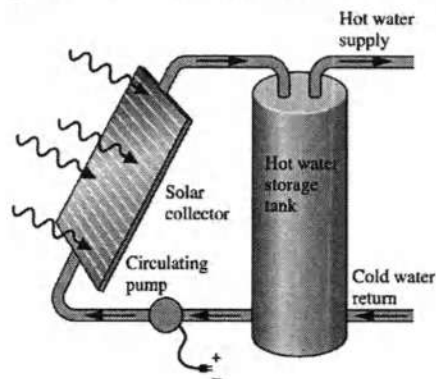


Figure 1

- b. A piston cylinder device restrained by a linear spring ($k = 2000 \text{ kN/m}$) shown in Figure 2 contains a gas initially at a pressure of 400 kPa and a volume of 0.05 m^3 . Initially, spring touches the piston but exerts no force on it. Heat is transferred to the system until its volume doubles. If the cross-sectional area of the piston is 0.4 m^2 , determine [2+2+2]
- the final pressure inside the cylinder,
 - the total work done by the gas, and
 - the fraction of total work done consumed for the compression of spring.

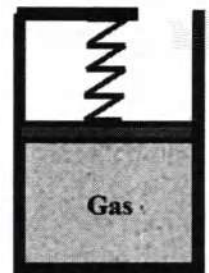


Figure 2

2.

- a. What is a pure substance? Derive a formula for calculating quality of a two-phase mixture. [2+3]
- b. Air is contained in a variable-load piston-cylinder device equipped with a paddle wheel. Initially, air is at 400 kPa and 17°C . The paddle wheel is turned by an external electric motor until 75 kJ/kg of work has been transferred to air. During this process, heat is transferred to maintain a constant air temperature while allowing the gas volume to triple. Calculate the required amount of heat transfer, in kJ/kg . [6]

- 3.
- a. Write down the two Carnot principles. Draw P-v and T-s diagrams for a Carnot cycle for heat engines and derive an expression for Carnot thermal efficiency. [5]
 - b. Steam enters an adiabatic turbine at 8 MPa and 500°C at a rate of 3 kg/s and leaves at 20 kPa. If the power output of the turbine is 2.5 MW, determine the temperature of the steam at the turbine exit. [6]
- 4.
- a. Describe with h-s diagrams, how you will calculate isentropic efficiency of turbines and pumps in terms of actual and ideal enthalpy changes. [5]
 - b. Steam expands in a fully insulated turbine steadily at a rate of 40,000 kg/h, entering at 8 MPa and 500°C and leaving at 40 kPa as saturated vapor. Determine the rate of entropy generation for this process. [6]
- 5.
- a. Write down five most important air standard assumptions for analysis of air-standard cycles. [5]
 - b. An air standard Otto Cycle has a compression ratio of 6, the lowest cycle pressure of 0.1 MPa and operates between temperature limits of 27°C and 1569°C. Calculate the temperature and pressure at each point in the cycle and thermal efficiency. [6]