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Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2024- 2025)

Subject: Engineering Thermodynamics

Time: 3 Hours Max. Marks: 100

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A 20

1. Attempt all parts:-

1-a. A closed thermodynamic system is one in which (CO1, K1) 1

(a) There is no energy or mass transfer across the boundary

(b) There is no mass transfer, but energy transfer exists

(c) There is no energy transfer, but mass transfer exists

(d) Both energy and mass transfer take place across the boundary, but the mass transfer is controlled by valves

1-b. Ice kept in a well insulated thermo flask is an example of which system? (CO1, K1) 1

(a) Open system

(b) Closed system

(c) Isolated system

(d) Non flow adiabetic system

1-c. Change in entropy is zero during (CO2, K1) 1

(a) Constant pressure process

(b) Constant volume process

(c) Constant temperature process

(d) Reversible adiabatic process

1-d. Which of the following can be considered as an application of entropy principle? (CO2, K1) 1

(a) transfer of heat through a finite temperature difference
(b) mixing of two fluids
(c) maximum temperature obtainable from two finite bodies
(d) All of the mentioned

1-e. At ideal condition of vapour power cycle, reversible constant pressure heat rejection is carried out at (CO3, K1) 1

(a) Boiler
(b) Turbine
(c) Condenser
(d) Feed pump

1-f. Which processes do the Rankine cycle contain? (CO3, K1) 1

(a) two isothermal and two isochoric processes
(b) two isentropic and two isobaric processes
(c) two isentropic and two isothermal processes
(d) two isothermal and two isobaric processes

1-g. Which of the following is a water tube boiler? (CO4, K1) 1

(a) Locomotive boiler
(b) Lancashire boiler
(c) Cornish boiler
(d) Babcock and wilcox boiler

1-h. The economiser is used in boilers to (CO4, K1) 1

(a) Increase thermal efficiency of boiler
(b) Economise on fuel
(c) Increase flue gas temperature
(d) Extract heat from the exhaust the gases

1-i. The governing principle of steam turbines are_____. (CO5, K1) 1

(a) Nozzle control governing
(b) Throttle governing
(c) Bypass governing
(d) All of the above

1-j. In a reaction turbine,when the degree of reaction is zero,then there is (CO5, K1) 1

(a) No heat drop in the moving blades
(b) No heat drop in the fixed blades
(c) Maximum heat drop in the moving blades
(d) Maximum heat drop in the fixed blade

2. Attempt all parts:-

2.a. Describe thermodynamic equilibrium of a system. (CO1, K2) 2

2.b. Define COP. State its SI unit. (CO2, K1) 2

2.c.	Why Rankine cycle is use instead of Carnot cycle for steam power plant? (CO3, K2)	2
2.d.	What is perfect intercooling in gas turbine? (CO4, K1)	2
2.e.	What is degree of reaction in turbines? (CO5, K1)	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	State the significance of Thermodynamic Equilibrium. Also state its types. Also state the significance of zeroth law of thermodynamics. (CO1, K2)	6
3-b.	Differentiate between open and closed system. State limitations of first law of thermodynamics. (CO1, K2)	6
3-c.	State the significance of heat engine. Determine the heat to be supplied to a Carnot engine operating between 400ºC and 15ºC and producing 200 kJ of work. (CO2, K3)	6
3-d.	Write short notes on the following: Heat reservoir, Heat engine, Heat pump and Refrigerator. (CO2, K2)	6
3.e.	Describe reheat cycle and compare it with simple Rankine cycle. (CO3, K3)	6
3.f.	What is the significance of a boiler? Differentiate between fire tube and water tube boilers. (CO4, K2)	6
3.g.	Determine the mass flow rate of steam through a nozzle having isentropic flow through it. Steam enters nozzle at 10 bar, 500oC and leaves at 6 bar. Cross-section area at exit of nozzle is 20 cm2, determine nozzle efficiency. Velocity of steam entering nozzle may be considered negligible. Show the process on h-s diagram also. (CO5, K3)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	State the significance of steady flow. Derive Steady flow energy equation. Also mention the assumptions. (CO1, K2)	10
4-b.	Differentiate between: (i) Reversible and irreversible process (ii) Intensive and Extensive properties (iii) Heat and Work (iv) Open and closed system. (CO1, K2)	10

5. Answer any one of the following:-

5-a.	State the significance of Claussius inequality. A heat engine is supplied with 278 kJ/s of heat at a constant fixed temperature of 283°C and the heat rejection takes place at 5°C. The following results were reported : (i) 208 kJ/s are rejected, (ii) 139 kJ/s are rejected, (ii) 70 kJ/s are rejected. Classify which of the results report a reversible cycle or irreversible cycle or impossible results. (CO2, K3)	10
5-b.	What is difference betwwen heat pump and refrigerator. 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. (CO2,	10

K3)

6. Answer any <u>one</u> of the following:-

6-a.	A steam power plant operates on a theoretical reheat cycle. Steam at boiler at 150 bar, 550°C expands through the high pressure turbine. It is reheated at a constant pressure of 40 bar to 550°C and expands through the low pressure turbine to a condenser at 0.1 bar. Draw T-s and h-s diagrams. Find : (i) Quality of steam at turbine exhaust ; (ii) Cycle efficiency ; (iii) Steam rate in kg/kWh. (CO3, K3)	10
6-b.	Discuss the effect of pressure of steam at inlet to turbine, temperature at inlet to turbine and pressure at exit from turbine upon Rankine cycle performance. Steam enters an engine at a pressure 10 bar absolute and 400°C. It is exhausted at 0.2 bar. The steam at exhaust is 0.9 dry. Find : (i) Drop in enthalpy ; (ii) Change in entropy. (CO3, K3)	10

7. Answer any <u>one</u> of the following:-

7-a.	Describe the significance and location of: i) Steam stop valve ii) Safety valve iii) Water level indicator iv) Steam trap v) Chimney. (CO4, K2)	10
7-b.	An ideal air-standard Brayton cycle operates at steady state with compressor inlet conditions of 300 K and 100 kPa and a fixed turbine inlet temperature of 1700 K. For the cycle, determine the net work developed per unit mass flowing, in kJ/kg, heat supplied and the thermal efficiency for a compressor pressure ratio of 8. Also draw T-s diagram. (CO4, K3)	10

8. Answer any <u>one</u> of the following:-

8-a.	Explain Pressure Compounded impulse turbine with neat sketch. Also state its advantages. (CO5, K3)	10
8-b.	State the significance of turbines. State all its classification. Differnentiate between impulse and reaction turbine with the help of diagram. (CO5, K3)	10