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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech.

SEM: III - LATERAL / LEFT OVER THEORY EXAMINATION (2021 - 2022) (ONLINE)

Subject: Basic Thermodynamics

Time: 02:00 Hours

Max. Marks: 100

**General Instructions:**

1. *All questions are compulsory. It comprises of two Sections A and B.*
- *Section A - Question No- 1 has 35 objective type questions carrying 2 marks each.*
- *Section B - Question No- 2 has 12 subjective type questions carrying 3 marks each. You have to attempt any 10 out of 12 question.*
- *No sheet should be left blank. Any written material after a Blank sheet will not be evaluated/checked.*

**SECTION A**

35 x 2 = 70

**1. Attempt ALL parts:-**

- |       |                                                                                                                                                                                                                                                                                                              |   |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 1.1.a | A closed thermodynamic system is one in which                                                                                                                                                                                                                                                                | 1 |
|       | (a) There is no energy or mass transfer across the boundary,<br>(b) There is no mass transfer, but energy transfer exists.<br>(c) There is no energy transfer, but mass transfer exists.<br>(d) Both energy and mass transfer take place across the boundary, but the mass transfer is controlled by valves. |   |
| 1.1.b | Thermodynamic work is the product of                                                                                                                                                                                                                                                                         | 1 |
|       | (a) Two intensive properties<br>(b) Two extensive properties<br>(c) An intensive property and change in an extensive property<br>(d) An extensive property and change in an intensive property                                                                                                               |   |
| 1.1.c | Work done by a system is taken to be                                                                                                                                                                                                                                                                         | 1 |
|       | (a) Zero<br>(b) Positive<br>(c) Negative<br>(d) Varies according to condition                                                                                                                                                                                                                                |   |
| 1.1.d | Constant pressure process is also known as                                                                                                                                                                                                                                                                   | 1 |
|       | (a) Isochoric process<br>(b) Isothermal process<br>(c) Isentropic process<br>(d) Isobaric process                                                                                                                                                                                                            |   |
| 1.1.e | By first law of thermodynamics,                                                                                                                                                                                                                                                                              | 1 |
|       | (a) $Q = \Delta E - W$<br>(b) $Q = -\Delta E - W$<br>(c) $Q = \Delta E + W$<br>(d) $Q = -\Delta E + W$                                                                                                                                                                                                       |   |
| 1.1.f | In a constant volume process, internal energy change is equal to                                                                                                                                                                                                                                             | 1 |
|       | (a) heat transferred<br>(b) work done                                                                                                                                                                                                                                                                        |   |

- (c) zero  
(d) maximum
- 1.1.g An isolated system is a special type of closed system that does not interact in any way with its surroundings. 1  
(a) True  
(b) False
- 1.2.a Two blocks which are at different states are brought into contact with each other and allowed to reach a final state of thermal equilibrium. The final temperature attained is specified by the 1  
(a) Zeroth Law of Thermodynamics  
(b) First Law of Thermodynamics  
(c) Second Law of Thermodynamics  
(d) Third law of thermodynamics
- 1.2.b The processes of a Carnot cycle are 1  
(a) two isothermals and two isentropics  
(b) two isobarics and two isentropics  
(c) two isothermals and two isobarics  
(d) two adiabatic and two constant volume
- 1.2.c In the differential form, the SFEE becomes 1  
(a)  $dQ + dW = dh + VdV + gdZ$   
(b)  $dQ - dW = dh + VdV + gdZ$   
(c)  $dQ + dW = dh - VdV - gdZ$   
(d)  $dQ - dW = dh - VdV + gdZ$
- 1.2.d The steady flow energy equation is applied to which of the following processes? 1  
(a) pipe line flows  
(b) heat transfer processes  
(c) combustion processes  
(d) all of the mentioned
- 1.2.e Carnot cycle is 1  
(a) a reversible cycle  
(b) an irreversible cycle  
(c) practical cycle  
(d) real cycle
- 1.2.f The low temperature reservoir of the heat reservoirs is known as 1  
(a) Source reservoir  
(b) Heel reservoir  
(c) Toe reservoir  
(d) Sink reservoir
- 1.2.g The first law of thermodynamics for steady flow accounts for all energy entering and leaving a control volume. 1  
(a) True  
(b) False
- 1.3.a Which of the following is the correct criteria for a spontaneous process? 1  
(a)  $\Delta S_{\text{system}} - \Delta S_{\text{surroundings}} > 0$   
(b)  $\Delta S_{\text{surroundings}} > 0$  only  
(c)  $\Delta S_{\text{system}} + \Delta S_{\text{surroundings}} > 0$   
(d)  $\Delta S_{\text{system}} > 0$  only

|       |                                                                                                                                                                                                                                                                                    |   |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 1.3.b | Higher the entropy increase of the universe then higher will be<br>(a) Irreversibility<br>(b) Reversibility<br>(c) Both a and b<br>(d) None of the mentioned                                                                                                                       | 1 |
| 1.3.c | Change in entropy is zero during<br>(a) Constant pressure process<br>(b) Constant volume process<br>(c) Constant temperature process<br>(d) Reversible adiabatic process                                                                                                           | 1 |
| 1.3.d | When system gains entropy from the surrounding, what will be the effect on the molecules of the system?<br>(a) molecular disorder increases<br>(b) molecular disorder decreases<br>(c) no change on molecular system<br>(d) none of the mentioned                                  | 1 |
| 1.3.e | Availability function for a closed system is given by<br>(a) $u - pv - Ts$<br>(b) $u + pv + Ts$<br>(c) $u - pv + Ts$<br>(d) $u + pv - Ts$                                                                                                                                          | 1 |
| 1.3.f | Third law of thermodynamics is helpful in<br>(a) Prediction of the extent of a chemical reaction<br>(b) Calculating absolute entropies of substances at different temperature<br>(c) Evaluating entropy changes of chemical reaction<br>(d) Both b and c                           | 1 |
| 1.3.g | The equation $dQ = TdS$ is true only for a irreversible process.<br>(a) True<br>(b) False                                                                                                                                                                                          | 1 |
| 1.4.a | Superheated vapour behaves<br>(a) Exactly as gas<br>(b) As steam<br>(c) As ordinary vapour<br>(d) Approximately as a gas                                                                                                                                                           | 1 |
| 1.4.b | In isentropic process<br>(a) $W = 2(u_2 - u_1)$<br>(b) $W = (u_2 - u_1)^2$<br>(c) $W = (u_2 - u_1)$<br>(d) $W = (u_2 - u_1) / 2$                                                                                                                                                   | 1 |
| 1.4.c | In Rankine cycle the work output from the turbine is given by<br>(a) change of internal energy between inlet and outlet<br>(b) change of enthalpy between inlet and outlet<br>(c) change of entropy between inlet and outlet<br>(d) change of temperature between inlet and outlet | 1 |
| 1.4.d | For water, as temperature increases, volume always increases.<br>(a) True                                                                                                                                                                                                          | 1 |

|       |                                                                                                                     |   |
|-------|---------------------------------------------------------------------------------------------------------------------|---|
|       | (b) False                                                                                                           |   |
| 1.4.e | The triple point is a line on the p-V diagram, where all the three phases, solid, liquid and gas exist.             | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.4.f | Saturation temperature is a function of pressure.                                                                   | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.4.g | In the Rankine cycle, working fluid is water only.                                                                  | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.5.a | For a given compression ratio the work output of Otto cycle is                                                      | 1 |
|       | (a) increases with increase in r                                                                                    |   |
|       | (b) decreases with increase in r                                                                                    |   |
|       | (c) is not affected                                                                                                 |   |
|       | (d) none of the above                                                                                               |   |
| 1.5.b | Clausius Clapeyron equation applies to the process                                                                  | 1 |
|       | (a) Sublimation                                                                                                     |   |
|       | (b) Melting                                                                                                         |   |
|       | (c) Vaporisation                                                                                                    |   |
|       | (d) All of the mentioned                                                                                            |   |
| 1.5.c | The intake and exhaust processes are not considered in the p-V diagram of Otto cycle.                               | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.5.d | In SI engines air-fuel mixture is compressed.                                                                       | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.5.e | In CI engines air-fuel mixture is compressed.                                                                       | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.5.f | When an ideal gas is made to undergo a Joule-Kelvin expansion, i.e., throttling, there is no change in temperature. | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |
| 1.5.g | $dU = TdS - pdV$                                                                                                    | 1 |
|       | (a) True                                                                                                            |   |
|       | (b) False                                                                                                           |   |

## SECTION B

10 X 3 = 30

2. Answer any TEN of the following:-

|       |                                        |   |
|-------|----------------------------------------|---|
| 2.1.a | What is PMM1?                          | 2 |
| 2.1.b | Why PMM1 is impossible?                | 2 |
| 2.2.a | Define COP. State its SI unit.         | 2 |
| 2.2.b | Explain the terms 'source' and 'sink'. | 2 |
| 2.2.c | Why PMM2 is impossible?                | 2 |
| 2.3.a | When does the system become dead?      | 2 |

|       |                                                                                 |   |
|-------|---------------------------------------------------------------------------------|---|
| 2.3.b | Define the second law efficiency.                                               | 2 |
| 2.3.c | Why and when is exergy completely destroyed?                                    | 2 |
| 2.4.a | Discuss different zones on T–V diagram for steam.                               | 2 |
| 2.4.b | What do you understand by " Quality of steam is 0.85"?                          | 2 |
| 2.5.a | What does the area enclosed by the cycle represent on a P-v diagram? Define it. | 2 |
| 2.5.b | Draw the p-V and T-s diagram of diesel cycle.                                   | 2 |