PAPER ID-310446

Subject Code: BME301

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM III) THEORY EXAMINATION 2025-26
THERMODYNAMICS

TIME: 3 HRS **M.MARKS: 70**

Note: Attempt all Sections. In case of any missing data; choose suitably.
Steam table& Mollier chart is allowed.

SECTION A

1. Attempt *all* questions in brief. **02 x 7 = 14**

Q no.	Question	CO	Level
Q no.	Question	1	Level
a.	Differentiate between macroscopic and microscopic viewpoints in thermodynamics.	1	K2
b.	State the Zeroth Law of Thermodynamics.	1	K2
c.	What is a PMM-I? Why is it impossible?	2	K3
d.	State the Kelvin-Planck statement of the Second Law.	2	K3
e.	Define Available Energy and Unavailable Energy.	4	K2
f.	Write down the two fundamental TdS equations.	3	K3

SECTION B

2. Attempt any *three* of the following: **07 x 3 = 21**

Q no.	Question	CO	Level
a	Define thermodynamics and the concept of a thermodynamic system. Differentiate between open, closed, and isolated systems.	1	K2
b	Derive the steady flow energy equation and apply it to a compressor and turbine.	2	K2
c	State the Kelvin-Planck and Clausius statements of the second law and establish their equivalence.	3	K2
d	Derive Maxwell's equations.	4	K2
e	Define saturated states, sub-cooled liquid, and superheated vapor state.	5	K2

SECTION C

3. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Define work and heat. Discuss the conventions used for sign assignment for both heat and work interactions.	1	K2
b.	A gas is compressed from an initial state of 100 kPa and 0.01 m^3 to a final state of 500 kPa and 0.002 m^3. The process follows the path $PV^{1.2}$ = constant. Calculate the shaft work done if the process is carried out in a piston-cylinder device.	1	K3

PAPER ID 310446

Subject Code: BME301

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM III) THEORY EXAMINATION 2025-26
THERMODYNAMICS

TIME: 3 HRS **M.MARKS: 70**

4. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Define Internal Energy and Enthalpy. Show that for an ideal gas, both internal energy and enthalpy are functions of temperature only.	2	K3
b.	Air enters a compressor at 1 bar, 300 K with negligible velocity and exits at 5 bar, 500 K with a velocity of 100 m/s. The mass flow rate is 0.5 kg/s. The power input to the compressor is 100 kW. Assuming air as an ideal gas with Cp = 1.005 kJ/kg K, determine the rate of heat transfer from the compressor.	2	K3

5. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	State the Carnot principle and prove its corollaries: (i) The efficiency of an irreversible heat engine is always less than the efficiency of a reversible one operating between the same two thermal reservoirs, and (ii) The efficiencies of all reversible heat engines operating between the same two thermal reservoirs are the same.	3	K3
b.	A heat pump is used to maintain a house at 25°C. The house is losing heat at a rate of 80,000 kJ/h to the outside air at 5°C. Determine the minimum power required to run the heat pump.	3	K3

6. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	10 kg of water at 100°C is mixed with 5 kg of water at 10°C in an insulated tank. Calculate the total entropy change for the process. Take Cp = 4.18 kJ/kg K.	4	K3
b.	Define Second Law Efficiency (II). Show that the Irreversibility(I) for a process is equal to the product of the reference temperature (T0) and the Entropy Generation (Sgen)..	4	K2

7. Attempt any *one* part of the following: **07 x 1 = 07**

Q no.	Question	CO	Level
a.	Derive the Maxwell Relations from the basic thermodynamic potentials (Helmholtz and Gibbs function).	5	K3
b.	Draw and explain the ideal Rankine cycle on both T-S and P-h diagrams. List the four basic components of the cycle and state the process that occurs in each component.	5	K3