PAPER ID-311593

Subject Code: KME301

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

BTECH
(SEM III) THEORY EXAMINATION 2023-24
THERMODYNAMICS

TIME: 3HRS **M.MARKS: 100**

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief.

Q no.	Question	Marks	CO
a.	Explain the following terms: (i) State, (ii) Process,	2	KME301.1
b.	How does a homogeneous system differ from a heterogeneous system?	2	KME301.1
c.	What do you mean by 'Clausius inequality'?	2	KME301.2
d.	What do you mean by the term 'Entropy'?	2	KME301.2
e.	Define the term 'availability'	2	KME301.3
f.	Define the co-efficient of Isothermal compressibility	2	KME301.3
g.	What is a triple point ?	2	KME301.4
h.	What is a pure substance ?	2	KME301.4
i.	State the advantages of simple Rankine cycle	2	KME301.5
j.	Explain the various operations of a Carnot cycle	2	KME301.5

SECTION B

2. Attempt any *three* of the following:

Q no.	Question	Marks	CO
a.	Define a thermodynamic system. Differentiate between open system, closed system, and isolated system.	10	KME301.1
b.	A fish-freezing plant requires 40 tons of refrigeration. The freezing temperature is – 35°C while the ambient temperature is 30°C. If the performance of the plant is 20% of the theoretical reversed Carnot cycle working within the same temperature limits, calculate the power required. Given: 1 ton of refrigeration = 210 kJ/min.	10	KME301.2
c.	Derive an expression for the decrease in available energy when heat is transferred through a finite temperature difference.	10	KME301.3
d.	What advantages are obtained if superheated steam is used in steam prime movers ?	10	KME301.4
e.	Explain the various operation of a Carnot cycle. Also represent it on a T-s and p-V diagrams	10	KME301.5

SECTION C

3. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	A system receives 50 kJ of heat while expanding with volume change of 0.14 m^3 against an atmosphere of 1.2×10^5 N/m^2. A mass of 90 kg in the surroundings is also lifted through a distance of 5.5 meters. (i) Find the change in energy of the system. (ii) The system is returned to its initial volume by an adiabatic process which requires 110 kJ of work. Find the change in energy of the system. (iii) For the combined processes of (i) and (ii) to determine the change in energy of the system.	10	KME301.1

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b.	Find the coefficient of performance and heat transfer rate in the condenser of a refrigerator in kJ/h which has a refrigeration capacity of 12000 kJ/h when power input is 0.75 kW.	10	KME301.1

4. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	An ice plant working on a reversed Carnot cycle heat pump produces 15 tonnes of ice per day. The ice is formed from water at 0°C and the formed ice is maintained at 0°C. The heat is rejected to the atmosphere at 25°C. The heat pump used to run the ice plant is coupled to a Carnot engine which absorbs heat from a source which is maintained at 220°C by burning liquid fuel of 44500 kJ/kg calorific value and rejects the heat to the atmosphere. Determine: (i) Power developed by the engine; (ii) Fuel consumed per hour. Take enthalpy of fusion of ice = 334.5 kJ/kg	10	KME301.2
b.	An iron cube at a temperature of 400°C is dropped into an insulated bath containing 10 kg water at 25°C. The water finally reaches a temperature of 50°C at a steady state. Given that the specific heat of water is equal to 4186 J/kg K. Find the entropy changes for the iron cube and the water. Is the process reversible? If so why?	10	KME301.2

5. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Air at the rate of 25 kg/min is compressed in a centrifugal air compressor from 1 bar to 2 bar. The temperature increases from 15°C to 100°C during compression. Determine the actual and minimum power required to run the compressor. The surrounding air temperature is 15°C. Neglect the heat interaction between the compressor and surroundings and changes in potential and kinetic energy. Take for air, cp = 1.005 kJ/kg K, R = 0.287 kJ/kg K.	10	KME301.3
b.	Derive the Maxwell relations and explain their importance in thermodynamics.	10	KME301.3

6. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	The air supplied to a room of a building in winter is to be at 17°C and have a relative humidity of 60%. If the barometric pressure is 1.01325 bar, find (i) The specific humidity; (ii) The dew point under these conditions.	10	KME301.4
b.	Define the following terms: (i) Saturated air (ii) Dry bulb temperature (iii) Dew point temperature (iv) Relative humidity	10	KME301.4

7. Attempt any *one* part of the following:

Q no.	Question	Marks	CO
a.	Explain with the help of neat diagram a 'Regenerative Cycle'. Derive also an expression for its thermal efficiency	10	KME301.5
b.	The adiabatic enthalpy drop across the prime mover of the Rankine cycle is 840 kJ/kg. The enthalpy of steam supplied is 2940 kJ/kg. If the back pressure is 0.1 bar, find the specific steam consumption and thermal efficiency.	10	KME301.5