Name:

Enrolment No:

UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

Supplementary Examination, January 2021

Course: Engineering Thermodynamics (MECH 2014) **Semester: III**
Program: B. Tech Mechatronics
Time: 3 Hours **Max. Marks: 100**

SECTION A

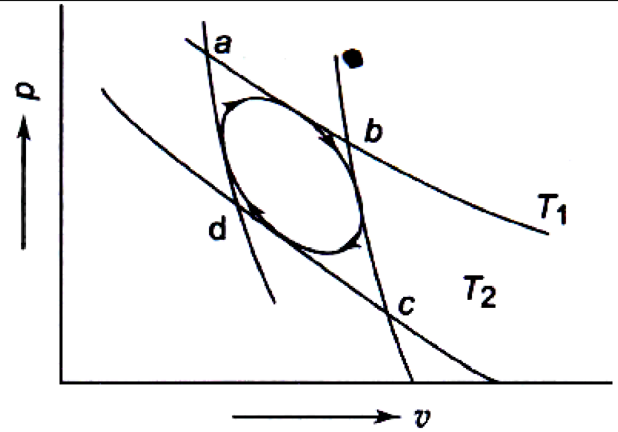
Note: For Q-1 to Q-6, Type the final answer only. Write precisely and to the point.

S. No.		**Marks**	**CO**
Q-1	Explain why the term “thermodynamics” is a misnomer?	**5**	**CO1**
Q-2	Differentiate between the microscopic and macroscopic approaches. Explain the concept of continuum.	**5**	**CO1**
Q-3	What do you understand by path function and point function? What are exact and inexact differentials? What is an indicator diagram?	**5**	**CO1**
Q-4	What do you understand by the entropy principle? When the system is at equilibrium why would any conceivable change in entropy be zero?	**5**	**CO1**
Q-5	Explain the term Mean Effective pressure. What is air standard efficiency?	**5**	**CO1**
Q-6	What is PMM1, PMM2, and PMM3? What guidelines does it prescribe for energy conversion?	**5**	**CO1**

SECTION B

Q-7	What is a steady flow process? Give the differential form of SFEE. How does Bernoulli equation compare with SFEE?	**10**	**CO2**
Q-8	A gas flows steadily through a rotary compressor. The gas enters the compressor at a temperature of 16 °C, a pressure of 100 kPa, and an enthalpy of 391.2 kJ/kg. The gas leaves the compressor at a temperature of 245°C, a pressure of 0.6 MPa, and an enthalpy of 534.5 kJ/kg. There is no heat transfer to or from the gas as it flows through the compressor. (a) Evaluate the external work done per unit mass of gas assuming the gas velocities at entry and exit to be negligible. (b) Evaluate the external work done per unit mass of gas when the gas velocity at entry is 80 m/s and that at exit is 160 m/s.	**10**	**CO2**
Q-9	An imaginary engine receives heat and does work on a slowly moving piston at such rates that the cycle of operation of 1 kg of working fluid can be represented as a circle	**10**	**CO2**

	10 cm in diameter on a p–v diagram on which 1 cm = 300 kPa and 1 cm = 0.1 m^3/kg. (a) How much work is done by each kg of working fluid for each cycle of operation? (b) The thermal efficiency of an engine is defined as the ratio of work done and heat input in a cycle. If the heat rejected by the engine in a cycle is 1000 kJ per kg of working fluid, what would be its thermal efficiency?		
Q-10	Evaluate the entropy change of the universe as a result of the following processes: (a) A copper block of 800 g mass and with *Cp* of 250 J/K at 150°C is placed in a lake at 8°C. (b) The same block, at 8°C, is dropped from a height of 100 m into the lake. (c) Two such blocks, at 150 and 0°C, are joined together.	**10**	**CO3**
Q-11	What do you understand by Air standard cycle? Find the air standard efficiencies for Otto cycle with a compression ratio of 6 using ideal gases having specific heat ratios 1.4, 1.5, and 1.67. Plot the results for efficiency and heat ratios. **OR** A heat engine receives reversibly 420 kJ/cycle of heat from a source at 327°C, and rejects heat reversibly to a sink at 27°C. There are no other heat transfers. For each of the three hypothetical amounts of heat rejected, in (a), (b), and (c) below, compute the cyclic integral of *dQ* /*T*. from these results show which case is irreversible, which reversible, and which impossible: (a) 210 kJ/cycle rejected; (b) 105 kJ/cycle rejected; (c) 315 kJ/cycle rejected	**10**	**CO2**
SECTION C			
Q 12	In the temperature range between 0°C and 100°C, a particular system maintained at constant volume has a heat capacity. $Cv = A + 2BT$ With *A* = 0.014 J/K and *B* = 4.2 × 10-4 J/K2 A heat reservoir at 0°C and a reversible work source are available. What is the maximum amount of work that can be transferred to the reversible work source as the system is cooled from 100°C to the temperature of the reservoir? **OR** In Figure, *abcd* represents a Carnot cycle bounded by two reversible adiabatic and two reversible isotherms at temperatures *T*1 and *T*2 (*T*1 >*T*2).	**20**	**CO3**

	 The oval figure is a reversible cycle, where heat is absorbed at temperature less than, or equal to, $T1$, and rejected at temperatures greater than, or equal to, $T2$. Prove that the efficiency of the oval cycle is less than that of the Carnot cycle.		