Name: **Enrolment No:**	UPES UNIVERSITY WITH A PURPOSE

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End term Examination, May/June 2021

Course: Mechanical Engineering **Semester: IV**
Program: BT /Civil **Time : 03 hrs.**
Course Code: MECH2028 **Max. Marks: 100**

Instructions:

SECTION A

S. No.		Marks	CO
Q 1	Define the terms: process, cycle, intensive and extensive properties.	**5**	**CO1**
Q 2	State the Perpetual Motion Machine of first and second kind and explain why it is not possible to make such kind of machine.	**5**	**CO1**
Q 3	Enlist the all five basic types of pdv-work with the equation.	**5**	**CO1**
Q4	Derive an expression of Air standard efficiency of Otto cycle with neat sketch on P-V and T-S diagram.	**5**	**CO2**
Q5	State (a) Carnot theorem, (b) Kelvin-Planck statement and (c) Clausius statement	**5**	**CO2**
Q6	Enlist four different types of temperature measurement system briefly.	**5**	**CO2**

SECTION B

Q 5	Show the triple point and critical point of water on (a) pressure-volume diagram with constant temperature line (b) enthalpy-entropy diagram with constant volume and pressure line and (c) volume-heat diagrams at atmospheric pressure. **OR** Ten grams of water at 20°C is converted into ice at –10°C at constant atmospheric pressure. Assuming the specific heat of liquid water to remain constant at 4.2 J/gK and that of ice to be half of this value, and taking the latent heat of fusion of ice at 0°C to be 335 J/g, calculate the total heat removed.	**10**	**CO3**
Q 6	A fluid system undergoes a non-flow frictionless process following the pressure volume relation as follows. $$P = \frac{5}{V} + 1.5$$ Where P is pressure in bar and V is the volume in m^3. Determine the final volume and pressure of the system. During the process the volume changes from $0.15 m^3$ to	**10**	**CO4**

	0.05 m^3 and the system rejects 45 KJ of heat to surroundings. Determine: (a) change in internal energy and (b) change in enthalpy.		
Q7	A gas expands from 0.2 m^3 to 0.4 m^3 isobarically at 50 bar and followed by polytropic expansion process n= 1.3 to a volume 0.8 m^3.After that at constant volume cools down to a lower pressure. Plot the process on PV diagram and find the total work done.	**10**	**CO3**
Q8	A reversible engine operates between temperatures T_1 and T ($T_1 > T$). A second reversible engine at the same temperature "T" receives the energy rejected from this engine. The second engine rejects energy at temperature T_2 ($T_2 < T$). Show that temperature T is the arithmetic mean of temperatures T_1 and T_2 if the engines produce the same amount of work output. **OR** It is given that temperature of the source and sink are equal to T_h and T_L. If the source and sink are finite i.e. as the heat engine operates the temperature of source fall and temperature of sink rises to an equilibrium temperature T_f. By the entropy principle prove that the T_f is an geometric mean of T_H and T_L.	**10**	**CO2**
Q9	Show the triple point and critical point of water on (a) pressure-volume diagram with constant temperature line (b) enthalpy-entropy diagram with constant volume and pressure line and (c) volume-heat diagrams at atmospheric pressure.	**10**	**CO2**
SECTION-C			
Q 10	A single cylinder engine with 0.25 liter swept volume and Compression Ratio =10, operates on a 4-stroke cycle. It is connected to a dynamometer, which gives a brake output torque reading of 15 N-m at 6000 rpm. The Air/Fuel=13, and mechanical efficiency of the engine is 98%. At the start of compression, the cylinder gas pressure is 100kPa, and temperature is 40°C. . Calculate (1) air consumption rate (kg/h); (2) fuel consumption rate (kg/h); (3) brake thermal efficiency; (Ideal gas constant, R=0.287kJ/kg-K, fuel calorific value (Q_{LHV}) =43000kJ/kg)	**20**	**CO4**