Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2018

Program: B Tech / PSE **Semester – V**

Subject : Fundamental of Thermodynamics **Max. Marks : 100**

Course Code: EPEG2006 **Duration : 3 Hrs**

No. of page/s: 3

Instructions:

SECTION A

S. No.		Marks	CO
Q 1	Define the Perpetual Motion Machine of Ist and IInd kind.	**4**	**CO1**
Q 2	State (a) 2nd law of thermodynamics, (b) Kelvin-Planck statement, (c) Clausius statement and (d) Source and sink reservoirs.	**4**	**CO1**
Q 3	Differentiate between the available and unavailable energy using Tds diagram for constant pressure expansion.	**4**	**CO2**
Q 4	Explain the working principle of four-stroke IC engine.	**4**	**CO2**
Q 5	Show the compressed liquid region, saturated liquid line, saturated vapour line and superheated region for water on pv-diagram.	**4**	**CO1**

SECTION B

Q 6	Two Carnot engines A and B are connected in series between two thermal reservoirs maintained at 1000 K and 100 K respectively. Engine A receives 1680 kJ of heat from the high-temperature reservoir and rejects heat to the Carnot engine B. Engine B takes in heat rejected by engine A and rejects heat to the low-temperature reservoir. If engines A and B have equal thermal efficiencies, determine	**10**	**CO2**

	(a) The heat rejected by engine B (b) The temperature at which heat is rejected by engine A.		
Q 7	Using an engine of 30% thermal efficiency to drive a refrigerator having a COP of 5, what is the heat input into the engine for each MJ removed from the cold body by the refrigerator?	**10**	**CO3**
Q 8	Ten gram 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 entropy change of the system. OR In a Carnot cycle, heat is supplied at 350°C and rejected at 27°C. The working fluid is water which, while receiving heat, evaporates from liquid at 350°C to steam at 350°C. The associated entropy change is 1.44 kJ/kg K. If the cycle operates on a stationary mass of 1 kg of water, how much is the work done per cycle, and how much is the heat supplied?	**10**	**CO3**
Q 9	Air at 300°C having mass 0.2 kg is heated reversibly at constant pressure to 2066 K. Find the available and unavailable energies of the heat added. Take T_0 = 30°C (ambient) and Cp = 1.0047 kJ/kg K.	**10**	**CO4**
	SECTION-C		
Q 10	In Otto cycle the volume varies between 0.03 and 0.06m^3, the maximum pressure is 0.2 MPa, and the temperature varies between 540°C and 270°C. The working fluid is air (an ideal gas). Find the efficiency and the work done per cycle for the simple cycle. OR	**20**	**CO4**

	An air standard limited pressure cycle has a compression ratio of 15 and compression begins at 0.1 MPa, 40°C. The maximum pressure is limited to 6 MPa and the heat added is 1.675 MJ/kg. Compute (a) the heat supplied at constant volume per kg of air, (b) the heat supplied at constant pressure per kg of air, (c) the work done per kg of air, (d) the cycle efficiency, (e) the temperature at the end of the constant volume heating process, (f) the cut-off ratio, and (g) the m.e.p. of the cycle.		
Q 11.	A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188°C, enthalpy 2785 kJ/kg, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, enthalpy 2512 kJ/kg, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?	**20**	**CO4**