Name:

Enrolment No:

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, Dec 2019

Course: Thermodynamics and phase behavior (MEPD2005) **Semester: III**
Program: APE UP
Time: 3 hrs. **Max. Marks: 100**

Instructions: answer all the questions. Internal choice is given.

SECTION A
Type the answer

S. No.		Marks	CO
Q 1	Explain the following terms: (a) Kelvin-Plank statement (b) Clausius statement , (c) Carnot theorem, (d) Clausius inequality and (e) Perpetual motion machine of second kind.	5	CO3
Q 2	How is the concept of entropy and unavailability energy related to each other	5	CO3
Q 3	Discuss the use of air standard cycle analysis for study of the I.C. engine.	5	CO6
	Type the answer with correct match (no partial marking) for Q4, 5, and 6		
Q 4	1.In spark ignition four stroke cycle engine cam shaft runs 2.Spark ignition engine 3.Compression ignition system 4.For maximum power of SI engine the fuel air ratio is 5. Ratio of break power to fuel energy input (a) Half the speed of crank shaft (b) Same speed of crank shaft (c) Petrol engine (d) Gas engine (e) Diesel engine (f) Lean (g) reach (h) Thermal efficiency (i) Relative efficiency	5	CO6
Q 5	1. A reverse Carnot cycle has COP equal to 4. The ratio of higher temperature to lower temperature 2. Reverse Carnot cycle assume all process 3. A Carnot refrigerator requires 70 KJ/min of work to produce 1 ton of refrigeration at -40 degree centigrade (a) 1.25 (b) 3 (c) non flow and steady flow (d) transient flow (e) 100 KJ/min (f) 70 kJ/min	5	CO2

	4. The COP of Carnot refrigerator is 3 and produce 1 ton of refrigeration. The work done is			
Q 6	1. Triple point of water 2. The specific volume of ice when heating from zero degree centigrade 3. At critical point of water 4. Throttling calorimeter used for measuring dryness fraction above	(a) solid vapor and liquid coexist (b) ice have maximum volume (c) increases steadily (d) increases and decreases (e) p= 231.2 bar (f) v= 0.00317 m3/kg (g) 0.98 (e) 0.62	**5**	**CO5**
	SECTION B **Upload pdf file**			
Q 7	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.		**10**	**CO1**
Q 8	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**	**CO4**
Q 9	0.2 kg of air at 300°C is heated reversibly at constant pressure to 2066 K. Find the available and unavailable energies of the heat added. Take T_0 = 30°C and Cp = 1.0047 kJ/kg K.		**10**	**CO6**
Q10	Prove that for an ideal gas $$S_2 - S_1 = C_p\, Log\left(\frac{V_2}{V_1}\right) + \; C_v\, Log(\frac{P_2}{P_1})$$ The terms have their usual meanings as 'S' is entropy, 'P' is pressure, 'V' is volume at thermodynamic state 1 and 2. Cp and Cv are the co-efficient at constant pressure and constant volume.		**10**	**CO2**

Q11	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 (a) The heat rejected by engine B (b) The temperature at which heat is rejected by engine A.	**10**	**CO3**
	SECTION-C **Upload pdf file**		
Q 12.	Two engines are operating on ideal Otto cycle and Diesel cycle for which the following information are available. Maximum temperature = 1277^0 C Exhaust temperature = 477^0 C Ambient condition = 0.1 MPa and 37^0C Air consumption = 2 kg/min Estimate (a) compression ratio (b) air standard efficiency (c) power output **OR**	**20**	**CO6**
	An eight cylinder four stroke petrol engine with bore and stroke of 10 cm each uses volatile fuel of composition C- 84%, H2-16 %. The throat diameter of choke tube is 40 mm. The volumetric efficiency at 3000 rpm is 0.75 referred to 0^o C and 1.013 bar, The pressure depression is 0.116 bar and the temperature at throat is 16^oC. if chemically correct air fuel ratio is supplied for combustion find (a) fuel consumption in kh/hr and (b) air velocity through tube. Assume R for 287 J/Kg ^{0}K for air and 971 J/Kg ^{0}K for fuel vapor		