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

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End semester Examination, DEC, 2021

Programme Name : B.Tech- ADE **Semester : III**
Course Name : Thermodynamics and Heat engine **Time : 02 hrs.**
Course Code : MEPD 2006 **Max. Marks: 100**
Nos. of page(s) :

Note:
1. The paper consists of 3 sections A, B and C.
2. For Section A, type your answers in the browser directly
3. For Sections B and C, scan and upload your answers.

Section A (Attempt All of the following)

Q1.	a. . The following cycle is used for air craft refrigeration (a) Brayton cycle (b) Joule cycle(c) Carnot cycle (d) Bell-Coleman cycle (e) Reversed-Brayton cycle b. A manufacturer claims to have a heat engine capable of developing 20 h.p. by receiving heat input of 400 kcal/mt and working between the temperature limits of 227° C and 27° C. His claim is (a) justified (b) not possible (c) may be possible with lot of sophistications (d) cost will be very high (e) theroretically possible c. Minimum work in compressor is possible when the value of adiabatic index n is equal to (a) 0.75 (b) 1 (c) 1.27 (d) 1.35 (e) 2 d. For same compression ratio and for same heat added (a) Otto cycle is more efficient than Diesel cycle (b) Diesel cycle is more efficient than Otto cycle (c) efficiency depends on other factors	**4**	**CO1**

	(d) both Otto and Diesel cycles are equally efficient (e) none of the above		
Q2.	In a cyclic process, heat transfers are + 14.7 kJ, – 25.2 kJ, – 3.56 kJ and +31.5 kJ. What is the network for this cyclic process?	**4**	**CO1**
Q3.	Discuss the conditions which must be fulfilled by a reversible process. Give some examples of ideal reversible processes.	**4**	**CO1**
Q4.	Explain the term “Quasi static process.”	**4**	**CO1**
Q5.	Elaborate the significance of characteristic gas constant.	**4**	**CO3**
	Section B(Attempt any four of the following)		
Q6.	A household refrigerator is maintained at a temperature of 2°C. Every time the door is opened, warm material is placed inside, introducing an average of 420 kJ, but making only a small change in the temperature of the refrigerator. The door is opened 20 times a day, and the refrigerator operates at 15% of the ideal COP. The cost of work is Rs. 2.50 per kWh. What is the monthly bill for this refrigerator? The atmosphere is at 30°C.	**10**	**CO3**
Q7	680 kg of fish at 5°C are to be frozen and stored at – 12°C. The specific heat of fish above freezing point is 3.182, and below freezing point is 1.717 kJ/kg K. The freezing point is – 2°C, and the latent heat of fusion is 234.5 kJ/kg. How much heat must be removed to cool the fish, and what per cent of this is latent heat?	**10**	**CO2**
Q8	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 cm in diameter on a p–v diagram on which 1 cm = 300 kPa and 1 cm = 0.1 m3/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? OR A heat pump is to be used to heat a house in winter and then reversed to cool the house in summer. The interior temperature is to be maintained at 20°C. Heat transfer through the walls and roof is estimated to be 0.525 kJ/s per degree temperature difference between the inside and outside. (a) If the outside temperature in winter is 5°C, what is the minimum power required to drive the heat pump? (b) If the power output is the same as in part (a), what is the maximum outer temperature for which the inside can be maintained at 20°C?	**10**	**CO3**
Q9	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.	**10**	**CO3**
	Section C(Attempt all of the following)		

Q10	Two engines are to operate on Otto and Diesel cycles with the following data: Maximum temperature 1400 K, exhaust temperature 700 K. State of air at the beginning of compression 0.1 MPa, 300 K. Estimate the compression ratios, the maximum pressures, efficiencies, and rate of work outputs (for 1 kg/min of air) of the respective cycles. OR Helium is used as the working fluid in an ideal Brayton cycle. Gas enters the compressor at 27°C and 20 bar and is discharged at 60 bar. The gas is heated to l000°C before entering the turbine. The cooler returns the hot turbine exhaust to the temperature of the compressor inlet. Determine: (a) the temperatures at the end of compression and expansion, (b) the heat supplied, the heat rejected and the net work per kg of He, and (c) the cycle efficiency and the heat rate. Take cp = 5.1926 kJ/kg K.	**20**	**CO4**
Q11	Calculate the amount of heat which enters or leaves 1 kg of steam initially at 0.5 MPa and 250°C, when it undergoes the following processes: (a) It is confined by a piston in a cylinder and is compressed to 1 MPa and 300°C as the piston does 200 kJ of work on the steam. (b) It passes in steady flow through a device and leaves at 1 MPa and 300°C while, per kg of steam flowing through it, a shaft puts in 200 kJ of work. Changes in K.E. and P.E. are negligible. (c) It flows into an evacuated rigid container from a large source which is maintained at the initial condition of the steam. Then 200 kJ of shaft work is transferred to the steam, so that its final condition is 1 MPa and 300°C.	**20**	**CO2**