Enrollment No:

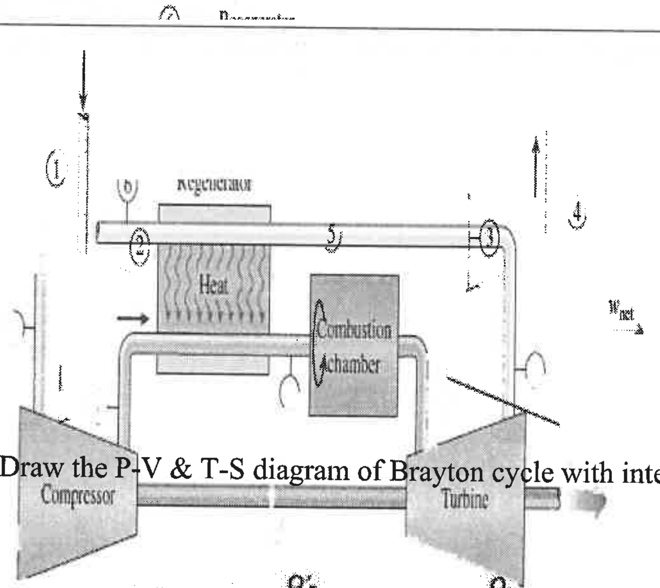
PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech Mid Semester Exam

Semester: 6th
Subject Code: (203120359)
Subject Name: (Pump and Compressor)

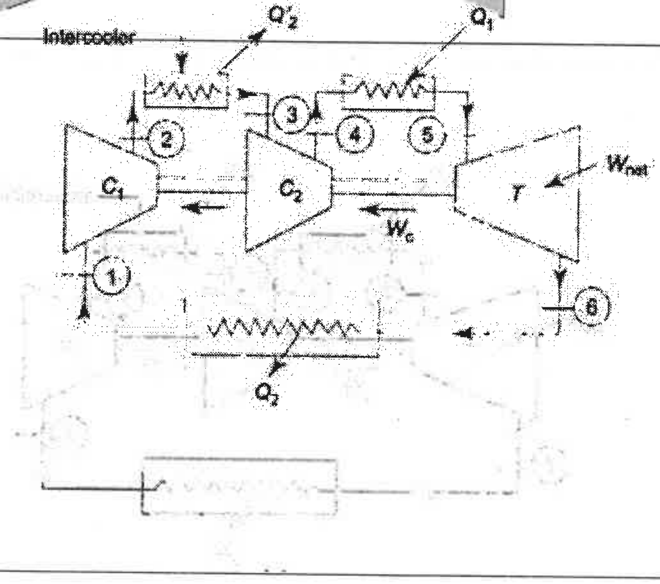
Date: (01/02/2024)
Time: ~~(1hr: 30min)~~
Total Marks: 40

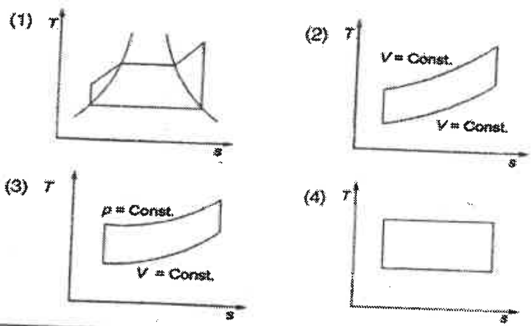
Sr. No.		Marks
~~Q.1~~	~~(A) Five One line Questions~~	~~05~~

1. Draw the P-V & T-S diagram of Brayton cycle with Regeneration



2. Draw the P-V & T-S diagram of Brayton cycle with intercooler



	3. The correct sequence of the given four cycles on T-s plane in Figure (1), (2), (3) (4) is (a) Rankine, Otto, Carnot and Diesel (b) Rankine, Otto, Diesel and Carnot (c) Otto, Rankine, Diesel and Carnot (d) Otto, Rankine, Carnot and Diesel 	
	4. The bore and stroke of the cylinder of a 6-cylinder engine working on an otto-cycle are 17 cm and 30 cm respectively, total clearance volume is 9225 cm3, then what is the compression ratio ----------------	
	5. In SI engines for higher thermal efficiency a) compression ratio should be high within the available limits b) Heat liberation during combustion should be maximum c) Surface to volume ratio should be high d) long flame travel distance	
	(B) Five Fill in the blanks	
	1. An Otto cycle has a compression ratio of 8. If 250 kJ of work is extracted from the cycle, the heat rejected by the cycle is-----------------	05
	2. Consider the following statements for the air- standard efficiency of Diesel cycle: 1) For the same compression ratio, the efficiency decreases with increasing cutoff ratios. 2) For the same compression ratio and same heat input, Diesel cycle is more efficient than Otto cycle. 3) For constant maximum pressure and constant heat input, Diesel cycle is more efficient than otto cycle Which of the above statements are correct? a) 1, 2 and 3 b) 1 and 2 only c) 1 and 3 only d) 2 and 3 only	

	3. What do mean by Isentropic efficiency of Turbine in Brayton cycle	
	4. An ideal Otto-cycle works between minimum and maximum temperatures of 300 K and 1800 K. What is the compression ratio of the cycle for maximum work output when y = 1.5 for this ideal gas__________	
	5. An IC engine has a bore and stroke each equal to 2 units. The total area to calculate heat loss from the engine can be taken as_______	
Q.2	Attempt any four (Short Questions)	12
	(1) Write down the comparison between Simple Brayton cycle (S.B.C) and Brayton cycle with intercool (B. C. I) with help of T-S and PV diagram, also comment on Efficiency	
	(2) An one-litre cubic capacity, four-stroke, four-cylinder SI engine has brake thermal efficiency of 30% and indicated power is 40 kW at full load. At half load, it has a mechanical efficiency of 65%. Assuming constant mechanical losses, calculate: (i) brake power (ii) frictional power (iii) mechanical efficiency at full load (iv) indicated thermal efficiency. If the volume decreases by eight-fold during the compression stroke, calculate the clearance volume	
	(3) A spark-ignition engine working on ideal Otto cycle has the compression ratio 6. The initial pressure and temperature of air are 1 bar and 37 °C. The maximum pressure in the cycle is 30 bar. For unit mass flow, calculate (i) p, V and T at various salient points of the cycle and (ii) the ratio of heat supplied to the heat rejected. Assume $\gamma = 1.4$ and R = 8.314 kJ/kmol K	
	(4) What is effect of pressure ratio on efficiency of Brayton cycle, optimum pressure ratio and W_{max}	
	(5) A gas turbine plant operates on the Brayton cycle between T_{min} = 300 K and T_{max} = 1073 K. Find the maximum work done per kg of air, and the corresponding cycle efficiency. How does this efficiency compare with the Carnot cycle efficiency operating between the same two temperatures	
Q.3	Attempt any two questions	08
	(1) Drive the efficiency of dual cycle in terms of cut-off ratio	
	(2) An air standard limited pressure cycle has a compression ratio of 15 and compression begins at 0.1 MPa, 104°F. 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.

(3) An oil engine working on the dual combustion cycle has a compression ratio 14 and the explosion ratio obtained from an indicator card is 1.4. If the cut-off occurs at 6 per cent of stroke, find the ideal efficiency. Take γ for air = 1.4

Q.4 (A) In a simple Brayton cycle, the pressure ratio is 8 and temperatures at the entrance of compressor and turbine are 300K and 1400K, respectively. Both compressor and gas turbine have isentropic efficiencies equal to 0.8. For the gas, assume a constant value of Cp, (specific heat at constant pressure) equal to 1kJ/kgK and ratio of specific heat as 1.4. Neglect changes in kinetic and potential energies. **05**

a) Power required by the compressor KJ/Kg of gas flow rate is

b) The thermal efficiency of cycle in percentage (%)

c) work ratio in percentage (%)

d) Back work Ratio

e) Specific air consumption (Kg/K-W-hr)

(B) When you compare Simple Brayton cycle Vs Regeneration, Intercooling and Reheat Brayton cycle. What is the effect of Regeneration, Intercooling and Reheat on efficiency, net work and work ratio (It will increase or decrease). **05**

Brayton cycle with ↓	Efficiency (η)	$W_{net.}$	Work Ratio
Regeneration			
Intercooling			
Reheat			
Regeneration + Intercooling			
Regeneration + Reheat			
Intercooling + Reheat			

OR

(B) A gas turbine unit receives air at 1 bar and 300 K and compresses it adiabatically to 6.2 bar. The compressor efficiency is 88%. The fuel has a heating valve of 44186 kJ/kg and the fuel-air ratio is 0.017 kJ/kg of air. The turbine internal efficiency is 90%. Calculate the work of turbine and compressor per kg of air compressed and thermal efficiency. For products of combustion, Cp = 1.147 kJ/kg K and γ = 1.333 **05**