Reg. No.															

Question Paper Code	12794

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2024

Fourth Semester

Mechanical Engineering

20MEPC404 - THERMAL ENGINEERING

Regulations - 2020

(Use of Steam Table, Refrigeration Table and Psychrometric chart is permitted)

Duration: 3 Hours Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Plot the Otto cycle on p-V and T-s diagrams.	2	K2	CO1
2.	List down the various processes of the Brayton cycle.	2	K1	CO1
3.	What are the main functions of steam nozzles?	2	K1	CO2
4.	Define degree of reaction.	2	K1	CO3
5.	What do you mean by perfect intercooling?	2	K1	CO4
6.	Mention the few applications of air compressors.	2	K1	CO4
7.	Compare SI and CI engines.	2	K2	CO5
8.	What are the different types of governing systems?	2	K1	CO5
9.	What are the properties of good refrigerants?	2	K1	CO6
10.	Name any two Psychrometric process & represent them on the Psychrometric chart.	2	K1	CO6

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

			Marks	K – Level	CO
11.	a)	In an Otto cycle air at 17° C and 1 bar is compressed adiabatically until the pressure is 15 bar. Heat is added at constant volume until the pressure rises to 40 bar. Calculate the air standard efficiency, compression ratio and mean effective pressure for the cycle. Cv = 0.717 kJ/kgK, Cp = 1.005 kJ/kgK and R = 8.314 kJ/kmol K.	13	K2	CO1
		OR			
	b)	Derive an expression for air standard efficiency for a Constant pressure Cycle.	13	K2	CO1
12.	a)	Dry saturated steam at a pressure of 7 bar enters a convergent divergent nozzle and leaves it at a pressure of 1.4 bar. If the flow is isentropic and if the corresponding expansion index is 1.3, find the ratio of cross-sectional area at exit and throat for maximum discharge.	13	K2	CO2
		OR			

b) Derive the expression of maximum mass flow rate when steam passes through steam nozzle. *13 K2 CO2*

13. a) Derive an expression for equation of work in terms of clearance factor in a single stage compressor with n as the index of expansion and compression. *13 K3 CO4*

OR

b) A single stage, double acting compressor has a free air delivery (F.A.D) of 14 m^3 /min measured at 1.013 bar and 15^o C. The pressure and temperature in cylinder during induction are 0.95 bar and 32^o C. The delivery pressure is 7 bar and index of compression and expansion, n=1.3. The clearance volume is 5% of the swept volume. Calculate: *13 K3 CO4*
1. Indicated power required.
2. Volumetric efficiency.

14. a) Explain the working principle of 4-stroke SI engine with neat sketch. *13 K2 CO5*

OR

b) Explain why cooling is necessary in IC engine with a neat sketch and describe the working of water cooling system used for multi cylinder engine. *13 K2 CO5*

15. a) A vapour compression refrigerator uses Methyl Chloride and operates between temperature limits -10°C and 45°C. At entry to the compressor, the refrigerant is dry saturated and after compression it acquires a temperature of 60°C. Find the COP of the refrigerator. The relevant properties of Methyl Chloride are as follows. *13 K3 CO6*

Saturation Temperature °C Enthalpy(kJ/kg)

Saturation Temperature °C	Enthalpy(kJ/kg)		Entropy(kJ/kg)	
	Liquid (h_f)	Vapour(h_g)	Liquid(S_f)	Vapour(S_g)
-10°C	45.4	460.7	0.183	1.637
45°C	133	483.6	0.485	1.587

OR

b) Describe the working principle of vapour absorption refrigeration system with neat layout sketch. *13 K2 CO6*

PART - C (1× 15 = 15 Marks)

16. a) Draw velocity diagram for impulse turbine and derive condition for maximum efficiency of an Impulse turbine. *15 K3 CO3*

OR

b) In De-lavel turbine, the steam enters the wheel through a nozzle with a velocity of 500 m/s and at an angle of 20^0 to the direction of the motion of the blade. The Blade speed is 200 m/s and the exit angle of the moving blood is 25^0. Find the inlet angle of the moving blade, exit velocity of steam and its direction and work done per kg of steam. *15 K3 CO3*