Q. Code: 567224

Reg. No. | | | | | | | | | | | | | |

B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Fourth Semester

ME18401 – THERMAL ENGINEERING

(Mechanical Engineering)

(Regulation 2018 / 2018A)

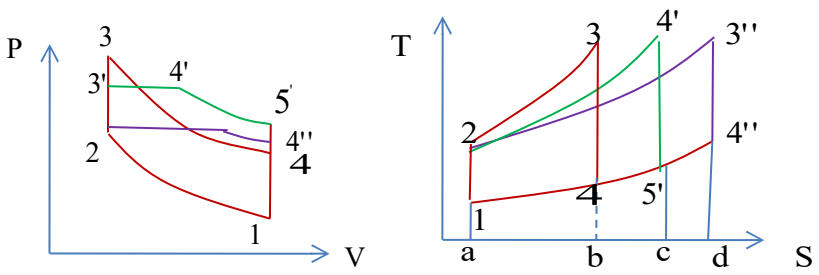
(Use of Steam table, Mollier chart and Psychometric chart is permitted)

TIME: 3 HOURS **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Student are able to compare and contrast the various system & components of IC engine and also to analyze their performance of air standard cycles.	**4**
CO 2	Student are able to understand the various system used in IC engine and also to analyze their performance.	**4**
CO 3	Students are able to distinguish the different types of nozzle, turbines and compressor and to analyze their performance.	**4**
CO 4	Students are able to distinguish the different types of air compressor and to analyze their performance.	**4**
CO 5	Students are able to analyze the performance of different air conditioning system and to design an air conditioning system for chosen application.	**4**

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	State the condition for an Otto Cycle to operate at its best.	**1**	**2**
2.	 Comments the above PV and TS diagram .	**1**	**3**
3.	Two stroke engines will have more cooling requirements compared with Four stroke engines. Why?	**2**	**3**
4.	What is the purpose of a thermostat in an engine cooling system?	**2**	**2**
5.	Mention the applications of nozzle.	**3**	**2**
6.	Identify the technique for adjusting the flow rate to keep the steam turbine running at a constant speed even when the load varies. Name its various types.	**3**	**3**
7.	Why clearance volume is necessary and explains its importance?	**4**	**3**
8.	Distinguish between a reciprocating air compressor and a rotary air compressor.	**4**	**3**

9.	Sketch p-h diagram for the vapor compression cycle when the vapor is super-heated after compression.	**5**	**2**	
10.	Define Room Sensible Heat Factor.	**5**	**2**	

PART- B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	A gas engine working on the Otto cycle has cylinder bore of 200 mm and stroke length of 250 mm. The clearance volume if 1570 cm^3. The pressure and Temperature at the beginning of compression are 1 bar and 27° C respectively. The maximum temperature of the cycle is 1400° C. Determine the pressure and temperature at the salient points. The air standard efficiency, the work done and mean effective pressure.	**(14)**	**1**	**3**
	(OR)			
(b)	In an air standard diesel cycle the compression ratio is 16. At the beginning of isentropic compression the temperature is 15^0 C and pressure of 0.1 Mpa. Heat is added until the temperature at the end of constant pressure process is 1480^0 C. Calculate (i). The cut-off ratio (ii). Heat added per kg of air (iii). Cycle efficiency (iv). M.E.P	**(14)**	**1**	**3**
12. (a)	Identify and explain the cooling system operating principle commonly used for multi cylinder heavy duty IC engines.	**(14)**	**2**	**3**
	(OR)			
(b)	The following observations were recorded in a test of one-hour duration on a single cylinder oil engine working on four stroke cycle. Bore = 300 mm Stroke = 450 mm Fuel used = 8.8 kg C.V. of fuel = 41800 kJ/kg Average speed = 200 rpm MEP = 5.8 bar Brake friction load = 1860 N Quantity of cooling water = 650 kg Temperature rise = 22°C Diameter of the brake wheel = 1.22 m Calculate (i) η_m, (ii) η_{BT} & (iii) draw heat balance sheet.	**(14)**	**2**	**3**
13. (a)	To get the maximum discharge from the nozzle, there is only one ratio. Discover its name and work out the formula.	**(14)**	**3**	**3**
	(OR)			
(b)	In a De level turbine steam issues from the nozzle with a velocity of 1200	**(14)**	**3**	**3**

m/s. The nozzle angle is 20^0. The mean blade velocity is 400 m/s and the inlet and out let angles of blades is equal. The mass of steam flowing through the turbine per hour is 1000 kg. Calculate (i). Blade angles, (ii). Relative velocity of steam entering the blades, (iii). Tangential force on the blades (iv). Power developed (v). Blade efficiency, Take blade velocity co-efficient as 0.8.

14. (a)	**(i)**	Drive an expression for volumetric efficiency of an air compressor and explain why it is less than unity.	**(7)**	**4**	**2**
	(ii)	With the help of pV diagrams, explain the working of a vane type compressor.	**(7)**	**4**	**2**

(OR)

(b)	A double acting compressor running at 210 rpm has a bore of 25 cm and a stroke of 36 cm. The inlet air is at 0.95 bar and 40°C. The volumetric efficiency of the compressor is 72 %. Determine the power required if the delivery is at 5 bar and the index of compression is 1.3. Also determine the delivery temperature and FAD in m^3/h referred to 1 bar 20°C.	**(14)**	**4**	**3**
15. (a)	What kind of vapor absorption refrigeration system is utilized in air conditioning units?	**(14)**	**5**	**3**

(OR)

(b)	An ammonia refrigerator produces 15 tonnes of Ice from and at 0° C in a dry. The temperature range of the working cycle is 25° C and -10° C. The ammonia vapour is dry and saturated at the end of compression. Assume actual C.O.P is 55% of theoretical. Calculate the power required to drive the compressor and mass flow rate in kg/min. Take latent heat of ice = 335 kJ/kg and Cp = 4.2 kJ/kg K	**(14)**	**5**	**3**

Temperature	Specific enthalpy		Specific entropy	
°C	Liquid kJ/kg	Vapor kJ/kg	Liquid kJ/kgK	Vapor kJ/kg K
25	380.74	1319.21	0.3473	4.4894
-10	-54.56	1304.99	-0.2134	5.0585

PART- C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	An office space is to be air conditioned for 60 people. The Outdoor conditions are Dry Bulb temperature is 30^0 C, Relative humidity is 60 %. The quantity of air supplied is 0.4 m^3/minute/person. Evaluate the following (a). Capacity of cooling coil in kW (b). Capacity of heating coil in kW (c). Amount of water vapor removed per hour. Assume inlet dry bulb temperature is 20^0 C and 60% RH. Air is conditioned first by cooling and dehumidifying and then by heating.	**(10)**	**5**	**3**

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