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Question Paper Code	12080

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B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

Fourth Semester

Mechanical Engineering

20MEPC404 - THERMAL ENGINEERING

(Regulations 2020)

(Use of Standard Steam Table, Mollier Chart, Compressibility Chart and Psychometric Chart are permitted)

Duration: 3 Hours | Max. Marks: 100

PART - A (10 × 2 = 20 Marks)

Answer ALL Questions

		Marks, K-Level, CO
1.	List the assumptions made for air standard cycle analysis.	*2,K1,CO1*
2.	In an engine working on an ideal Otto cycle, temperatures at the beginning at the end of compression are 27°C and 327°C respectively. Estimate the compression ratio and air standard efficiency of the engine.	*2,K2,CO1*
3.	State the relation between the velocity of steam and heat during any part of a steam nozzle.	*2,K1,CO2*
4.	Explain the need of compounding in steam turbine.	*2,K2,CO3*
5.	Define volumetric efficiency of an air compressor and write the expression for volumetric efficiency.	*2,K1,CO4*
6.	List effects of multi stage compression with inter cooling over single stage compression for the same pressure ratio.	*2,K1,CO4*
7.	Compare SI and CI engines.	*2,K2,CO5*
8.	Define 'mist' lubrication.	*2,K1,CO5*
9.	State ton of refrigeration.	*2,K1,CO6*
10.	Define RSHF and RTH.	*2,K1,CO6*

PART - B (5 × 13 = 65 Marks)

Answer ALL Questions

11.	a)	The minimum pressure and temperature in an Otto cycle are 100kPa and 27°C. The amount of heat added to air per cycle is 1500kJ/kg. Determine the pressures and temperatures at all points of the air standard Otto cycle. Also Estimate the specific work, Mean Effective Pressure and thermal efficiency of the cycle for the compression ratio of 8:1. Take for air C_v = 0.72 kJ/kgK and γ = 1.4.	*13,K2,CO1*
		OR	
	b)	Derive an expression for air the air standard efficiency and mean effective pressure of diesel cycle.	*13,K2,CO1*

12. a) Derive an expression for the critical pressure ratio of steam nozzles in terms of the index of expansion. *13,K2,CO2*

OR

b) 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*

13. a) A single stage single acting air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of suction stroke are 30°C and 1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of the swept volume. Assuming the index of compression and expansion to be 1.3, Compute the: *13,K3,CO4*

(i) Volumetric efficiency of the compressor.

(ii) Power required if the mechanical efficiency is 85% and speed of the compressor.

OR

b) With the help of schematic and PV diagrams, summarize the working of rotary screw compressor. *13,K3,CO4*

14. a) Summarize the Battery ignition system with a neat sketch. Discuss the Advantages and Disadvantages over magneto ignition system. *13,K3,CO5*

OR

b) Explain stages of combustion in SI engine with the help of P-theta diagram and discuss the effect of various Engine parameters on combustion. *13,K3,CO5*

15. a) Explain briefly simple vapour absorption system. Interpret the comparison between vapour compression system and vapour adsorption system. *13,K3,CO6*

OR

b) An air conditioning plant is to be designed for a small office for winter conditions with the following data: *13,K3,CO6*

Outdoor conditions = 10°C DBT and 8°C WBT

Required indoor conditions = 20°C DBT and 60% RH

Amount of air circulation = 0.3 m^3 /min/person

Seating capacity of the office = 50 persons

The required condition is achieved first by heating and then by adiabatic humidifying. Calculate:

(i) Heating capacity of the coil in kW and the surface temperature, if the by-pass factor of the coil is 0.32 ; and

(ii) Capacity of the humidifier.

PART - C (1 × 15 = 15 Marks)

16. a) Explain with a neat sketch of velocity compounding, pressure compounding, pressure-velocity compounding. *15,K3,CO3*

OR

b) In a De-Laval turbine steam issues from the nozzle with a velocity of 1200 m/s. The nozzle angle is 20°, the mean blade velocity is 400 m/s, and the inlet and outlet angels of blades are equal. The mass of steam flowing through the turbine per hour is 1000 kg. Estimate: *15,K3,CO3*

(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 as0.8.