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

B.E. / B.TECH. DEGREE EXAMINATION, MAY 2023

Fourth Semester

AE18401 - THERMAL ENGINEERING AND HEAT TRANSFER

(Regulations 2018A)

(Use of approved Heat and Mass Transfer Data book, Psychrometric table/chart and Steam table are permitted)

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

CO1 Analyze various energy transferring / transforming equipment using I law of thermodynamics.
CO2 Analyze various energy transforming equipment and Heat and Reversed heat engines using II law of thermodynamics.
CO3 Obtain different thermodynamic relations & equations for ideal and real gases from basics and to estimate the properties of gas mixtures.
CO4 Discuss the process of steam generation and analyze steam flow through nozzles and steam power cycles.
CO5 Analyze thermodynamically the refrigeration and refrigeration cycles.

PART - A (10 x 2 = 20 Marks)

(Answer all Questions)

		CO	RBT LEVEL
1.	Mean effective pressure is preferred to compare air standard cycles of reciprocating engines, but not rotary engines. Say true or false.	1	3
2.	Differentiate between the two-stage and double acting air compressors. In which compressor the intercooling is used?	1	3
3.	Differentiate between moist air and dry air. Write Dalton's law for moist air.	2	3
4.	Show humidification and adiabatic humidification process on Psychrometric chart.	2	2
5.	Why are fins provided on air cooled engines, but on liquid cooled engines?	3	3
6.	Differentiate between the steady state and transient heat transfer.	3	2
7.	What is Reynolds number? Give its maximum value for laminar flow over a flat plate.	4	2
8.	Define Nusselt number and what is its significance?	4	2
9.	What is shape factor? Define Radiosity and Irradiation. Write the radiation heat transfer equation in terms of radiosity and irradiation.	5	2
10.	Define effectiveness of heat exchanger. What is its significance?	5	2

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PART - B (5 x 14 = 70 Marks)

		Marks	CO	RBT LEVEL
11. (a)	A gas engine operating on the ideal Otto cycle has a compression ratio of 6:1. The pressure and temperature at the commencement of compression are 1 bar and 300 K. The heat added during the constant volume combustion process is 1170 kJ/kg. Determine the pressure and temperatures at the salient points, work output per kg of air and air standard efficiency. Assume Cv = 0.717 kJ/kgK and ratio of specific heats to be 1.4 for air.	(14)	1	3
	(OR)			
(b)	A single stage double acting compressor has a FAD of 14 m^3/min measured at 1 bar & 15ºC. The pressure & temperature during compression are 0.95 bar & 32ºC. The delivery pressure is 7 bar and index of compression is 1.3. The clearance volume is 5 % of the swept volume. Calculate indicated power and volumetric efficiency of the compressor.	(14)	1	3
12. (a)	For a hall to be air conditioned, the following conditions are given: Outdoor condition: 40ºC DBT, 20ºC WBT Required comfort condition: 20ºC DBT, 60% RH Seating capacity of hall = 1000 Amount of air supplied = 0.28 m^3/min per person If the required condition is achieved first by adiabatic humidification and then by cooling, estimate (a) capacity of the cooling coil in tones, and (b) the capacity of the humidifier.	(14)	2	3
	(OR)			
(b)	1 kg of saturated air from cabin at 20ºC is mixed adiabatically with the 2 kg of outside air at 35ºC and 50% RH before entering the automotive air conditioning system. Assuming adiabatic mixing condition at 1 atm determine specific humidity, relative humidity, and dry bulb temperature after mixing.	(14)	2	3
13. (a)	A steel pipe (k = 48 W/m-K) having a 50 mm OD is covered with a 42 mm thick layer of magnesia (k = 0.07W/m-K) which in turn covered with a 24 mm layer of fiberglass insulation (k = 0.048 W/m-K). The pipe wall outside temperature is 370 K and the outer surface temperature of the fiberglass is	(14)	3	3

305 K. What is the interfacial temperature between the magnesia and fiberglass? Also calculate the steady state heat transfer.

(OR)

		Marks	CO	RBT
(b)	A copper slab of 500 mm x 500 mm size with a thickness of 4 mm has a uniform temperature of 320ºC. Its temperature is suddenly lowered to 30ºC. Calculate the time required for the plate to reach the temperature of 100ºC. How the time is affected with change in the size of 400 mm x 400 mm with the same thickness? Take h = 90 W/m^2K	**(14)**	**3**	**3**
14. (a)	Explain the concept of thermal a boundary layer on a flat plate and discuss various regions with the help of suitable diagram. Also discuss the approach of determining heat transfer coefficient in the flow through tube bank.	**(14)**	**4**	**3**
	(OR)			
(b)	Air at 25ºC flows past a flat plate at 2.5 m/s. The plate measures 600 mm x 400 mm and is maintained at a uniform temperature of 95ºC. Calculate the heat loss from the plate if the air flows parallel to the 600 mm side. How would this heat loss be affected if the flow of air is made parallel to the 400 mm side?	**(14)**	**4**	**3**
15. (a)	Calculate the heat transfer rate per m^2 area between the surfaces of two long cylinders having radii 120 mm and 60 mm respectively. The small cylinder being in the larger cylinder, the axes of the cylinders are parallel to each other and separated by a distance of 25 mm. The surfaces of the inner and outer cylinders are maintained at 127ºC and 27ºC respectively. The emissivity of both surfaces is 0.4. Assume the medium between the two cylinders is non absorbing.	**(14)**	**5**	**4**
	(OR)			
(b)	Show the temperature distribution curves in parallel and counter flow heat exchangers and derive LMTD for a parallel flow heat exchanger.	**(14)**	**5**	**4**

PART - C (1 x 10 = 10 Marks)

(Q.No.16 is compulsory)

		Marks	CO	RBT LEVEL
16.	Discuss the heat transfer mechanism in automotive radiators and suggest relevant equations for designing air cooled radiators.	**(10)**	**5**	**4**

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