Q. Code: 351729

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

B.E. / B.TECH. DEGREE EXAMINATIONS, DEC 2019

Fifth Semester

AE16501 – APPLIED THERMODYNAMICS AND HEAT TRANSFER

(Automobile Engineering)

(Regulation 2016)

Time: Three Hours **Maximum : 100 Marks**

(Approved HMT Data Book is Permitted)

Answer **ALL** questions

PART A - (10 X 2 = 20 Marks)

		CO	RBT
1.	What is meant by air standard cycle?	1	U
2.	Define Compression ratio.	1	R
3.	What is meant by free air delivered?	2	R
4.	Name four important properties of a good refrigerant.	2	R
5.	State Fourier's law of heat conduction.	3	R
6.	Define Biot number.	3	R
7.	State Newton's law of cooling.	4	R
8.	Distinguish between laminar & turbulent flow.	4	U
9.	State Stefan Boltzmann law.	5	R
10.	What is LMTD?	5	R

PART B - (5 X16 = 80 Marks)

11.	(a)	An air standard Otto cycle has a compression ratio of 8. At the start of the compression process, the temperature is 26°C and the pressure is 1 bar. If the maximum temperature of the cycle is 1080°C, calculate a) the heat supplied / kg of air, b) the network done / kg of air and c) the thermal efficiency of the cycle.	**(16)**	1	AN

(OR)

(b) An amount of a perfect gas has initial condition of volume 1 m^3, pressure 1 bar and temperature 18°C. It undergoes ideal diesel cycle operations, the pressure after isentropic compression being 50 bar and the volume after constant pressure expansion be 0.1 m^3. Calculate the temperatures at the major points of the cycle and evaluate the thermal efficiency of the cycle. Assume $\gamma = 1.4$ for the gas. **(16) 1 AN**

12. (a) 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. **(16) 2 AN**

(OR)

(b) A vapour compression refrigerator works between the pressure limits of 60 bar and 25 bar. The working fluid is just dry at the end of compression and there is no under-cooling of the liquid before the expansion valve. Determine: 1. C.O.P. of the cycle; and 2. Capacity of the refrigerator if the fluid flow is at the rate of 5 kg/min. **(16) 2 AN**

Pressure (bar)	**Saturation temperature (K)**	**Enthalpy (kJ/kg)**		**Entropy (kJ/kg K)**	
		Liquid	**Vapour**	**Liquid**	**Vapour**
60	295	*151.96*	*293.29*	*0.554*	*1.0332*
25	*261*	*56.32*	*322.58*	*0.226*	*1.2464*

13. (a) Hot air at a temperature of 65˚C is flowing through a steel pipe of 120 mm diameter. The pipe is covered with two layers of different insulating materials of thickness 60 mm and 40 mm, and their corresponding thermal conductivities are 0.24 and 0.4 W/m˚C. The inside and outside heat transfer coefficients are 60 and 12 W/m^2˚C. The atmosphere is at 20˚C. Find the rate of heat loss from 60 m length of pipe. **(16) 3 AN**

(OR)

	(b)	Find out the amount of heat transferred through an iron fin of length 50 mm, width 100 mm and thickness 5 mm. Assume k = 210 kJ/mh°C and h = 42 kJ/m^{2}h°C for the material of the fin and the temperature at the base of the fin as 80°C. Also determine the temperature at tip of the fin, if the atmosphere temperature is 20°C.	**(16)**	**3**	**AN**
14.	(a)	A flat plate 1.0m wide and 1.0m long is placed in a wind tunnel. The temperature and velocity of free stream air are 10˚C and 80 m/s respectively. The flow over the whole length of the plate is made turbulent with the help of a turbulizing grid placed upstream of the plate. Determine the thickness of the boundary layer at the trailing edge of the plate. Also calculate the mean value of the heat transfer coefficient from the surface of the plate.	**(16)**	**4**	**AN**

(OR)

	(b)	Consider a square plate 0.5 m by 0.5 m with one surface insulated and the other surface maintained at a uniform temperature of 385 K which is placed in air at atmospheric pressure and 315 K. Calculate the average heat transfer coefficient for free convection for the following three orientations of the hot surface: a) The plate is horizontal, and the hot surface faces up, b) The plate is vertical, c) The plate is horizontal, and the hot surface faces down.	**(16)**	**4**	**AN**
15.	(a)	A pipe carrying steam having an outside diameter of 20 cm runs in a large room and is exposed to air at a temperature of 30˚C. The pipe surface temperature is 400˚C. Calculate the loss of heat to surroundings per metre length of pipe due to thermal radiation. The emissivity of the pipe surface is 0.8. What would be the loss of heat due to radiation if the pipe is enclosed in a 40 cm diameter brick conduit of emissivity 0.91?	**(16)**	**5**	**AN**

(OR)

(b) Hot oil with a capacity of 2500 W/K flows through a double pipe heat exchanger. It enters at 360°C and leaves at 300°C. Cold fluid enters at 30°C and leaves at 200°C. If the overall heat transfer coefficient is 800 W/m^2K, determine the heat exchanger area required for (i) parallel flow (ii) counter flow. **(16) 5 AN**