BT MRE–IV(R/S)–06–22–0762 Reg. No. | | | | | | | | |

B

B.Tech. Degree IV Semester Regular/Supplementary Examination in Marine Engineering June 2022

19-208-0402 THERMAL ENGINEERING AND HEAT TRANSFER

(2019 *Scheme*)

Time: 3 Hours Maximum Marks: 60

Course Outcome

On successful completion of the course, the students will be able to:

CO1: Understand the combustion of fuel gas turbine plant.
CO2: Calculate the work requirement for a given compression ratio.
CO3: Get an insight on conduction and apply it for optimizing the thickness of insulation.
CO4: Solve convective heat transfer problems and understand radiation heat transfer.
CO5: Attain information of parallel and counterflow heat exchangers and their design aspects.

Bloom's Taxonomy Levels (BL): L1 – Remember, L2 – Understand, L3 – Apply, L4 –Analyze, L5 – Evaluate, L6 – Create

PO – Programme Outcome

(5 × 15 =75)

			Marks	BL	CO	PO
I.	(a)	Explain the experimental determination of the calorific value of fuel by Bomb Calorimeter.	5	L2	1	1
	(b)	The volumetric composition of six sample gases fuel contain 50% H_2, 20% CH_4, 2% C_2H_4, 5% CO_2, 16% CO and 7% N_2. Determine	10	L3	1	2
	(i)	the molecular mass (apparent), the characteristics gas constant and the density of the mixture at S. T. P.				
	(ii)	the partial pressure of constituent gases, if the total pressure of the mixture is 1.01325 bar.				
		OR				
II.	(a)	Explain with neat sketch closed cycle gas turbine plant.	5	L1	1	1
	(b)	In a gas turbine plant, air is compressed from 1 bar and 15°C through a pressure ratio of 4:1. It is then heated to 650°C in a combustion chamber and expanded back to atmospheric pressure of 1 bar in a turbine. The isentropic efficiencies of the turbine and compressor are 85% and 80% respectively. If a perfect heat exchanger is used, calculate	10	L3	1	2
	(i)	The cycle efficiency				
	(ii)	The work ratio.				
III.	(a)	Explain various types of valves used in compressors.	5	L1	1	1
	(b)	Two single stage compressors work between the same pressure limits, the one having no clearance and the other having a definite clearance. Prove that, if they take in equal volumes, they will also discharge equal volumes and that the work done according to the indicator cards will be the same for both if n in $PV^n = C$ is same for all expansion and compression curves.	10	L4	2	2
		OR				
IV.	(a)	Explain with neat sketch single stage air compressor.	5	L1	1	1
	(b)	Determine the size of the cylinder for a double acting air compressor of 37 kW, in which air is drawn in at 1 bar and 15°C and compressed, according to the law $PV^{1.2}$ = constant, to 6 bar. The compressor runs at 100 r.p.m. with average piston speed of 152.5 m/min. Neglect clearance.	10	L4	1	2

(P.T.O.)

V.	(a)	Derive general heat conduction equation in cylindrical coordinates.	5	L1	3	1
	(b)	Determine the maximum current that a 1 mm diameter bare aluminium (k = 204 W/m K) wire can carry without exceeding a temperature of 200°C. The wire is suspended in air at temperature 25°C and h = 10 W/m^2 K. The electrical resistance of this wire per unit length is 0.037 Ω/m.	10	L3	3	2
		OR				
VI.	(a)	Derive general heat conduction equation in Cartesian coordinates.	5	L1	3	1
	(b)	A hollow sphere of inside radius 4 cm and outside radius 6 cm is electrically heated at the inner surface at a constant rate of 10^5 W/m^2. At the outer surface it dissipates heat by convection into a fluid at temperature 100°C and a heat transfer coefficient of 450 W/m^2K. The thermal conductivity of the solid is 20 W/m K. Calculate the inner and outer surface temperatures.	10	L3	3	2
VII.	(a)	State Newton's law of cooling and its applications.	5	L2	4	1
	(b)	A brick wall having an emissivity of 0.85 is 6 m wide and 4 m high. It is at a distance of 4 m from a 500 mm × 400 mm opening in a furnace of the wall. The center line of the opening lies 1 m lower and 1 m left of the center of the wall. The furnace temperature is 1500°C and that of the wall is 37°C. Calculate the rate of radiation heat transfer between the opening and the wall.	10	L4	4	2
		OR				
VIII.	(a)	Define Prandtl number and its significance.	5	L2	4	3
	(b)	Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500°C: (i) Monochromatic emissive power at 1.2μm length. (ii) Wavelength at which the emission is maximum. (iii) Maximum emissive power. (iv) Total emissive power. (v) Total emissive power of the furnace if it is assumed as a real surface with emissivity equal to 0.9.	10	L4	4	2
IX.	(a)	Compare the LMTD method and ε-NTU method.	5	L2	5	3
	(b)	Derive LMTD for parallel flow heat exchangers.	10	L2	5	3
		OR				
X.	(a)	Explain the significance of fouling factor.	5	L2	5	3
	(b)	Explain different type of heat exchangers.	10	L2	5	3

Bloom's Taxonomy Levels
L1=13.33%. L2=33.33%. L3=26.66%. L4=26.66%.

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