BT–MRE – IV – 05.16 –0811 Reg. No. | | | | | | | | |

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B.Tech. Degree IV Semester Examination in Marine Engineering May 2016

MRE 1402 THERMODYNAMICS AND HEAT TRANSFER

Time : 3 Hours Maximum Marks : 100

(5 × 20 = 100)

I. (a) State and explain Clausius and Kelvin Plank's versions of II[nd] law of Thermodynamics. (4)

(b) Explain Carnot cycle with PV and TS diagram. (4)

(c) Write notes on: (12)

(i) Entropy

(ii) Clausius inequality

(iii) Availability.

OR

II. (a) Define fuel. What are the approximate chemical composition of petrol and diesel? (4)

(b) Define equivalence ratio. Explain the effect of equivalence ratio variation on combustion process. (4)

(c) The percentage composition of coals from two different mines are given below: (12)

	C	H_2	O_2	S	N_2	Ash
Coal 1	90	3	2	1	2	2
Coal 2	65.5	6.65	17.5	1.8	Nil	8.55

Determine which coal is more suitable considering only the heat evolved by each type of coal.

III. (a) Explain Rankine's Cycle. (4)

(b) Explain binary vapour cycle and its effect on thermal efficiency. (4)

(c) Calculate the final velocity of steam issuing from a nozzle, if the pressure at the entry is 147 N/Cm^2. The steam is dry and saturated initially and expands up to 4.9 N/cm^2. (12)

OR

IV. (a) Explain pressure compounding and velocity compounding of turbines. (8)

(b) Steam with a velocity of 244 m/sec relative to blades enters an impulse moving row at an angle 30° . The tangential velocity of blades is 183 m/sec. The work developed in blades is estimated as 75 Kj/Kg of steam. (12)

Find (i) The blade efficiency and

(ii) The blade friction for relative velocities.

V. (a) Explain the working of compressed air motors. (4)

(b) What is tandem and in-line arrangement in compressors? (4)

(c) A single stage air compressor is required to compress 1.2 m^3 of air per minute from 1 bar and 15°C to 8 bar. Determine the temperature at the end of compression, I.P. and heat rejected if compression follows (i) adiabatic (ii) isothermal and polytropic $PV^{1.25}$. (12)

OR

(P.T.O.)

VI. (a) Discuss the significance of inter cooling upon the performance of multi stage compression. (8)

(b) A multi stage compressor has to be designed to supply air at 135 bar. While atmospheric condition is 1.03 bar and 15°C, the value of compression index may be assumed as 1.35. Due to practical reasons the intercoolers are not able to cool the air below 45°C. While the maximum temperature allowable in the system is 120°C, calculate the number of stages that are necessary in the compression and the rate of cooling water circulated per Kg of air (take Cp = 1 Kj/Kg C). (12)

VII. (a) Explain Fourier's law of heat conduction. (4)

(b) Explain the effect of insulation thickness on the heat transfer rate. (4)

(c) Hot air at 40°C is flowing through a steel pipe of 10 cm diameter. The pipe is covered with two layers of insulating materials of thickness 4 cm and 3 cm and their corresponding conductivities are 0.1 and 0.32 W/m-°C respectively. The inside and outside convective heat transfer coefficients are 50 and 10 W/m^2-°C. If the atmospheric temperature is 10°C, find the heat lost from 10 m length of pipe. Neglect the resistance of the pipe material. Also find the overall heat transfer coefficient based on the outer surface of the composite cylinder. (12)

OR

VIII. (a) Write notes on heat transfer though radiation. (8)

(b) Find the length of a double pipe heat exchanger required to transfer 32000 KJ of heat per hour from hot gas to cold air. The inside and outside diameter of the inside tube are 50 mm and 60 mm respectively. The air is heated from 50°C to 100°C where the hot gas temperature is reduced from 400°C to 150°C. The air side and gas side heat transfer coefficients are 100 and 160 W/m^2-°C respectively. Neglect the resistance and assume that the fluids flow parallel to each other. Air flows inside and gas flows through the annulas. (12)

IX. (a) Differentiate natural and forced connection. (4)

(b) What is meant by fouling factor? How does it affect the performance of heat exchanger? (8)

(c) Explain the working of a Marine Condensor. (8)

OR

X. Explain the following dimensionless numbers and its physical importance. (20)

(i) Prandtl No. (ii) Nusselt No. (iii) Reynolds No.

(iv) Stanton No. (v) Grashot No.

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