B.Tech. Degree IV Semester Supplementary Examination in Marine Engineering June 2023

MRE 1402 THERMODYNAMICS AND HEAT TRANSFER
(2013 *Scheme*)

Time: 3 Hours   Maximum Marks: 100

Answer *ALL* questions   (5 × 20 = 100)

I.   (a)   Differentiate between T-S diagram and H-S diagram. How it is used in steam and gas process?   (10)

    (b)   Explain the following: (10)

       (i)   Entropy

       (ii)   Carnot cycle.

OR

II.   (a)   What is a Fuel? What are the desirable qualities of a good fuel?   (10)

    (b)   Discuss the effect of Dissociation of fuel on IC engine.   (10)

III.   (a)   Explain Rankin's cycle.   (10)

    (b)   Sketch hypothetical indicator diagram of a modified Rankin's cycle of steam engine. Also write notes on mean effective pressure and work transfer.   (10)

OR

IV.   (a)   Differentiate between impulse and reaction turbines. Show simple sketch illustrating the working principle of both the turbines.   (10)

    (b)   Discuss the various aspects of flow through a nozzle, effect of friction, critical condition, super saturated flow etc., for one dimensional steady flow of compressibles fluid.   (10)

V.   (a)   Derive an expression for the work done in single stage air compressor. Also explain the working of a single stage compressor with the help of neat sketch.   (10)

    (b)   A single stage, single cylinder reciprocating air compressor has a piston displacement of 0.05 m^3. Air is sucked by the compressor at 1 bar and 17°C. The air after compression to 6 bar is delivered to the receiver at constant pressure.   (10)

Three alternatives of compression are:

      1.   Isentropic compression ($\gamma = 1.5$)

      2.   Polytrophic compression ($n = 1.3$)

      3.   Isothermal compression

Determine for each alternative:

      (i)   Temperature at the end of compression

      (ii)   Net work done on the air per cycle.

OR

VI.   (a)   Draw P-V diagram for two stage compressor with perfect inter cooling. Also explain its working.   (10)

    (b)   A two stage air compressor with complete inter cooling delivers air to the mains at a pressure of 30 bar, the suction conditions being 1 bar and 27°C. If both the cylinders have the same stroke, find the ratio of the cylinder diameters, for the efficiency of compression to be maximum, assume $n = 1.3$.   (10)

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VII. (a) Explain Fourier's law of heat conduction   (10)

      (b) A 30 cm thick wall of reactor is made up of an inner layer of fire brick   (10)
           (k_1 = 0.85 W/mK) covered with a layer of insulation (k_2 = 0.15 W/mK).
           The reactor operates at a temperature of 1600 K whilst the ambient
           temperature is 295 K. Calculate the thickness of fire brick and insulation
           which gives minimum heat loss. Also work out heat loss presuming that
           the insulating material has a maximum temperature of 1475 K if the
           calculated heat loss is unacceptable, would the addition of another layer of
           insulation be a satisfactory solution?

                                        OR

VIII. (a) Explain the terms absorptivity, reflectivity and transmissivity of radiant   (10)
           energy. Give a general equation that relates these terms.

      (b) It has been observed that when the Sun is overhead the earth's surface on a   (10)
           clear day, the radiation received by the Earth's surface is 1 kW/m^2 and an
           additional 0.3 kW/m^2 is absorbed by the Earth's atmosphere. Assuming the
           Sun to be a black body, determine the temperature of the Sun.

IX.   (a) Differentiate between mechanism of heat transfer by free and forced   (10)
           convection. Mention some of the areas where these mechanisms are
           predominant.

      (b) Explain any two non-dimensional numbers used in heat transfer, mention   (10)
           its physical importance

                                        OR

X.   (a) Write the area of application of heat transfer in the following: (10)
           (i)   Condensers
           (ii)   Evaporators.

      (b) Explain working of a Marine Heat exchanger with neat sketch.   (10)

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