B. Tech Degree III Semester Examination in Marine Engineering December 2011

MRE 303 THERMODYNAMICS AND HEAT TRANSFER

(All questions carry *EQUAL* marks)

Time : 3 Hours Maximum Marks : 100

I. (a) Prove that efficiency of an engine working as a reversible cycle is independent of nature or amount of working substance undergoing the cycle.

(b) A carnot engine does 0.27 KJ of work per cycle while receiving 0.64KJ of heat at 260°C. Determine (i) the temperature of the sink at which heat is rejected (ii) the thermal efficiency.

OR

II. (a) Define irreversibility. What are the causes of irreversibility and explain them?

(b) Which is the more effective way to increase the efficiency of a Carnot engine (i) to increase T_1, keeping T_2 constant (ii) to decrease T_2, keeping T_1 constant ($T_1 > T_2$)?

III. (a) Describe a Carnot power cycle for steam and explain difficulties for making it a practical engine.

(b) Determine the thermal efficiency, work ratio, specific steam consumption of a carnot cycle engine operating with a boiler pressure of 12MPa and a condenser pressure of 10KPa. Assume that the steam enters the boiler as saturated liquid and leaves as saturated vapour.

OR

IV. (a) Sketch the Rankine cycle on $p-v$, T-S and H-S diagrams for wet, dry and superheated steam.

(b) A turbine is supplied with steam at 50bar pressure and temperature of 350°C. The steam is expanded isentropically to a pressure of 0.07 bar. Find the dryness fraction at the end of expansion and cycle efficiency. If the steam is re-heated at 5 bar to the same temperature and then expanded to 0.07 bar, calculate the efficiency of the re-heat cycle.

V. (a) Explain the effect of friction on the performance of a steam nozzle. Explain the same on T-S and H-S diagram.

(b) Steam initially dry and saturated is expanded in a nozzle from 12 bar to 0.95 bar. If the frictional loss in the nozzle is 10% of the total heat drop, calculate the mass of steam discharged when exit diameter is 12mm.

OR

VI. (a) Explain velocity compounded impulse steam turbine showing pressure and velocity variations along the axis.

(b) In an impulse turbine, the steam issues from the nozzle with a velocity of 900m/s. Following data are also available (i) Nozzle angle – 25° (ii) Mean blade velocity – 400m/s. (iii) Mass flow rate – 1200 Kg/min. (iv) friction factor 0.9. Assuming that the blades are symmetrical, determine (i) blade angle (ii) blade efficiency (iii) power developed.

(P.T.O.)

VII. (a) Derive an expression for the heat transfer through a thick plane homogeneous wall with conductivity varying with temperature.

(b) The inner surface of a 250mm thick brick wall of a furnace is kept at 900°C and it is found that the outer surface is at 120°C. Calculate the heat loss per square metre of wall area given that conductivity is 0.765 W/mk.

OR

VIII. (a) Explain the concept of a black body. What is Stephan Boltzman law.

(b) A black surface, $0.35m^2$ in area is having a temperature of 800°C. Calculate the total rate of energy emission.

IX. (a) Derive an expression for the LMTD of a parallel flow heat exchanger.

(b) In a liquid heat exchanger fluid-A enters at 450°C and leaves at 250°C. Fluid B enters at 150°C and leaves at 200°C. Assuming overall coefficient of heat transfer constant, determine the LMTD for parallel and counter flow.

OR

X. (a) Explain with figures the shell and tube heat exchanger.

(b) Explain Reynold's Nusselt, Prandtl and Stanton numbers

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