BT – MRE – III – 12.12 – 039

B.Tech. Degree III Semester Examination in Marine Engineering December 2012

MRE 303 THERMODYNAMICS AND HEAT TRANSFER

Time : 3 Hours Maximum Marks : 100

I. (a) State Clausius statement and Kelvin Plank statement. Establish their equivalence. (10)

(b) Ultimate analysis of coal burnt in a boiler gave 84% C, 9% H, 7% incombustibles. Determine the mass of dry flue gases, if the Orsat analysis gave following results: CO_2 – 8.75%, O_2 – 8.00%, CO – 2.25%, N_2 – 81% (By difference). (10)

OR

II. Write notes on: (20)
(i) availability (ii) reversibility (iii) excess air (iv) dissociation and its effects.

III. (a) With the help of a diagram, explain a binary vapour cycle. (10)

(b) A steam turbine operating on Rankine cycle receives steam from boiler at 3.5 MPa and 300°C. It is exhausted to condenser at 10kPa. Calculate: (10)
(i) the energy supplied to the boiler per kg of steam generator
(ii) Rankine efficiency including pump work

OR

IV. Steam at 50 bar, 400°C expands in a Rankine engine to 0.34 bar. For 150kg/s of steam, determine: (i) the power developed (ii) thermal efficiency (iii) specific steam consumption for Rankine cycle and Rankine engine (20)

V. (a) Derive an expression for critical pressure ratio of steam passing through a nozzle. Neglect velocity of approach. (10)

(b) What is meant by super saturated flow? Represent it on PV and TS diagrams. (10)

OR

VI. Steam issues from the nozzle of a De Laval turbine with a velocity of 800m/s. Nozzle angle is 20°. Mean blade velocity is 300 m/s. Assuming symmetrical blades, neglecting friction and 100% efficient nozzle find: (i) blade angles (ii) axial thrust on rotor (iii) work done per kg of steam (iv) power developed. How the results will be modified when friction factor = 0.8, $\eta_{nozzle} = 0.95$. (20)

(P.T.O.)

VII. A steam pipe of 10cm outer dia is covered with two layers of insulating material each of 2.5cm thick, one having thermal conductivity thrice the other. Show that the effective conductivity of two layers is less, when better insulating material is inside than when it is on the outside. Determine the percentage reduction. (20)

OR

VIII. Write notes on: (4 x 5 = 20)

(i) Fouriers law of conduction
(ii) Stefans – Bottzmans law
(iii) Absorptivity, reflectivity
(iv) Transmissibility

IX. (a) Differentiate between condensor and evaporator. Sketch the variation of temperature in both cases. (10)

(b) Derive an expression for LMTD of a counterflow HX. (10)

OR

X. (a) Explain the significance of (10)

(i) Prandtl Number
(ii) Nusselt Number
(iii) Reynolds Number
(iv) Grashof Number

(b) Water flows in a tube that has 2.5cm outer dia and 2cm inner dia. If 10kg/minute of water at 200°C is flowing, calculate the heat transfer coefficient on the inside of tube. Assume forced convection. (10)

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