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Code No: 136EB

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, November/December - 2020

THERMAL ENGINEERING – II

(Mechanical Engineering)

Time: 2 hours **Max. Marks: 75**

Answer any five questions

All questions carry equal marks

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1.a) Describe the regenerative cycle with the help of neat sketch. Also represent the cycle on T-S diagram.

b) A steam power plant is to operate with a boiler pressure of 50 bar and a condenser pressure of 0.07 bar. The steam leaving the boiler is at a temperature of 350 ^{0}C. Determine the efficiency, specific steam consumption and work ratio of the Rankine cycle. [7+8]

2.a) Establish a condition for maximum discharge of flue gases through a chimney of given height.

b) Sketch and describe the working of Babcock and Wilcox water tube boiler. [7+8]

3.a) Derive an expression for maximum mass flow through a convergent-divergent nozzle when the steam is expanded isentropically from rest.

b) A group of convergent-divergent nozzles are supplied with steam at a pressure of 2 MN/m^2 and a temperature of 325 ^{0}C. Supersaturated expansion according to the law $PV^{1.3}$ = constant, occurs in the nozzle down to an exit pressure of 0.36 MN/m^2. Steam is supplied at the rate of 7.5 kg/s. Determine the required throat and exit areas. [7+8]

4.a) Derive the expression relating the critical pressure ratio to index of expansion n, for expansion in a nozzle.

b) Steam at 10 bar and 250^{0}C is expanded in a nozzle to a pressure of 2 bar. The area at exit is 2 cm^2 and inlet velocity is negligible. Calculate the mass flow rate, if phase equilibrium is assumed throughout the expansion and if steam is assumed to be supersaturated. [7+8]

5. A simple impulse turbine has one ring of moving blades running at 150 m/s, absolute velocity of steam at exit is 85 m/s at an angle 80^0 with the tangent of wheel, friction coefficient is 0.82, rate of steam flowing 2 Kg/s. Assuming the moving blades to be a symmetrical, find the a) Blade angles b) Nozzle angle c) absolute velocity of steam at entrance and d) power developed. [15]

6. At a particular stage of Parson's reaction turbine the mean blade speed is 60 m/s and the steam pressure is 3.5 bar with a temperature of 175 ^{0}C. The identical fixed and moving blades have inlet angles of 30^0 and outlet angles of 20^0. Determine a) power developed by the stage, b) the blade height if it is 1/10th of the blade ring diameter for a flow rate of 810 kg/min, and c) the specific enthalpy drop if the stage efficiency is 85%. [5+5+5]

7.a) Explain the operation of central flow surface condenser with the help of neat sketch.

b) The following readings were taken during a test on a surface condenser: Mean condenser temperature = 35 ^{0}C, Hot well temperature = 30 ^{0}C, condenser vacuum = 69 cm of Hg, barometer reading 76 cm of Hg. Condensate collected 16 kg/min, cooling water enters at 20 ^{0}C and leaves at 32.5 ^{0}C, flow rate being 37,500 kg/h. Calculate i) mass of air present per cubic metre of condenser, ii) quality of steam at condenser inlet. [7+8]

8.a) Describe the operation of turbojet engine with a neat sketch and explain its thermodynamic cycle.

b) Derive expression for the trust and propulsion efficiency of rocket and compare with those of turbojet. [7+8]

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