Code No: 155DG

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year I Semester Examinations, September - 2021
THERMAL ENGINEERING - II
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Answer any five questions
All questions carry equal marks

1.a) Explain the Regenerative cycle in detail with a neat sketch.
b) In a Rankine cycle, the steam at inlet to turbine is saturated at pressure of 30 bar and exhaust pressure is 0.25 bar. Determine (i) The pump work (ii) Turbine work (iii) Rankine efficiency (iv) Condenser heat flow (v) dryness at the end of expansion. Assume flow rate of 10 kg/s. [7+8]

2.a) Sketch and describe the operation of Babcock and Wilcox boiler and explain its limitations.
b) Derive an expression for maximum discharge rate of gases through the chimney for a given height of the chimney. [7+8]

3. During a test on steam nozzle steam impinges a stationary flat plate which is perpendicular to the direction of flow and the force on the plate is measured. The force is found to be 350 N when dry saturated steam at 8 bar is expanded to 1 bar. Throat cross-section area is 5 cm^2 and exit area is such that the complete expansion is achieved under these conditions. Determine the discharge at throat. [15]

4.a) What do you understand by nozzle? Discuss different types of nozzles.
b) A convergent-divergent nozzle is required to discharge 2 kg of steam per second. The nozzle is supplied with steam of 10 bar and 200 ^{0} C and discharge takes place against a back pressure of 0.34 bar. Estimate the throat and exit areas. Assume isentropic flow and take the index n = 1.3. If the nozzle efficiency is assumed to be 85%, determine the exit area. [7+8]

5.a) Why compounding is necessary in the impulse turbines? What are the types and explain any one type of compounding with neat sketch.
b) Sketch the velocity diagram of a single stage impulse turbine and determine the expression for the force, work done, diagram efficiency and axial thrust. [7+8]

6. A Parson's reaction turbine has mean diameter of blades as 1.6 m and rotor moving at 1500 rpm. The inlet and outlet angles are 80^0 and 20^0 respectively. Turbine receives steam at 12 bars, 200 ^{0}C and has isentropic heat drop of 26 kJ/kg. 5% of steam supplied is lost through leakage. Determine the following considering horse power developed in stage to be 600 hp.
a) The stage efficiency
b) The blade height. [8+7]

7.a) Explain working principle of Surface Condenser with neat sketch.

b) A surface condenser is designed to handle 10000 kg of steam per hour. The steam enters at 0.08 bar abs. and 0.9 dryness and the condensate leaves at the corresponding saturation temperature. The pressure is constant throughout the condenser. Estimate the cooling water flow per hour, if the cooling water temperature rise is limited to 10 ^{0}C. [8+7]

8.a) Derive the expressions of thrust and thrust power for jet engine.

b) A gas turbine unit receives air at 100kPa and 300K and compresses it adiabatically to 620kPa with efficiency of the compressor 88%. The fuel has a heating value of 44,180kJ/kg and the fuel/air ratio is 0.017kg fuel/kg air. The turbine internal efficiency is 90%. Calculate the compressor work, turbine work and thermal efficiency. [8+7]

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