CLASS: BTECH   SEMESTER : IV
BRANCH: MECHANICAL   SESSION : SP/2023

SUBJECT: ME209 ENERGY CONVERSION SYSTEMS

TIME: 3 Hours   FULL MARKS: 50

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. STEAM TABLE with MOLLIER CHART to be supplied to the candidates in the examination hall.

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Q.1(a) Evaluate the greatest allowable steam pressure at the turbine inlet and the Rankine   [5]   1   5
cycle efficiency for the given steam conditions: a steam temperature of 360°C at
turbine inlet, an exhaust pressure of 0.08 bar, expansion of steam in the turbine is
isentropic, and the moisture content at the turbine exhaust is 15%.

Q.1(b) In a steam power plant the condition of steam at inlet to the steam generator is 20 bar   [5]   1   5
and 300°C. The condenser pressure is 0.1 bar. Two feed water heaters operate at
optimum temperature. Evaluate: (i) quality of steam at the turbine exhaust, (ii) net
work per kg of steam, (iii) cycle efficiency, and (iv) the steam rate. Neglect pump work.

Q.2(a)   i.   Explain the procedure to estimate the heat loss due to incomplete combustion in   [5]   2   5
boiler unit.
         ii.   The ultimate analysis (by mass) of coal is C 78%; H2 3%; O2 3%; S 1%; ash 10%; and
moisture 5%. Excess air supplied is 30%. Evaluate actual mass of air to be supplied.

Q.2(b) Derive the condition for maximum discharge through the chimney and then express the   [5]   2   3
draught for maximum discharge.

Q.3(a) Explain with the help of relationship between area, velocity and pressure why the   [5]   3   2
nozzle is converging followed by diverging cross-sections.

Q.3(b) In a steam nozzle the inlet conditions are 10 bar and 200°C, the Back Pressure = 0.5   [5]   3   5
bar, and the throat diameter = 12mm. Evaluate the mass flow rate of steam in a nozzle.

Q.4(a) Derive the condition for maximum blade efficiency of impulse steam turbine   [5]   4   3

Q.4(b) The velocity of steam exiting the nozzle of impulse stage of a turbine is 400m/s. The   [5]   4   5
blades operate close to the maximum blading efficiency. The nozzle angle is 20°.
Considering equiangular blades and neglecting blade friction, evaluate the diagram
power and the diagram efficiency for the steam flow of 0.6kg/s.

Q.5(a) Explain the function of Steam Condenser. Draw the schematic diagram showing the   [5]   5   2
working of counterflow jet condenser.

Q.5(b) Compare with diagrams the Down flow Surface Condenser and Central Flow Surface   [5]   5   4
Condenser.