BE III Year Examination February 2022
Mechanical Engineering
MER6C4: Energy Conversion Systems

Duration: 1 Hrs. **Max. Marks : 20**

Q1. (a) Give the function of ***Boiler Chimney***. Derive an expression for the ***Maximum Discharge Rate*** of gases through the chimney for a given height 5

(b) A boiler house has natural draught of 20m height. Flue gases are at temperature of 380 ^{O}C and ambient temperature is 27 ^{O}C. ***Determine the Draught in mm of water column*** for maximum discharge through chimney and also the air supplied per kg of fuel burnt 5

Q2. (a) Draw Rankine Cycle on P-v, h-s and T-s Diagram. Derive the Expression for its Efficieney. 5

(b) Name the Principles of Increasing the Thermal Efficiency of Rankine Cycle . Explain the Effect of Increasing Pressure, Effect of Superheating and Effect of Back Pressure on the Efficiency of Rankine Cycle. 5

$$H_1 = H\left(\frac{m_a}{m_a+1}\frac{T_g}{T_a} - 1\right)$$

BE III Year Examination March 2022
Mechanical Engineering
MER6C4: Energy Conversion Systems

Duration: 70 mins. **Max. Marks : 20**

Note: Attempt all questions.

Q. 1 **(a)** Derive the Thermal Efficiency of Binary Cycle Plant **04**

(b) Explain and describe the any one method of Steam Turbine Governing **03**

(c) Explain any one method of Steam Turbine Compounding **03**

Q. 2 **(a)** Define Nozzle. Show that the Maximum Discharge per unit Area through the nozzle takes place when the ratio of the pressures is $\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ where n is the Adiabatic Expansion Index **06**

$$\frac{m}{A} = \sqrt{\frac{2n}{n-1}\frac{p_1}{v_1}\left(\left(\frac{p_2}{p_1}\right)^{2/n} - \left(\frac{p_2}{p_1}\right)^{\frac{n+1}{n}}\right)}$$

(b) In a Steam Nozzle, the steam expands from 3 bar to 0.1 bar. The initial velocity is 90m/s and initial temperature is 150 ^{o}C. The Nozzle Efficiency is 0.95. Determine its Exit velocity **04**

$$\frac{m}{A} = \sqrt{\frac{2n}{n-1}\frac{p_1}{v_1}\left(\left(\frac{p_2}{p_1}\right)^{2/n} - \left(\frac{p_2}{p_1}\right)^{\frac{n+1}{n}}\right)}$$

$= 251.4 + 0.864 \times 2358.3$

$h_2 = 2288.971 \text{ kJ/kg}$

$\Delta h_{34} = v_3 \times \Delta P_{34}$

$= 0.00107 \times \frac{70 - 0.2}{10^5} \times 10^5$

$= 7.099$

$h_4 = h_3 + \Delta h_{34} = h_{f@0.2} + \Delta h_{34}$

$= 251.4 + 7.099 = 258.49$

Rankine cycle - η Quality, $h_1 = 3530.9 \text{ kJ/kg}$, $S_1 = 6.986$

$S_1 = S_2 = 6.986$

$S_2 = S_{f@0.2} + x_2 S_{fg0.2}$

$6.986 = 0.8320 + x_2 7.0766$

$x_2 = 0.864$

$h_2 = h_f + x_2 h_{fg}$

$h_2 = 251.4 + 0.864 \times 2358.3$

$h_2 = 2288.971 \text{ kJ/kg}$

BE III YEAR MECHANICAL ENGINEERING

CLASS TEST III, APRIL 2022

Energy Conversion System -MER 6C4

Duration: 70 Min **Marks: 20**

Q1	Draw and Explain in short the elements of a water cooled condensing unit	05
Q2	Explain and describe any surface condenser	03
Q3	Derive the equation of mass of water to be circulated in a steam condenser	08
Q4	Explain the Range, Approach and Cooling Efficiency of cooling tower	04

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BE III Year Examination May 2022
Mechanical Engineering
MER6C4: Energy Conversion Systems

Duration: 3 Hrs. **Max. Marks : 60**

Note: *Every Question has three parts (a), (b) and (c). Attempt any two parts from every question. All questions carry equal marks. Any assumptions made answering the questions, should be stated. Use of Steam Table and Mollier Chart is allowed.*

Q. 1 **(a)** Explain the Degree of reaction in case of turbine and explain following losses in turbine (i) Regulating valve losses (ii) losses in nozzles. (iii) Disc friction losses (iv) blade windage losses **06**

(b) The mean diameter of the blades of an impulse turbine with a single row wheel is105 cm. and the speed is 3000 rpm. The nozzle angle is 18°, the ratio of blade speed to steam speed is 0.42, and the ratio of the relative velocity at outlet from the blades to that at inlet is 0.84. The outlet angle of the blade is to be made 3° less than the inlet angle. The steam flow is 8 kg/sec. Draw the velocity diagram for the blades and calculate the following. **06**
(i) Resultant thrust on the blades. (ii) Tangential thrust on the blades (iii) axial thrust on the blades (iv) power developed in blades (v) Blading efficiency

(c) A steam turbine of the de Lavel type receives steam at a pressure of 10 bar, dry and saturated and exhausts it at 1 bar. There are four nozzles, each of which is inclined at 20° to the plane of the wheel. The average peripheral speed of the blades is 450 m/s. Obtain the best angles for the blades, assuming that the inlet and outlet angles are the same. . What is the approximate power developed if the area at the throat of each nozzles is 0.24 cm^2. Assume isentropic expansion through nozzle. (For drawing velocity triangle use graphical method, use bigger scale for larger diagram). **06**

Q. 2 **(a)** 'An Efficient Power Plant need not to be essentially Economic". Comment upon the validity of the statement and List the factors essential for the Power Plant Economics **06**

(b) Steam enters a turbine at 60 bar and 600°C. Steam is bled off at 7 bar for regenerative feed heating and remaining steam is condensed in condenser to condenser temperature 30°C .Calculate (i) Amount of bled steam (ii) Cycle network (iii) Ideal thermal efficiency of cycle. For an ideal turbine and with same states, Calculate (iv) Ideal turbine work,(v) Ideal efficiency (vi) Steam rate in kW/kWh **06**

(c) A steam turbine plant is supplied with steam at pressure 17 bar and superheated to 100°C. The exhaust pressure is 0.06 bar. The temperature of the condensate in the hot well is actually 33°C. if the measured steam condensate is 5 kg /kWh and if the generator efficiency is 96%, calculate the absolute thermal efficiency of whole boiler and turbine plant **06**

Q. 3 **(a)** Define the terms Equivalent Evaporation and, Evaporative Capacity of a Boiler. How they are expressed. Derive the expressions for calculating Boiler Efficiency when the steam is (i) Wet (ii) Dry Saturated and (iii) Superheated . **06**

Jai Mata Di
Jai Mata Di (12)

BE III YEAR MECHANICAL ENGINEERING

CLASS TEST III, APRIL 2022

Energy Conversion System -MER 6C4

Duration: 70 Min **Marks: 20**

Q1 Draw and Explain in short the elements of a water cooled condensing unit	05
Q2 Explain and describe any surface condenser	03
Q3 Derive the equation of mass of water to be circulated in a steam condenser	08
Q4 Explain the Range, Approach and Cooling Efficiency of cooling tower	04

BE III YEAR - MECHANICAL ENGINEERING
MER6C4- ENERGY CONVERSION SYSTEM
CLASS TEST- I, Date 06/02/2019

DURATION: 70 MIN. **MAX.MARKS: 20**

Q1 Draw the flow diagram for a steam power plant and make a first law analysis for main components to find thermal efficiency. **06**

Q2 Explain the ways and their effects for increasing thermal efficiency of Rankine cycle based power plant. **06**

Q3 What are the limitations of vapour carnot cycle. **03**

Q4 what do you mean by equivalent evaporation of boiler and explain the boiler trial **05**

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BE III Year - Mechanical Engineering
CLASS TEST- II, March 2019
MER6C4, ENERGY CONVERSION SYSTEM

DURATION: 70 MIN. MAX.MARKS: 20

Q1 what are the characteristics of working fluid in rankine cycle and what is necessity of binary vapour cycle. Derive efficiency of binary (Hg- water vapour) cycle for power plant (4)

Q2 A Steam power plant equipped with regenerative as well as reheat arrangement is supplied with steam to the HP turbine at 80 bar and 470°C. For feed heating, a part of steam is extracted at 7 bar and the remaining steam is reheated to 350°C in a reheater and then expanded in LP turbine down to 0.035 bar. Calculate 1.amount of steam bled off for feed heating 2. Amount of steam in LP turbine 3. Heat supplied in boiler and reheater 4. Output of turbine 5. Cycle efficiency (6)

Q3 Classify steam turbine on basis of principle of operation and direction of flow and describe these (5)

Q4 Explain pressure and velocity compounding of Impulse steam turbine (5)

BE III Year Examination April 2019
Mechanical Engineering
MER6C4: Energy Conversion Systems

Duration: 1 Hrs. **Max Merks:20**

Q1 Define ***Nozzle***. Show that the ***Maximum Discharge per unit Area*** through the nozzle takes place when the ratio of the pressures is $\left(\frac{2}{n+1}\right)^{\frac{n}{n-1}}$ where n is the ***Adiabatic*** **07**

Q2 What is the function of steam condenser explain with P-V and T-S diagram **03**

Q3 Describe in brief elements of water cooled condensing and cooling system **04**

Q4 In a ***Steam Nozzle***, the steam expands from 3 bar to 0.1 bar. The initial velocity is 90m/s and initial temperature is 150 ^{o}C. The ***Nozzle Efficiency*** is 0.95.Determine its ***Exit velocity***. **06**