[Total No. of Questions - 9] [Total No. of Printed Pages - 4]

Dec.-22-0246

ME-605 (Thermal Engineering)

B.Tech. 6th (CBCS)

Time : 3 Hours Max. Marks : 60

*The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.*

**Note :** Attempt Five Questions in all Sections. Selecting one question from each section A, B, C, D. Section E, Question 9 is compulsory. Assume the suitable value of any missing data. Use of steam tables is allowed.

## SECTION - A

1. (a) Sketch and describe the operation of Babcock and Wilcox boiler. (5)

   (b) Why boiler accessories are installed? Explain the operation of economiser with the help of simple diagram. (5)

OR

2. In a boiler the following observation made Pressure of steam=10 bar, steam condensed= 540kg/h, fuel used=65kg/h, moisture in fuels is 2% by mass, mass of dry flue gases 9kg/kg of fuel. Lower calorific value= 32000kJ/kg, Temperature of flue gases=325°C, temperature of boiler house=25°C, Feed water temperature=50°C, mean specific heat of gases= 1kJ/kg K, Dryness fraction of steam=0.95. Draw the heat balance sheet of boiler. (10)

## SECTION - B

3. (a) Show that the thermal efficiency of a regenerative cycle is always greater than that of a simple Rankine cycle regardless of where steam is tapped off. (4)



   (b) In an ideal Rankine cycle, the steam condition at turbine inlet is 20 bar and 350°C. The condenser pressure is 0.08 bar. Determine the cycle efficiency. If the steam flow rate is 2000kg/h, what is the power output in kW? (6)

OR

4. (a) 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°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. (6)

   (b) Derive the value of critical velocity in terms of sonic velocity at inlet conditions and index of expansion. (4)

## SECTION - C

5. (a) Draw the line diagram and explain pressure compounded impulse turbine. (4)

   (b) In a reaction turbine 6 kg/s steam is admitted at 15 bar dry saturated in the first stage. Turbine has eight pairs on mean diameter of 50 cm and run at 3000 rpm with mean blade speed to steam velocity ratio of 0.8. There occurs tip leakage of steam at all rows amounting to 10% of total and efficiency of working steam is 85%. Considering blade outlet angles for both fixed and moving blades to be 20°, determine the following analytically, i) The output from turbine in hp ii) The pressure of steam leaving turbine, iii) The mean blade height. (6)

OR

6. (a) What are the losses in steam turbines? (5)

(b) In a stage reaction turbine, the mean diameter of the rotor is 1.4 m. The speed ratio is 0.7. Determine the blade inlet angle if the blade outlet angle is 20°. The rotor speed is 50 rps. Also find the diagram efficiency. Find the percentage increase in diagram efficiency and rotor speed if the rotor is designed to run at the best theoretical speed, the exit angle is 20°. (5)

## SECTION - D

7. (a) Write short notes on (i) Cooling ponds, (ii) Cooling towers. (4)

(b) A 180 kW steam engine consumes 9.5 kg of steam per kWh. The back pressure of the engine and the condenser pressure are equal to 0.15 bar. The temperature of the cooling water at the inlet and outlet are 18°C and 34°C respectively. The temperature of the condensate is 35°C. Determine the quantity of cooling water required per hour if the steam exhausted to the condenser is dry saturated. (6)

OR

8. (a) Explain the Dalton Law of Partial Pressures. (4)

(b) The following readings are recorded during a test on a steam condenser: vacuum in condenser = 71.5 cm of Hg, barometer reading = 76.5 cm of Hg, mean temperature of condenser = 33°C, hot well temperature = 29°C, inlet temperature of cooling water = 9°C, outlet temperature of cooling water = 26.5°C. Calculate (i) corrected vacuum to standard barometer, (ii) vacuum efficiency, (iii) under-cooling of the condensate, and (iv) condenser efficiency. (6)



## SECTION - E

**(Compulsory Question - each 2marks)**

9. (a) Represent the contributions of various losses in an actual cycle of an IC engine with PV diagram.

(b) Write differences between External and internal fired boilers

(c) Compare Rankine cycle and Carnot cycle

(d) What is the effect of friction on nozzle?

(e) What is reheat factor in steam turbines?

(f) What is the difference between impulse and reaction blading?

(g) What do you understand about Bypass governing?

(h) Write a short note on Edwards Air Pump.

(i) Give the requirements of a modern surface condenser.

(j) Explain the purpose of compressor in gas turbine plant. (10×2=20)