**[Total No. of Questions - 9] [Total No. of Printed Pages - 3]**
**(2063)**

**815**

**B.Tech 4th Semester Examination**

**Mechanical Engineering**

**ME-4005**

**Time : 3 Hours** **Max. Marks : 100**

*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 :** Candidates are required to attempt five questions in all selecting one question from each of the sections A, B, C, D of the question paper and all subparts of the questions in Section E. Use of non-programmable calculator, steam table and Mollier chart is allowed.

## SECTION - A

1. The ultimate analysis of a solid fuel is as follows; C = 78%, $O_2$ = 3%, $H_2$ = 3%. S = 1%, moisture = 5%, and ash content = 10%. Calculate the mass of air supplied and mass of product of combustion per kg of fuel if 30% of excess air is supplied for combustion. **(20)**

2. With the help of a neat sketch discuss the working of a Babcock and Wilcox boiler. Give a comparison between fire tube and water tube boilers. **(16+4)**

## SECTION - B

3. The net power output of an ideal regenerative-reheat steam cycle is 80 MW. Steam enters the

high pressure turbine at 80 bar, 500°C and expands till it becomes saturated vapour. Some of the steam then goes to an open feed water heater and the balance is reheated to 400°C, after which it expands in the low pressure turbine to 0.07 bar. Compute (a) the reheat pressure, (b) the steam flow rate to the high pressure turbine (c) the cycle efficiency. Neglect pump work. **(20)**

4. Steam expands isentropically from the state of 8 bar and 250°C to 1.5 bar in a convergent-divergent nozzle. The steam flow rate is 0.75 kg/s. Find out (a) velocity of steam at exit from the nozzle, (b) exit area of nozzle. Neglect the inlet velocity of steam. **(20)**

## SECTION - C

5. The velocity of steam from the nozzles of the simple impulse stage of a turbine is 400 m/s. The blades operate close to maximum efficiency. The nozzle angle is 20°. Considering equiangular blades and neglecting blade friction, calculate for a steam flow of 0.6 kg/s the power and diagram efficiency. **(20)**

6. Why compounding is necessary for turbines? Explain with combined velocity diagram. The pressure-velocity compounded impulse turbine. **(20)**

## SECTION - D

7. What do you understand by steam turbine governing? With the help of neat sketches explain about various types of governing. **(20)**

8. Calculate the vacuum efficiency and condenser efficiency if the following data were available in a test on condenser. Condenser vacuum = 700 mm of Hg., barometer reading = 754 mm of Hg, hot well temperature = 30°C, inlet temperature of cooling water = 12°C, outlet temperature of cooling water = 26°C. **(20)**

## SECTION - E

9. (a) State and explain Dalton's law of partial pressure.

   (b) Enumerate merits and demerits of a jet condenser.

   (c) Explain impulse principle.

   (d) Differentiate between impulse and reaction turbine with examples.

   (e) What are the functions of an Orsat apparatus?

   (f) Define adiabatic flame temperature. What is its significance in furnace design?

   (g) Differentiate between HCV and LCV.

   (h) With the help of T-S diagram discuss the limitations of Carnot cycle.

   (i) Define critical pressure ratio.

   (j) Define 'fusible plug' and 'economiser'. **(20)**