

6. (a) Explain the governing methods of steam turbines with neat sketches. 4
- (b) In a stage of an impulse turbine provided with a single row wheel, the mean diameter of blade ring is 0.80 m and the speed of rotation is 3000 rpm. The steam issues from the nozzle with a velocity of 300 m/s and the nozzle angle is 20° . The blades are equiangular and blade coefficient is 0.85. Determine the power developed in the blades when the axial thrust on the blade is 150 N. Also determine the diagram efficiency. 6

Section D

7. (a) What are the main types of condensers ? State the advantages of a surface condenser over a jet condenser ? 5
- (b) The vacuum in a surface condenser is found to be 70.5 cm of Hg when the barometer reads 76 cm of Hg. The cooling water enters the condenser at 20°C and leaves at 36.5°C . Determine the condenser efficiency. 5

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B.Tech. EXAMINATION, 2022

Semester VI (CBCS)

THERMAL ENGINEERING

ME-605

Time : 3 Hours

Maximum 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, selecting *one* question from each Sections A, B, C and D. Q. No. 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 Cochran vertical boiler. What are its special features ? 5

(b) Why boiler mountings are installed ? Explain the operation of fusible plug with the help of simple diagram. 5

2. Steam plant consisting of a boiler, superheater and economiser has the following particulars Steam pressure = 12.6 bar; Temperature of steam leaving superheater = 245°C; Fuel used per hour = 1000 kg; Feed water per hour = 9000 kg; Temperature of feed water entering the economiser = 40°C Temperature of feed water leaving the economiser = 115°C; Dryness fraction of steam leaving the boiler = 0.9, Calorific value of fuel used = 30 240 kJ/kg. Calculate (i) Overall efficiency of the plant (ii) Percentage of heat in fuel used in the boiler, economiser and superheater. 10

Section B

3. (a) Discuss the effects of the following parameters in a Rankine cycle. (i) Steam pressure at inlet to the turbine and (ii) Steam temperature at inlet to the turbine. 5

(b) A steam power plant operates on ideal Rankine cycle. The steam enters the turbine at 3 MPa, 350°C and is condensed in the condenser at 75 kPa, calculate thermal efficiency, back work ratio and work ratio of this cycle. 5

4. (a) Derive the equation for critical pressure ratio of nozzle for different conditions. 4

(b) In a convergent-divergent nozzle, the steam enters at 15 bar and 300°C and leaves at 2 bar. The inlet velocity to the nozzle is 150 m/s. Find the required throat and exit areas for a mass flow rate of 1 kg/s. Assume nozzle efficiency to be 90% and $C_p = 2.4$ kJ/kg K. 6

Section C

5. (a) Derive the conditions for maximum efficiency and blade height of reaction turbine. 5

(b) In a Parson reaction turbine, the angles of receiving tips are 35° and of discharging tips 20°. The blade speed is 100 m.s. Calculate the tangential force, power developed, diagram efficiency and axial thrust of the turbine, if its steam consumption is 1 kg/min. 5

- (g) Give two losses in steam turbines.
- (h) Draw different nozzle cross-sections and explain them.
- (i) Compare the merits and demerits of surface condenser over jet condenser.
- (j) Why compression ratio is restricted to maximum 12 in case of petrol engines ? $10 \times 2 = 20$

8. (a) Explain working principle of Surface Condenser with neat sketch. 4
- (b) A closed vessel of 0.7 m^3 capacity contains saturated water vapor and air at a temperature of 42.7°C and a pressure of 0.13 bar abs. Due to further air leakage into the vessel, the pressure rises to 0.28 bar abs. and temperature falls to 37.6°C . Calculate the mass of air which has leaked in. Take $R = 287 \text{ J/kg K}$ for air. 6

(Compulsory Question)

9. (a) What is meant by cetane number ? Give the details.
- (b) Name four important variables that affect the volumetric efficiency.
- (c) Draw Rankine cycle on p-V and T-S diagrams.
- (d) Write the significance of accessories of a boiler.
- (e) Draw velocity triangle at exit for impulse turbine.
- (f) Draw different nozzle cross-sections and explain them.