[Total No. of Questions - 9] [Total No. of Printed Pages - 4]
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B. Tech 3rd Semester Examination

Applied Thermodynamics (NS)

ME-212

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 the subparts of the questions in Section E. Use of non programmable calculators is allowed and use of steam table, charts, graphical plots are permitted.

SECTION - A

1. (a) Describe with a neat diagram the construction and working of La- Mont boiler. (10)

   (b) The following observations were made on a boiler during a test

   Pressure of steam=10 bar; Steam condensed=540 kg/h; Fuel used=65 kg/h; Moisture in fuel=2% by mass; Mass of dry flue gases=9kg/kg of fuel; lower calorific value of fuel=32000 kJ/kg; Temperature of the flue gases=325°C; Temperature of boiler house=28°C; Feed water temperature=50°C; Mean specific heat of flue gases= 1kJ/kg K; Dryness fraction of steam=0.95; Specific heat of superheated steam 2.1 kJ/kg K. Draw up a heat balance sheet for the boiler. (10)

2. (a) Explain the following boiler terms :

   (i) Grate.

   (ii) Mountings.

   (iii) Accessories.

   (iv) Blowing off.

   (v) Shell. (10)

   (b) In a chimney of height 40 meters, temperature of flue gas with natural draught is 350°C. The temperature of waste gas using artificial draught is 150°C. The temperature of atmospheric air is 38°C. If air supplied is 20 kg/kg of fuel burnt, determine the efficiency of chimney. Assume c_p= 1.005 kJ/kg K. (10)

SECTION - B

3. (a) Explain with neat diagram the working of a Binary vapour cycle. (10)

   (b) A steam power plant equipped with regenerative as well as reheat arrangement is supplied with steam to the H.P. turbine at 80 bar 470°C. For feed heating, a part of steam is extracted at 7 bar and remainder of the steam is reheated to 350°C in a reheater and then expanded in L.P. turbine down to 0.035 bar. Determine (i) Amount of steam Bled-off for feed heating, (ii) Amount of steam supplied to L.P. turbine, (iii) Heat supplied in the boiler and reheater, (iv) Cycle efficiency, and (v) Power developed by the system. The steam supplied by the boiler is 50 kg/s. (10)

4. (a) Write short note on :

   (i) Steam nozzle, (ii) Effect of friction on the flow through a steam nozzle, (iii) Supersaturated flow. (10)

[P.T.O.]

(b) Define critical pressure ratio for the nozzle of the steam turbine. Obtain analytically its value in terms of the index of expansion (10)

SECTION - C

5. (a) What do you mean by compounding of steam turbines? Discuss various methods of compounding steam turbines. (10)

(b) A steam jet enters the row of blades with a velocity of 375 m/s at an angle of 20° with the direction of motion of the moving blades. If the blade speed is 165 m/s, find the suitable inlet and outlet blade angles assuming that there is no thrust on the blades. The velocity of steam passing over the blades is reduced by 15%. Also determine power developed by the turbine per kg of steam flowing over the blades per second. (10)

6. (a) Explain throttle governing, nozzle control governing and by pass governing method of governing of steam turbines. (10)

(b) Define the following as related to steam turbine.

(i) Stage efficiency (ii) Overall efficiency (iii) Reheat factor (iv) Back pressure turbine. (10)

SECTION - D

7. (a) Describe with the neat diagram working and principle requirements of steam condensing plant. (10)

(b) Define vacuum efficiency and condenser efficiency.
The following data were obtained from the test of a surface condenser :
condenser vacuum = 711mm of Hg; Hot well temperature = 32°C; Inlet temperature of circulated water = 12°C; Outlet temperature of circulated water = 28°C; Barometer reading = 760 mm of Hg. Compute the vacuum efficiency and the efficiency of the condenser. (10)

8. (a) Derive Clausius-Clapeyron's equation. (10)

(b) Derive Maxwell's relations. (10)

SECTION - E

9. (a) Name the device attached to the steam chest for preventing explosions due to excessive internal pressure of steam.

(b) What is the difference between jet and surface condenser?

(c) Define Binary Vapour cycle.

(d) What is the effect of friction in a nozzle on dryness fraction of steam?

(e) Differentiate impulse turbine and reaction turbine.

(f) What are the losses in steam turbines?

(g) State Dalton's law of partial pressures.

(h) Define enthalpy, entropy and internal energy.

(i) Give comparison between fire tube and water tube boilers.

(j) Define compressibility factor.

(10×2=20)