6. (a) How does air leakage affect the condenser performance? (3)

(b) A surface condenser receives 250t/h of steam at 40°C with 12% moisture. The cooling water enters at 32°C and leaves at 38°C. The pressure inside the condenser is found to be 0.078 bar. The velocity of circulating water is 1.8 m/s. the condenser tubes are of 25.4 mm OD and 1.25 mm thickness. Taking the overall heat transfer coefficient as 2600 W/m^2K. Determine (i) the rate of flow of cooling water (ii) the rate of air leakage into the condenser shell, (iii) the length of tubes, and (iv) the number of tubes. (12)

7. (a) State the conditions which lower the volumetric efficiency. (3)

(b) A single-stage single-acting air compressor delivers 0.6 kg of air per minute at 6 bar. The temperature and pressure at the end of suction stroke are 30°C and 1 bar. The bore and stroke of the compressor are 100 mm and 150 mm respectively. The clearance is 3% of the swept volume. Assuming the index of compression and expansion to be 1.3, find : (i) Volumetric efficiency of the compressor, (ii) Power required if the mechanical efficiency is 85%, and (iii) Speed of the compressor (rpm). (12)

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Roll No. ..... Total Pages : 4

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August/September 2022

B.Tech. (ME) 4th Semester

Applied Thermodynamics (PCC-ME-401-21)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*
4. *Ask the invigilator for Steam Table/Mollier chart.*

PART-A

1. (a) What is the function of a boiler chimney ? (1.5)

(b) What do you understand by ultimate analysis of coal? (1.5)

(c) State any *two* methods by which mean temperature of heat addition can be increased. (1.5)

(d) How is the maximum pressure of a cycle fixed up? (1.5)

(e) What is the velocity of a pressure pulse in an isentropic flow? (1.5)

(f) What is critical pressure rations for (i) air and (ii) dry saturated steam ? (1.5)

(g) How is degree of reaction defined? (1.5)

(h) Why are reaction blades unsymmetrical? (1.5)

(i) What is a spray condenser? Where is it used? (1.5)

(j) State the conditions which lower the volumetric efficiency. (1.5)

PART-B

2. (a) Describe the construction and working of the following boilers with neat sketches : (i) Babcock and Wilcox boiler (ii) Cochran boiler. (10)

(b) Calculate the height of chimney required to produce a draught equivalent to 1.7 cm of water if the flue gas temperature is 270°C and ambient temperature is 22°C and minimum amount of air per kg of fuel is 17 kg. (5)

3. (a) When does reheating of steam become necessary? Explain the effect of reheat on cycle output and efficiency. (7)

(b) Consider a steam power plant operating on the simple ideal Rankine cycle. Steam enters the turbine at 3 MPa and 350°C and is condensed in the condenser at a pressure of 75 kPa. Determine the thermal efficiency of this cycle and compare this with Carnot efficiency. (8)

4. (a) Explain (i) supersonic nozzle, (ii) subsonic nozzle, (iii) subsonic diffusor, (iv) supersonic diffusor. (6)

(b) Air at 7.8 bar and 180°C expands through a convergent-divergent nozzle into a space at 1.03 bar. The flow rate of air is 3.6 kg/s. Assuming isentropic flow throughout and neglecting the inlet velocity, calculate the throat and exit areas of the nozzles. (9)

5. (a) Define (i) diagram power, (ii) diagram efficiency and derive for the same for reaction turbines with neat and clean sketch. (7)

(b) The velocity of steam entering a simple impulse turbine is 1000 m/s, and the nozzle angle is 20°. The mean peripheral velocity of blades is 400 m/s and the blades are symmetrical. If the steam is to enter the blades without shock, what will be the blade angle? Neglecting the friction effects on the blades, calculate the tangential force on the blades and the diagram power for a mass flow of 0.75 kg/s. Estimate also the axial thrust and diagram efficiency. (8)