

Code No: 136EB

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year II Semester Examinations, February - 2023

THERMAL ENGINEERING – II

(Mechanical Engineering)

Time: 3 Hours

Max. Marks: 75

Note: i) Question paper consists of Part A, Part B.

ii) Part A is compulsory, which carries 25 marks. In Part A, Answer all questions.

iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

- 1.a) Why regeneration process is used in Rankine cycle? [2]
- b) Difference between natural and artificial draught. [3]
- c) What do you understand by “degree of under-cooling”? [2]
- d) Define nozzle velocity coefficient and how it is related to nozzle efficiency? [3]
- e) What is the main difference between impulse and reaction turbines? [2]
- f) What is the effect of blade friction on steam turbine performance? [3]
- g) What are the sources of air in the condensers? [2]
- h) List out the merits and demerits of closed and semi-closed cycle gas turbines. [3]
- i) What are the types of jet propulsion systems? [2]
- j) What is thrust power and propulsion efficiency of jet propulsion? [3]

PART – B

(50 Marks)

- 2.a) Describe with a neat sketch the construction and working principle of Benson boiler.
- b) What are the essentials of a good steam boiler? Estimate the factors which should be considered while selecting a boiler. [5+5]

OR

- 3.a) Describe the regenerative cycle with the help of neat sketch. Also represent the cycle on T-S diagram.
- b) Calculate the height of a chimney required to produce a draught equivalent to 1.6 cm of water, if the flue gas temperature is 2500°C and ambient temperature is 270°C and minimum amount of air per kg of fuel is 20 kg. [5+5]

4. Steam issues from a nozzle at 800 m/s the velocity of moving blade is 200 m/s and mass of steam flow is 2 kg/s. The nozzles are inclined at an angle of 16° to the plane of the wheel, talking friction factor 0.8 and outlet angle of blade as 30° find: (a) Power developed (b) The blade angle at inlet (c) The blade efficiency. [10]

OR

- 5.a) Explain the classification and working principle of a nozzle.
- b) Dry saturated steam at a pressure of 8 bar enters a convergent divergent nozzle and leaves it at a pressure of 1 bar. If the flow is isentropic and the corresponding expansion index is 1.135. Find the ratio of cross-sectional area at exit and throat for maximum discharge. [4+6]

6.a) Explain the working of single stage reaction turbine. Sketch the pressure and velocity variations along the axis of the turbine.

b) In an impulse turbine, the steam issues from the nozzle with a velocity of 300m/s. The nozzle is inclined at 14° to the wheel tangent. The mean diameter of the wheel is 300mm. The wheel run at 10000RPM. Determine the blade inlet angle for shock less entry. If the blade exit angle is equal to the inlet angle, determine the work done per kg of steam and also axial thrust. [5+5]

OR

7.a) Explain the working principle of an impulse turbine with neat sketch.

b) A reaction turbine runs at 3000 rpm and the steam consumption is 20000 kg/hr. The pressure of steam at a certain pair is 2 bar, its dryness fraction is 0.93 and the power developed by the pair is 50 kW. The discharge blade angle is 20° for both the fixed and moving blades and the axial velocity of flow is 0.72 times the blade velocity. Find the drum diameter and the blade height. Take the tip leakage steam as 8%. Neglect blade thickness. [5+5]

8.a) Define condensers and explain the classification of condensers in detail with neat sketches.

b) Draw the line diagram and explain the working of Reheat gas turbine cycle. [5+5]

OR

9.a) Discuss the merits and demerits of surface condensers over jet condensers.

b) Explain the semi closed cycle gas turbine with neat sketch and write its advantages and disadvantages. [5+5]

10.a) Derive expression for the trust and propulsion efficiency of rocket and compare with those of turbojet.

b) A turbo jet engine consumes air at the rate of 60.2 kg/s when flying at a speed of 1000 km/hr. Calculate (i) Fuel flow rate in kg/s, when air fuel ratio is 70:1 (ii) propulsive power (iii) propulsive efficiency. [5+5]

OR

11.a) Showing the basic components, explain the working of turbojet engine.

b) A turbojet engine indicates 45 kg of air per second and propels an aircraft with a uniform flight speed of 880 km/h. The isentropic enthalpy change for nozzle is 188.37 kJ/kg and its velocity coefficient is 0.96. The fuel-air ratio is 0.012, the combustion efficiency is 0.95 and the lower heating value of the fuel is 44,000kJ/kg. Calculate: i) the thermal efficiency of the engine, ii) the fuel flow rate in kg/h, iii) the propulsion power in kW, iv) the thrust power, v) the propulsive efficiency. [5+5]

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