

R18

Code No: 155DG

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, March - 2024

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) Discuss briefly the advantages of a regenerative feed heating in steam power cycle. [2]
- b) Define: equivalent evaporation and boiler efficiency. [3]
- c) Discuss the effects of friction on the flow through a steam nozzle. [2]
- d) What do you understand by "degree of under-cooling"? [3]
- e) What do you understand by degree of reaction? [2]
- f) Define the following as related to steam turbines. (i) Blade velocity coefficient (ii) Diagram efficiency (iii) stage efficiency. [3]
- g) Brief about the High level Jet condenser. [2]
- h) Discuss the advantages and disadvantages of a closed cycle gas turbine over open cycle gas turbine. [3]
- i) Write the principle of jet propulsion and classify the Jet propulsive engines. [2]
- j) Where rocket propulsion is used? What are the kinds of rocket propellants? [3]

PART - B

(50 Marks)

2. In a reheat cycle steam enters the H.P turbine at 100 bar and 500°C. The expansion is continued to a pressure of 8.5 bar with isentropic efficiency of 80%. There is a pressure drop of 1.5 bar in the reheater and then steam enters the L.P turbine at 7 bar and 500°C in which expansion is continued to a back pressure of 0.04 bar with isentropic efficiency of 85%. Determine a) thermal efficiency b) specific steam consumption? [5+5]

OR

- 3.a) Discuss the advantages and disadvantages of artificial draught system over natural draught system.
- b) Why mountings are essential in boilers? Name different mountings and give functions of each. [5+5]
4. Discuss the process of super saturation in steam nozzles with the help of enthalpy entropy diagram. Define degree of super-saturation and degree of under-cooling. Explain in detail the physical significance of abrupt change at Wilson's line? [10]

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OR

5. Dry saturated steam at 10bar is expanded in a nozzle to 0.4 bar. The throat area is 7cm and the inlet velocity is negligible. Estimate the mass flow and the exit area. Assume isentropic flow and take the index $n=1.135$ for dry saturated steam? [10]

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6. A simple impulse turbine has one ring of moving blades running at 120 m/s, absolute velocity of steam at exit is 75 m/s at an angle 80° with the tangent of wheel, friction coefficient is 0.85, rate of steam flowing 2.5 Kg/s. Assuming the moving blades to be a symmetrical, find the a) Blade angles, b) Nozzle angle, c) absolute velocity of steam at entrance, and d) power developed? [2+3+2+3]

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OR

7. Derive an expression for degree of reaction and show that inlet and outlet velocity triangles are symmetrical for a 50% degree of reaction turbine? [10]

8. A condensing plant condenses 13750kg of steam per hour and the leakage of air in the system is 1kg per 2500kg of steam. The vacuum in the air pump suction is 71.5cm (barometer 76cm) and the temperature 32.9°C. Compute the capacity of the air pump which removes both air and water in m³/min, taking the volumetric efficiency as 80%? [10]

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OR

9. A simple turbine jet unit was tested when stationary and the ambient conditions were 1bar and 15°C. The pressure ratio for the compressor was 4:1. A fuel consumption of 0.37kg/s was obtained for an air flow of 23kg/s. Calculate the thrust produced if the exhaust gases from the turbine were expanded to atmospheric pressure in a convergent nozzle. Assume the following data:

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Isentropic efficiency of compressor-80%

Isentropic efficiency of turbine-85%

Efficiency of nozzle-93%

Transmission efficiency-98%

Calorific value of fuel-42000kJ/kg

Assuming working fluid to be air throughout? [10]

10.a) Derive expressions for the thrust and propulsion efficiency of rockets and compare with those of turbojet.

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b) Define and explain the terms: i) Thrust ii) Thrust power, iii) Effective jet exit velocity, iv) Propulsive efficiency related to turbojet engines? [5+5]

OR

11. A jet plane having 2 jets works on turbo-jet system. It flies at a speed of 800km/hr at an altitude where density of air is 0.15 kg/m³. The propulsive efficiency is 55%. The drag on the plane is 6500N. Calculate a) Absolute velocity of jet b) quantity of compressed air and c) diameter of jet? [3+3+4]

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