CBCS SCHEME

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17AE46

Fourth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Turbomachines

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define turbomachine and explain the principles of turbomachines. Also explain the components of turbomachines. **(05 Marks)**

b. Compare and differentiate between positive displacement machine and turbomachine. **(05 Marks)**

c. Using dimensional analysis, find the expression for discharge (Q) of a power absorbing turbomachine : The discharge (Q) depends on RPM(N), Rotor diameter (D), Energy/unit mass flow (gH), Density of the fluid (ρ) and dynamic viscosity (μ). Also mention the terms according to Fan laws. **(10 Marks)**

OR

2 a. Obtain the expression for alternate form of Euler turbine equation and explain about components of energy transfer. **(08 Marks)**

b. Derive the relation for degree of reaction and utilization factor. **(04 Marks)**

c. An axial flow turbine rotor with an absolute velocity of 550m/s and a direction of 18° from the wheel tangent. If the absolute velocity at the rotor exit is axially directed, when the blade speed is 300m/s. Find the power output and degree of reaction if the mass flow rate is 60kg/s. **(08 Marks)**

Module-2

3 a. Derive the expression for polytrophic efficiency as a function of stage efficiency and overall efficiency for a compression process with necessary sketch. **(10 Marks)**

b. An axial flow compressor has 8 stages of equal temperature rise in each stage. Inlet temperature is 300K and actual total temperature rise is 360K. In exit total temperature is 660K. Calculate the pressure rise and the efficiency at each stage. **(10 Marks)**

OR

4 a. Obtain the relation for multistage turbines for the condition of :
i) Constant stage pressure ratio
ii) Constant stage temperature drop. **(10 Marks)**

b. A gas turbine engine has 3 stage turbine with an overall pressure ratio of 10 and efficiency 90%. If the pressure ratio of each stage is same and inlet temperature is 1500K. Determine the following :
i) Pressure Ratio in each stage
ii) Polytrophic efficiency and stage efficiency
iii) Reheat Factor
iv) Exit temperature
v) Total power output.
Take mass flow rate is 50kg/s. Assume Cp = 1.005kJ/kg.k and $\gamma = 1.4$. **(10 Marks)**

Module-3

5 a. Draw neatly and explain about dements of centrifugal compressor. Also explain its function and operation. **(12 Marks)**

b. Explain the phenomenon of surging and choking, with the characteristic curve for the centrifugal compressor. **(08 Marks)**

OR

6 a. With the help of enthalphy – entropy diagram, derive the relation for work done and efficiency for axial flow compressor. **(10 Marks)**

b. An air compressor has eight stages of equal pressure ratio 1.35. The mass flow rate through the compressor is 50kg/s and overall efficiency of 82%. If the conditions of air at entry are 1 bar and 40°C.

Determine :

i) State of air at exit (Pressure and Temperature)
ii) Polytropic efficiency
iii) Stage efficiency
iv) Power required to derive the compressor

Assume manometric efficiency as 90%. **(10 Marks)**

Module-4

7 a. Obtain the relation for degree of reaction for axial flow turbines. **(10 Marks)**

b. Draw and explain about turbine cooling methods. **(10 Marks)**

OR

8 a. Draw and explain the parts and functions of radial turbine. **(10 Marks)**

b. Explain about losses occurring in radial turbine. **(10 Marks)**

Module-5

9 a. Draw and explain about operation of centrifugal pump and various heads of centrifugal pump. **(10 Marks)**

b. Draw and explain about multistage pumps in parallel and series. Also write its applications. **(10 Marks)**

OR

10 a. Write and explain about the classification of hydraulic turbines. **(10 Marks)**

b. Draw and explain about different types of draft tubes and their function. **(10 Marks)**

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