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18AE46

**Fourth Semester B.E. Degree Examination, July/August 2022**  
**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. Compare the differentiate between turbomachine and positive displacement machines. (08 Marks)
- b. The performance of a turbomachine depends on Discharge (Q), Speed in rpm (N), Rotor diameter (D), Energy/unit mass (gH), Density of fluid( $\rho$ ), Power (P) and Dynamic Viscosity ( $\mu$ ), Analyse using Buckingham's -  $\pi$  theorem and obtain discharge. (12 Marks)

**OR**

- 2 a. Derive alternate form of Euler turbine equation and explain the significance of each energy components. (10 Marks)
- b. Derive expression for degree of reaction and obtain relationship between degree of reaction and utilization factor. (10 Marks)

**Module-2**

- 3 a. Define polytrophic efficiency and obtain the relation for polytrophic efficiency for compression process. (10 Marks)
- b. An axial flow compressor has 8 stages of equal pressure ratio of 1.35 and the flowrate through the compressor and its overall efficiency are 50kg/s and 0.82 receptively. If the conditions of air at entry are 1 bar and 300K.  
Determine :  
i) State of air at compressor exit  
ii) Polytrophic efficiency and stage efficiency  
iii) Power required if  $\eta_{trans} = 90\%$ . (10 Marks)

**OR**

- 4 a. For multistage turbines, derive the relation for constant stage pressure ratio and constant stage work. (10 Marks)
- b. Overall pressure ratio across three stage gas turbine is 11 and its efficiency is 88%. If pressure ratio each stage varies and if it is having constant stage temperature drop. Find pressure ratio and stage efficiency if the inlet temperature is 1500K. (10 Marks)

**Module-3**

- 5 a. Classify the power absorbing turbomachines and explain the important elements of centrifugal compressor with neat sketch. (10 Marks)
- b. Derive the expression for slip, slip co-efficient, energy transfer, power input factor, overall pressure ratio and loading pressure co-efficient. (10 Marks)

**OR**

- 6 a. Draw the stage velocity diagrams for an axial flow compressor and explain the important parts and working of axial flow compressor. (10 Marks)
- b. Draw the h-s diagram and derive the expression for work done factor for axial flow compressor. (10 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and /or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-4**

- 7 a. For an axial flow turbines. Draw the velocity triangle for different values of degree of reaction and explain. (10 Marks)
- b. Explain about different types of turbine cooling methods with neat sketch. (10 Marks)

**OR**

- 8 a. Draw the velocity triangle for radial flow turbines and obtain relation for degree of reaction. (10 Marks)
- b. Explain about losses and efficiencies of radial flow turbines. (10 Marks)

**Module-5**

- 9 a. Explain about losses occurring in hydraulic pumps and various efficiency terms related to hydraulic pumps and write the expression. (10 Marks)
- b. Draw and explain about :
- i) Pumps in series
  - ii) Pumps in parallel
  - iii) Volute casing
  - iv) Vortex casing. (10 Marks)

**OR**

- 10 a. Classify the hydraulic turbines based on :
- i) Based on action of water on blades
  - ii) Based on direction of fluid through runner
  - iii) Based on specific speed
- Give example for each type. (10 Marks)
- b. Explain about different types of draft tube used in hydraulic turbines and functions of draft tube. (10 Marks)

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