Subject: - Turbo-Machine (7ME04)

Assignment 1

1. Classify turbo-machines and derive the Euler's energy transfer equation from fundamentals.
2. Explain the Geometric, Kinematic and Dynamic similarities. State two governing parameters for each kind of similarity.
3. A turbine develops 6600 kW, when running at 100 rpm. The head on the turbine is 30 m. if the head on turbine is reduced to 18 m. determine the speed and the power developed by the turbine..
4. A turbine is to operate under a head of 25 m at 200 rpm. The discharge is 9 m^3/s. If the efficiency is 90%. Determine the performance of the turbine under a head of 20 m.
5. Derive the expression of the specific speed of hydraulic turbine.
6. Derive the expression of the specific speed of hydraulic Pump.
7. How are the following laws and governing equations applied to the turbo Machine?
   a) Steady state energy equation
   b) Continuity equation
   c) Second law of thermodynamics d) Newton second law of motion
8. A turbine develops 7500 kW under a head of 24.7 m at 135 rpm. What is the Specific speed? What would be its normal speed and output under head of 19.5 m?
9. The efficiency of turbo machine depends on density ρ, dynamic viscosity μ of the fluid, angular velocity ω, diameter of the rotor D and the discharge Q. Express η in terms of the dimensionless parameters.
10. What is the physical significance the energy equation by using of the velocity triangle?

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Assignment 2

1. What is the Centrifugal Compressor? Also write the applications of centrifugal compressors
2. Define overall, total to total and isentropic efficiency.
3. Define the following terms.
    i. Power input factor
    ii. Work factor
    iii. Loading co-efficient
    iv. Degree of reaction
    v. Pressure co-efficient
    vi. Stagnation properties
4. Explain the phenomenon of surging, stalling and chocking in a centrifugal compressor.
5. Derive the expression for the degree of reaction for centrifugal compressor. Also explain the different types of condition
6. Draw the velocity diagram for an axial flow compressor and explain it detail.
7. Derive the expression for the degree of reaction for axial flow compressor. Also explain the different types of condition
8. Explain the construction, working and principle of operation with help of axial flow compressor neat and clean diagram.
9. Explain the construction, working and principle of operation with help of centrifugal compressor neat and clean diagram.
10. A centrifugal compressor has to deliver 35 kg/s air. The impeller is 76 cm diameter revolving at 11500 rpm with the adiabatic efficiency of 80 %.if the pressure ratio is 4.2:1, estimate the axial width of impeller at impeller tip if the radial velocity is 120 m/s. the inlet condition is 1 bar and 47°C.

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Assignment 3

1. Draw velocity triangles at the inlet and the outlet of a centrifugal pump.
2. Define the following terms
    a. NPSH
    b. Slip factor
    c. Mechanical efficiency
    d. Priming
    e. Cavitation
3. Write the short notes on head developed by a centrifugal pump.
4. What is the centrifugal pump? Explain the working of the centrifugal pump with the suitable sketch.
5. Describe the performance curves of the centrifugal pump with neat and clean sketch.
6. What is the Reciprocating pump? Explain the working of the Reciprocating pump with the suitable sketch.
7. Derive the expression of the minimum starting speed of the centrifugal pump with the usual meaning.
8. A single stage centrifugal pump impeller diameter of 30 cm rotates at 2000 rpm and lifts 3 m^3/s to height of 30 m with an efficiency of 75%. Find the number of stages and the diameter of each impeller of a similar multistage pump to lift 5 m3/s to a height of 200 m, when the rotating at 1500 rpm.
9. An axial flow pump has the following specifications
    a. Discharge = 180 L/s
    b. Head developed = 2 m
    c. Specific speed = 250
    d. Speed ratio = 2.4
    e. Flow ratio = 0.5

    Calculate (i) speed of the pump (ii) the runner diameter
    (iii) The boss diameter
    Assume the flow is axial inlet

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Assignment 4

1. What are the applications of gas turbine? Also write the assumptions in ideal gas turbine cycle
2. Derive the expression for thermal efficiency and specific work output in an ideal heat exchange cycle
3. What are various advantages and disadvantages of gas turbine cycle over the reciprocating engines?
4. With the help of thermodynamic cycles, explain the working of the turbojet engine. Enlist advantages and applications also.
5. With the help of thermodynamic cycles, explain the working of the Ramjet engine. Enlist advantages and applications also.
6. Define the compressor efficiency and the turbine efficiency. Derive them.
7. Compute the mean effective pressure and efficiency of a joule cycle if the temperature at the end of the combustion 2000 K and the temperature and pressure before the compression is 350 K and 1 bar. The pressure ratio is 1.3 and C_p = 1.005 kJ/Kg-K
8. Calculate the improvement in the efficiency when a heat exchanger is added to the simple cycle given in the previous question.

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Assignment 5

1. Explain the sketch and the h-s diagram the working of reaction turbine.
2. How do you differentiate between an impulse and reaction turbine?
3. Write the short notes on the reaction turbine.
4. Write the short notes on the reaction turbine.
5. Gas at 7 bars and 300°C expands to 3 bars in an impulse turbine stage. The nozzle angle is 70° with the reference to the exit direction the rotor blades have equal inlet and outlet angles. And stage operates with the optimum speed ratio. Assuming the isentropic efficiency of the nozzles is 0.9and that the velocity at entry to the stage is negligible. Deduce the blade angle and the mass flow for this stage to produce 75 kW. C_p = 1.15 kJ/kg-k

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