7E7014

Roll No. _____ Total No of Pages: 4

7E7014

B. Tech. VII Sem. (Main/Back) Exam., Nov.-Dec.-2016
Mechanical Engineering
7ME4A Turbomachines

Time: 3 Hours

Maximum Marks: 80
Min. Passing Marks Main: 26
Min. Passing Marks Back: 24

Instructions to Candidates:

*Attempt any **five questions,** selecting **one question** from **each unit.** All questions carry **equal** marks. Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly.*

Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination. (Mentioned in form No. 205)

1. NIL 2. NIL

UNIT – I

Q.1 (a) How are the following laws and governing equations applied to the Turbo-machine? [2+2+2+2=8]

(i) Steady flow energy equation

(ii) Second law of thermodynamics

(iii) Newton's second law of motion

(iv) Continuity equation

(b) A turbine develops 7500kW under a head of 24.7m at 135 rpm. What is the specific speed? What would be its normal speed and output under a head of 19.5m? [8]

OR

Q.1 (a) Explain Geometric, kinematic and dynamic similarities. State two governing parameters for each kind of similarity. [6]

(b) Prove the following equation for the performance of a turbo compressor. [10]

$$\frac{P_{01}}{P_{02}} = \left(\frac{N}{\sqrt{T_{01}}}, \frac{m\sqrt{T_{01}}}{P_{01}} \right)$$

UNIT – II

Q.2 (a) Explain following performance parameters: [2+2+2+2=8]

(i) Power input factor

(ii) Pressure coefficients

(iii) Slip factor

(iv) Compressor efficiency

(b) A centrifugal compressor has to deliver 35kg of air per sec. The impeller is 76 cm diameter revolving at 11,500 rpm with an adiabatic efficiency of 80%. If the pressure ratio is 4:2:1, estimate the probable axial width of the impeller at the impeller tip if the radial velocity is 120 m/s. The inlet conditions are 1 bar and 47°C. [8]

OR

Q.2 (a) Draw a sketch of an axial flow compressor with inlet guide vanes and explain working principle and performance coefficients. [8]

(b) Derive an expression of Degree of reaction for axial flow compressor. [8]

UNIT – III

Q.3 (a) State the main components of a centrifugal pump and describe the function of each. [8]

(b) A centrifugal pump has to deliver 20 liters/sec of water when running at 1200rpm. The inlet vane angle is 30° and exit vane angle is 45°. If the velocity of flow is constant in the impeller, the power supplied to run the pump by motor is 40kW. Assuming the mechanical efficiency 90%, find the inlet and outlet diameters of the impeller. Take $D_2 = 2D$. [8]

OR

Q.3 (a) Define cavitations and explain causes for creating the cavitations. Mention the effects of cavitations. [8]

(b) The piston area of a single acting reciprocating pump 0.15 m^2 and stroke is 30cm. The water is lifted through a total head of 15m. The area of delivery pipe is 0.03m^2. If the pump is running at 50 rpm, find the percentage slip, coefficient of discharge and the power required to drive the pump.
The actual discharge is 350 L/sec. Take mechanical efficiency 85%. [8]

UNIT – IV

Q.4 (a) Derive the expression for specific work output and efficiency of a simple gas turbine cycle with intercooler. [8]

(b) A gas turbine cycle has a perfect heat exchanger. Air enters the compressor at a temperature and pressure of 300K and 1 bar and discharges at 475K and 5 bar. After passing through the heat exchanger the air temperature increases to 655K. The temperatures of air entering and leaving the turbine are 870°C and 450°C. Assuming no pressure drop through the heat exchanger, compute –

(i) The output per kg of air

(ii) The efficiency of the cycle

(iii) The work required to drive the compressor. [8]

OR

Q.4 (a) Explain working of turboprop engine with the help of neat sketch and T-S diagram. Write the basic characteristics and application also. [8]

(b) Explain with suitable graphs the performance of a turbojet engine. What are the advantages and disadvantages of a turbojet engine? [8]

UNIT – V

Q.5 (a) How do you differentiate between an impulse and a reaction turbine? With neat sketch explain the working of an impulse and a reaction stage. [8]

(b) What do you understand by pressure compounding of a multistage impulse turbine? Show Enthalpy-Entropy diagram for flow through a gas turbine stage. [8]

OR

Q.5 (a) Explain following: [2+2+2=6]

(i) Loading coefficient

(ii) Flow coefficient

(iii) Velocity triangles for a impulse turbine

(b) Gas at 7 bar and 300°C expands to 3 bar in an impulse turbine stage. The nozzle angle is 70° with reference to the exit direction. The rotor blades have equal inlet and outlet angles, and the stage operates with the optimum blade speed ratio. Assuming that the isentropic efficiency of the nozzle is 0.9, and that the velocity at entry to the stage is negligible, deduce the blade angle used and the mass flow required for this stage to produce 75kW. [10]

Take, Cp = 1.15kJ/kgk.
