Code No: RR312003 **Set No. 1**

III B.Tech I Semester Regular Examinations, November 2006
TURBO MACHINERY
(Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. Derive the continuity equation for one-dimensional compressible flow in differential form? What are the assumptions made while deriving the above equation? Establish the momentum equation for the compressible fluid flow? [16]

2. In a stage of axial flow compressor the total head temperature at inlet is 27^0C, the stage isentropic efficiency is 88%. If the mean diameter blade speed is 180 m/s and blade angles at entry and outlet are 45^0 and 15^0C respectively. Determine the stage total head pressure ratio. [16]

3. (a) With a neat sketch explain the working principle of a centrifugal compressor.
   (b) What are the design requirements of a centrifugal compressor, explain in brief. [8+8]

4. Derive an expression for specific work output, efficiency and work ratio in terms of cycle maximum to minimum temperature ratio and pressure ratio for an ideal gas turbine cycle from basic thermodynamic equations. What are the various assumptions made while deriving the above equations? [16]

5. (a) What are the different types of nozzles? Explain each with a neat sketch.
   (b) A convergent-divergent nozzle is required to discharge 2kg/s of steam at 7bar and 180^0C and discharge takes place against a backpressure of 1bar. Expansion is assumed to be isentropic and approach velocity is 75m/s. Estimate the suitable area for the throat and exit. [6+10]

6. The following data refers to a 50% reaction turbine;drum diameter : 2m, speed of rotation : 800RPM, and steam flow rate is 15kg/s. The height blade is 15cm and the steam has a pressure of 0.4bar and 0.95 dryness fraction. For 20^0 discharge angle and assuming turbine efficiency as 80%. Estimate the power developed in this particular ring and enthalpy drop when the steam passes through the turbine pair. [16]

7. (a) Differentiate Ramjet and Pulsejet.
   (b) List out the advantages and disadvantages of Ram-jet and what are its applications? [8+8]

8. Write the short notes-
   (a) Mach number, Mach angle

(b) Reaction turbine

(c) Flame stabilization

(d) By-pass governing [4+4+4+4]

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Code No: RR312003 **Set No. 2**

III B.Tech I Semester Regular Examinations, November 2006
TURBO MACHINERY
(Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) What is a turbo machine? Describe briefly the applications of turbo machines?
   (b) Classify the turbo machines and explain the working principle of each in detail.

   [8+8]

2. (a) Draw the inlet and outlet velocity triangles of an axial flow compressor?
   (b) An axial flow compressor of 50% reaction desig has blades with inlet and outlet angles of 40^0 and 10^0. The compressor is to produce a pressure ratio of 5:1 with an overall isentropic efficiency of 87%. The mean blade speed and axial velocity are constant through out the compressor. Assuming blade velocity of 180 m/s and work input factor 0.85, find the number of stages required.

   [6+10]

3. A centrifugal compressor aspires air at pressure and temperature of 0.9bar and 7^0C respectively, at a velocity of 110m/s. It is adiabatically compressed by the impeller to 1.6 bar and 70^0 C, final exit velocity is 300m/s. If the mass flow rate is 180 kg/min, calculate the power required to drive the compressor and estimate the isentropic efficiency of the compression process. [16]

4. (a) What are the reasons for not using constant volume gas turbine cycles in the present day gas turbine plants?
   (b) A simple constant pressure gas turbine plant operates at a pressure ratio of 6:1 and turbine inlet temperature is 730^0C. The air inlet temperature and pressure are 15^0C and 1.02bar respectively. If the isentropic efficiencies of compressor and turbine are 85% and 92% respectively. Determine work out put and overall efficiency of the plant. Take $C_p = 1.005$ kJ/kg.K and $\gamma = 1.4$.

   [6+10]

5. The steam from nozzles of a single wheel impulse turbine discharges with a velocity of 600m/s and at $20^0$to the plane of wheel. The blade wheel rotates at 3000RPM and the mean blade radius is 590mm. The axial velocity of steam at exit from the blades is 164m/s and the blades are symmetrical. Calculate
   (a) the blade angles,
   (b) the diagram work per unit mass flow rate of steam,
   (c) the diagram efficiency, and
   (d) the blade velocity co-efficient. [16]

6. A 50% Parson's reaction turbine has a mean drum diameter of 200cm. The speed is 600RPM and the steam consumption is 5kg/s. The other pertinent data is; blade to speed ratio : 0.45 ,velocity loss factor : 0.85, nozzle efficiency both for stator and rotor blades : 0.9, exit angle of stator and rotor blades : 20^0. Neglecting carry over and windage loss, estimate:
   (a) power developed per stage,
   (b) blade efficiency, and
   (c) stage efficiency. [16]
7. (a) Explain the working principle of a Turbo-prop? List out the advantages compared to turbojet?
   (b) What is thrust augmentation? What are the common thrust augmentation methods, explain each briefly? [8+8]
8. Write the short notes:-
   (a) Losses in flow passages
   (b) Impulse turbine
   (c) Impeller
   (d) Bleeding of steam [4+4+4+4]

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Code No: RR312003 **Set No. 3**

III B.Tech I Semester Regular Examinations, November 2006
TURBO MACHINERY
(Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Show that for a perfect gas when it is adiabatically decelerated stagnation temperature is T_o = T (1 + ((γ -1)/2) M^2).
   (b) Show that the discharge through a nozzle is maximum, when there is a sonic condition at its throat. [6+10]

2. (a) Draw the inlet and outlet velocity triangles of an axial flow compressor?
   (b) An axial flow compressor of 50% reaction desig has blades with inlet and outlet angles of 40^0 and 10^0. The compressor is to produce a pressure ratio of 5:1 with an overall isentropic efficiency of 87%. The mean blade speed and axial velocity are constant through out the compressor. Assuming blade velocity of 180 m/s and work input factor 0.85, find the number of stages required.

   [6+10]

3. (a) With a neat sketches describe the various essential parts of a centrifugal compressor.
   (b) Briefly explain, with suitable diagram how does the blade shape affect the performance of the compressor. [8+8]

4. (a) Explain the working of a closed cycle gas turbine unit with flow diagram and T-S diagram.
   (b) What are the advantages and disadvantages of a closed cycle gas turbine over open cycle gas turbine. [8+8]

5. The velocity of steam at inlet to a simple impulse turbine is 1000m/s, and the nozzle angle is 18^0. The blade speed is 400m/s and the blades are symmetrical. Determine the blade angles if the steam is to enter the blades without shock. If the friction effects on the blade are negligible, calculate the tangential force on the blades and the diagram power for a mass flow of 0.75kg/s. What is the axial thrust and the diagram efficiency? [16]

6. The following data refers to a 50% reaction turbine;drum diameter : 2m, speed of rotation : 800RPM, and steam flow rate is 15kg/s. The height blade is 15cm and the steam has a pressure of 0.4bar and 0.95 dryness fraction. For 20^0 discharge angle and assuming turbine efficiency as 80%. Estimate the power developed in this particular ring and enthalpy drop when the steam passes through the turbine pair. [16]

7. (a) Classify the propulsive systems?

(b) The exit velocity from a jet unit is 650m/s for airflow of 40 kg/s through the unit. The aircraft is flying at 250km/hr. Calculate the thrust developed, the power and propulsive efficiency. [6+10]

8. Write the short notes-

(a) Mach number, Mach angle

(b) Reaction turbine

(c) Flame stabilization

(d) By-pass governing [4+4+4+4]

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Code No: RR312003 **Set No. 4**

III B.Tech I Semester Regular Examinations, November 2006
TURBO MACHINERY
(Production Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain with neat sketch the development of boundary layer on a smooth plate held parallel to uniform flow?
   (b) Define and explain the terms boundary layer and boundary layer theory?

   [10+6]

2. (a) What is the effect of compressibility on fluid flow?
   (b) A light plane has a wing span of 10m and a chord of 2m for the aerofoil section. What are the lift and drag forces at the instant of take-off at a speed of 60 m/s, if the co-efficients of lift and drag are 0.95 and 0.1. [8+8]

3. The following data refers to a design of a centrifugal compressor:

inlet diameters of impeller	- 7.1cm
outlet diameters of impeller	- 13.2cm
speed	- 5000RPM
index of compression	- 1.56
pressure ratio	- 1.33
velocity of flow	- 70 m/s
free air delivered	- 1000 m^3/min

   Assuming that all pressure rise taken place in the impeller, find the angle at which air from the impeller enters the casing, breadth of the impeller blade at inlet and outlet. [16]

4. (a) Explain the working of a closed cycle gas turbine unit with flow diagram and T-S diagram.
   (b) What are the advantages and disadvantages of a closed cycle gas turbine over open cycle gas turbine. [8+8]

5. (a) Define critical pressure ratio? From fundamentals, derive the expression relating the critical pressure ratio to the index of expansion 'n' for expansion in nozzles.
   (b) The inlet and exit conditions of steam supplied to a nozzle has enthalpy 3210 kJ/kg and 2930kJ/kg. Taking velocity at inlet as 60m/s. Find
      i. the exit velocity of steam,
      ii. mass flow rate for an inlet area of 0.1 m^2 and specific volume of 0.19 m^3/kg inlet. Neglect the effect of friction. [6+10]

6. The stages of an ideal reaction turbine develop 3000kW when the mass flow of steam is 18,000kg/h. The mean value of the blade velocity is 0.8 times the steam velocity from fixed blades. The exit angle of each blade is constant at 20^0 and the axial velocity is constant throughout the turbine. Calculate the inlet angle of the blades and the enthalpy drop in each moving row. [16]

7. (a) Explain the working principle of Turbojet with a neat sketch and also draw the thermodynamic cycle?

   (b) Explain the working of Pulsejet with a neat sketch? List out the applications of Pulsejet? [8+8]

8. Write the short notes:-

   (a) Blade terminology

   (b) Compressible flow

   (c) Characteristic curves of Centrifugal Compressor

   (d) Classification of Gas Turbines [4+4+4+4]

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