Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2015

Subject Code: 150102 Date: 05-05-2015

Subject Name: Fundamentals of Turbo machines

Time: 02.30 pm - 05.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Draw and explain the h-S diagram for the radial turbine stage. **07**

(b) Draw and explain the different types or multistage arrangements in axial turbines. **07**

Q.2 **(a)** Explain in the detail the losses in turbomachines. **07**

(b) Write a short note on surging and choking in centrifugal compressor stage. **07**

OR

(b) Write a short note on slip factor and derive an expression for the same. **07**

Q.3 **(a)** Define and write the expressions for the followings for the axial compressor stage. **07**

a) flow coefficient
b) rotor pressure loss coefficient
c) rotor enthalpy loss coefficient
d) stator pressure loss coefficient
e) stator enthalpy loss coefficient
f) blade loading coefficient
g) degree of reaction

(b) An axial compressor stage has the following data: Temperature and pressure at entry is 300K and 1bar, DOR is 50%, mean blade ring diameter 36cm, rotational speed is 18,000 RPM, blade height at entry 6Cm, air angles at rotor and stator exit is 25, axial velocity 180m/s, work done factor 0.88, stage efficiency 0.85%, mechanical efficiency 96.7%. Determine: air angles at rotor and stator entry, the mss flow rate of air, power requires to drive the compressor, loading coefficient, pressure ratio developed by the stage, and the Mach number at the rotor entry. **07**

OR

Q.3 **(a)** An axial flow compressor has a flow coefficient of 0.8 and the loading coefficient is 0.88. if the blades are symmetrical, calculate the blade angles and the speed of the compressor. Take axial velocity as 200m/s and mean blade diameter as 47.75cm. **07**

(b) Draw the velocity triangle of outward flow reaction turbine. **07**

Q.4 **(a)** Explain briefly the performance graphs of a reaction turbine. **07**

(b) Define utilization factor and derive the expression for maximum utilization factor for 50% reaction stage. **07**

OR

Q.4 **(a)** Gas at 7bar 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 nozzles is 0.9, and **07**

that the velocity t entry to the stage is negligible, deduce the blade angle used and the mass flow required for this stage to produce 75KW.

Q.4 **(b)** Explain the general matching procedure for the jet engines. **07**

Q.5 **(a)** A centrifugal compressor has a pressure ratio of 4:1 with the efficiency of 0.8 when running at 15000 rpm and inducing air at 293K. curved vanes at inlet give the air a prewhirl of 25° to the axial direction at all radii and the mean diameter of eye is 250mm. the absolute air velocity at inlet is 150m/s. impeller tip diameter is 600mm. calculate the slip factor. **07**

(b) Discuss the axial turbine stage with radial equilibrium condition. **07**

OR

Q.5 **(a)** The convergent nozzle is having the pressure ratio of 2. The conditions at the nozzle entry are 25°C and 4.2 bar. The velocity at the entry is 30m/s. Calculate the Mach no at the entry and the exit of the nozzle and the stagnation and static properties at the exit to the nozzle. Nozzle efficiency is 85% **07**

(b) Discuss zero reaction stage, 50% reaction stage and the 100% reaction stage in detail. **07**

****