Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- Vth SEMESTER–EXAMINATION – MAY/JUNE - 2012

Subject code: 150102 Date: 02/06/2012

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)** Define Turbo machines and classify the same. **07**

(b) Differentiate axial compressor and centrifugal compressor. **07**

Q.2 **(a)** With a neat sketch explain the schematic of centrifugal compressor. **07**

(b) A centrifugal compressor has to deliver 35 kg of air per sec. the impeller is 76cm diameter revolving at 11,500RPM 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 radial velocity is 120m/s. the inlet condition are 1 bar and 47°C. **07**

OR

(b) A centrifugal compressor has inlet eye 15cm diameter. The impeller revolves at 20,000RPM and the inlet air has an axial velocity of 107m/s, inlet stagnation temperature 294K and inlet pressure 1.03kg/cm^2 determine **07**

1) Theoretical angle of the blade at this point
2) Mach number of the flow at tip of eye.

Q.3 **(a)** Draw and explain change in *h-s* diagram for axial turbine with different degree of freedom. **07**

(b) Draw velocity triangle for 2 stage velocity compounded turbine stages. **07**

OR

Q.3 **(a)** In a single stage impulse turbine the nozzle discharge the fluid on the blades at an angle of 65° to the axial direction and the fluid leaves the blade with an absolute velocity of 300m/s at an angle of 30° to the axial direction. If the blades have equal inlet and outlet angles and there is no axial thrust, estimate the blade angle, power produced per kg/s of the fluid and the blade efficiency. **07**

(b) An axial turbine rotating with the speed 6000RPM and having tip and hub diameter 750mm and 450mm respectively. Air angle at nozzle exit is 75º and relative angles at rotor entry and exit are 45 º and 76 º respectively. **07**

Draw velocity triangles for mean flow and determine

1) degree of reaction
2) blade to gas speed ratio
3) specific work

Q.4 **(a)** Draw *h-s* diagram for radial turbines. **07**

(b) A ninety degree IFR turbine stage has the following data. **07**

Total to static pressure ratio: 3.5,
Exit pressure: 1bar
Stagnation temperature at entry:650°C
Blade to gas sped ratio σ=0.66
Rotor diameter ratio: 0.45
Rotor speed :16000rpm

Nozzle exit angle: 20°
Calculate:

1) Rotor diameter
2) Rotor blade exit air angle
3) The mass-flow rate

OR

Q.4	**(a)**	Write a short note on losses in turbine.	**07**
	(b)	Explain the component matching procedure for turbo machines.	**07**
Q.5	**(a)**	Explain surging and chocking in axial compressor	**07**
	(b)	Air at a temperature of 290K enters a ten stage axial flow compressor at the rate of 3kg/s. the pressure ratio is 6.5 and the isentropic efficiency is 90%, the compression process being adiabatic. The compressor has symmetrical blades. The axial velocity of 110m/s is uniform across the stage and the mean blade speed of each stage is 180m/s. Determine the direction of the air at entry to and exit from the rotor and the stator blades and also the power given to the air. Assume Cp=1.005kJ/kgK and γ=1.4.	**07**

OR

Q.5	**(a)**	Draw and explain the velocity triangle for stage of axial compressor.	**07**
	(b)	What is radial equilibrium? Derive the equation for radial equilibrium.	**07**

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