Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER 2013

Subject Code: 150102 Date: 16-05-2013

Subject Name: Fundamentals of Turbo Machines

Time: 10:30 pm to 01:00 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 h-s diagram for an Axial compressor. **07**

(b) Differentiate turbo-machines and positive displacement machines **07**

Q.2 **(a)** What is degree of reaction? Obtain relations between different velocities and angles in 50% degree of reaction stages of an axial compressor. Also draw velocity triangles for the same. **07**

(b) Draw and explain h-s diagram for Centrifugal compressor. **07**

OR

(b) Draw and explain h-s diagram for the Axial turbine stage. **07**

Q.3 **(a)** Explain elements of a centrifugal compressor stage with neat sketch. **07**

(b) Derive the expression for axial flow compressor efficiency with the help of adiabatic efficiency and isentropic efficiency also explain design criteria of axial flow compressor. **07**

OR

Q.3 **(a)** Explain the stalling and surging for an axial compressor stage. **07**

(b) Axial flow compressor has following data: **07**

Temperature and pressure at inlet : 37^0C and 103kpa
Degree of reaction : 0.50
Mean blade ring diameter : 370mm
Rotational speed :20000rpm
Blade height at entry : 60mm
Air angle at rotor and stator exit : 25^0
Axial velocity : 180m/s
Work done factor : 0.88
Stage efficiency : 0.85
Mechanical efficiency : 0.97
Calculate:

1. Air angles at rotor and stator inlet
2. Mass flow rate
3. Specific work

Q.4 **(a)** Derive Euler's equation for turbo machine in the form of **07**

$$w = \frac{1}{2}\left(v_1^2 - v_2^2\right) + \frac{1}{2}\left(u_1^2 - u_2^2\right) + \frac{1}{2}\left(w_2^2 - w_1^2\right)$$

(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 speed ratio σ =0.66
Rotor diameter ratio: 0.45
Rotor speed :16000rpm
Nozzle exit air angle: 20°
Calculate:

1) Rotor diameter
2) Rotor blade exit air angle

OR

Q.4	**(a)**	Draw a velocity triangle for an axial turbine stages.	**07**
	(b)	Explain work, Blade loading and flow coefficients for an Axial turbine stages.	**07**
Q.5	**(a)**	Explain velocity triangles for an inward flow radial turbine stage with cantilever blades.	**07**
	(b)	Explain stage losses for Radial turbine stages.	**07**

OR

Q.5	**(a)**	Draw and explain performance charts for an Axial turbine stages.	**07**
	(b)	Explain the matching procedure for the compressors and turbines.	**07**

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