Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V • EXAMINATION – SUMMER • 2014

Subject Code: 150102 Date: 13-06-2014

Subject Name: Fundamentals of Turbo machines

Time: 10.30 am - 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 the complete h-s diagram for (1) Centrifugal Compressor, and (2) Axial Turbine	**07**
	(b)	What is equilibrium running of any gas turbine plant? Which are the conditions for equilibrium? Write procedure to find equilibrium points.	**07**
Q.2	**(a)**	Derive expressions for spouting velocity and stage efficiencies for radial turbine.	**07**
	(b)	1) How performance of axial compressor is evaluated? 2) Which are the basic assumptions made for matching trends of components for single spool turbojet engine?	**07**
		OR	
	(b)	Draw velocity triangles at entry and exit for 2-stage Pressure compounded impulse turbine, also explain variation in pressure and velocity while flow passing through the stages.	**07**
Q.3	**(a)**	Explain the phenomenon of *slip* in centrifugal compressor. What is slip factor? How it affects the actual work done and efficiencies of the centrifugal compressor.	**07**
	(b)	Classify the turbo machines in detail.	**07**
		OR	
Q.3	**(a)**	Compare the axial machines and the radial machines.	**07**
	(b)	List the general matching procedure for the gas turbine engines.	**07**
Q.4	**(a)**	Write a short note on losses in turbine.	**07**
	(b)	Draw and explain the velocity triangle for stage of axial compressor.	**07**
		OR	
Q.4	**(a)**	A 50% reaction, axial flow compressor runs at a mean blade speed of 50m/s. the pressure ratio developed by the machine is 1.3. Determine the blade and air angle if the mean flow velocity was 200m/s. condition at inlet are 1bar and 300K.	**07**
	(b)	Explain radial turbine stage with stage velocity triangle for radial turbine.	**07**
Q.5	**(a)**	Define degree of reaction and derive the expression for the same. Define the low reaction stage and high reaction stage.	**07**
	(b)	A multistage gas turbine is to be designed with impulse stages, and is to operate with an inlet pressure and temperature of 6 bar and 900 K and at outlet pressure of 1 bar. The isentropic efficiency of the turbine is 85%. All the stages are to have a nozzle outlet angle of 75° and equal outlet and inlet blade angles. Mean blade speed of 250 m/s and equal inlet and outlet gas velocities. Estimate the number of stages required considering optimum blade to gas speed ratio.	**07**
		OR	
Q.5	**(a)**	Draw and explain zero percent, fifty percent and hundred percent reaction axial turbine stages.	**07**
	(b)	For a ninety percent IFR turbine stage derive the expressions for power, stage loading coefficient and degree of reaction.	**07**

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