Seat No.: _____ **Enrolment No._____**

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–V (NEW) - EXAMINATION – SUMMER 2017

Subject Code: 2150102 **Date: 27/04/2017**

Subject Name: Fundamentals of Turbo Machines

Time: 02:30 PM to 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.**

			MARKS
Q.1		**Short Questions**	**14**
	1	What is the need of turbomachines?	
	2	What is the purpose of turbine?	
	3	Why nozzle is required in jet engines?	
	4	What is the need of diffuser in jet engines?	
	5	What is the basic working principle of all turbomachines?	
	6	What is the main purpose of compressor in jet engines?	
	7	Give example of an impulse turbine.	
	8	What is surging?	
	9	Differentiating stalling and surging?	
	10	What is an annular loss in turbomachine?	
	11	What is the difference between impulse turbines and reaction machines?	
	12	What is Degree of Reaction?	
	13	Define utilization factor.	
	14	Why multistaging of compressor is required in jet engines?	
Q.2	**(a)**	Differentiate between reciprocating machines and turbomachines.	**03**
	(b)	Draw h-s diagram for axial turbine stage.	**04**
	(c)	Explain the matching procedure for turbine and compressors.	**07**
		OR	
	(c)	Write a short note on rotating stall.	**07**
Q.3	**(a)**	Differentiate between axial machines and radial machines.	**03**
	(b)	A diffuser is having a pressure ratio of 2. Flow enters with the static conditions of 1bar, 288K and 100m/s. Calculate static and stagnation properties at exit to the diffuser.	**04**
	(c)	Draw h-s diagram for different reaction stages.	**07**
		OR	
Q.3	**(a)**	Draw a schematic diagram for centrifugal compressor.	**03**
	(b)	A nozzle is having a pressure ratio of 0.6. Flow enters with the static conditions of 1bar, 500K and 25m/s. Calculate static and stagnation properties at exit to the nozzle.	**04**
	(c)	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 an outlet pressure of 1 bar. The efficiency of turbine is 85%. All the stages	**07**

area to have a nozzle outlet angle of 75° and equal inlet and outlet gas velocities. Estimate the maximum number of stages required. Consider optimum blade to gas speed ratio.

Q.4 **(a)** Enlist the different types of losses occurred in turbomachines. **03**

(b) Draw h-s diagram for centrifugal compressor stage. **04**

(c) Draw and explain velocity triangle for axial compressor stage. **07**

OR

Q.4 **(a)** For radial machines prove that $h_{o1rel} - ½ u_1^2 = h_{o2rel} - ½ u_2^2$ **03**

(b) Draw entry and exit velocity triangles for backward swept blades. **04**

(c) 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 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. **07**

Q.5 **(a)** Draw variation of degree of reaction with flow coefficient for various values of blade angles for an axial turbine stage. **03**

(b) Draw entry and exit velocity triangles for forward swept blades. **04**

(c) Draw and explain h-s diagram for flow through a centrifugal compressor stage. **07**

OR

Q.5 **(a)** Determine the pressure ratio developed and the power required to drive a centrifugal air compressor (impeller diameter = 45 cm) running at 7200 rpm. Take zero swirl at the entry and T_{01} = 288 K. Assume isentropic flow with no shock, and radially tipped impeller blades. **03**

(b) Derive the expressions for spouting velocity and stage efficiency for radial turbine stage. **04**

(c) Explain in details the components of ninety degree inward flow radial turbine stage. **07**

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