Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE - SEMESTER–VII (NEW) EXAMINATION – WINTER 2023

Subject Code:3171927 Date:01-12-2023

Subject Name: Turbo Machines

Time: 10:30 AM 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.**
4. **Simple and non-programmable scientific calculators are allowed.**

Q.1	**(a)**	Define turbomachines. Explain driving and driven type of turbomachines.	**03**
	(b)	Differentiate fans and blowers. Also discuss noise issue for blowers and fans.	**04**
	(c)	Explain significance of following terms- 1. Flow coefficient 2. Head coefficient 3. Power coefficient	**07**
Q.2	**(a)**	Draw superimposed velocity triangle of axial flow turbines with proper notations.	**03**
	(b)	Write a note on compounding in axial flow turbines. Classify compounding.	**04**
	(c)	The data pertaining to an impulse turbine is as follows: Steam velocity = 500 m/s, blade speed = 200 m/s, Exit angle of moving blade = 20°. Neglecting the effect of friction, when passing through blade passages, determine: (a) inlet angle of moving blade, (b) exit velocity and direction, (c) work done per kg of steam, (d) axial thrust and power developed for a steam flow rate of 5 kg/s and (e) diagram or blade efficiency.	**07**
		OR	
	(c)	Draw and explain velocity triangle for inward flow radial (IFR) turbine. Also show that for 90° IFR turbine, stage loading coefficient is unity.	**07**
Q.3	**(a)**	Define degree of reaction for an IFR turbine stage.	**03**
	(b)	Explain internal and mechanical losses occurred into the axial flow compressor.	**04**
	(c)	The following data refers to an axial flow compressor: Relative flow angle at inlet, $\beta_1 = 60°$, turning angle = 30° and difference of whirl velocity between inlet and outlet, $\Delta C_w = 100$ m/s, degree of reaction 50%, speed 36000 rpm, mean diameter = 140 mm, inlet pressure = 2 bar and inlet temperature = 57°C. Find air flow angle, α_1, the pressure rise, the amount of air handled and power, if the blade height is 20 mm.	**07**
		OR	
Q.3	**(a)**	Define blade to gas speed ratio for an axial flow turbine.	**03**
	(b)	Describe two stage axial flow compressors consist of inlet guide vanes with proper schematic diagram.	**04**
	(c)	Plot *h-S* diagram for axial flow compressor and define overall total-to-total (isentropic) efficiency.	**07**
Q.4	**(a)**	Show slip and velocity distribution using velocity triangle of centrifugal compressor.	**03**
	(b)	Discuss general (Ideal) characteristics of a centrifugal Compressor.	**04**
	(c)	Explain vaneless and vaned diffuser for a centrifugal compressor.	**07**
		OR	
Q.4	**(a)**	What is the function of diffuser in centrifugal compressor? Also draw a sketch of volute or scroll collector.	**03**
	(b)	List out and explain losses in centrifugal compressor.	**04**

	(c)	Explain slip and slip factor with significance in centrifugal compressor.	**07**
Q.5	**(a)**	Classify fans and blowers.	**03**
	(b)	List out and explain different losses in fans.	**04**
	(c)	Explain advantages, disadvantages and limitations of CFD.	**07**

OR

Q.5	**(a)**	Define for fans: 1. Static and total efficiency 2. Volumetric efficiency	**03**
	(b)	Explain theoretical and actual characteristics of centrifugal fan.	**04**
	(c)	How CFD is useful in designing and analysis of turbomachinery? Explain in detail.	**07**

****