Enrolment No./Seat No_____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER–V (NEW) EXAMINATION – WINTER 2024

Subject Code:3150102 Date:17-12-2024

Subject Name:Fundamentals of Turbomachines

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.**

			Marks
Q.1	**(a)**	Define and classify turbo-machines in detail.	**03**
	(b)	Write difference between fan, blower, compressor and pump.	**04**
	(c)	Draw velocity triangles at entry and exit for 2-stage Pressure-compounded impulse turbine with explain variation in pressure and velocity while flow passing through the stages.	**07**
Q.2	**(a)**	Explain the performance charts for an axial turbine stage.	**03**
	(b)	Explain cooling technique used for gas turbine blades with neat sketches.	**04**
	(c)	A gas turbine nozzle pressure ratio is 2.5, pressure at entry is 1.01325 bar, and temperature is 300 K. The efficiency of nozzle is 85 %. Determine the exit Mach number, velocity at exit of nozzle. Take gama (r) = 1.4, draw h-s diagram for nozzle.	**07**
		OR	
	(c)	An axial turbine rotating with the speed 5000 RPM and having tip and hub diameter 700 mm and 400 mm respectively. Air angle at nozzle exit is 75^o and relative angles at rotor entry and exit are 40^o and 70^o respectively. Draw velocity triangles for mean flow and determine: Degree of reaction, Blade to gas speed ratio, Specific work.	**07**
Q.3	**(a)**	Explain Stalling of an axial flow compressor.	**03**
	(b)	With a neat sketch explain the working principle of axial flow compressor.	**04**
	(c)	A 50 % reaction, axial flow compressor runs at a mean blade speed of 40 m/s. the pressure ratio developed by the machine is 1.2. Determine the blade and air angle if the mean flow velocity was 150 m/s. condition at inlet are 1 bar and 300 K.	**07**
		OR	
Q.3	**(a)**	Write difference between axial compressor and centrifugal compressor.	**03**
	(b)	Draw and explain H-S diagram of Axial compressor stage.	**04**
	(c)	An axial flow compressor has a flow coefficient of 0.75 and the loading coefficient is 0.85. if the blades are symmetrical, calculate the blade angles and the speed of the compressor. Take axial velocity as 200 m/s and mean blade diameter as 48 cm.	**07**
Q.4	**(a)**	List the losses in centrifugal compressor.	**03**
	(b)	Write a short note on surging and choking in centrifugal compressor stage.	**04**
	(c)	Explain slip factor and its effect on flow and pressure ratio in the stage of centrifugal compressor, also derive the Stodola's relation for slip factor.	**07**
		OR	

Q.4	**(a)**	Draw sketches of the three types of impellers and the velocity triangles at their exits.	**03**
	(b)	Define: Utilization factor, Flow coefficient, Work loading coefficient, Total to total efficiency.	**04**
	(c)	With the help of diagram, explain the various components of centrifugal compressor. Also explain role of various components described.	**07**
Q.5	**(a)**	Write six differences between axial turbine and radial turbine.	**03**
	(b)	Explain radial equilibrium and derive the equation for radial equilibrium.	**04**
	(c)	Derive expressions for spouting velocity and stage efficiencies for radial turbine.	**07**

OR

Q.5	**(a)**	Defne: Design condition, Off design condition, Matching point.	**03**
	(b)	Write the steps to find equilibrium point in a turbojet engine.	**04**
	(c)	Explain General matching procedure of jet engines.	**07**

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