Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE – SEMESTER – V (NEW) EXAMINATION – WINTER 2015

Subject Code: 2150102 **Date:05/12/ 2015**

Subject Name: Fundamentals of Turbomachines

Time:10:30am to 1:00pm **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)** Explain surging and chocking in axial compressor stage. **07**

(b) An axial compressor stage has the following data: **07**

Temperature and Pressure at entry 300K and 2 bar
Degree of reaction is 50%
Mean blade ring diameter is 46 cm
Rotational speed is 18000rpm
Blade height ay entry is 7cm
Air angles at rotor and stator exit is 25^0
Axial velocity is 190m/s
Work done factor is 0.88
Stage efficiency is 88%
Mechanical efficiency is 98%
Find out

1. Air angles at the rotor and stator entry
2. The mass flow rate of air
3. The power required to drive the compressor
4. The loading efficient
5. The pressure ratio developed by the stage

Q.2 **(a)** With the help of diagram, explain the various components of centrifugal compressor. **07**

(b) A Nozzle has a pressure ratio of 1.8, pressure at entry is 1.01325 bar and temperature is 280K, efficiency of nozzle is 85%, determine exit velocity and exit mach number. **07**

OR

(b) Draw and explain the complete velocity triangle for Axial Turbine stage and derive the expressions for work developed by the turbine and degree of reaction. **07**

Q.3 **(a)** Differentiate turbo-machines and positive displacement machines **07**

(b) Explain and draw h-s diagram of an axial flow compressor. **07**

OR

Q.3 **(a)** Explain elements of a Radial turbine stage with neat sketch. **07**

(b) Explain Spouting velocity and Stage efficiency for radial turbine stage. **07**

Q.4 **(a)** Explain velocity triangles for a single impulse stage with negative swirl at exit and maximum utilization factor with neat sketch. **07**

(b) Explain Multi stage pressure compounded impulse for axial turbine stage. **07**

OR

Q.4 **(a)** Explain Enthalpy-entropy diagram for 50% & 100% reaction stage for axial turbine stage. **07**

	(b)	A gas turbine having single stage rotates at 15000 rpm. The nozzle pressure ratio 3, inlet temperature is 900^0C. A gas leaves stage in axial direction, nozzle outlet angle is 25^0 with tangential and total nozzle loss is 10%. Calculate power output by turbine and gas angles at entry. The mean plate diameter is 70cm, mass flow rate of gas is 25kg/s.	**07**
Q.5	**(a)**	Explain performance charts for zero reaction, 50% reaction, and axial exit for axial turbine stage.	**07**
	(b)	Define degree of reaction and derive the expression for the same for axial compressor stage. Also derive 50 % reaction stage.	**07**

OR

Q.5	**(a)**	A Centrifugal compressor operates with no prewal condition and is run with rotor tip speed of 500 m/s, the slip factor is 0.95, Ambient temperature is 16^0C, calculate the following 1. Pressure ratio. 2. Work required per kg of air. 3. power require for flow of 30 kg/s.	**07**
	(b)	Explain general matching procedure of components.	**07**

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