

Seat No.: _____

Enrolment No. _____

GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER-V EXAMINATION – WINTER 2015

Subject Code: 150102

Date: 17/12/2015

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) Define degree of reaction and derive the expression for the degree of reaction for axial compressor stage. **07**
- (b) Draw and explain the sketch of two stage axial compressor with IGVs. **07**
- Q.2** (a) 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**
- (b) With the help of diagram, explain the various components of centrifugal compressor. **07**
- OR**
- (b) Explain radial turbine stage with stage velocity triangle for radial turbine. **07**
- Q.3** (a) Explain Stalling of an axial flow compressor. What is rotating stall? **07**
- (b) Differentiate turbo-machines and positive displacement machines **07**
- OR**
- Q.3** (a) Write a short note on losses in turbine. **07**
- (b) Explain and draw h-s diagram of an axial flow compressor. **07**
- Q.4** (a) An axial flow compressor of 50% reaction has blades with inlet and outlet angle of 50° & 15° the compressor is to produce pressure ratio of 8:1 with an overall isentropic efficiency of 80%. The inlet static temperature 40°C . The blade speed and axial velocity are constant throughout compressor. Blade speed is 200m/s, Find number of stages required, if work done factor is 1. **07**
- (b) Draw and explain h-s diagram for Centrifugal Compressor. **07**
- OR**
- Q.4** (a) Explain surging and choking in axial compressor. **07**
- (b) A gas turbine nozzle pressure ratio is 2, pressure at entry is 1.01325 bar, and temperature is 280K. The efficiency of nozzle is 80%. Determine the exit mach number, velocity at exit of nozzle. Take $\gamma=1.4$, draw h-s diagram for nozzle. **07**
- Q.5** (a) What is radial equilibrium? Derive the equation for radial equilibrium. **07**

- (b) A gas turbine having a single stage rotates at 15000 rpm, the nozzle pressure ratio is 3, and inlet temperature is 900°C . A gas leaves stage in axial directions, nozzle outlet angle is 25° with tangential and total nozzle loss is 10%.
The mean plate diameter is 70 cm; mass flow rate of gas is 25 kg/s.
Calculate
1. Power output by turbine
 2. Gas angle at entry

OR

- Q.5** (a) Explain general matching procedure of components. **07**
(b) Air enters the inducer blades of a centrifugal compressor at $p_{01}=1.02$ bar, $T_{01}=335\text{K}$, the hub and tip diameter of the impeller eye are 10 and 25 cm. If the compressor runs at 7200 rpm and delivers 5 kg/s of air, **07**

Find out

1. The air angle at the inducer blade entry
2. Relative mach number

If IGVs are used to obtain a straight inducer section,
Determine

1. The air angle at the IGVs exit
2. The new value of the relative Mach number.
