Roll No										

B.E./B.Tech (Full-Time) DEGREE END SEMESTER EXAMINATION, APRIL/MAY 2013
Mechanical Engineering Branch
FIFTH Semester- REGULATIONS 2008

ME 9031 – TURBO MACHINERY

Note: 1. Draw neat sketches and velocity diagrams wherever necessary
2. Assume any missing data suitably giving justification

Time : Three hours Maximum : 100 marks

Answer ALL questions

Part A – (10 × 2 = 20 marks)

1. How do you classify power absorbing machines?
2. What is the usefulness of specific speed?
3. List some of the attractive aspects of centrifugal fan.
4. What are the main causes of fan noise?
5. What is the role of IGV in centrifugal compressor?
6. Express stage work equation for centrifugal compressor with and without IGV.
7. Show the variation of pressure and velocity in axial compressor stage.
8. Compare the merits and demerits of pressure producing machine.
9. What do you mean by utilization factor for axial turbine?
10. Define degree of reaction for radial turbine.

Part B – (5 × 16 = 80 marks)

11.a) i Explain the procedure adopted for Buckingham's Pi- Theorem. **(10)**

ii A turbo machine operating with a pressure ratio of 5 has temperatures at the two ends of the machine as 76°C and 202°C. The process through the machine is adiabatic and the fluid medium is air. Find whether it is a power absorbing or producing machine **(6)**

12.a) The inner and outer diameter of the centrifugal fan impeller are 18 cm and 20 cm respectively. Speed is 1450 rpm. The relative and absolute velocities respectively are: At entry 20 m/s and 21 m/s; At exit 17 m/s and 25 m/s. Flow rate is 0.5 kg/s. Motor efficiency is 78%. Determine (i) The stage pressure rise (ii) Degree of Reaction (iii) The power required to drive the fan. Take density of air = 1.25 kg/m^3

(Or)

b) Compare the pros and cons of backward-swept, forward-swept and radial blades of centrifugal power absorbing machine through its velocity triangles.

13.a) A centrifugal compressor has the following data:

Impeller type : radial tipped
Entry pressure, temperature & relative mach number : 1 bar, 303 K & 0.4
Speed : 116 rps
Hub diameter and inlet cross sectional area : 0.15 m and 0.05 m^2
Blade width at impeller exit : 0.0602 m

Flow enters axially at inducer section of the impeller. Fluid leaves radially and having density 10 % higher than the inlet density.

Find (a) specific work and mass flow rate handled by the machine. Also complete the inlet and exit velocity triangle.

(Or)

b) Write short note on the following (i) Performance characteristics of centrifugal compressor (ii) Slip factor and its effects (iii) Vaned diffuser (iv) h-s diagram for flow through a centrifugal compressor stage

14.a) An axial flow air compressor of 50% reaction design has blades with inlet and outlet angles of 45^0 and 10^0 (both angles measured from axial direction) respectively. The compressor is to produce a pressure ratio of 6:1 with an overall isentropic efficiency of 0.85 when inlet static temperature is 37^0 C. The blade speed and axial velocity are constant throughout the compressor. Assuming a value of 200 m/s for blade speed find the number of stages required if the work done factor is (i) unity and (ii) 0.87 for all stages.

(Or)

b) Write short notes on the following (i) Low and high degree of reactions (ii) work done factor and its effects (iii) Stalling and (iv) Surging

15.a) Why some axial turbines are designed by having compounding method? Explain (i) multi stage velocity compounding and (ii) multi stage pressure compounding

(Or)

b) An inward flow radial turbine has the following data:

Power	: 150 kW
Speed	: 533.33 rps
Outer diameter of the impeller	: 20 cm
Inner diameter of the impeller	: 8 cm
Absolute velocity of gas at entry	: 387 m/s
Absolute velocity of gas at exit	: 193 m/s (radial)

The gas enters the impeller radially.

Construct the velocity triangles at the entry and exit of the impeller and determine: (i) the mass flow rate (ii) the percentage energy transfer due to the change of radius.