1. In axial flow compressors, describe the functions of Inlet Guide Vanes (IGV), Rotor Blades, and Stator Blades.

2. In axial flow compressors, prove that the stage loading factor can be calculated by the relation $\psi = 1 - \phi(\tan\alpha_1 + \tan\beta_2)$.

3. Describe about the "Surge" phenomenon in an axial flow compressor.

4. An axial flow compressor is required to deliver 50kg/s of air at a stagnation pressure of 500 kPa. At inlet to the first stage the stagnation pressure is 100 kPa and the stagnation temperature is $23 \circ$C. The hub and tip diameters at this location are 0.436 m and 0.728m. At the mean radius, which is constant through all stages of the compressor, the reaction is 0.50 and the absolute air angle at stator exit is 28.8deg for all stages. The speed of the rotor is 8000 rpm. Determine the number of similar stages needed assuming that the polytropic efficiency is 0.89 and that the axial velocity at the mean radius is constant through the stages and equal to 1.05 times the average axial velocity.

5. For an axial flow compressor with the following information, find the exit stagnation temperature:

   (a) Relative Mach number of 0.7 on the rotor.

   (b) The flow coefficient is 0.5.

   (c) The relative flow angle at rotor outlet is 30 deg measured from the axial direction.

   (d) The stage reaction is 50%.

   (e) $\gamma = 1.4$, $R = 287$.

6. Each stage of an axial flow compressor is of 0.5 reaction, has the same mean blade speed and the same flow outlet angle of 30 deg relative to the blades. The mean flow coefficient is constant for all stages at 0.5. At entry to the first stage the stagnation temperature is 278 K, the stagnation pressure 101.3 kPa, the static pressure is 87.3 kPa and the flow area 0.372 m^2. Using compressible flow analysis determine the axial velocity and the mass flow rate. Determine also the shaft power needed to drive the compressor when there are six stages and the mechanical efficiency is 0.99.