

Exercise Problem # 1

- An axial flow compressor of 50 percent reaction design has blades with inlet and outlet angles at 45° and 10° respectively. The compressor is to produce a pressure ratio of 6:1 with overall isentropic efficiency of 0.85 when inlet static temperature is 37°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 (a) unity and (b) 0.87.
- Ans: (a) 8 (b) 9

Exercise Problem # 2

- Air at 1 bar and 288 K enters an axial flow compressor stage with an axial velocity of 150 m/s. There are no inlet guide vanes. The rotor has a tip diameter of 60 cm and a hub diameter of 50 cm and rotates at 100 rps. The air enters the rotor and leaves the stator with no change in velocity or radius. The air is turned through 30° as it passes through the rotor. Determine (a) the blade angles (b) mass flow rate (c) power required and (d) the degree of reaction.
- Ans: (a) $49^\circ, 19^\circ$ (b) 14.38 kg/s © 300.7 kW (d) 0.65

Exercise Problem # 3

- An axial compressor stage has the following data: Degree of reaction : 50%, Mean blade dia: 36cm, rotational speed: 18000 rpm, blade height at entry: 6 cm, air angles at rotor and stator exit: 25°, axial velocity: 180 m/s, workdone factor: 0.88, stage efficiency: 0.85, mechanical efficiency: 96.7%. Determine (a) air angles at rotor and stator entry (b) mass flow rate (c) power required (d) stage loading coefficient (e) pressure ratio developed by stage (f) relative Mach number at rotor entry.
- Ans: (a) 54.82°, 25° (b) 14.37 kg/s (c) 51.2 kJ/kg (d) 0.44 (e) 1.6 (f) 0.90

Exercise Problem # 4

- A 50% reaction axial flow compressor has inlet and outlet blade angles of 45° and 12° , respectively. The blade speed at the tip of the rotor is 320 m/s. If the inlet total temperature is 300 K, determine the tip relative Mach number.
- Ans: 1.146

Exercise Problem # 5

- A 10 stage axial flow compressor develops an overall pressure ratio of 8.0 with an isentropic efficiency of 0.85. The absolute velocity component of air enters the rotor at an angle of 27° to the axial direction. The axial component of velocity is constant throughout the compressor and is equal to 150 m/s. If the ambient air conditions are 15°C and 1 bar, determine the angle which the relative component of velocity makes with the axial direction at the exit of the rotor.
- Ans: 14°