(Electric Machine)
Synchronous Machines and Single Phase Machines

QN1 The rotor of a synchronous generator has two numbers of magnetic poles. At which speed the rotor shall be driven to generate the voltage at 50Hz? If the 4-pole machine is driven at the same speed, would be the generated frequency? If the required frequency is 50Hz, at what speed, the rotor shall be driven?
[Ans: 3000rpm, 100Hz, 1500rpm]

QN2 A 500 kVA, 3-phase, star-connected synchronous generator has a rated line to line terminal voltage of 3300V when the generator is fully loaded with 0.8 lagging power factor. The resistance and synchronous reactance per phase of the stator winding are 0.3Ω and 4.0Ω respectively. Calculate the internal emf generated by the generator and voltage regulation. If the generator is fully loaded with 0.8 leading power factor, calculate the internal emf generated by the generator and voltage regulation.
[Ans: 2152.2<7.05 V, 12.97% and 1741.34<79.775 V, -8.59%]

QN3 A 500 kW, 3300V, 3-phase, star-connected synchronous motor has resistance and synchronous reactance per phase of 0.8Ω and 8.0Ω respectively. When the motor is loaded, the magnitude of back emf is equal to the magnitude of supply voltage, but it lags by an angle of 36degrees. The DC field excitation current is 10 A. Calculate the magnitude of current drawn by the motor and input power factor of the motor. If the DC excitation current is made double keeping the load on the motor constant, calculate the magnitude of armature current and power factor.
[Ans: 146.43<-12.3 A, 0.97 lagging and 314.68 <33.44, 0.834 leading]

QN4 A 500 kVA, 6.6kV, 3 Phase, 50Hz, star connected synchronous generator has a synchronous reactance per phase of 25Ω and negligible resistance. It supplies full load current at 0.8 leading power factor and a rated terminal voltage. Calculate the terminal voltage for the same excitation when the generator is supplying full load current at unity power factor.

QN5 A four-pole, single phase, 120V, 50Hz induction motor gave the following standstill impedances when tested at rated frequency:
Main winding: $Z_m = (1.5 + j4)$ ohms
Auxiliary winding : $Z_a = (3 + j6)$ ohms
Determine the value of external capacitor and resistor to be inserted in series with the auxiliary winding to obtain maximum starting torque keeping magnitude of auxiliary winding current constant. [Ans: C = 879.2 μF]

QN6 The main winding and starting winding of a 120V, 50 Hz capacitor start single-phase induction motor have impedances as follow:
Main winding: (3 + 3j) ohm
Starting winding: (7.5 + j3) ohm
Calculate the value of capacitor to be connected in series with the starting winding to produce a phase difference of 90^0 between main winding current and starting winding current at starting.
[Ans : 707.7 μF]