Q1.A three-phase 13.8 kV 25-MVA synchronous generator has three-phase short circuit loss of 52.8 kW at rated armature current. Calculate (a) its rated armature current and (b) its effective armature resistance in Ω/phase.
[1046 A, 0.0161 Ω]

Q2.A 3600 rpm, 60 Hz, 13.8 kV synchronous generator has a synchronous reactance of $20\ \Omega$ The generator is operating at rated voltage and speed with the excitation voltage $E_f = 11.5\ \text{kV}$ and the torque angle $\delta = 15°$. Calculate (*a*) stator current, (*b*) power factor, and (*c*) total output power. (*d*) the maximum power that can be converted from mechanical to electrical form without loss of synchronism if the field current is unchanged and the value of current I_a for this condition (hint: for max power $\delta = 90°$).
[216.35 A, 0.688 lagg., 3557.8 kW, 4.58 MW, 699.52 A]

Q3. A 500 MVA, 24 kV, 60 Hz three-phase alternator is operating at rated voltage and frequency with a terminal power factor of 0.8 lagging. The leakage reactance $X_1 = 0.15\ \Omega$ and the synchronous reactance $X_s = 0.8\ \Omega$. Stator coil resistance is negligible. The excitation voltage $E_f = 18\ \text{kV}$. Determine (a) the torque angle δ, (b) the total output power, (c) the line current I_a, and (d) the resultant/residual voltage $\bar{E}_r$ (voltage behind armature reactance).
Neglect armature resistance.

[15.12^0, 244 MW, 7.337 kA, 14.544 kV]

Q4.A 60-Hz, three-phase synchronous motor is observed to have a terminal voltage of 460 V (line-line) and a terminal current of 120 A at a power factor of 0.95 lagging. The field-current under this operating condition is 47 A. The machine synchronous reactance is equal to 1.68 **Ω**. Assume the armature resistance to be negligible.
Calculate (a) the generated voltage E_f in volts, (b) the electrical power input to the motor in kW and in horsepower, and (c) generated voltage E_f and phase angle ∂ of the generated voltage assuming input power stays constant at unity power factor.

[278.8 V∠-43.4^0, 90.8 kW, 122 hp, 328 V, -35.8^0]

Q5.A three-phase, 1200 HP, 2300 V, 60 Hz, RR synchronous machine has $R_s = 0.2\ \Omega$ and $X_s = 5.6\ \Omega$. When operated with the mechanical load disconnected with rated voltage and frequency, the field current is adjusted until line current has a minimum value. At this point, $I_a = 22.1\ \text{A}$, the measured input power is $P_T = 17.5\ \text{kW}$, and the measured field circuit values are $V_f = 276\ \text{V}$ and $I_f = 53.2\ \text{A}$. (*a*) Determine the rotational losses (core losses plus friction and windage) for this machine. (*b*) If the field current, frequency, and impressed terminal voltage are unchanged, but a mechanical load requiring 600 HP is attached, calculate line current, power factor, and efficiency.

[17.793 kW, 130.7 A, 0.977 (lagg.), 91.3%]

Q6. A 250 MVA, 24 kV, 60 Hz, three-phase alternator is operating at rated voltage, rated frequency, and rated apparent power with a terminal power factor of 0.8 lagging. Stator coil resistance is negligible. The excitation voltage $E_f = 20$ kV. Determine (a) the torque angle δ and (b) the value of synchronous reactance X_s.

[19.47^0, 1.38 Ω]