1.

At a location in Europe, it is necessary to supply 1000 kW of 60-fiz power. The only power sources available operate at 50 Hz. It is decided to generate the power by means of a motor-generator set consisting of a synchronous motor driving a synchronous generator. How many poles should each of the two machines have in order to convert 50-Hz power to 60-Hz power?

2.

A six-pole, 60-Hz synchronous machine has a peak fundamental air-gap flux density of 1.23T. The rotor length is 1.97m, the rotor radius is 58cm, and the air-gap length = 3.15cm. It consists of one full-pitch, 11-turn coil per pole pair, with the coils connected in series to form the phase winding. If the machine is operating at rated speed.

(a) What is the rated operating speed in r/min?

(b) Calculate the corresponding flux per pole.

(c) Calculate the rms generated voltage per phase.

# Homework 6

1. motor has $P_1$ poles,

generator has $P_2$ poles

$$\frac{P_1}{2} = \frac{50Hz}{f_1}, \quad \frac{P_2}{2} = \frac{60Hz}{f_1}$$

$$\Downarrow$$

$$\frac{P_1}{P_2} = \frac{5}{6}$$

Since $P_1, P_2$ must be even number

$$\frac{P_1}{P_2} = \frac{10}{12} = \begin{cases} P_1 = 10N \\ P_2 = 12N \end{cases}, \quad N \in N^*$$

2. (a) $\frac{n}{60} = \frac{6}{\frac{P_1}{2}}$

$n = 1200$ r/min

(b) $\Phi = \int B ds$

$= \frac{2}{P} 2lBr$

$= \frac{2}{6} \times 2 \times 1.97 \times 1.23 \times 0.58$

$= 0.9369$ V

(c) $V = \frac{\sqrt{2}}{2} 2\pi f N \Phi$

$= 4.44 \times 60 \times 11 \times 0.9369$

$= 2745$ V