WARSAW UNIVERSITY OF TECHNOLOGY
INSTITUTE OF ELECTRICAL MACHINES
ELECTRICAL MACHINES LABORATORY

SYNCHRONOUS MOTOR TESTS (SYN1)

RATINGS OF SYNCHRONOUS MOTOR AND DC BREAKER

Synchronous motor:

S_N = ...	U_N = ...		
I_N = ...	$\cos\varphi_N$ = ...		
U_{fN} = ...	I_{fN} = ...		
n_N = ...			

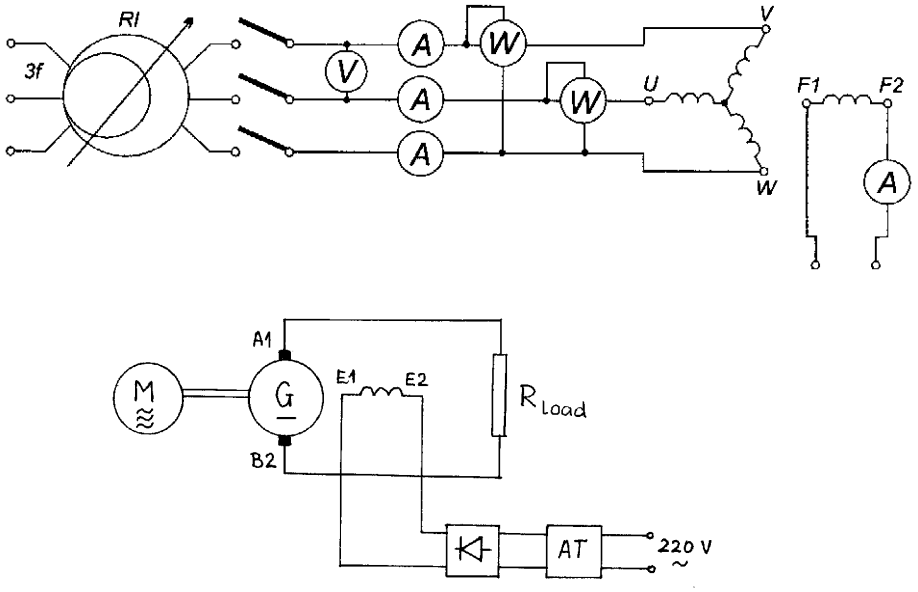
DC breaker:

P_N = ...	U_N = ...
I_N = ...	I_{fN} = ...
n_N = ...	

Measure the field winding resistance of synchronous motor R_f = ...
Draw the scheme of windings and terminals' symbols

1. STARTING OF THE SYNCHRONOUS MOTOR

Supply circuit of synchronous motor (applicable for all tests):



A start of synchronous motor due to the existing starting cage (squirrel cage) is similar to starting of squirrel cage induction motor. During first stage of start of synchronous motor the rotational speed of magnetic field in respect to the field winding is very high and may create high EMF (induced voltage). To reduce its level it is necessary to short circuit the field winding through resistor:

$$R_d = (5 \div 10)\, R_f$$

In this stage the supply voltage should be reduced in such a way that starting current is kept within the limits $(1\div2)I_N$. After current stabilisation the supply voltage should be increased to achieve rotational speed close to synchronous one. At this moment after switching field winding to the DC supply voltage, the field current flow should be increased to reach synchronous speed. Motor should be overexcited to such a value of field current that armature current equal to 0.25 I_N is forced.

2. V-SHAPE CHARACTERISTICS $I = f(I_f)$ for $U = U_N$ and P = const

Synchronous motor output power should be kept constant for several values:

$$P_{out} = 0, \qquad P_{out} = 0.25\ P_N, \qquad P_{out} = 0.5\ P_N.$$

During test the synchronous motor is loaded by DC generator being loaded by the load resistor R_{load} . The load can be varied by means of DC generator excitation current change. The input power of DC generator (being the same as output power of synchronous motor $P_{ing} = P_{out}$), can be calculated from the equation:

$$P_{ing} = P_{outg}/\eta_g$$

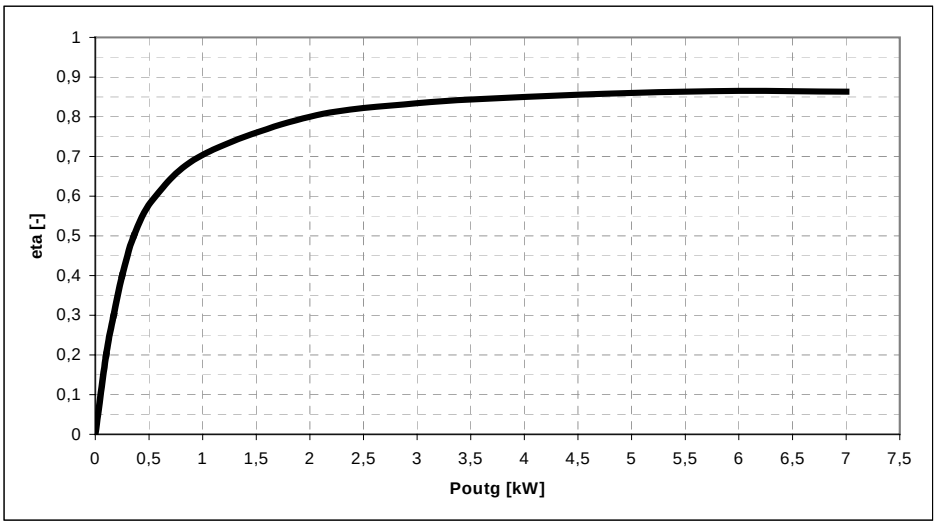
where η_g is efficiency of DC generator (determined from efficiency characteristic: $\eta_g = f(P_{outg})$. P_{outg} is calculated from the output current I_g and voltage U_g of DC generator. Field current of the synchronous motor should be changed from such a value for which armature current is equal to $1.1\times I_N$ to its possible minimum value. In this case regulations should be done very carefully due to possible stability problems in under-excited motor.

Table of measurements:

P_{out}	U_g	I_g	P_{outg}	η_g		1	2	3	...
P=0		0	0	0	I				
					I_f				
$0.25P_N$					I				
					I_f				
$0.5P_N$					I				
					I_f				

Draw the V-shape characteristics:

Efficiency characteristic $\eta_g = f(P_{outg})$ of DC generator:



3. LOAD CHARACTERISTICS $I, \cos\varphi, \eta = f(P_{out})$

Determine the load characteristics for nominal value of field current.

U_{in} = ...
I_f = ...

No of read.	I	P_α	P_β	$\cos\varphi$	U_g	I_g	I_{fr}	I_r	P_{in}	P_g	P_{out}	η
	A	W	W	-	V	A	p.u.	p.u.	W	W	W	-
1												
2												
...												

In common co-ordinates draw the following characteristics: I, $\cos\varphi$, $\eta = f(P_2)$ in per unit.

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