WARSAW UNIVERSITY OF TECHNOLOGY
INSTITUTE OF ELECTRICAL MACHINES
ELECTRICAL MACHINES LABORATORY

UNIVERSAL MOTOR TESTS (SK)
(Single-phase commutator series motor)

When alternating current is supplied to a series commutator motor, the stator magnetic flux and rotor current vary in exact time phase. Both reverse at the same instant and consequently the torque is always in the same direction, though pulsating in magnitude at twice line frequency. Average torque is produced and the performance of the motor is generally similar to that with DC. A series motor has the convenient ability to run on either AC or DC and with similar characteristics, provided both stator and rotor cores are laminated.
Small universal motors are used where light weight is important, as in vacuum cleaners, kitchen appliances, portable tools. They usually operate at high speeds (1500 - 15 000 rev/min). The universal motor provides the highest power per zloty in the small power range, at the expense of noise, relatively short life and high speed.

RATING OF THE MOTOR TO BE TESTED

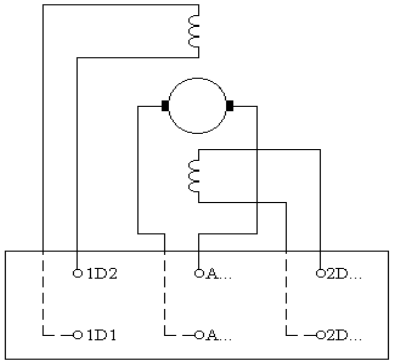
P_N = ... U_N = ... *Calculations:*

n_N = ... I_N = ... Rated torque M_N = ...

direction of rotation - ...

1. DETERMINATION OF WINDING TERMINALS

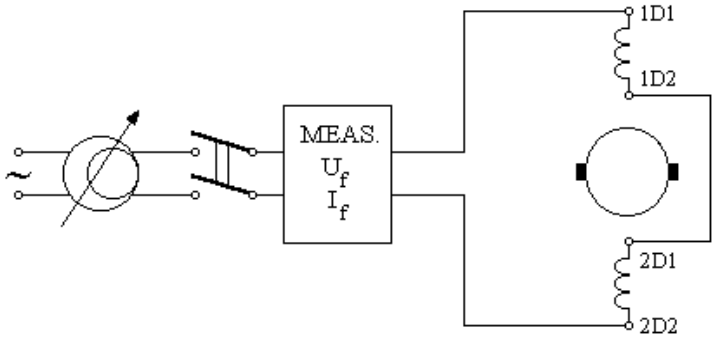
Measuring circuit diagram:

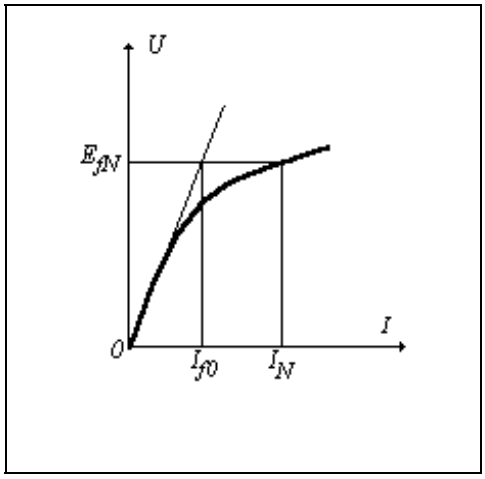


A - armature winding, D - field (exciting) winding

2. MAGNETIZATION CHARACTERISTIC U_f = f(I_f)

Measurements are to be made with the brushes located at commutator; the effect of shorted turns reaction is neglected.



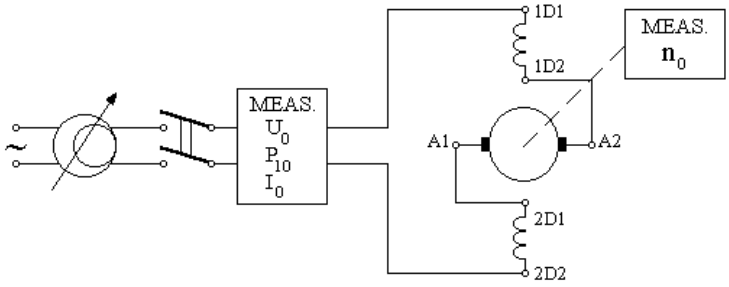


No of read	U_f V	I_f A
1		
2		
3		
...		

From the characteristic determine the voltage E_{fN} corresponding to $I_f = I_N$ and the magnetic circuit saturation ratio $k_{sat}=I_N/I_{f0}I$.

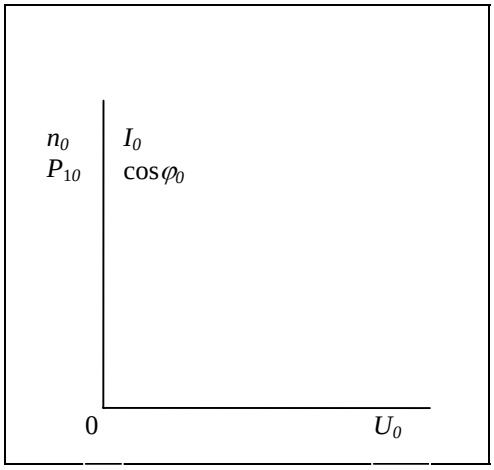
3. NO-LOAD CHARACTERISTICS

Measuring circuit diagram:



Measurements should be made with decreasing value of the supplying voltage. The speed should never exceed $1.3n_N$.

No of read.	U_0 V	I_0 A	P_{10} W	n_0 rev/min	$\cos\varphi_0$ -
1					
2					
3					
...					

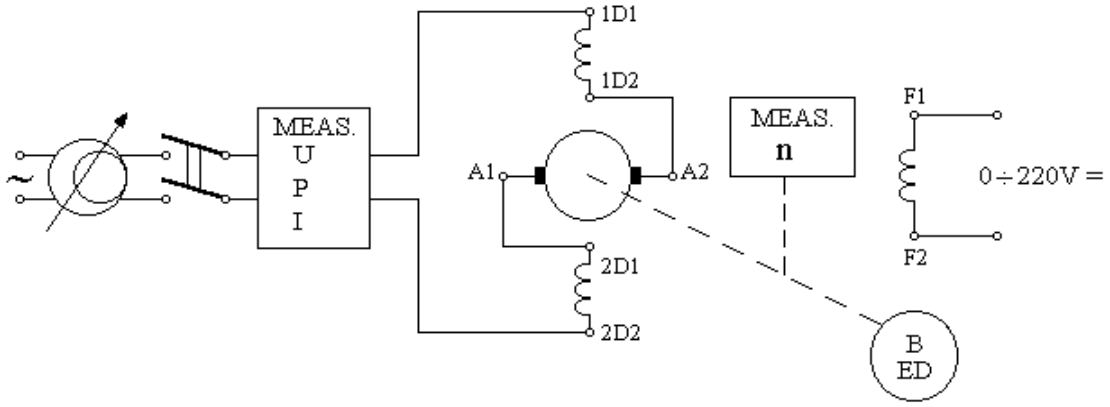


In common coordinates, at a single piece of the drawing paper of 1/2 of A4 size, draw the characteristics:

$$P_{10};\ I_0;\ n_0;\ \cos\varphi_0 = f(U_0)$$

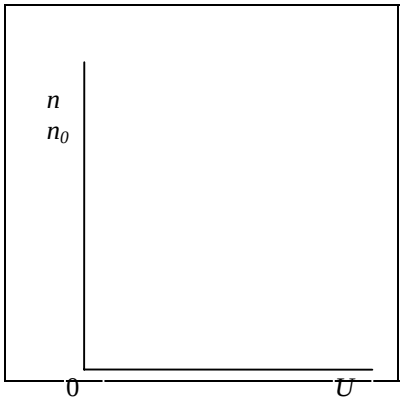
4. SPEED REGULATION CHARACTERISTICS $n = f(U)$ for $M = const.$

Measuring circuit diagram:



The measurement of torque is realized with the help of eddy-current brake (electromagnetic dynamometer) with the mass attached to its electromagnets and deflecting by the angle α from vertical axis. $M = M_m \sin\alpha$, where for construction applied in IME PW Lab M_m=.857 N.m.
Speed regulation characteristics should be determined for three different values of the torque.

No of read.	M_1=.2M_N=.....N.m α_1=.....^{o}		M_2=.4M_N=.....N.m α_2=.....^{o}		M_3=.8M_N=.....N.m α_3=.....^{o}	
	U	***n***	***U***	***n***	***U***	***n***
	V	rev/min	V	rev/min	V	rev/min
1						
2						
3						
...						

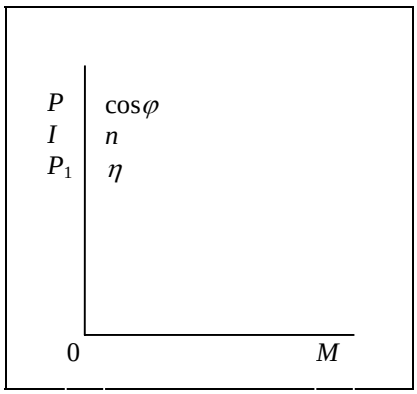


In common coordinates draw all three n=f(U) characteristics and that determined for no-load operation of the motor.

5. LOAD CHARACTERISTICS P_1; I; n = f(M) for $U = U_N$

Measuring circuit is as shown in p. 4.

No of read.	α deg	P_1 W	I A	n rev/min	M N.m	P W	η %	$\cos\varphi$ -
1								
2								
3								
...								



In common coordinates draw all required characteristics

$$P_1; P; I; n; \eta; \cos\varphi = f(M).$$

From the diagram, for $M=M_N$ read the nominal magnitudes of P_N, I_N, n_N and compare them with the nominal plate ratings of the motor.

BIBLIOGRAPHY

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