

ELECTRICAL MACHINES

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TRANSFORMERS

A three phase power transformer has following parameters: $50kVA$, $10/0,4kV/kV$, $Yy6$, short-circuit leakage reactance $x_k = 12\%$. All active power losses and magnetising reactance can be neglected. Transformer's primary coil is connected to constant rated voltage, and the secondary is loaded with $40kVA$ at $\cos\varphi_2 = 1$ (secondary current and voltage are in phase).

Determine relative voltage drop and secondary voltage in this regime.

DC MACHINES

A DC generator has parallel excitation (i.e. shunt DC generator) and rated parameters: $22kW$, $400V$, $850rpm$, armature resistance $R_a = 0,25\Omega$, voltage drop on brushes is $2V$. Field resistance is 200Ω . Field coil is split into two sections with $N_1 = 100$ and $N_2 = 50$ turns connected in series. Saturation can be neglected as well as iron losses, friction and ventilation losses. Generator is connected to an infinite power network at nominal voltage.

Determine the desired shaft speed if generator is delivering $10kW$ to network when the section N_2 is short-circuited.

INDUCTION MACHINES

A three phase induction motor has following parameters $380V$, $50Hz$, Y , $1410rpm$, stator and rotor resistance per phase are 3Ω and 2Ω (transformed to stator). Magnetizing inductance, iron losses, friction and ventilation losses can be neglected. Motor is connected to the infinite power network at rated voltage. The shaft is rotating on $1800rpm$ in the same direction as the rotating field.

Determine active and reactive power of the machine if the slip is equal to maximum torque slip (breakdown slip) at this operating point.

SYNCHRONOUS MACHINES

A three phase salient-pole synchronous machine has the following parameters: four poles, $380V$, $50Hz$, Y , $X_d = 20\Omega$, $X_q = 15\Omega$. Stator resistance, saturation effect, and all active power losses can be neglected. Machine is connected to infinite power network at rated voltage, and is working as motor. Field current is tuned to the regime in which machine delivers $1kVar$ to the network at $\cos\varphi = 0,74$.

Determine reactive power and power factor when the field current circuit is open. Consider constant load at motor shaft.

Petar Matić, M.Sc.EE,
Faculty of Electrical Engineering, Banjaluka