S-17.2030 Electromechanics and electric drives, examination 8.5.2014, 12-15, I346.

1. Explain the following concepts, use drawings and equations when adequate.
   a) Construction of salient pole synchronous machine. (stator, rotor and operation principles) (2 p.)
   b) Starting methods for synchronous motor and why they are needed? (2 p.)
   c) How the rotating field is produced in the air gape of AC machines (Hint: 3 phase winding, MMF, etc…) (2 p.)
   d) List the different loss components in a cage-induction motor and explain their origins (2 p.)
   e) The three running modes of operation of an induction machine by drawing the Torque-Speed/Slip curve and give the values of the slip for each mode of operation (2 p.)
   f) Effect of external resistance connected to the rotor of a wound-rotor induction motor on its speed-torque profile. (2 p.)

2. The magnetic circuit of Fig. 1 has a core of relative permeability $\mu = 2000$. The depth of the core is 5 cm. The coil has 400 turns and carries a current of 1.5 A.
   a) Draw the magnetic equivalent circuit and calculate its parameters (mmf and reluctance(s)) (2 p.)
   b) Calculate the flux and the flux density in the core (2 p.)
   c) Determine the inductance of the coil (2 p.)

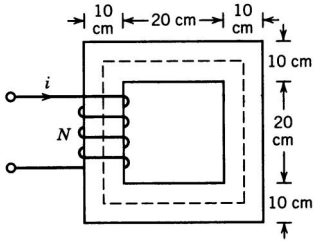

Fig. 1. A simple magnetic circuit.

3. Tests are performed on a 1-phase, 10 kVA, 2200/220 V, 60 Hz transformer and the following results are obtained:
   · Open-circuit test (high-voltage side open):
   Voltmeter 220 V, Ammeter 2.5 A, Wattmeter 100 W.
   · Short-circuit test (low-voltage side shorted):
   Voltmeter 150 V, Ammeter 4.55 A, Wattmeter 215 W.
   Derive the parameters for the approximate equivalent circuit, in which the shunt branch is moved to the supply terminal, referred to the high-voltage side (Fig. 2) (6p.)

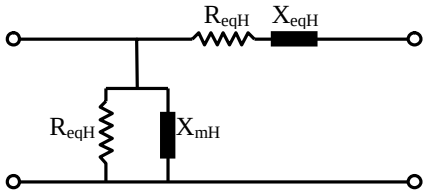

Fig. 2. Approximate equivalent circuit of the transformer in exercise 3.

4. DC-drive
   a) Draw a schematic speed-torque curve of a variable speed DC-drive and name the different regions (2 p.)
   b) How the speed of a DC-drive is increased from zero to the rated speed? (2 p.)
   c) How the speed of a DC-drive is increased above the rated? (2 p.)

Evaluation:

Grade	Lower limit	Upper limit
0	0	13
1	14	15
2	16	18
3	19	21
4	22	26
5	27	30