

MODELLING OF MACHINES

TUTORIAL SHEET 3

Ψ/i Modelling of Switched Reluctance Motors

1. What is the step angle of a three phase switched reluctance motor having 12 stator poles and 8 rotor poles? What is the commutation frequency in each phase at a speed of 6000 rpm?
2. Fig.1 shows ψ/i characteristics for the aligned and un-aligned positions of a switched reluctance rotor. Shade an area on the characteristic which represents the change in co-energy if the motor is driven from a constant voltage supply. Explain the form of the trajectory and list the parameters which affect its shape.
3. Fig.2 shows measured ψ/i characteristics for one phase of a 3 phase SR motor with 6 stator teeth and 4 rotor teeth. The motor is driven from a power electronic converter which applies constant current pulses to the appropriate windings.
 - a) Shade and label areas which represents the change in energy and co-energy when the rotor moves from the un-aligned to the aligned positions when a constant current of 8A flows in the windings
 - b) What is the average torque produced for currents of 3A and 8A?
 - c) Why is the torque per amp higher for the 3A case?
 - d) Calculate the total energy drawn from the supply during the movement from the un-aligned to the aligned positions.
 - e) By plotting the variation in flux-linkage with rotor angle calculate the emf induced in the phase for a current of 8A for a rotor position mid-way between the aligned and un-aligned positions when the rotor is running at 4500 rpm? List any assumptions are made in this calculation.
 - f) If the phase resistance of the motor is $30\text{m}\Omega$, calculate the power converter output voltage when the motor is operating under the conditions in (d)?
 - g) Plot the approximate variation of the instantaneous torque with rotor position for a current of 8A.
 - h) What is the average electrical power output in moving from the un-aligned to the aligned position when the rotor is rotating at 5000 rpm and the converter current is 8A?
- 4) Show by reference to appropriate Ψ/i diagrams that only about half the energy drawn from the electrical supply is converted into mechanical output power during the commutation interval of a phase.

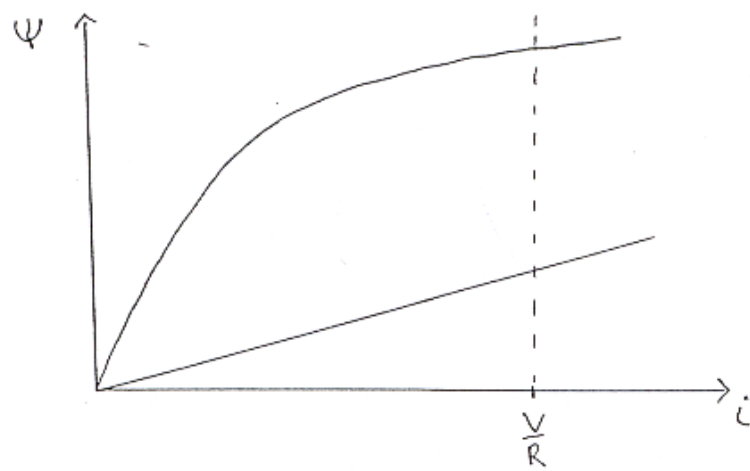


Fig 1

Measured flux-linkage for one phase of a 3phase 6-4 SR motor

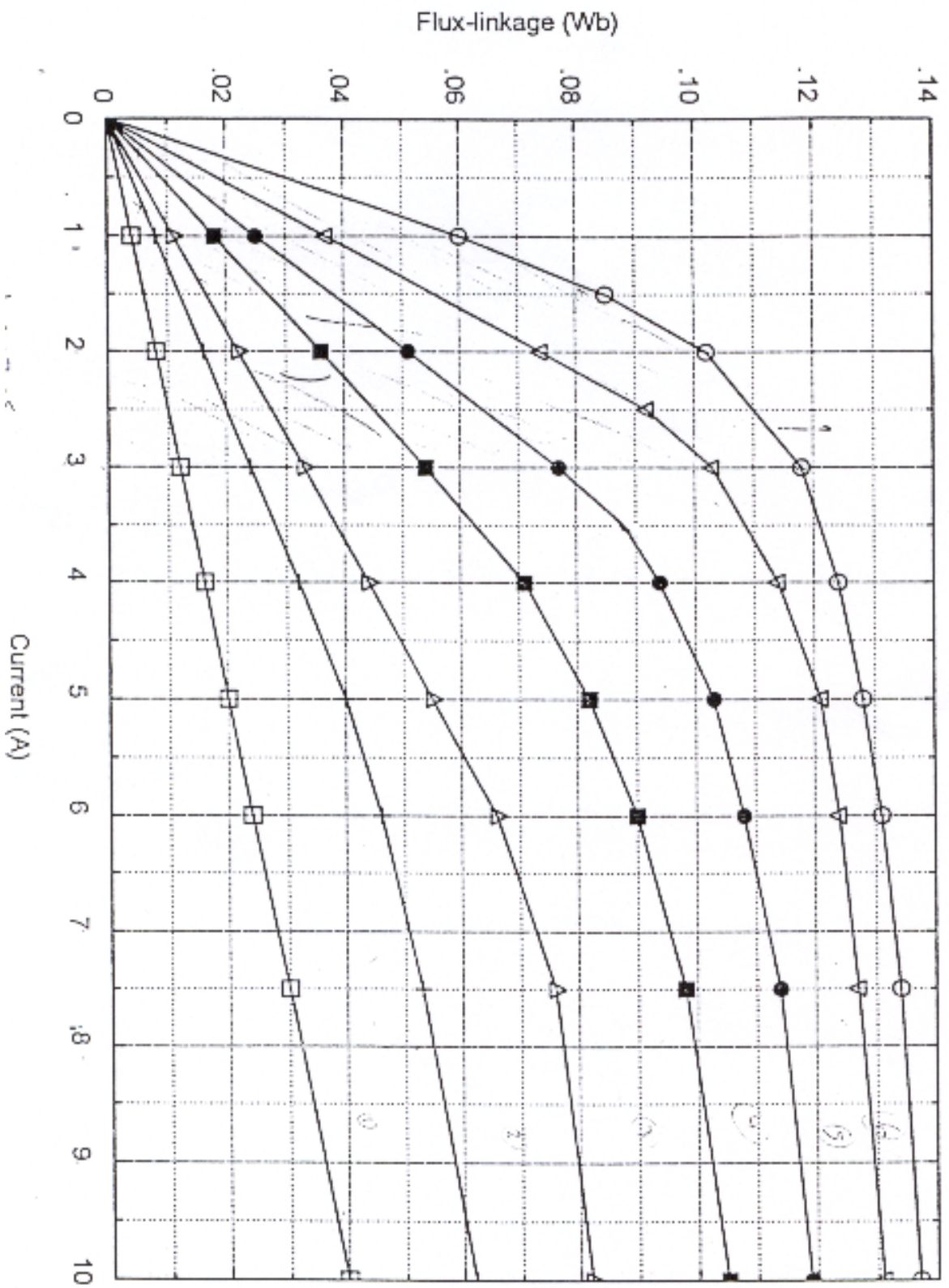


Fig 2.