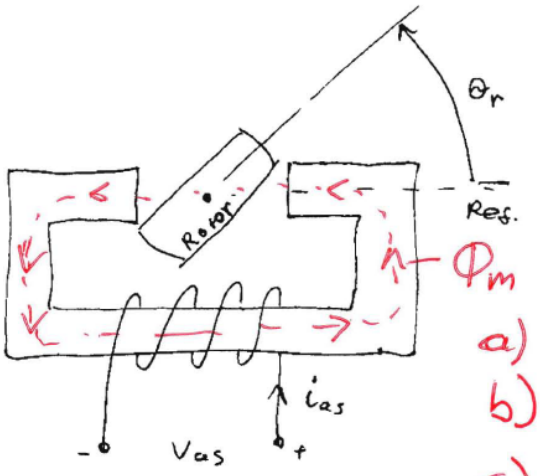
ELEC 343: Quiz 2 **6 February, 2020**

Name: Solution Student ID:_____

Close notes and books. Quizzes suspected of cheating and/or turned in late will not be marked. You have 10 minutes to answer the following questions:

Q1 (40pts): Consider a magnetically linear reluctance device shown in the figure with positive current i_{as}.



(a) (10pts) Show the flux Φ_m on the figure, and express the magnetizing inductance $L_m(\theta_r)$ as we did in class

(b) (10pts) Express the total self inductance $L(\theta_r)$

(c) (10pts) Express electromagnetic torque $T_e(i_{as}, \theta_r)$

(d) (10pts) Sketch the T_e obtained in (c) and mark the **stable** and **unstable** equilibrium points

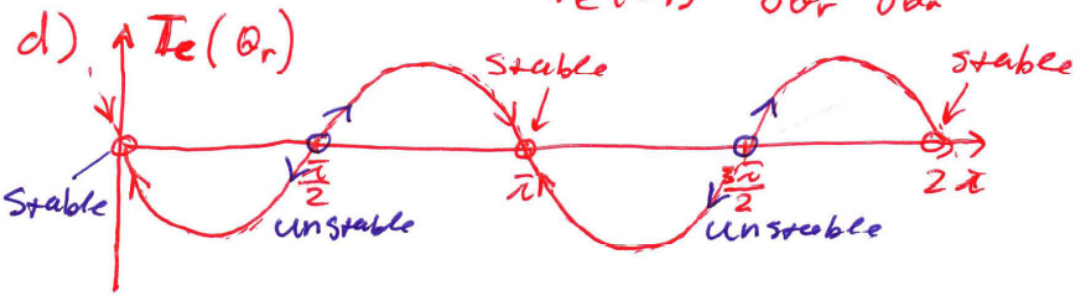
a) $L_m = L_A + L_B \cdot \cos(2\theta_r)$

b) $L(\theta_r) = L_{ls} + L_A + L_B \cdot \cos(2\theta_r)$

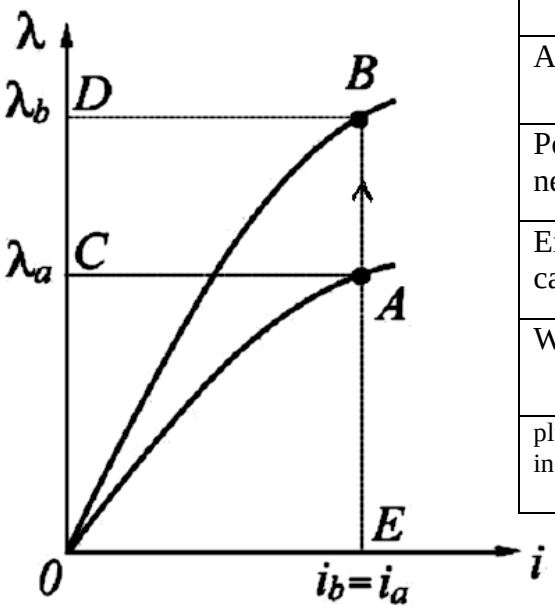
c) $W_f = \frac{1}{2} L_m \cdot i_{as}^2$

$$T_e(\theta_r) = \frac{\partial W_c}{\partial \theta_r} = \frac{\partial W_f}{\partial \theta_r} = -L_B \cdot i_{as}^2 \cdot \sin(2\theta_r)$$

d)



Q2 (60pts): Consider a basic electromagnet device discussed in class. The system has moved from pint **A** to point **B** as shown in the $\lambda - i$ figure. Express the change in coupling field energy ΔW_f, co-energy ΔW_c, inputs ΔW_e and ΔW_m in terms of respective areas in the figure. For each, state **positive** or **negative**. State where did the energy come **from** and went **to**? Has the plunger moved in or out?



Change	ΔW_f	ΔW_c	ΔW_e	ΔW_m
Area	OBDO – OACO >0	OBEO – OAEO >0	ACDB >0	OBAO <0
Positive or negative?	positive	positive	positive	negative
Energy came from	Electrical input (electrical system)			
Went to	Coupling Field and Mechanical System			
plunger moved in or out	circle one: **IN** or **OUT** **The plunger moved IN and did work in mech. system**			