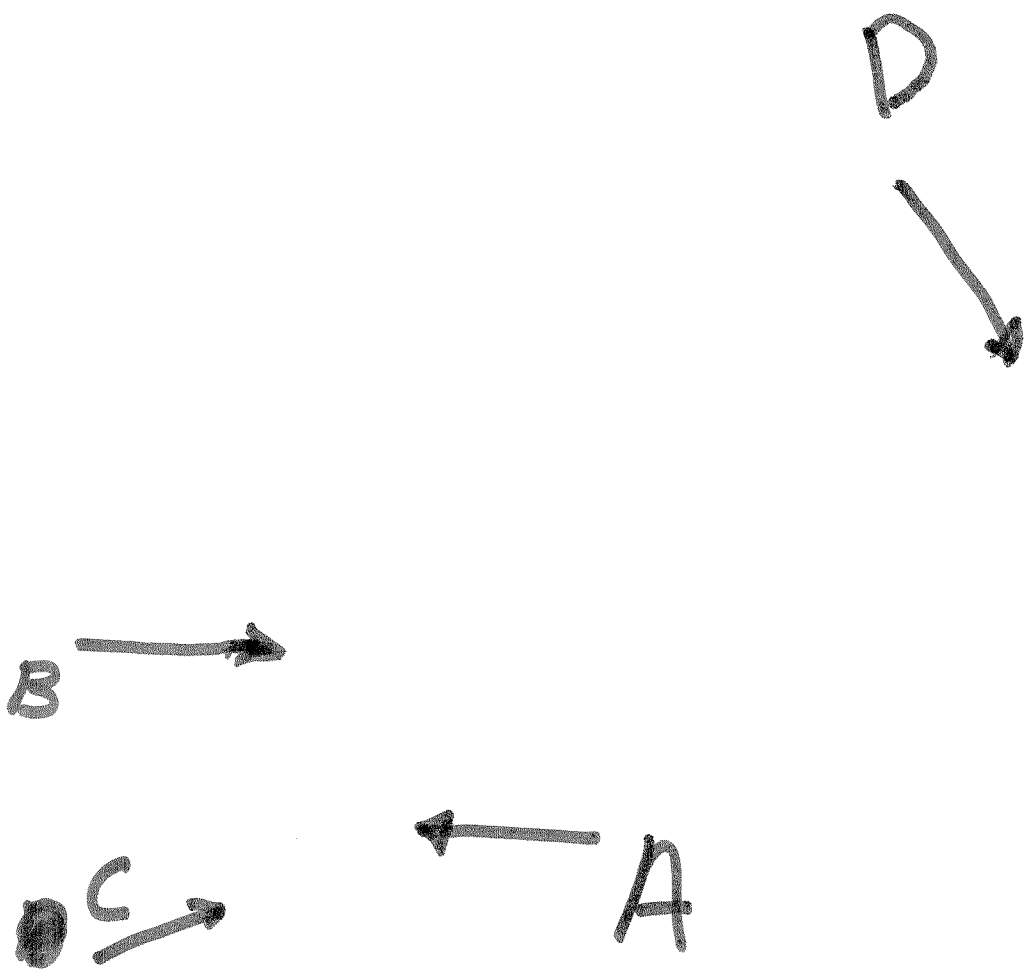
ECE 320 & ECE 329

ENERGY SYSTEMS I

BACKGROUND STUDY IN ENERGY SYSTEMS

SESSION no. 30


D
B
C
A

ECE 320 NAME _____

Quiz 7 30 March 2012

DC Machines

1. (6 points) For the machine shown on the monitor, identify the four parts indicated:

   A. ___Commutator_____ B. ___Armature windings or coils __

   C. ___Bearing_____ D. __Field winding or coil_____

2. (10 points) A separately excited DC motor operated with a terminal voltage of 180V and an armature current of 50A. Its armature resistance is 0.14 Ohms and its field resistance is 300 Ohms. The field voltage, being separately excited, is 240V. Mechanical losses are insignificant. Its saturation curve at 3000 RPM is given on the other side of this page.

   a. (5 points) Find its speed of rotation.

$V_A := 180 \cdot V \quad I_A := 50 \cdot A \quad R_A := 0.14 \cdot \Omega \quad R_F := 300 \cdot \Omega \quad V_F := 240 \cdot V$

Find the field current.

$$\omega_0 := 3000 \cdot \left(\frac{2 \cdot \pi}{60}\right) \cdot \frac{rad}{sec} = 314.159 \cdot \frac{rad}{sec}$$

$$I_F := \frac{V_F}{R_F} = 0.8\,A$$

At 3000 RPM and 0.8 Amps Field, the generated voltage E_A is 250V.

$E_{A0} := 250 \cdot V$

Find the generated voltage at the operating conditions.

$E_A := V_A - I_A \cdot R_A = 173\,V$

Set up the ratio of generated voltage and speed.

$$\frac{E_A}{E_{A0}} = \frac{K\Phi\omega}{K\Phi\omega_0}$$

Solve for ω. .

$$RPM := \frac{rad}{sec} \cdot \frac{2 \cdot \pi}{60}$$

$$\omega := \frac{E_A \cdot \omega_0}{E_{A0}} = 217 \cdot \frac{rad}{sec} \qquad \omega = 2076\,RPM$$

b. (2 points) Find Kϕ, its machine constant.

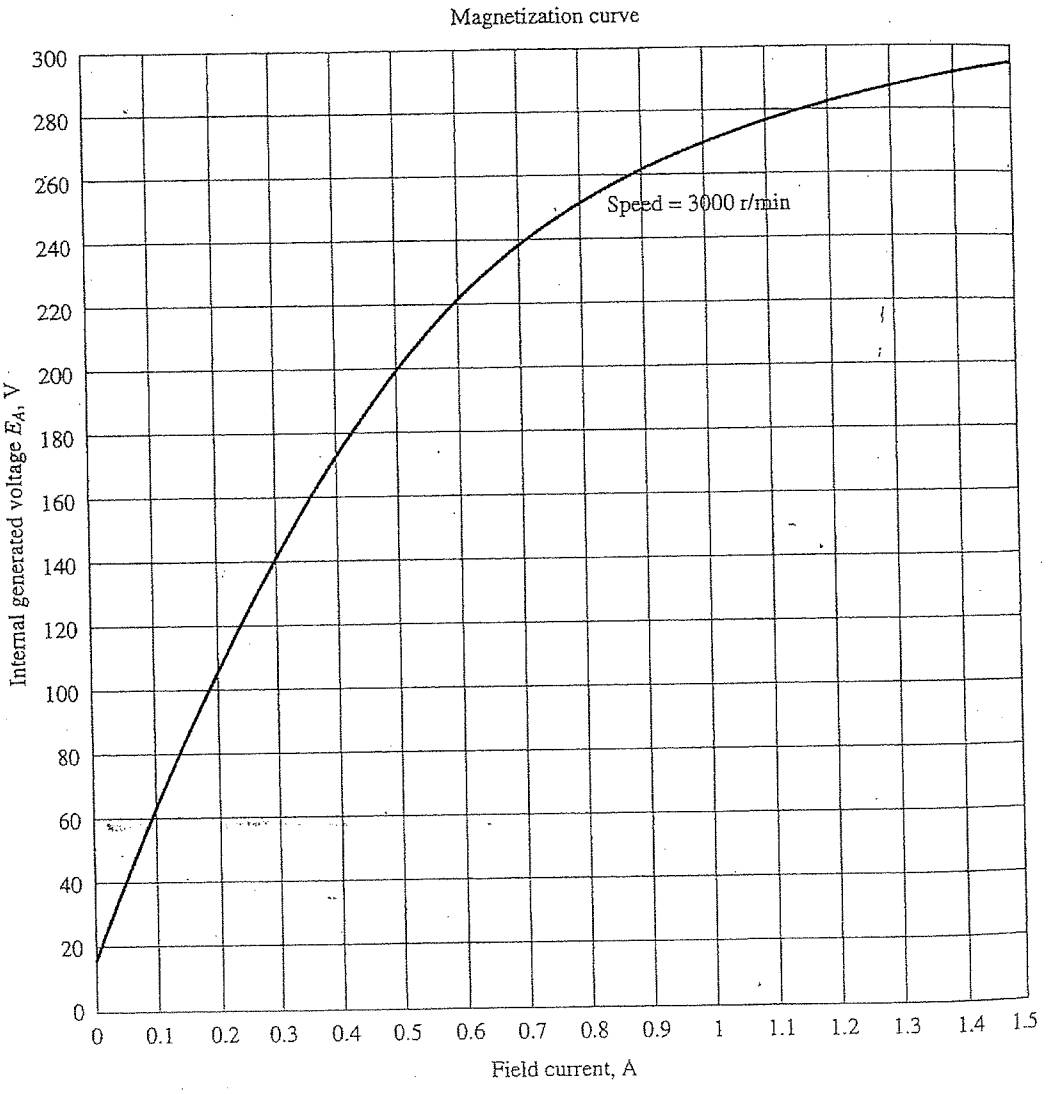
$$K\Phi := \frac{E_{A0}}{\omega_0} = 0.796 \cdot V \cdot sec \qquad K\Phi = 0.796 \cdot \frac{N \cdot m}{A}$$

c. **(3 points) Find its torque.**

$\tau := K\Phi \cdot I_A = 39.789\,N\cdot m$ $\quad \tau = \frac{E_A I_A}{\omega}$

3. (2 points) If the raise the armature current by adding load, the speed of our separately excited machine will _____increase decrease_____.
(increase / remain the same / decrease)

4. (2 points) If we raise the field current of our machine by increasing the field voltage, the speed of our separately excited machine will _____decrease_____.
(increase / remain the same / decrease)



ECE 320 NAME _____
Quiz 7 30 March 2012
DC Machines

1. (6 points) For the machine shown on the monitor, identify the four parts indicated:

   A. _____ B. _____

   C. _____ D. _____

2. (10 points) A separately excited DC motor operated with a terminal voltage of 180V and an armature current of 50A. Its armature resistance is 0.14 Ohms and its field resistance is 300 Ohms. The field voltage, being separately excited, is 240V. Mechanical losses are insignificant. Its saturation curve at 3000 RPM is given on the other side of this page.
   a. (5 points) Find its speed of rotation.

   b. (2 points) Find $K\phi$, its machine constant.

   c. (3 points) Find its torque.

There is more on the other side of this page.

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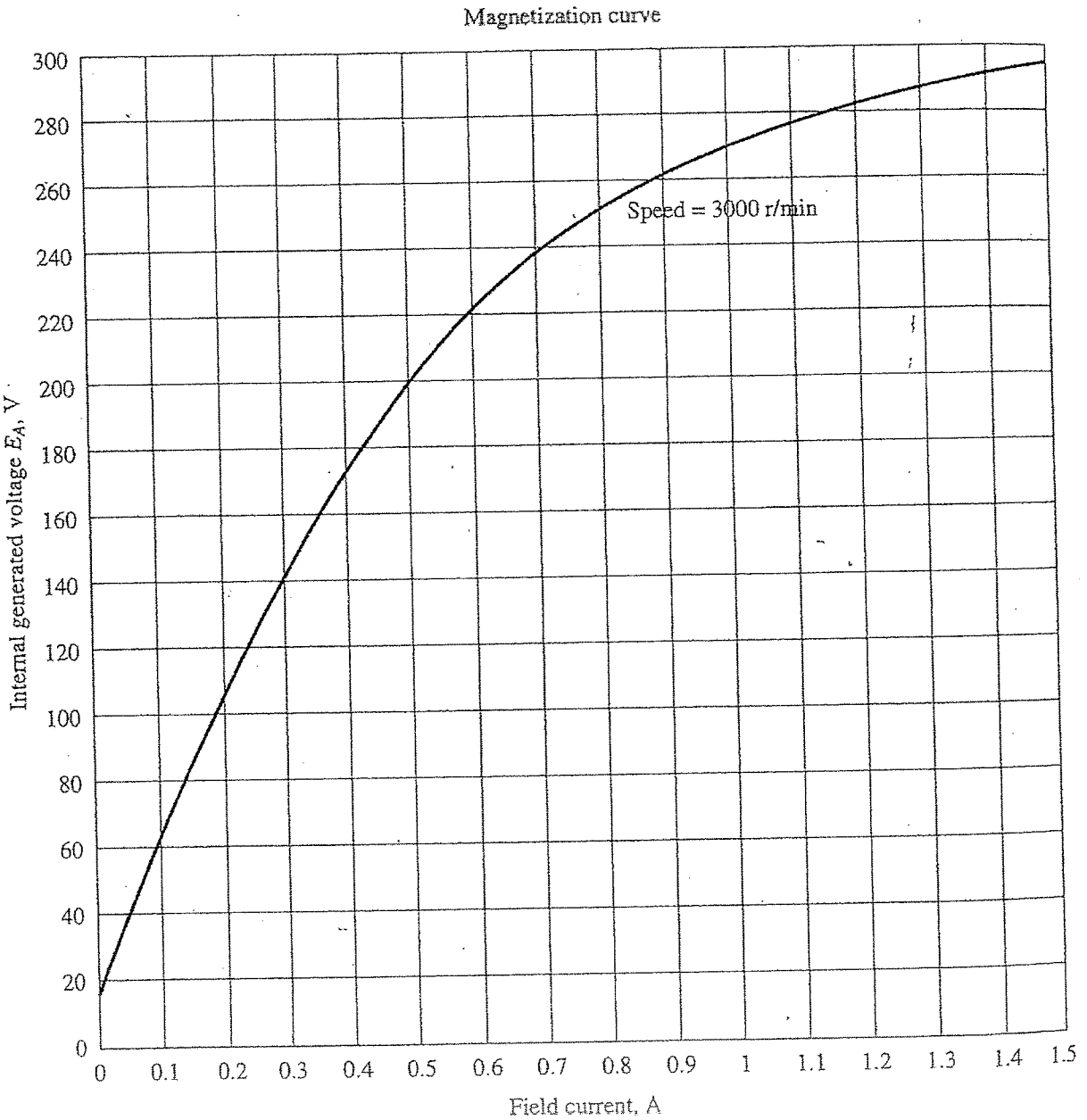
3. (2 points) If the raise the <u>armature</u> current by adding load, the speed of our separately excited machine will _____.
(increase / remain the same / decrease)

4. (2 points) If we raise the <u>field</u> current of our machine by increasing the field voltage, the speed of our separately excited machine will _____.
(increase / remain the same / decrease)



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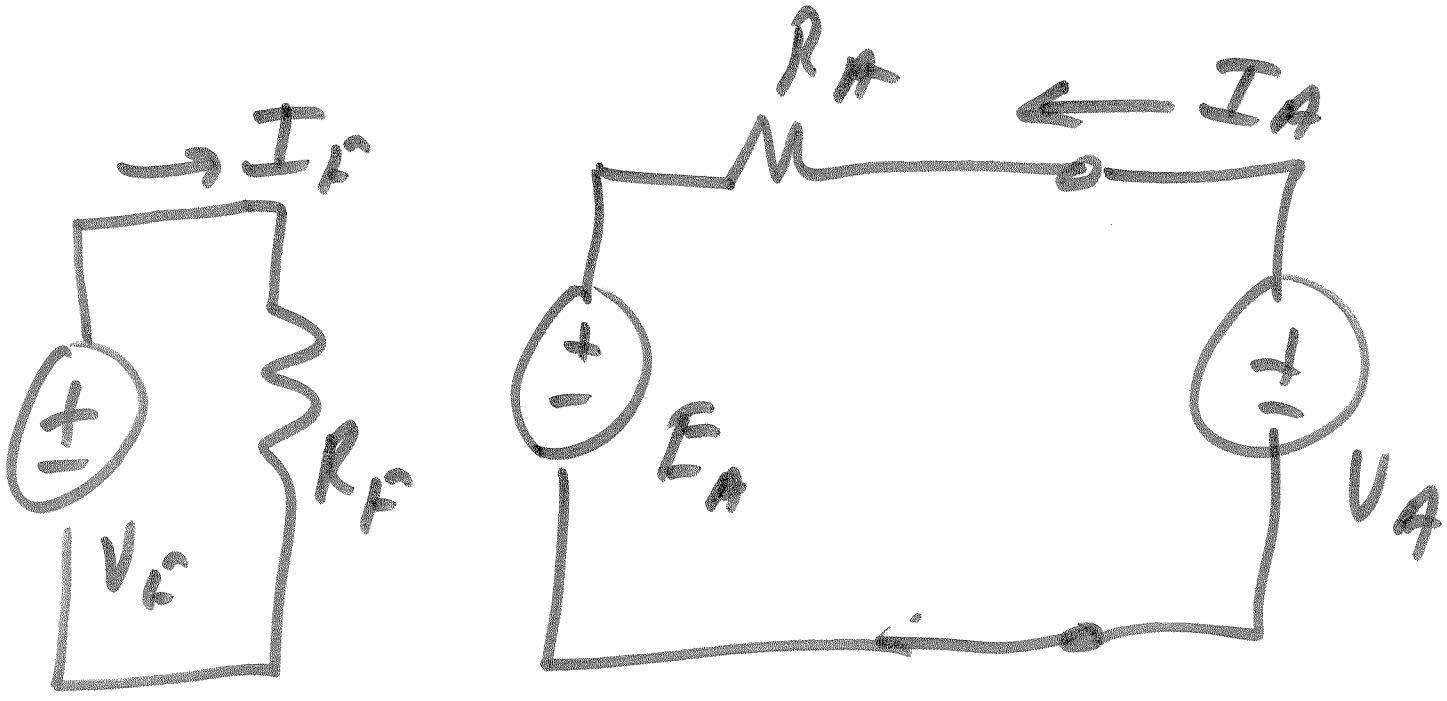
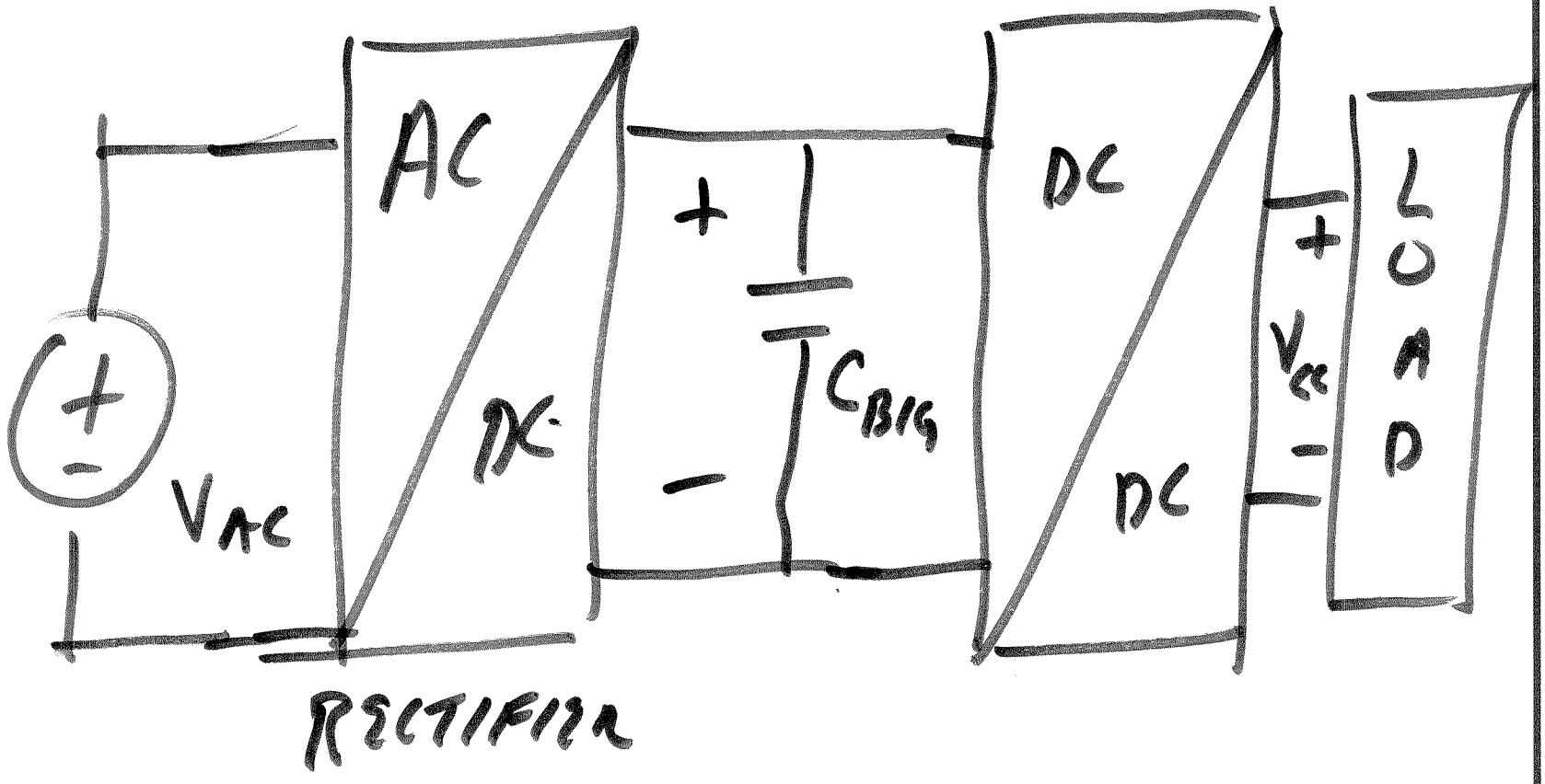
ECE 320 Recitation on campus: 9 April 2012
Homework Due on campus: 11 April 2012
Ideal DC / DC Converters

From the text handout by Daniel Hart, do the following problems:

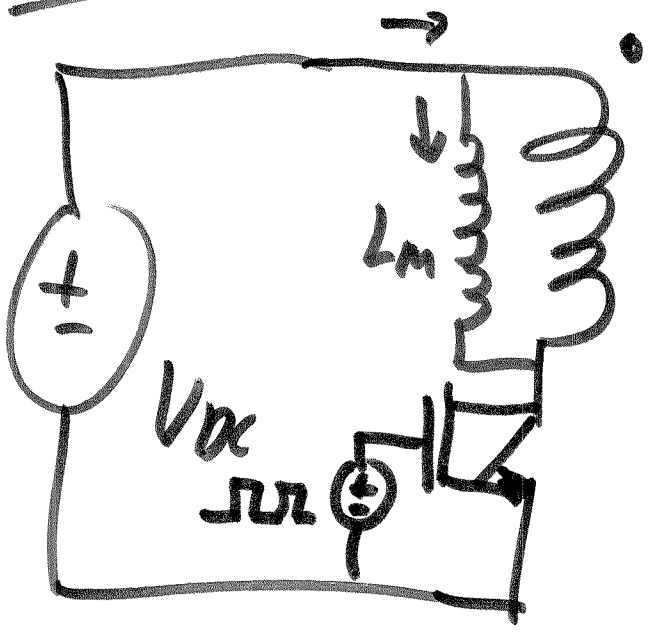
1. 6.1 and 6.2
2. Problem 6.7
3. Problem 6.13 There are many answers to this problem; just find one that works.
4. Problem 6.15
5. Problem 6.17
6. Problem 6.20

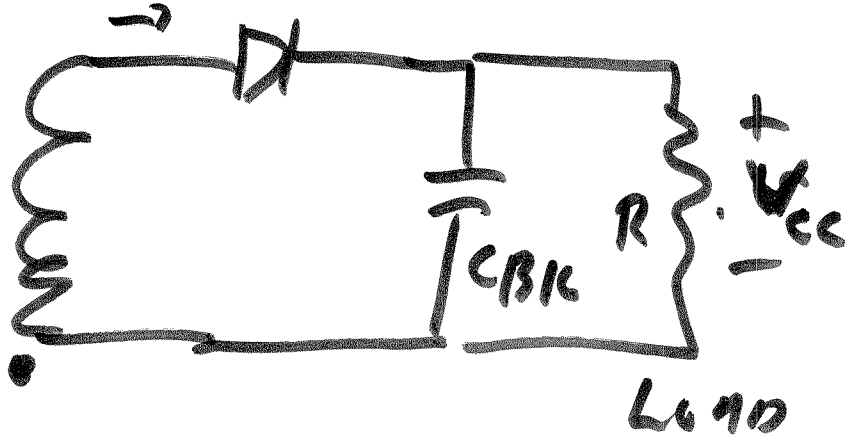

I_F
R_A
I_A
R_F
V_F
E_A
V_A

DC/DC CONVERSION

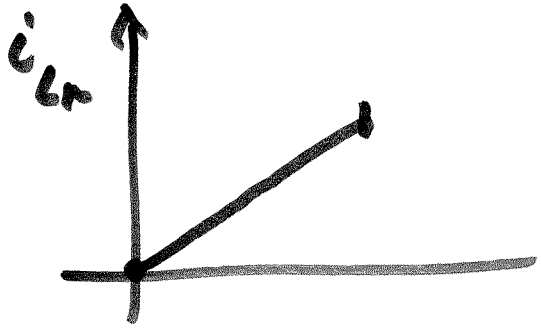


FLYBACK





$$i = \frac{1}{L_n} \int v \, dt$$



$$V = W \cup B \cap A$$

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Energy Systems I

Lesson 30

Power Electronics

Exam next lesson