Text problem 4.8

Text problem 4.9

Text problem 4.12

Special Problem #1, partial answer: $MI_s I_r$

A single-phase rotating machine has one coil on the stator with current $i_s$ and one coil on the rotor with current $i_r$. The inductances for this machine are (assume linear magnetic core):

$L_{ss} = L_s$, $L_{sr} = M \cos(\theta)$, $L_{rs} = M \cos(\theta)$, $L_{rr} = L_r$. The machine is being operated such that the currents $i_s$ and $i_r$ can be assumed to be constants at $I_s$ and $I_r$ respectively while the shaft is rotated from $\theta = 0$ to $\theta = \pi/2$. For this change from “point a” to “point b”, find:

a. The energy transferred from the mechanical system into the coupling field as the system moved from point a to point b with constant currents.

b. The energy transferred from the electrical system into the coupling field as the system moved from point a to point b with constant currents.

Special Problem #2, partial answer: 16 Joules, -800 N

An electromechanical system is described by the following flux-linkage vs current characteristic:

$$\lambda = \frac{0.04i}{x - 0.01}$$

(1)

It is operated on the closed cycle a - b - c - d - e as indicated below, with $x$ constant during a - b and also c - d. The current is constant during b - c and also d - e.

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
</tr>
</thead>
<tbody>
<tr>
<td>$i$ (Amps)</td>
<td>0</td>
<td>$i_b$</td>
<td>$i_b$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$\lambda$ (Wb turns)</td>
<td>0</td>
<td>8</td>
<td>$\lambda_c$</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>$x$ (meters)</td>
<td>.03</td>
<td>.03</td>
<td>.02</td>
<td>.02</td>
<td>.03</td>
</tr>
</tbody>
</table>

Find the following things:

a. $i_b$ and $\lambda_c$.

b. The energy stored in the coupling field at points b and c.

c. The force of electric origin at points b and c.
d. Sketch this cycle in the $\lambda$ vs $i$ plane (label points a, b, c, d, and e)

e. Sketch this cycle in the force vs $x$ plane (label points a, b, c, d, and e)

f. Is this a motor or a generator?