FYSE302 Electronics I (part B)
Final exam (retake) 11.6.2010
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1. Briefly define/explain:
   a. How to convert alternating current (AC) into direct current (DC) (2 p.)
   b. The safe/allowed operation area for a transistor in a power amplifier circuit (1 p.)
   c. AD converter types and their operation principles (AD=analog-to-digital) (3 p.)

2. Define the current I_2 in the circuit in figure 1.
   $E = 10\angle 0°$, $\omega = 2$ rad/s, $R_1 = 8\Omega$, $R_2 = 20\Omega$, $L = 8$ H ja $C = 0.05$ F.

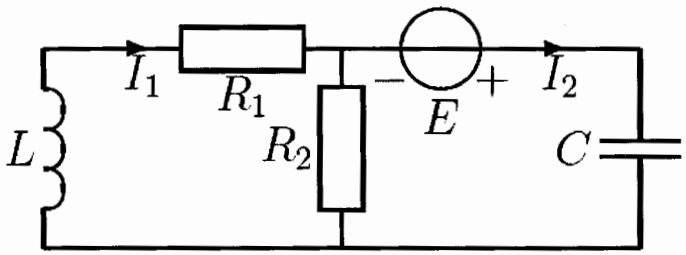

figure 1

3. Define v_o for the circuit in figure 2 (R-2R ladder). For what this circuit can be used for? (tip: use superposition principle)

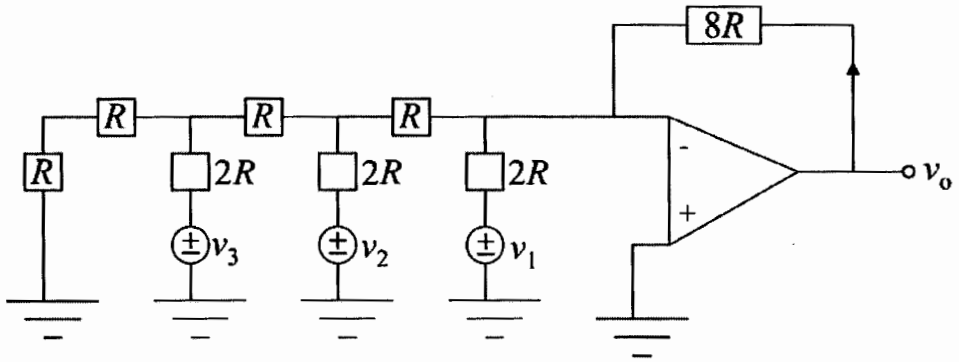

figure 2.

Turn the page!

4. Let's consider the amplifier stage in figure 3, where the transistor's current gain $\beta = 80$, operation voltage $V_{CC} = 15$ V, and components $R_1 = 20$ kΩ ja $R_2 = 60$ kΩ. The output resistance of the signal source is $R_S = 500\ \Omega$

   a) Determine the R_E so that in the transistor's operation point the $I_C = 2$ mA.

   b) Replace the transistor with a simple small-signal model (r_π - β-model, where $r_\pi = 0.025V/I_B$). Define the resistance R_C so that the amplification in the center-frequency range is $|v_o/v_s| = 160$. In this frequency range the intrinsic capacitances in the transistor can be neglected and the capacitors C_{C1}, C_{C2} and C_E are acting as a short-circuits. Assume that there is another amplifier stage, with input resistance of 10 kΩ, connected in the output.

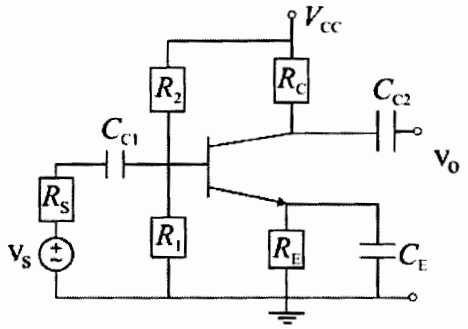

figure 3.

5. A system is represented by the following equations:

$$V_2 = V_1 - V_5$$
$$V_3 = A\ V_2$$
$$V_4 = V_3 + D\ V_5$$
$$V_5 = B\ V_4$$
$$V_6 = C\ V_5,$$

where A, B, C and D are the transfer functions for the different blocks of the system. V_i:s represent the signals at different locations in the system. Draw the block diagram and define the total transfer function $G_{TOT} = V_6/V_1$ for the whole system.