1. Please answer the following questions related to Impedance matching for amplification.

(1) Fill in the following table ((a) to (h)) for **ideal** amplifiers (8%)

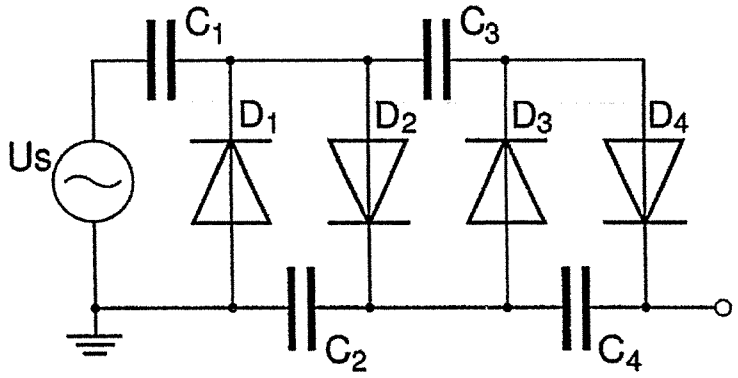
Amplifier type	Input impedance	Output impedance	Gain parameters
Voltage	(a)	(e)	A_{voc}
Current	(b)	(f)	A_{isc}
Transconductance	(c)	(g)	G_{msc}
Transresistance	(d)	(h)	R_{moc}

(2) Draw a circuit of a voltage follower using an OP. Using one of the four amplifiers in (1), describe how the voltage follower works (8%)

(3) Draw a circuit of a current follower using a BJT. Using one of the four amplifiers in (1), describe how the current follower works (8%)

(4) An amplifier has an output impedance of 1kΩ and is used to drive an 8Ω load. We want to use a transformer to allow 50% output power on the load. What is the ratio of turns of the transformer, (N_i/N_o)? (4%)

2. Please analysis the following circuit.



Initially, all capacitors are all fully discharged. All diodes and capacitors are ideal. The AC source, Us, is $Vsin(\omega t)$. Please answer the following questions

(1) When $t= \pi/2\omega$, calculate the voltages of the left side and right side for C_1 to C_4. (8%)

(2) When $t= 2\pi/\omega$, calculate the voltages of the left side and right side for C_1 to C_4. (8%)

(3) Electrolyte capacitors are used for C_1 and C_4. Assign polarity and voltage rating all of them. (12%)

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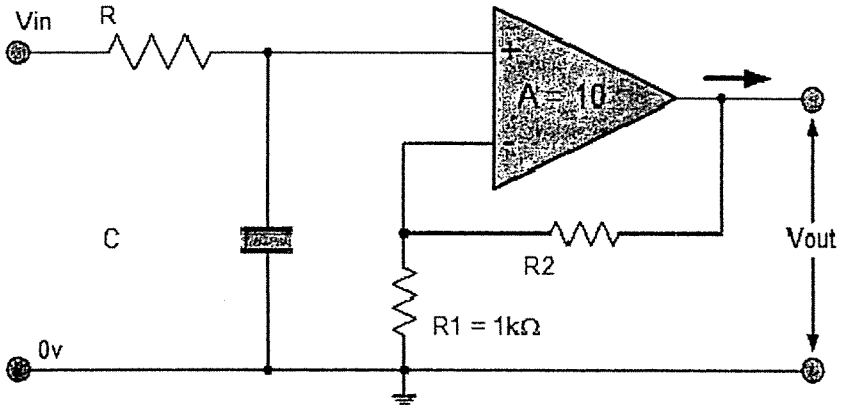
3.

(1) Design a non-inverting active low pass filter circuit that has a gain of ten at low frequencies, a high frequency cut-off or corner frequency of 159Hz and an input impedance of 10KΩ. Please assign the values of R2 and C. (5%)



(2) Design a simplified non-inverting amplifier filter circuit with a C location different from (1). Draw the circuit with component values assigned. (6%)

(3) Design an equivalent inverting amplifier filter circuit. Draw the circuit with component values assigned. (6%)

(4) Following (3), what does the circuit become if the feedback resistance is removed? (2%)

4. Consider the circuit shown below:

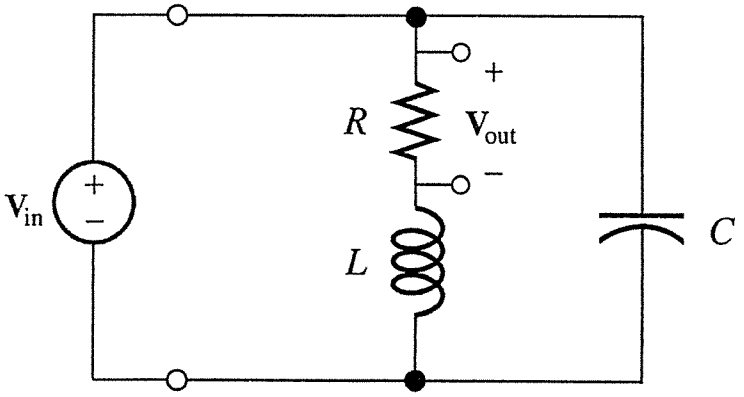
(a) Derive an expression for the transfer function $H(f) = V_{out} / V_{in}.v$ (5%)

(b) Derive an expression for the resonant frequency of this circuit. (5%)

(c) What type of the filter the transfer function $H(f)$ is? (5%)

(d) Draw the Bold plot for the magnitude of the transfer function $H(f)$ when $R = 10\ \Omega$, $L = 10$ mH, and $C = 0.02\ \mu$F. (5%)

(e) Draw the plot for the impedance magnitude the source voltage V_{in} sees. (5%)



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