

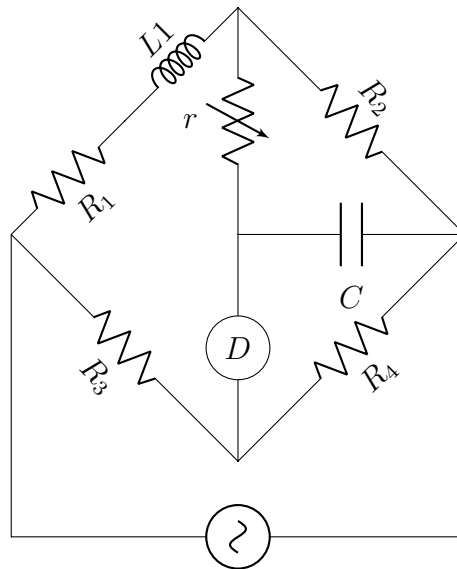
# PH3104 Mid Semester Examination

Total marks: 20

Time: 90 minutes

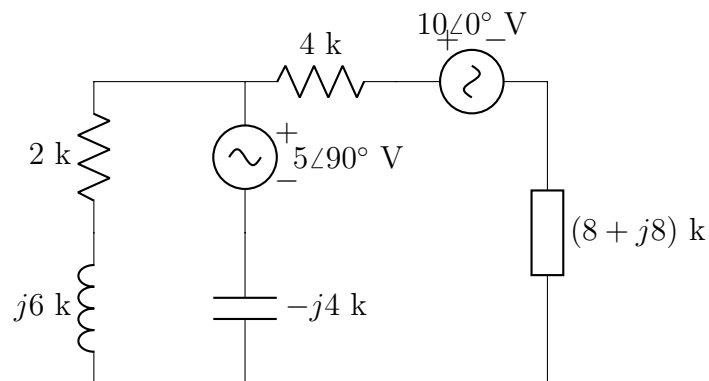
*Attempt all questions*

**Q 1)** A student attempted to construct an Anderson bridge in the lab, but by mistake he mixed up the detector  $D$  and the variable resistor  $r$ , so that he ended up with the circuit shown below.



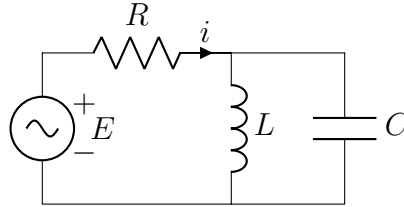
Will he be able to get the bridge to balance? That is, will he be able to adjust the circuit parameters (as well as, perhaps, the frequency of the source) so that no current flows through the detector  $D$ ? Write down the conditions for this to happen, and argue whether it is possible to satisfy them.[5]

**Q 2)** In the circuit below, find out the power dissipated through each of the components (including the voltage sources):



[5]

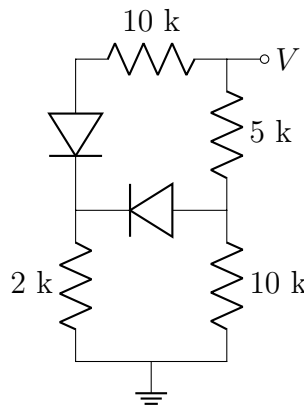
**Q 3)** Consider the parallel resonant circuit shown below. Write down the coupled differential equations obeyed by the current  $i$  through the resistor and the charge  $q$  stored in the capacitor. Determine the Laplace transforms  $\mathcal{L}_i$  and  $\mathcal{L}_q$  of these quantities in terms of the initial values  $i(0)$ ,  $\dot{i}(0)$  and  $q(0)$  and  $\mathcal{L}_E$  where the latter is the Laplace transform of the source voltage.



*You do not need to invert the transformations.*

[4]

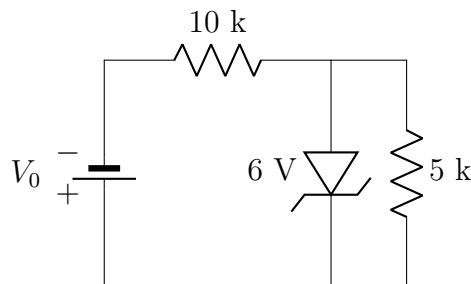
**Q 4)** Find the current in each one of the resistors when (a) the voltage  $V = +15$  V, and when (b) the voltage  $V = -15$  V.



Assume that the Diodes are ideal.

[3]

**Q 5)** Determine the minimum value that the voltage source  $V_0$  in the circuit below must have so that the output voltage (that across the 5 k ) is regulated.



Assume that the Zener knee current is negligible.

[3]