ELEC2070 2023 Assignment 4 Questions
(Solve at home and submit to iLearn by due date.)

Total 75 marks. PLEASE USE NEAT HANDWRITING. Assignments with poor handwriting will not be marked.

You are able to check your answers using LTSpice or Matlab but you are advised to do that after doing the full solution by yourself. Majority of the marks will be given to the hand written method and explanations.

1. (10 marks) The input to the circuit shown in Fig. 1 is the voltage of the voltage source v_s. The output of the circuit is the voltage v_o. Determine the network function:

$$H(\omega) = \frac{V_o(\omega)}{V_s(\omega)}$$

(Hint: Draw the circuit in the frequency domain first and represent the network function using element symbols – then put in the values. Operational amplifiers behave exactly the same way in the frequency domain.)

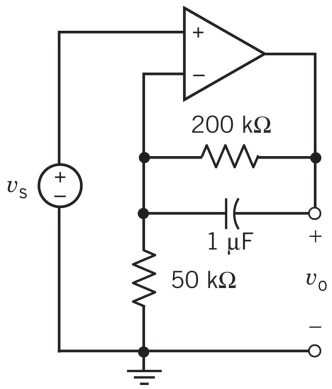

Figure 1

2. (10 marks) The input to the circuit shown in Fig. 2 is the current of the current source i_s. The output of the circuit is the resistor current i_o. The network function of the circuit is

$$\mathbf{H}(\omega) = \frac{\mathbf{I}_o(\omega)}{\mathbf{I}_s(\omega)} = \frac{0.8}{1+j\dfrac{\omega}{40}}$$

Determine the values of the resistances R_1 and R_2.

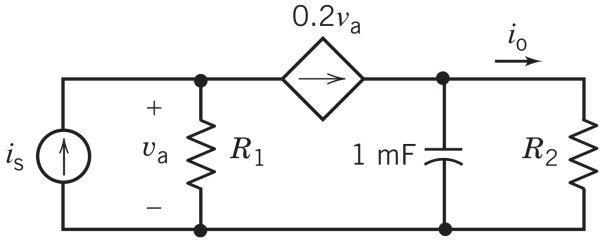

Figure 2

3. (20 marks) The input to the circuit shown in Fig. 3 is the source $v_{in}(t)$ and the response is the voltage across R_3, $v_{out}(t)$. The component values are R_1 = 5 kΩ, R_2 = 10 kΩ, C_1 = 0.1 µF, C_2 = 0.1 µF.
    a. Determine the network function first using the symbols in the circuit shown in Fig. 3.
    b. There are 2 corner frequencies – what are they?

c. Draw the Bode plot of $|H(\omega)|$.

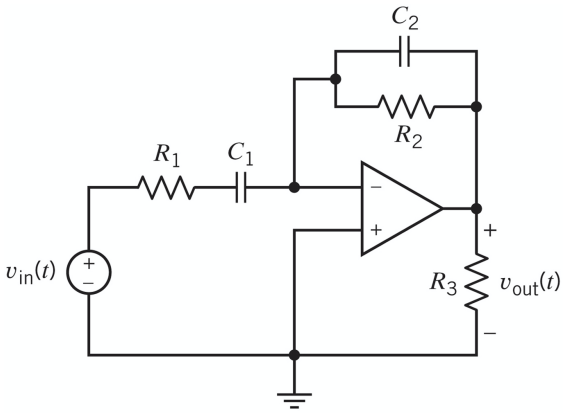

Figure 3

4. (15 marks) The circuit of Fig. 4 is operated for an extended period of time without interruption. The frequency-domain voltage which develops across the three elements can be represented as $1.8\angle 75^o$ V at a complex frequency of $s = -2 + j1.5\ s^{-1}$.
   a. Draw the circuit in the frequency domain
   b. Determine the time domain current i_s.

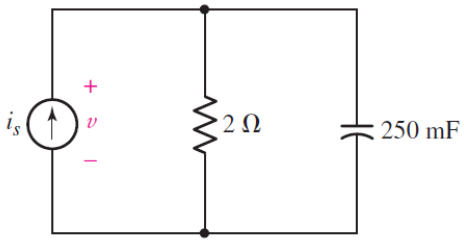

Figure 4

5. (10 marks) Determine **F(s)** if *f(t)* is equal to
   a. $3u(t-2)$
   b. $3e^{-2t}u(t) + 5u(t)$
   c. $\delta(t) + u(t) - tu(t)$
   d. $5\delta(t)$

6. (10 marks) Determine the inverse transform of **F(s)** equal to
   a. $5 + \frac{5}{s^2} - \frac{5}{s+1}$
   b. $\frac{1}{s} + \frac{5}{0.1s+4} - 3$
   c. $-\frac{1}{2s} + \frac{1}{(0.5s)^2} + \frac{4}{(s+5)(s+5)} + 2$
   d. $\frac{4}{(s+5)(s+5)} + \frac{2}{s+1} + \frac{1}{s+3}$