1. (40%) Consider the circuit shown in Fig. 1(a) and Fig. 1(b).
   (a) (20%) For Fig. 1(a), please find the current $i$ flowing through the resistor $3\Omega$ using the method of mesh current analysis.
   (b) (20%) Consider now the circuit of Fig. 1(b). Can we find the current $i$ using the method of mesh current analysis? If yes, please define the required mesh currents. If no, please suggest a feasible method and provide a procedure for solving the problem. **Note:** You do **not** need to find the value of $i$. Only a procedure is required.

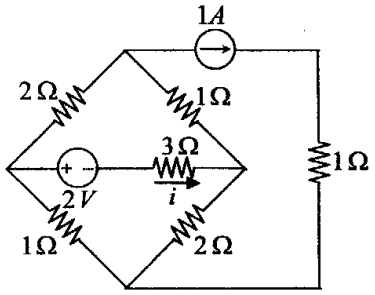


Fig. 1(a)

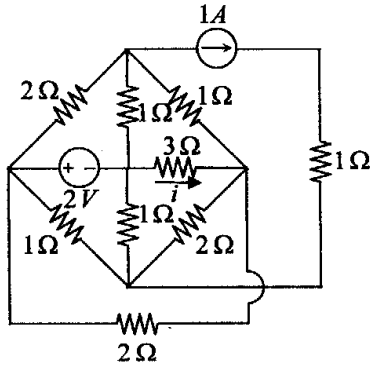


Fig. 1(b)

2. (15%) Consider the circuit shown in Fig. 2.
   (a) (10%) Find an expression for the voltage frequency response function

$$H_v(j\omega)=\frac{V_{out}(j\omega)}{V_{in}(j\omega)}$$

   (b) (5%) Please determine the undamped natural frequency and damping ratio of the above function $H_v(j\omega)$.

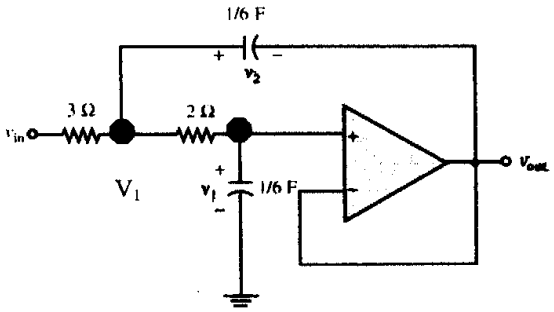


Fig. 2

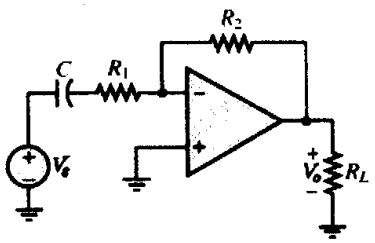


Fig. 3

3. (15%) For the circuit shown in Fig. 3, where C=1μF, $R_1$=1.8KΩ, $R_2$=8.2KΩ, $R_L$=333Ω. Please answer the following questions.
   (a) (5%) Is the circuit is a low- or high-pass filter?
   (b) (5%) Please find the gain $V_0/V_s$ in decibel in the passband.
   (c) (5%) Please find the cutoff frequency.

4. (10%) Consider the circuit shown in Fig. 4. Assume that both transistors are silicon-based with $\beta = 100$. Please determine $V_{CE1}$ and $V_{CE2}$ (the voltage from collector to emitter of the transistors $Q_1$ and $Q_2$, respectively).

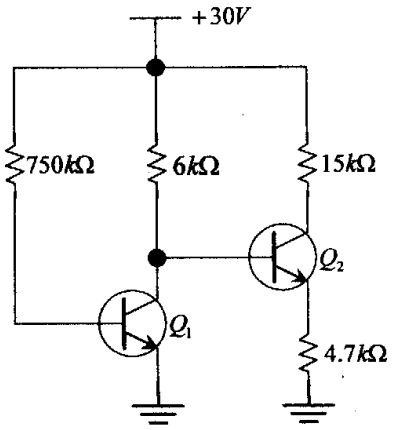


Fig. 4

5. (20%) Consider the circuit shown in Fig. 5, where $V_{DD} = 30$ V, $R_D = 10$ kΩ, $R_1 = R_2 = 1$ MΩ. Assume that the transistor possesses a threshold voltage of $V_T = 4$ V and conductance parameter of $K = 0.2188$ mA/V$^2$. Determine the appropriate value of $R_S$ such that the operating point $V_{DS} = 8$ V.

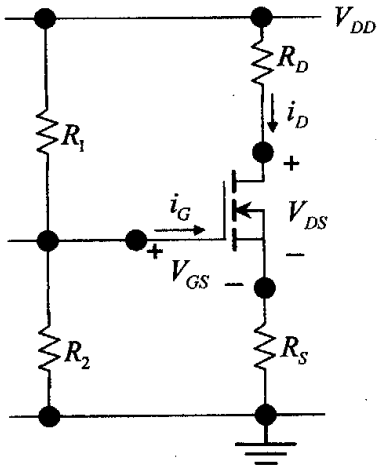


Fig. 5