

EE 3110 Analogue Electronic Circuits
2018-2019 Semester B
Assignment 2

Instructions:

- This assignment has **TWO** questions which scores 50 marks totally.
- Submit a scanned soft copy through CANVAS on or before **15 April 2019 (Monday) 11:55pm**, and the hardcopy to me on **16 or 17 April 2019 (Tuesday or Wednesday)** during the tutorial class of EE3110.
- TYPING of your solution is **NOT** required. However, you need to **print the assignment in hardcopy and write down your solution on the hardcopy for easy grading.**
- PLAGIARISM** is **PROHIBITED**. If you are being caught, you may **FAIL** in this course.
- My advice is that it is better for you to give up in submitting this assignment rather than commits plagiarism. It is better to loss the marks of one assignment than the whole courses due to plagiarism.

Question 1 [25 marks]

- Prove that the closed loop transfer function $A_f(s)$ of Figure 1(a) is given by $A_f(s) = \frac{v_o}{v_i} = \frac{A(s)}{1 - \beta(s)A(s)}$. Hence, write down the condition(s) for oscillation in terms of magnitude and phase criteria.
- Figure 1(b) shows a Wein Bridge Oscillator. Write down the feedback transfer function $\beta(s)$, and derive an expression for $A(s)\beta(s)$, where $s = j\omega$. Hence, determine the oscillation frequency ω_0 and other condition required for oscillation in terms of circuit components using Barkhausen criterion.
- Design an oscillator to generate a 2KHz 15V Vpp sinusoidal signal using the circuit as shown in Figure 1(b). You may choose any sensible component value in your design if necessary. In addition, please also indicates the minimum required supply voltages to drive the circuit without distortion.

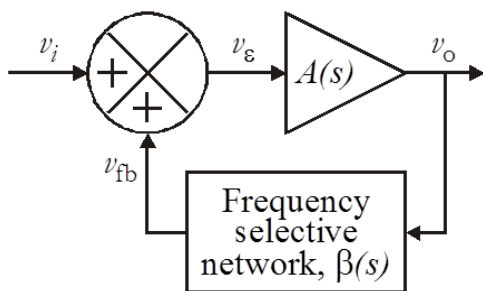


Figure 1(a)

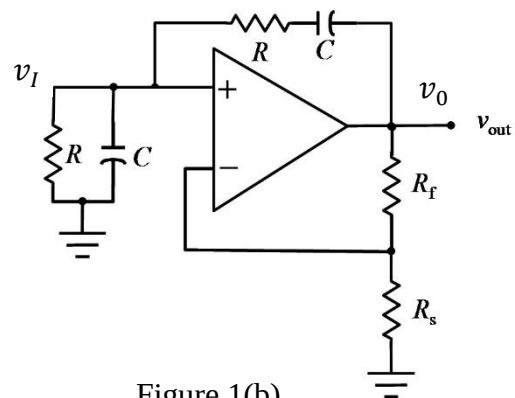


Figure 1(b)

Question 2 [25 marks]

The ac equivalent circuit at the oscillating frequency of a JFET Colpitts oscillator is shown in Figure 2. Answer the following questions.

- What is the configuration (CG, CD, CS) of the JFET amplifier? Justify your answer.
- Draw ac the small signal equivalent circuit using **simplified hybrid- π** transistor model for the JFET.
- Hence, show analytically that the conditions for oscillation are,

$$g_m R_L = \left(\frac{C_1}{C_2} \right) \text{ and } \omega_0 = \sqrt{\frac{C_1 + C_2}{L C_1 C_2}}$$

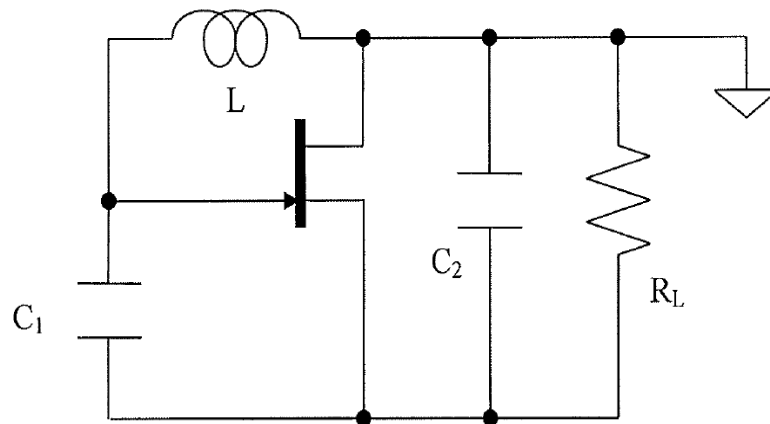


Figure 2