

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Electrical and Computer Engineering



Study Programme	: Bachelor of Science Honours in Engineering
Name of the Examination	: Final Examination
Course Codes and Title	: EEX6450 Analog Electronic Systems and Instrumentation
Academic Year	: 2023/24
Date	: 21 st February 2025
Time	: 1400 – 1700 hrs

General Instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **five (05) compulsory questions** in **three (03) pages**.
 3. Calculators are permitted to use.
 4. This is a Closed Book Test (CBT).
 5. Do not use a red colour pen to write the answers.
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Question 1**[20 marks]**

Consider the circuit shown in Figure-Q1.

The specifications of the Transistors are as follows.

Q1: $\beta = h_{fe} = 100, h_{ie} = 1k\Omega$

Q2: $\beta = h_{fe} = 60, h_{ie} = 1.4k\Omega$

You may assume that the effect from h_{oe} and h_{re} are negligible.

- (a) Find the quiescent values of $V_{CE1}, I_{C2}, V_{CE2}, V_{CE2}$ [08 marks]
 (b) Draw the low-frequency equivalent circuit model of the amplifier [06 marks]
 (c) Find the mid-band voltage gain, $\frac{V_o}{V_{in}}$ [06 marks]

Clearly state any assumptions you make.

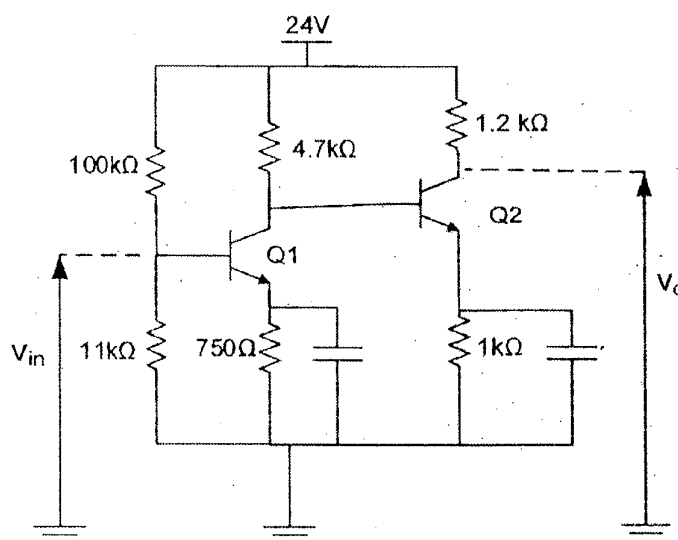


Figure-Q1

Question 2**[20 marks]**

- (a) Describe the operation of a field effect transistor (FET) as a voltage variable resistor using relevant equations on drain current and drain-source resistance. [03 marks]
- (b) The N-Channel JFET transistor amplifier is shown in Figure-Q2.
- Draw the high-frequency equivalent circuit for the above amplifier. [05 marks]
 - Find an expression for the voltage gain, A_V . [05 marks]
 Clearly state any assumptions you make.

- iii. Hence shows that the low-frequency voltage gain for this amplifier is $\frac{\mu}{\mu+1}$, Where $\mu = \frac{g_m}{g_d}$. [07 marks]

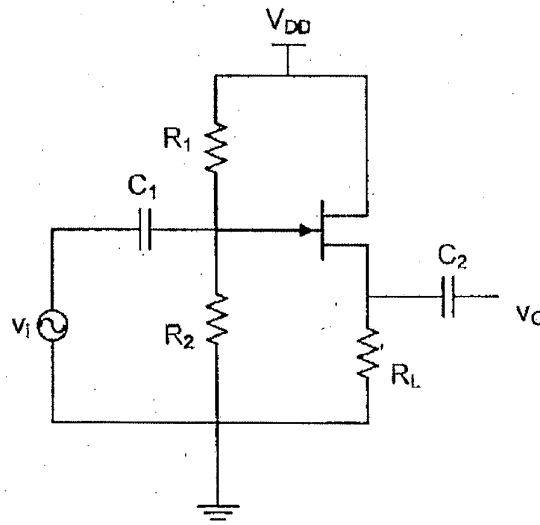


Figure-Q2

Question 3**[20 marks]**

- (a) Consider the feedback arrangement circuit diagram shown in Figure-Q3. The open loop gain of the Op-amp is 10,000 and the other parameters are as follows.

$$R_1 = R_3 = R_s = 2k\Omega, R_2 = 100k\Omega$$

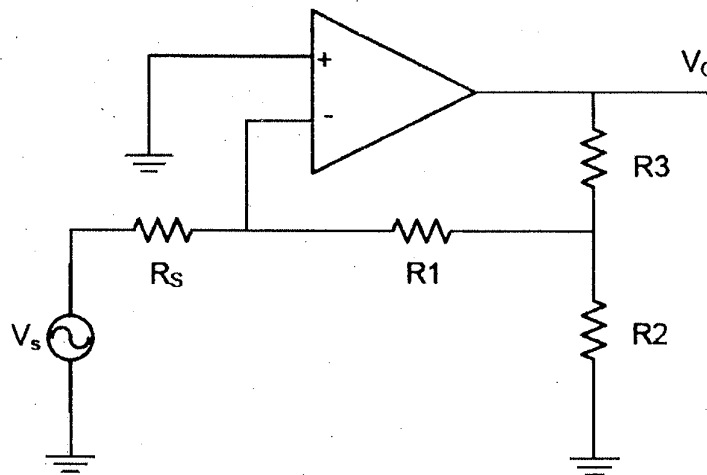


Figure-Q3

- Identify the type of feedback used. [05 Marks]
- Considering the effect of the source resistance R_s , calculate the feedback factor. [07 Marks]
- Considering the effect of the source resistance R_s , calculate the total closed loop. [08 Marks]

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[20 marks]

Figure-Q4 shows an active High-pass filter circuit.

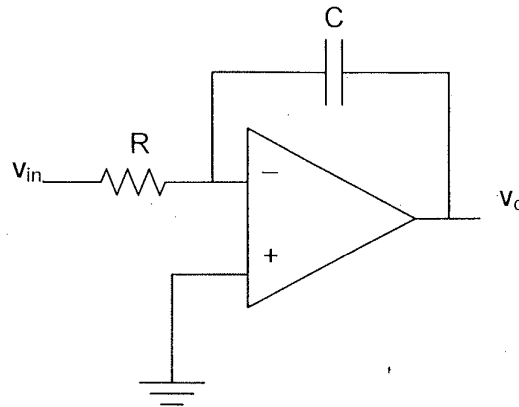


Figure-Q4

- (a) Assuming an ideal operational amplifier, derive the voltage gain transfer function of the above circuit in Figure-Q4. [04 marks]
- (b) Hence, sketch the magnitude and phase Bode plots. Plot the magnitude and phase Bode plots for an all-ideal operational amplifier in the same sketch. Assume $R = 1.6k\Omega$ and $C = 0.01\mu F$ (Clear axis labelling and plots are required.) [08Marks]
- (c) Derive the voltage gain transfer function of the above amplifier for a finite gain A . [08Marks]

Question 5

[20 marks]

- (a) Describe how the precision, accuracy, and sensitivity of measuring instruments impact the evaluation of FET-based small-signal amplifiers. Additionally, explain the role of instrument accuracy in determining the reliability of performance assessments for these amplifiers. [08 marks]
- (b) A small-signal FET amplifier is being tested using a voltmeter with an accuracy of $\pm 1\%$ of the full-scale reading and a resolution of 1 mV. The amplifier has an expected output voltage of 500 mV.
 - i. What is the possible range of measured output voltage due to the accuracy limitation of the voltmeter, if the voltmeter's full-scale range is set to 1V? [04 marks]
 - ii. If the sensitivity of the voltmeter is 0.5 mV, can it reliably detect a voltage change of 2 mV in the amplifier's output? Justify your answer. [04 marks]
 - iii. How does the instrument's accuracy and sensitivity affect the trustworthiness of performance evaluations in this scenario? Clearly state any assumptions you make. [04 marks]

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