00042

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

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: EEX6450 Analog Electronic Systems & Instrumentation**
Academic Year	: 2020/2021
Date	: 22nd February 2022
Time	: 0930-1230 hrs
Duration	**: 3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Five (5)** questions in **Four (4)** pages.
3. Answer **All** the questions.
4. Answer for each question should commence from a new page.
5. Relevant charts / codes are provided.
6. This is a Closed Book Test **(CBT).**
7. Answers should be in clear hand writing.
8. Do not use red colour pens.

Q1. Let the transistor in the amplifier circuit in Figure-Q1 has the following parameters with the usual notation. $r_{be} = 1k\Omega$, $r_{ce} = 80k\Omega$, $c_{bc} = 3pF$, $c_{be} = 100pF$ and $g_m = 50mAV^{-1}$.
Assume the effect of all the other unmentioned parameters to be negligible.

(a) Draw the high frequency hybrid-π equivalent circuit for this amplifier circuit. **(6Marks)**

(b) Using Miller's theorem, simplify the equivalent circuit model. **(6Marks)**

(c) Hence, find the voltage gain of the same amplifier. **(8Marks)**

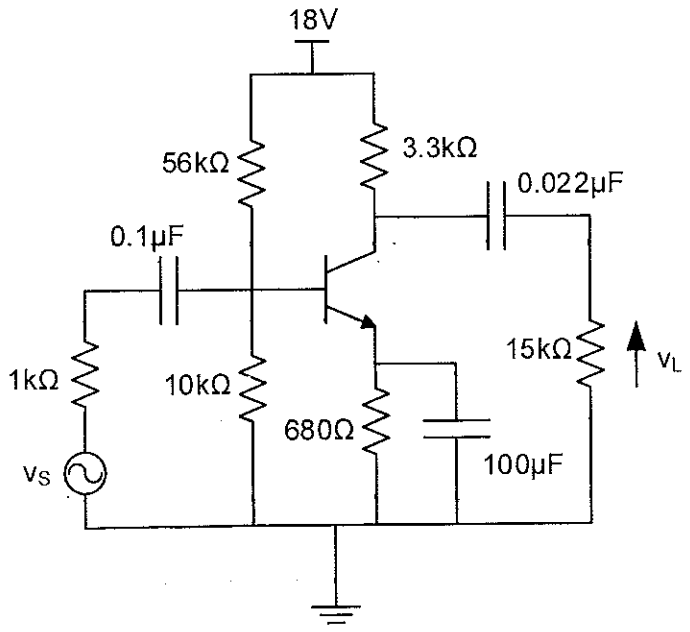

Figure-Q1

Q2. Consider the circuit in the Figure-Q2.

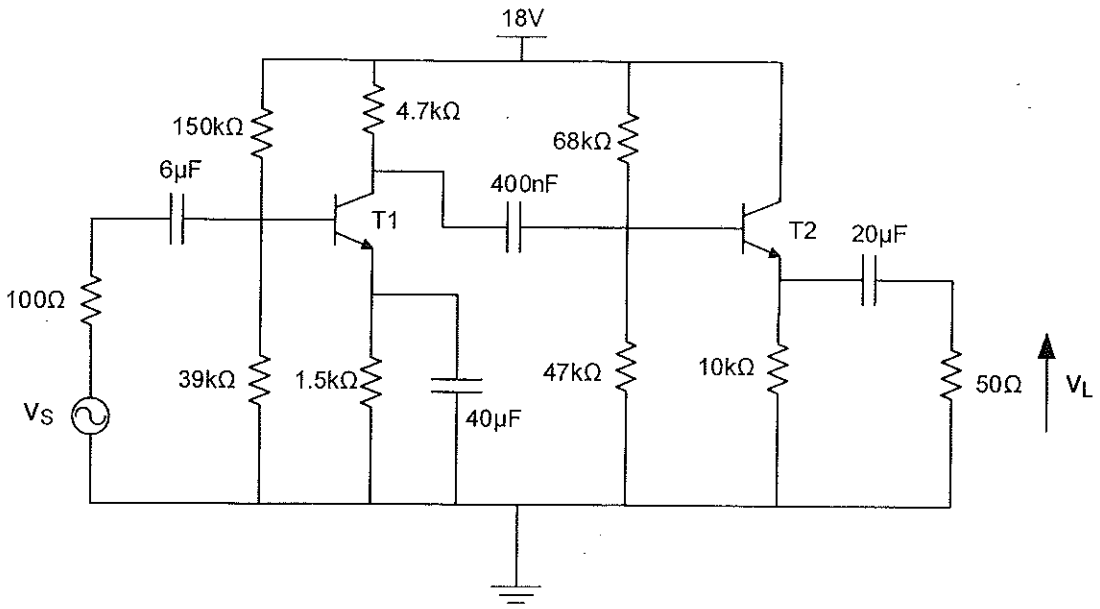

Figure-Q2

T1: $h_{ie} = 1.4k\Omega, h_{re} = 2 \times 10^{-4}, h_{fe} = 180$
T2: $h_{ic} = 2k\Omega, h_{rc} = 1, h_{fc} = -101$

(a) Draw the low frequency equivalent circuit. **(6 Marks)**

Hence find,

(b) Input impedance. **(4 Marks)**
(c) Output impedance. **(2 Marks)**
(d) Mid band voltage gain $\frac{V_L}{V_S}$. **(8 Marks)**

Q3.

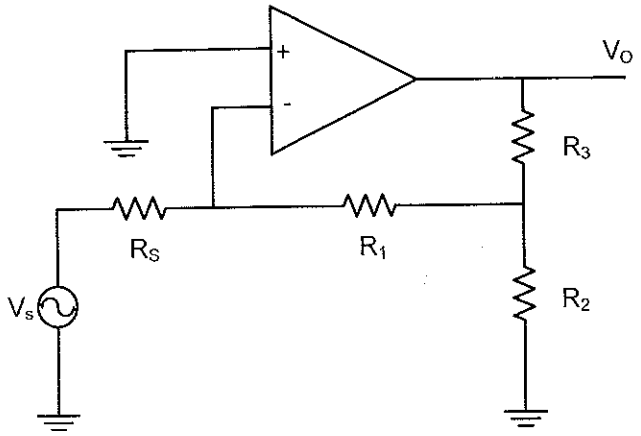

Figure –Q3

Consider the feed-back arrangement in the above Figure-Q3 circuit diagram. Let the open loop gain of the op-amp is 10,000.

$R_1 = R_3 = R_S = 1k\Omega,\ R_2 = 100k\Omega.$

(a) Identify the type of feed-back used. **(2 Marks)**
(b) Calculate the feedback factor, considering the effect of the input resistance. **(8 Marks)**
(c) Let the amplifier is connected with a load $R_L = 1k\Omega$. Calculate the total closed-loop gain considering the effects of load and input resistances. **(10Marks)**

Q4.

(a) List two commonly used filter transfer functions and their characteristics. **(4Marks)**

(b)

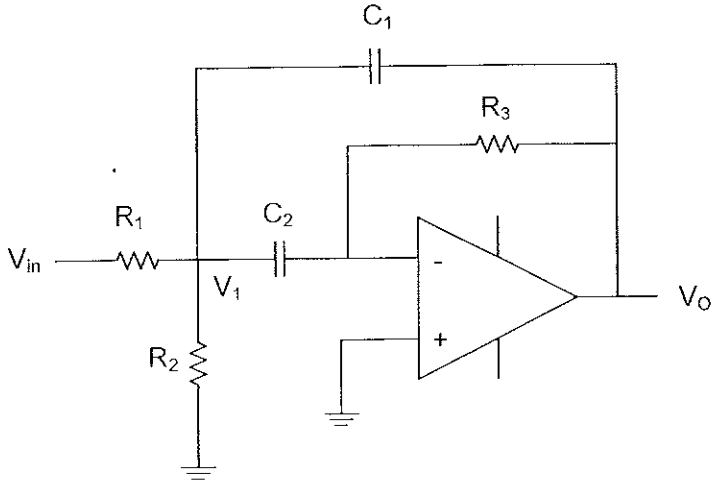

Figure Q4(a)

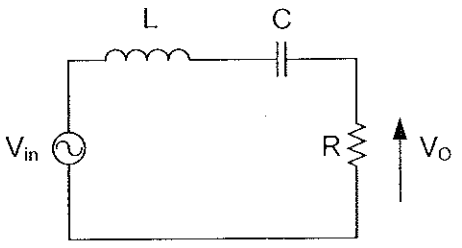

Figure Q4(b)

i. Derive the transfer function for the circuit in Figure Q4(a). **(8Marks)**
ii. Show that the filter effects are the same for both circuits. **(4Marks)**
iii. Find the expressions for the bandwidths of the two filter circuits. **(4Marks)**

Q5.

(a) Using an appropriate block diagram, explain the functionality of an analog megger tester. **(4Marks)**

(b) A certain megger tester has a frequency response given by $\frac{2}{(1+j\omega)(3+j\omega)}$. Using a suitable frequency domain analysis, calculate the minimum time one must wait after placing the megger tester at the point of measurement, to have an accurate static resistance reading. **(5Marks)**

(c) An analog Megger Tester static reading taken between two electrodes in 20 different occasions are given by 9.07, 9.54, 10.25, 10.24, 10.18, 9.50, 11.01, 9.86, 10.23, 9.94, 9.32, 10.48, 10.37, 9.90, 10.04, 10.04, 10.09, 10.39, 9.82, 10.79 Ohms.

i. Determine how well the above readings fit to a random Normal distribution. **(3Marks)**
ii. Determine the mean and the variance for the above Normal fit. **(4Marks)**
iii. Hence, determine the accuracy of the above meter with a confidence level of 95%. **(4Marks)**