00043

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	**: EEX6550 Analog Electronic Systems**
Academic Year	: 2020/2021
Date	: 22nd February 2022
Time	: 0930-1230hrs
Duration	**: 3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Seven (7)** questions in **Five (5)** pages.
3. Answer **only Five (5)** 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.
$g_m = 3.2mS, r_d = 100k\Omega$, $C_{gs} = 4pF$, $C_{ds} = 0.5pF$ and $C_{gd} = 1.2pF$.

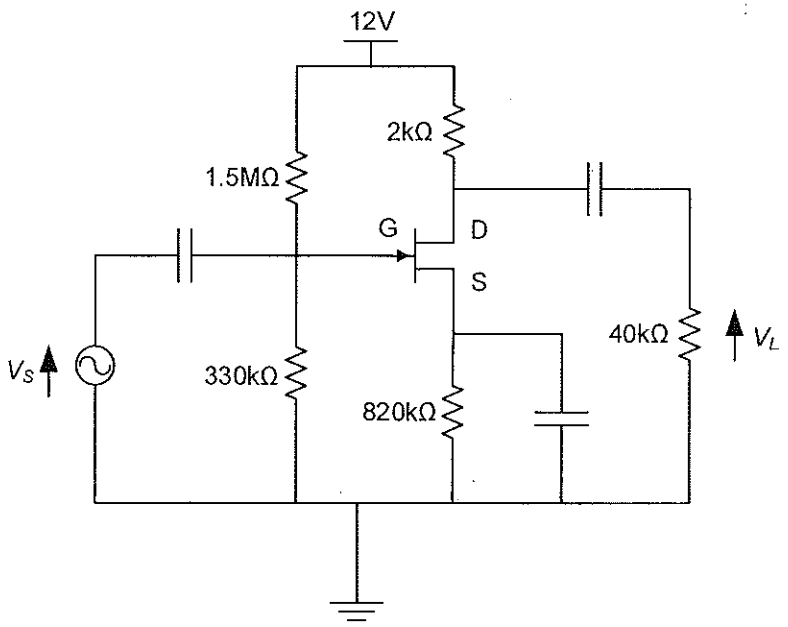

Figure-Q1

(a) Draw the high frequency equivalent circuit for this amplifier circuit. **(6 Marks)**
(b) Calculate the input and output impedances. **(8 Marks)**
(c) Find the mid-band voltage gain of this amplifier. **(6 Marks)**

Q2. Let the transistor in the amplifier circuit in Figure-Q2 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)**

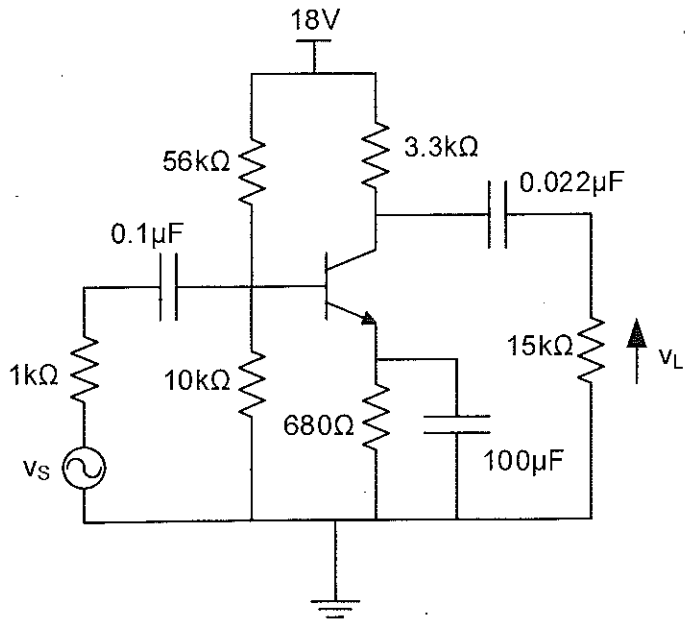

Figure-Q2

Q3. Consider the circuit in the Figure-Q3.

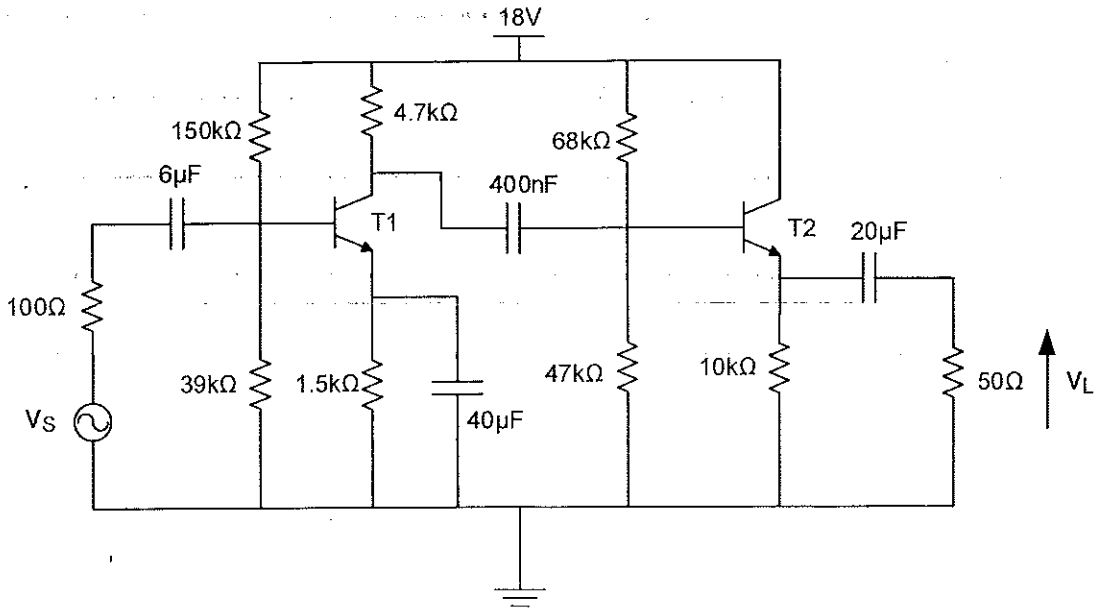

Figure-Q3

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)**

Q4.

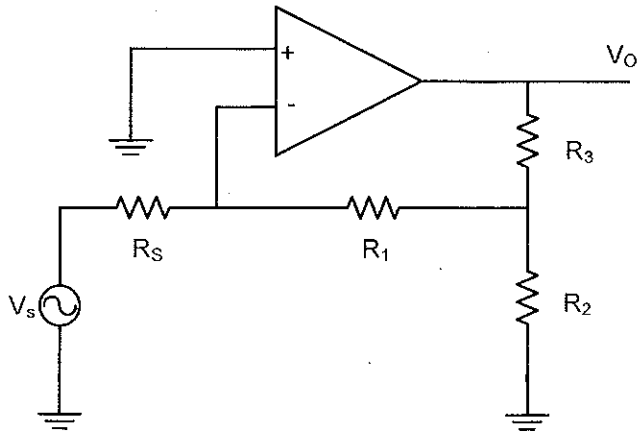

Figure –Q4

Consider the feed-back arrangement in the above Figure-Q4 circuit diagram. Let the open loop gain of the op-amp be 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)**

Q5.

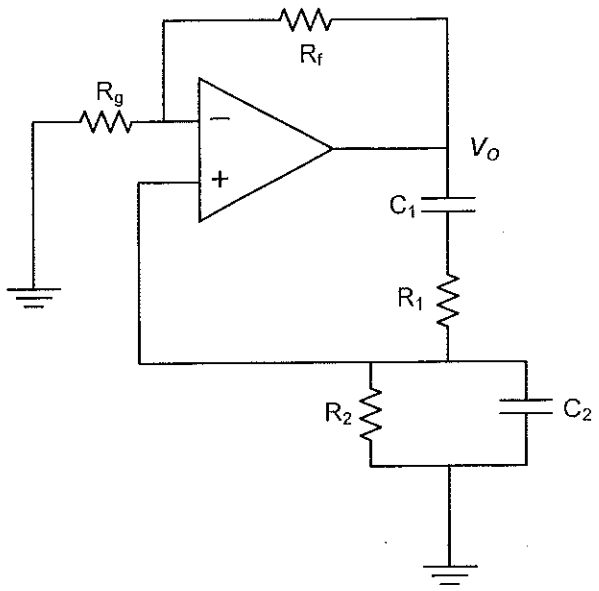

Figure-Q5

(a) Starting from the first principles, derive the Barkhousen criteria for oscillations to occur. **(4 Marks)**

(b) Stating all your assumptions, derive an expression for the feedback factor for the circuit in Figure- Q5. **(8 Marks)**

(c) Derive an expression for the forward gain. **(4 Marks)**

(d) Hence find the frequency of oscillation. **(4 Marks)**

Q6.

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

(b)

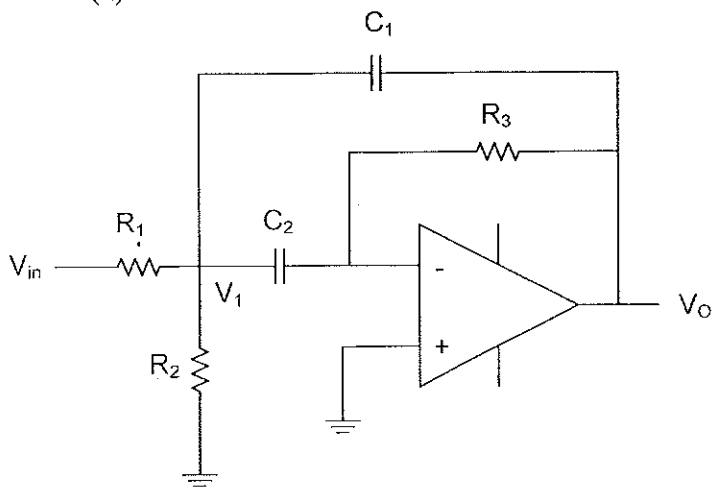

Figure Q6(a)

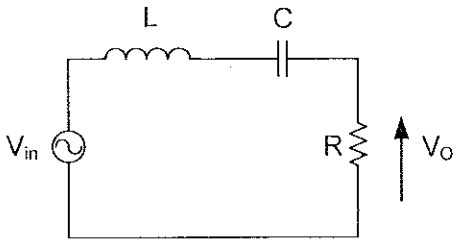

Figure Q6(b)

i. Derive the transfer function for the circuit in Figure Q6(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)**

Q7.

(a) Using proper diagrams compare the ideal and practical diode characteristics. **(4 Marks)**

(b) Consider the circuit diagram in Figure-Q7.

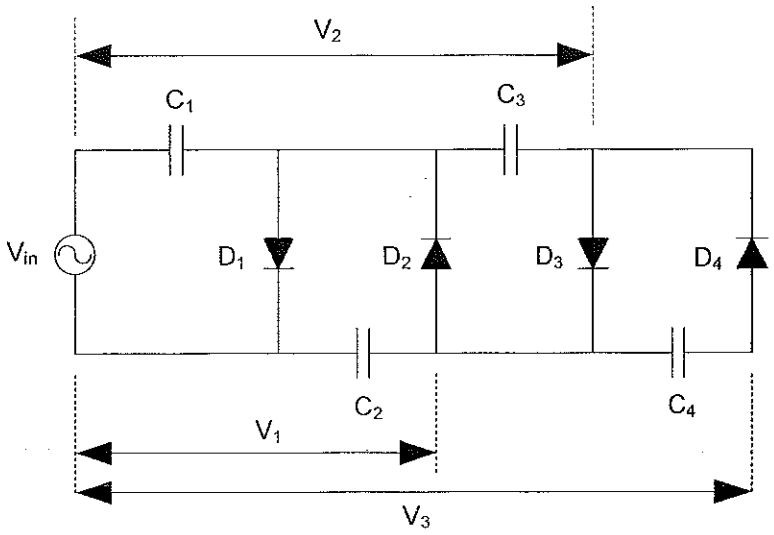

Figure-Q7

i. Assuming ideal diode and capacitor behavior, explain the operation of the above circuit. **(4 Marks)**
ii. Hence draw the waveforms of V_1, V_2 and V_3 for an input signal of $v_{in} = 10 \sin 20\pi t$. **(6 Marks)**
iii. Draw the waveforms of V_1, V_2 and V_3 under non-ideal (practical) Si diode characteristics. **(6 Marks)**