THE OPEN UNIVERSITY OF SRI LANKA
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING
BACHELOR OF TECHNOLOGY

FINAL EXAMINATION - 2015/2016

ECX6330 –ELECTRONIC SYSTEMS **(Closed Book)**

ANSWER ANY FIVE QUESTIONS.

Date 17.12.2016 ***Time: 9:30-12:30 hrs.***

Q1.

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

(b) Consider the circuit diagram in Figure-Q1.

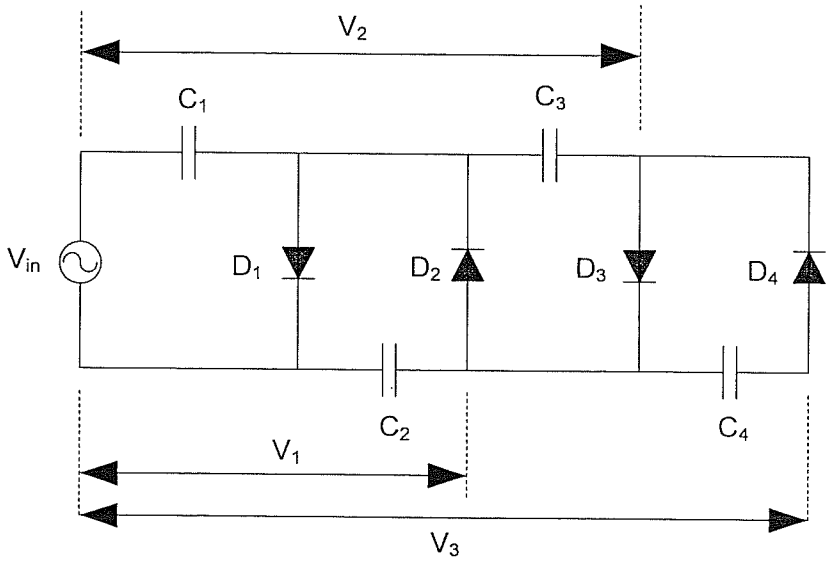

Figure-Q1

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)**

Q2. Let the transistor in the amplifier circuit in Figure-Q2 has the following parameters with the usual notation. $r_{be} = 1k\Omega, r_{bc} = 4M\Omega,\ r_{ce} = 80k\Omega,\ C_c = 3pF,\ C_e = 100pF$ and $g_m = 50mAV^{-1}$.
Assume the effect of all the other unmentioned parameters to be negligible.

(a) Draw the high frequency 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)**

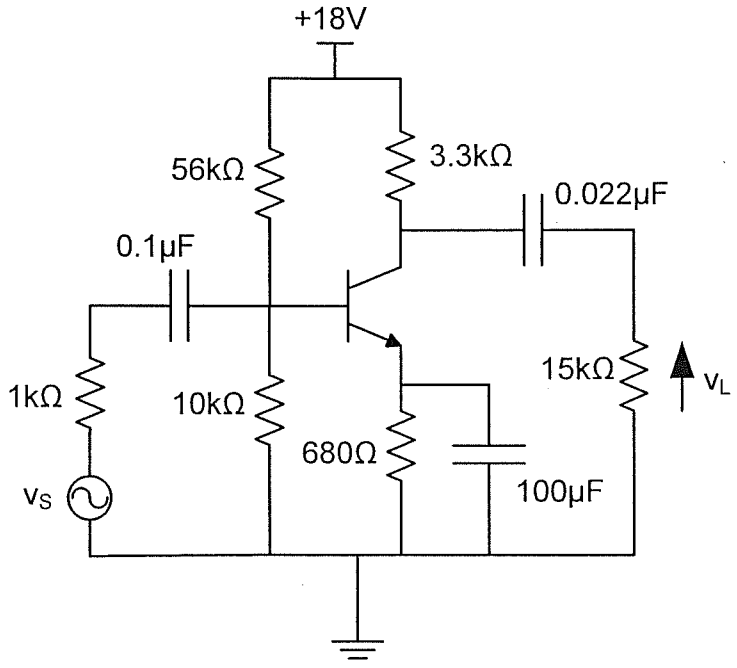

Figure-Q2

Q3.

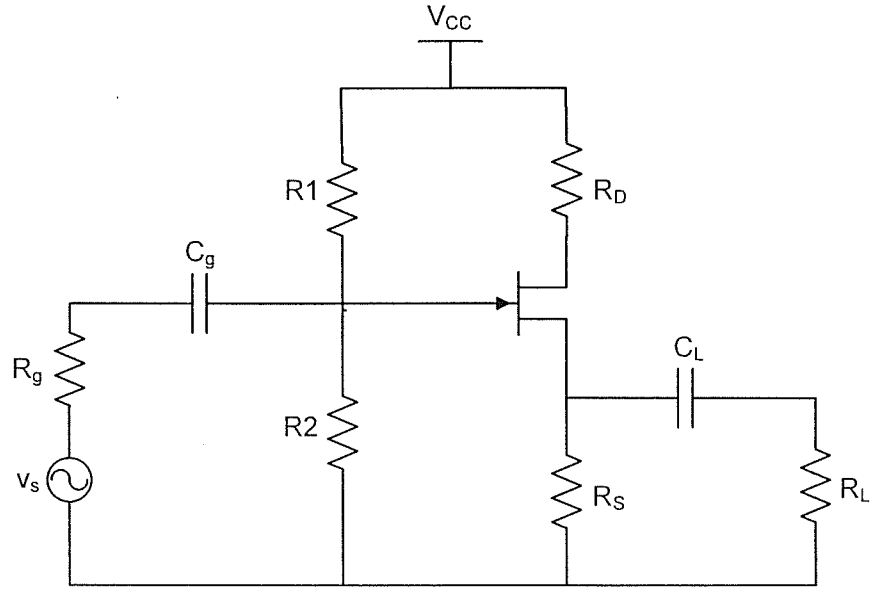

Figure –Q3

Consider the arrangement in the above Figure-Q3 circuit diagram.

i. Using the symbols under the usual notation, draw the high frequency equivalent circuit diagram. **(6Marks)**

ii. Find expressions for the voltage gain, input impedance and the output impedance. **(9Marks)**

iii. Hence derive an expression for the low frequency voltage gain of the above amplifier. **(5Marks)**

Q4.

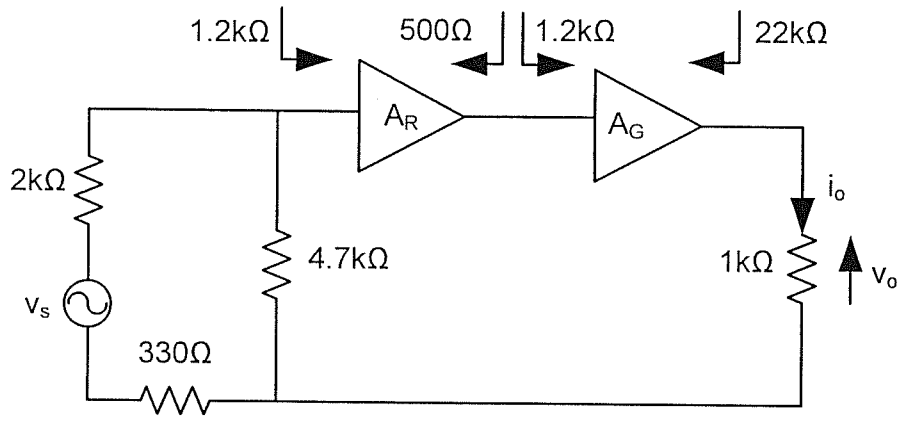

Figure-Q4

The circuit shown in the above Figure-Q4 has a transresistance amplifier and a transconductance amplifier with $A_R = -100\ VA^{-1}$ and $A_G = 50\ AV^{-1}$ respectively. The input and output impedances of the two amplifier stages are as shown.

(a) Draw the open loop ac equivalent circuit. **(6Marks)**

(b) Find the open loop gain and the feedback factor. **(8Marks)**

(c) Hence find the closed loop current gain, input impedance and the output impedance. **(6Marks)**

Q5.

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

(b)

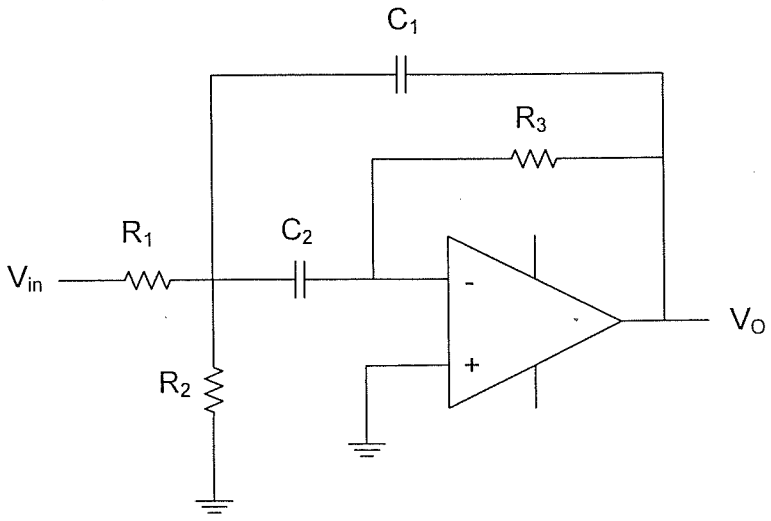

Figure Q5(a)

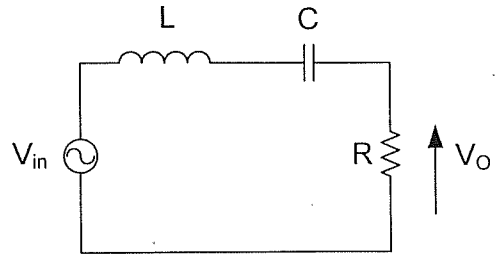

Figure Q5(b)

i. Derive the transfer function for the circuit in Figure Q5(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)**

Q6.

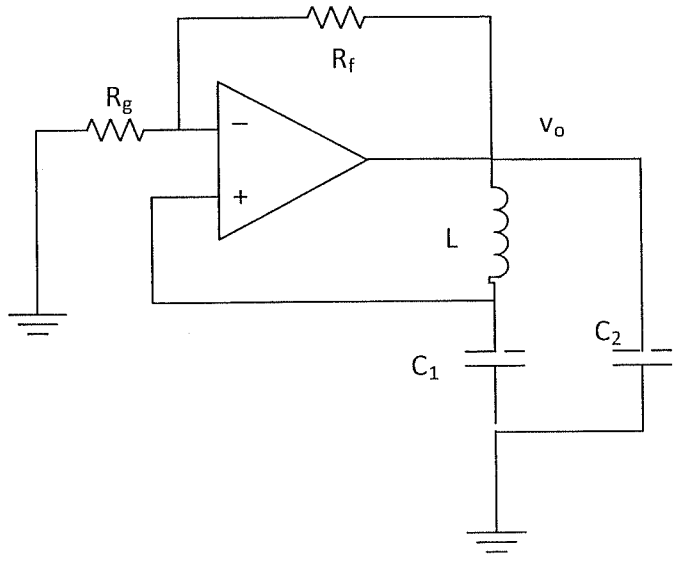

Figure Q6

(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 Q6. **(8 Marks)**

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

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

Q7.

(a) A weight measuring system should measure $500 - 2500kg$ with a resolution of at least $10kg$. Sensitivity of the transducer employed is $5mVkg^{-1}$. The output of the transducer is fed to an ADC. Calculate the minimum number of bits required at the ADC and the minimum possible resolution at the ADC input. **(6Marks)**

(b) A basic level microprocessor control unit is to be designed according to the following specifications.

- Operations: Addition, logical AND, logical OR, bitwise inversion.
- Operations to be performed by ALU on 4 bit data stored in A and B registers accordingly.
- Results of the ALU operation to be stored in the 4 bit register C.
- Current instruction (in binary for) is loaded to the instruction register (IR).
- Depending on the current instruction (in binary form) required functional circuit inside the ALU is activated together with the registers.

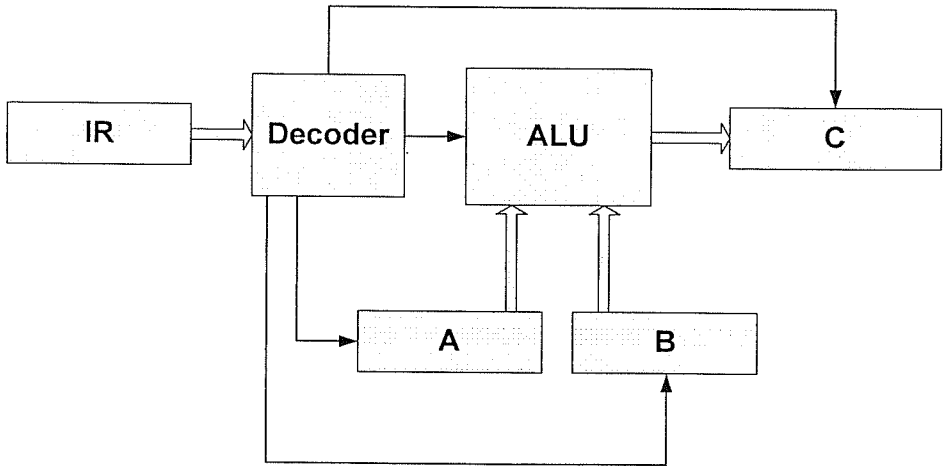

Figure Q7

i. Select a suitable binary instruction set. **(2Marks)**

ii. Design the combinational circuit in the decoder to activate the different circuit elements.

a. Draw the truth table. **(4Marks)**

b. Produce the simplified Boolean expressions. **(4Marks)**

c. Implement using an appropriate PLA. **(4Marks)**

Q8.

(a) Design a synchronous sequential circuit to detect a 101 in a long series of bits.

i. State the state table. **(2Marks)**

ii. Draw the state transition diagram. **(3Marks)**

iii. Produce the Boolean expressions. **(3Marks)**

iv. Draw the circuit with suitable logic gates. **(1Marks)**

(b) Design a counter circuit which counts 1 to 7 in odd numbers only.

i. How many flip flops are required to design this counter? **(1Marks)**

ii. Draw the state diagram for the counter. **(2Marks)**

iii. Draw the truth table and the state transition table. **(3Marks)**

iv. Simplify the functions using Karnaugh maps. **(3Marks)**

v. Design the circuit with required logic gates. **(2Marks)**