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THE OPEN UNIVERSITY OF SRI LANKA
Faculty of Engineering Technology
Department of Electrical & Computer Engineering

Bachelor of Technology Honors in Engineering

Final Examination (2016/2017)
ECX6250: Analog Electronic Systems

Date: 09th December 2017 (Saturday) **Time: 9:30 am – 12:30 am**

Answer any five (5) questions only. Show all steps very clearly. Underline your final answer where possible.

Q1. A Differential amplifier is shown in Fig-Q1. Transistors Tr1 and Tr2 are matched pair. The current gain is 100 for all three transistors.

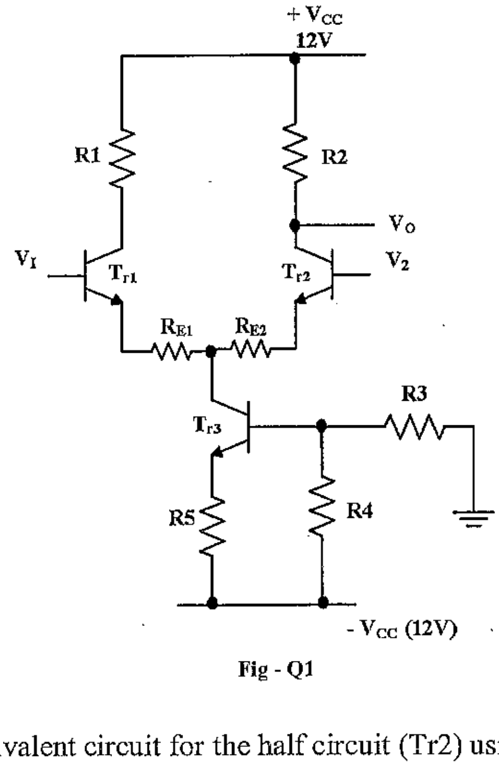

Fig - Q1

a) Draw the ac equivalent circuit for the half circuit (Tr2) using transconductance model of the transistor. [6marks]

b) Find an expression for the differential gain using the ac equivalent circuit. You may neglect the output resistance of the three transistors. [7marks]

c) Calculate the values R_2, R_{E2} and R_5, if Voltage gain of the circuit is 20 and current source draws a 1 mA current in operating in quiescent values. [7marks]

Q2. Fig-Q2 shows a common emitter stage driving a darlington pair connected as an emitter follower. Current gain of the transistor T_{R1}, T_{R2}, and T_{R3} are 200, 100,100 respectively.

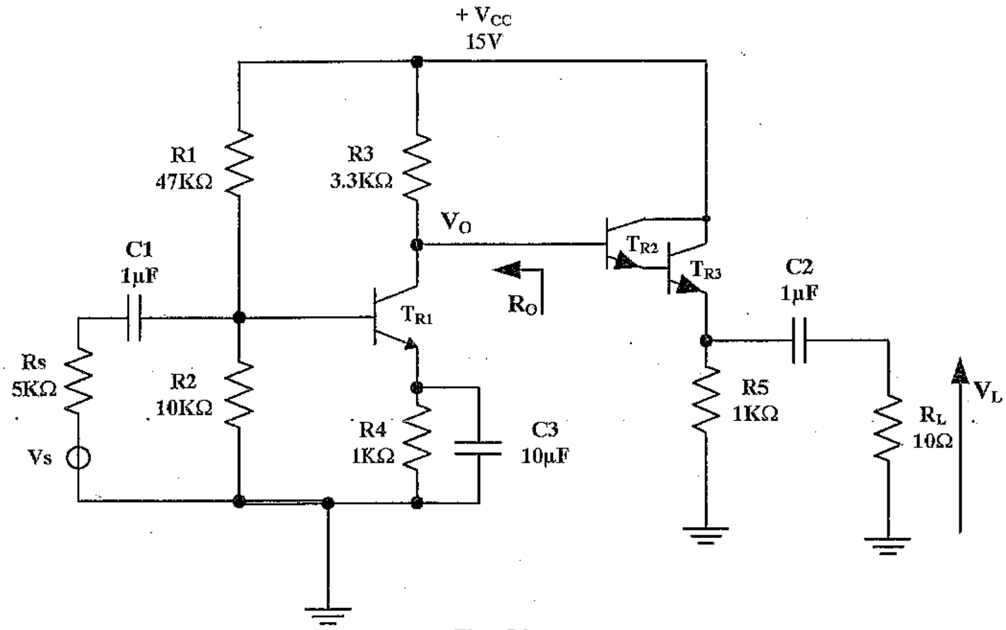

Fig - Q2

a) Calculate the internal emitter resistance- of the T_{R2} and T_{R3} transistors. Hence calculate the input impedance of the T_{R2} and T_{R3} transistors. [6marks]

b) Derive an expression for the overall voltage gain of the circuit given in Fig-Q2. Hence calculate the voltage gain. [7marks]

c) Explain the effect of the overall gain of Fig-Q2, if the Darlington pair is removed and 10Ω load (R_L) with the capacitor (C) is connected to the collector of T_{R1}. [7marks]

Q3. An operational amplifier circuit is shown in Fig-Q3.

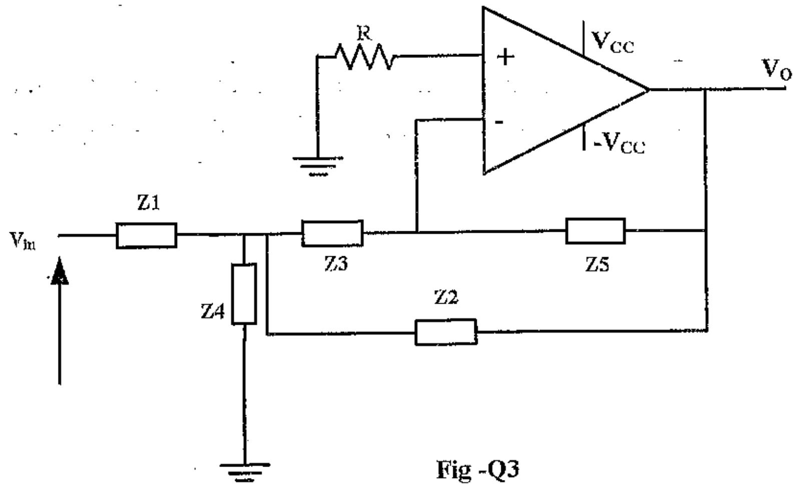

Fig -Q3

a) Derive the voltage transfer function H(s) for the circuit shown in Fig-Q3. [7marks]

b) Compare H(s) with the function $\frac{H_0\omega_0^2}{s^2+\alpha\omega_0 s+\omega_0^2}$ and find C1, C2 and H_o in terms of R, α and ω_0 where R is given by $R = R_1 = R_2 = R_3$. [7marks]

c) . Using the circuit given in Fig-Q3, design butterworth second -order low pass filter for the following specifications. Cut off frequency 100 KHz [6 marks]

Q4. Consider the amplifier circuit diagram in Fig - Q4.

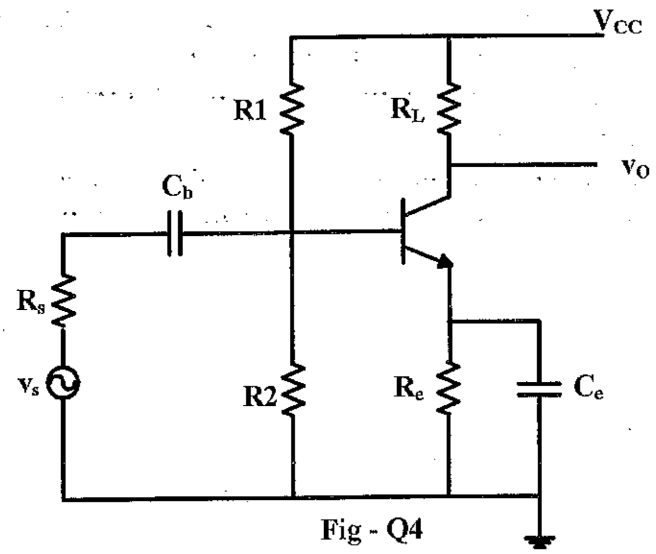

Fig - Q4

a) Find the voltage gain for the circuit shown in Fig - Q4. [8 marks]

b) Let, $R1//R2 \gg R_s$, $\frac{1}{h_{oe}} \gg R_L$, $R_s = 1k\Omega$, $R_e = 220\Omega$, $C_b = 10\mu F$, $C_e = 1\mu F$, $h_{fe} = 100$, $h_{ie} = 1.5k\Omega$ and $R_L = 4.7k\Omega$.

Sketch the Bode plots for gain and phase. [12 marks]

Q5. An electronic integrator circuit is shown in Fig-Q5.

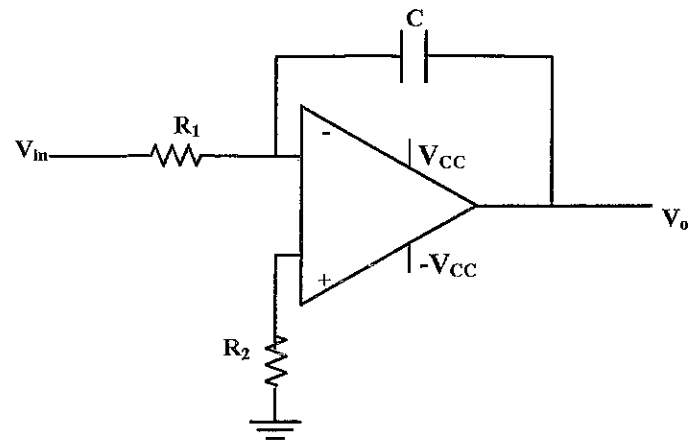

Fig-Q5

a) Derive an equation for the output voltage. [8 marks]
b) Hence, find the maximum amplitude of the output signal, if the input voltage is 0.5 sin(100t) V. [6 marks]
c) Comment on the integrator behaviour if the signal frequency increased by 10 times. [6 marks]

Q6.

a) State the condition for oscillation to design an oscillator. [4 marks]

b) A Wien bridge oscillator circuit is shown in Fig-Q6. Z1 is a series RC combination and Z2 is a parallel RC combination.

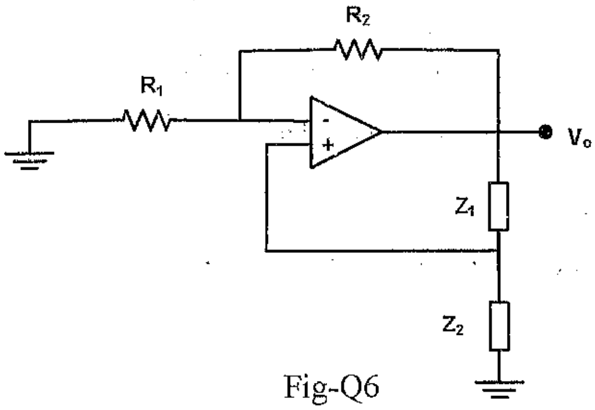

Fig-Q6

i. Derive the feedback ratio for the circuit shown in Fig-Q6. [6 marks]
ii. Hence find the oscillation frequency. [4 marks]
iii. Design a Wien bridge oscillator that oscillates at 25 kHz. Use 0.001 μF capacitors for the design. [6 marks]

Q7. A multistage amplifier is shown in Fig-Q7.

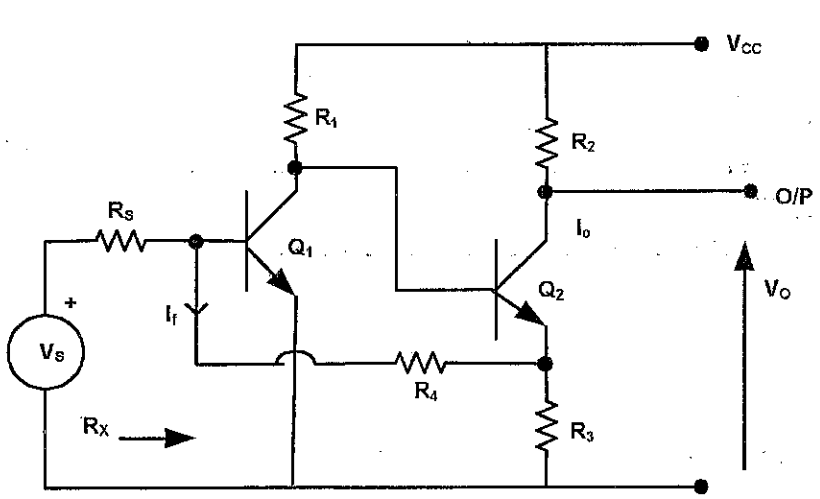

Fig-Q7

a) Identify the type of feedback used. [3 marks]
b) Draw the open loop ac equivalent circuit considering the effect from the feedback network. [4 marks]
c) Find expressions for the feedback factor and the open loop gain [13 marks]

Q8. An amplifier circuit is shown in Fig - Q8, which operates in high frequencies.

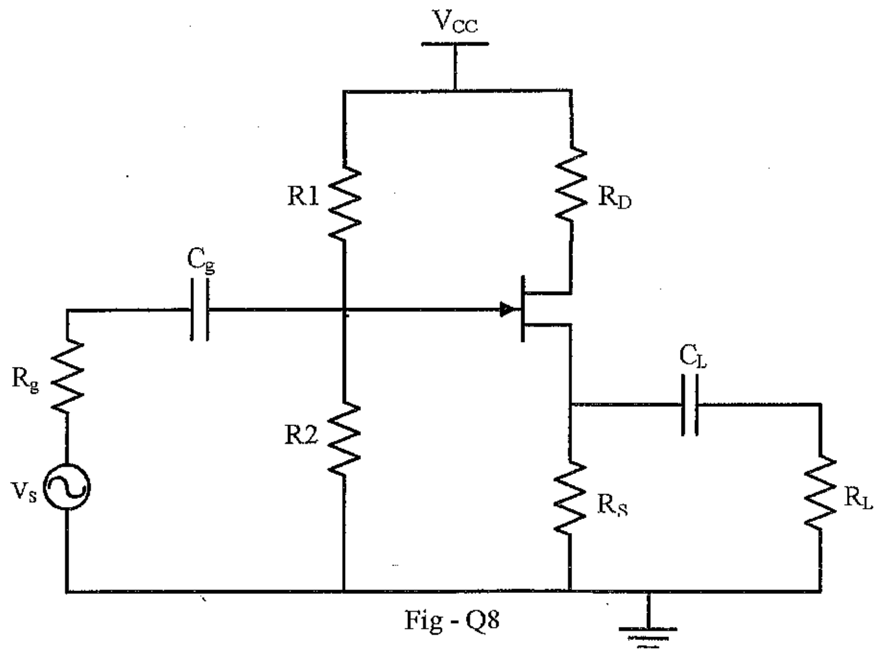

Fig - Q8

a) Using the symbols under the usual notation, draw the high frequency equivalent circuit diagram. [6 marks]

b) Find expressions for the voltage gain, input impedance and the o
utput impedance.

[9 marks]

c) Hence derive an expression for the low frequency voltage gain of the above amplifier. [5 marks]