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The Open University of Sri Lanka
Department of Electrical and Computer Engineering
Final Examination -2012
ECX4230 – Fault Diagnosis in Electronic Circuits

Date:30.08.2014 Time: 0930 -1230 hrs

Answer any five questions.

1. A two stage transistor amplifier circuit is shown in figure1. Circuit consists of two Si transistors. Tr1has high current gain. The current gain of Tr2 is 40.

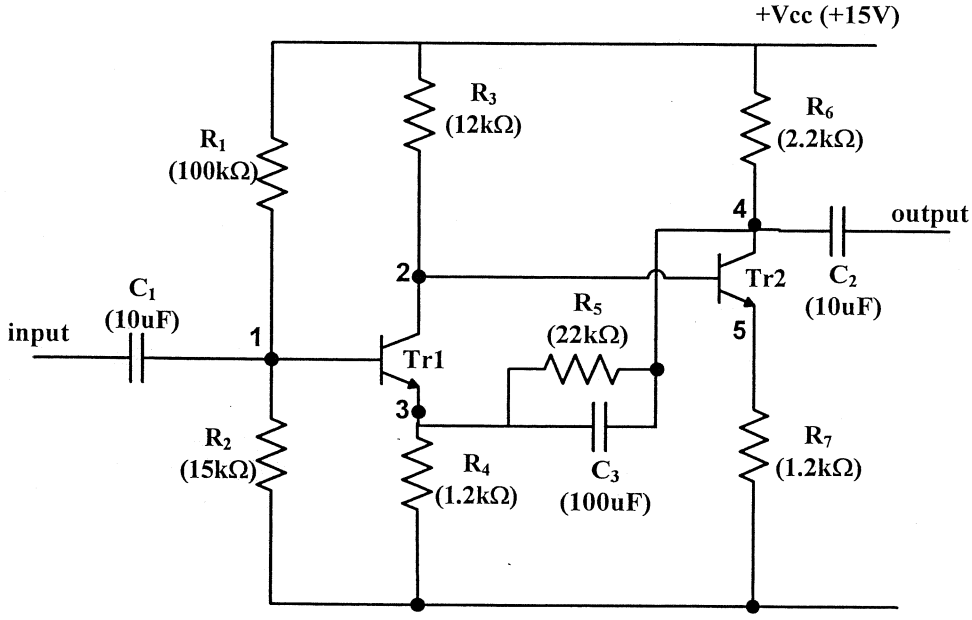

Figure 1

a. Calculate the current Ix, Iy and the test point voltages. [10 marks]
b. Estimate the open loop gain of this amplifier, if the output from the test point 4 is 930mV with the input signal of 6.2mV. [2 marks]
c. Determine the faulty component and the fault for the following cases giving reasons.

Case	1	2	3	4	5	
A	3.31	2.96	2.71	10.2	2.3	Positive half clips
B	1.96	6.66	1.31	14.8	6.6	No output
C	1.96	9.13	1.41	8.63	8.53	No out put
D	1.96	11.1	1.3	10.7	10.5	the output signal clips

[8 marks]

2. The circuit in figure 2 represents a Wien bridge oscillator. All transistors in the circuit are high gain type. RT is a thermistor.

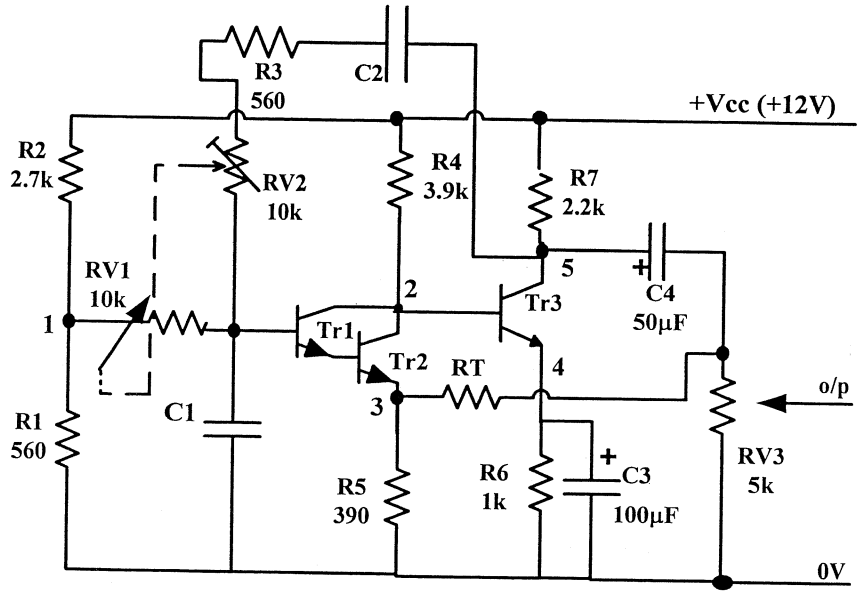

Figure 2

a. What are the main sections needed for a circuit to oscillate? [2 marks]
b. Write the components or paths in figure 2 for the section mention in 2.a. [2 marks]
c. State the function of RT. [1 mark]
d. Compute the capacitance value for the capacitor C1 and C2 if the circuit generates 15 kHz signal as a maximum operating frequency. (Consider C1 = C2). [2 marks]
e. Estimate the minimum operating frequency using the calculated capacitance value in 2.d. [2 marks]
f. Calculate the test point voltages for the circuit shown in figure2. [5 marks]
g. Find the fault and the faulty component/s for the following faulty cases.

Case	1	2	3	4	5	
A	2.061	3.381	0.861	12	0	No output
B	2.061	3.381	0.861	5.800	2.781	Output signal high and clipped
C	0	5.470	0	4.970	4.870	No output
D	2.061	3.381	0.861	5.800	2.781	There is a waveform at T.P.2, No output

[6 marks]

3. A Schmitt trigger circuit is shown in figure 3.1. Transistors have high gains and saturated collector emitter voltage is 0.

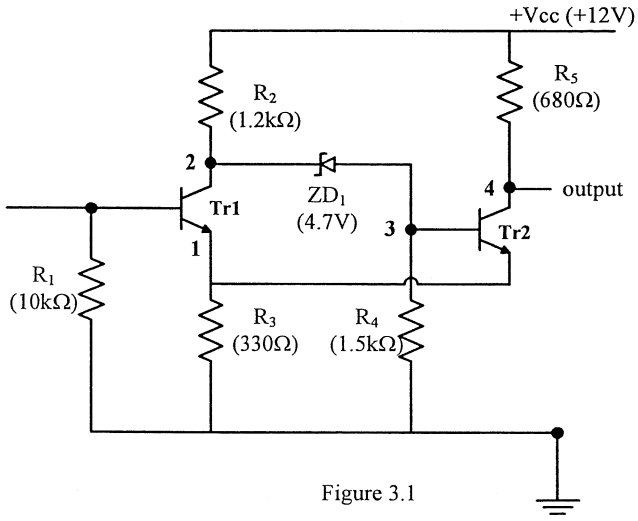

Figure 3.1

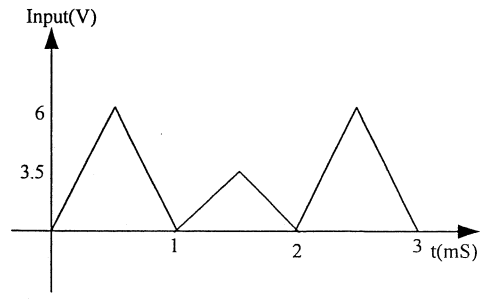

Figure 3.2

a. Calculate the threshold voltages. [2 marks]
b. Find the possible values for the output. Derive the test point voltages for each output value. [6 marks]
c. Draw the output waveform for the input signal shown in figure 3.2.[4 marks]
d. Under fault conditions, two dc voltages are given to the input and the resulting test point voltages are listed below. State the faulty component/s giving fault type with reason. [8 marks]

Case	input	1	2	3	4
A	6	5.4	8.2	4.1	12
B	6	5.4	5.6	0.9	0
C	0	0	12	0	12
D	0	0	8.2	4.1	12

4.

a.

i. What are the main sections of a tuner in a TV receiver? Explain the function of each section. [6 marks]
ii. In a defective TV receiver only the sound is received. Explain what sections are likely to be faulty and how you are going to identify the faulty section. [4 marks]

b.

i. Compare the R.F and A.F amplifiers in a radio receiver. [2 marks]
ii. Draw the block diagram of a superheterodyne receiver. [3 marks]
iii. A defective radio receiver gives a distorted audio. Explain process of the detection of the faulty section if you are given an oscilloscope. [5 marks]

5. A Switch mode power supply circuit is shown in figure 5.

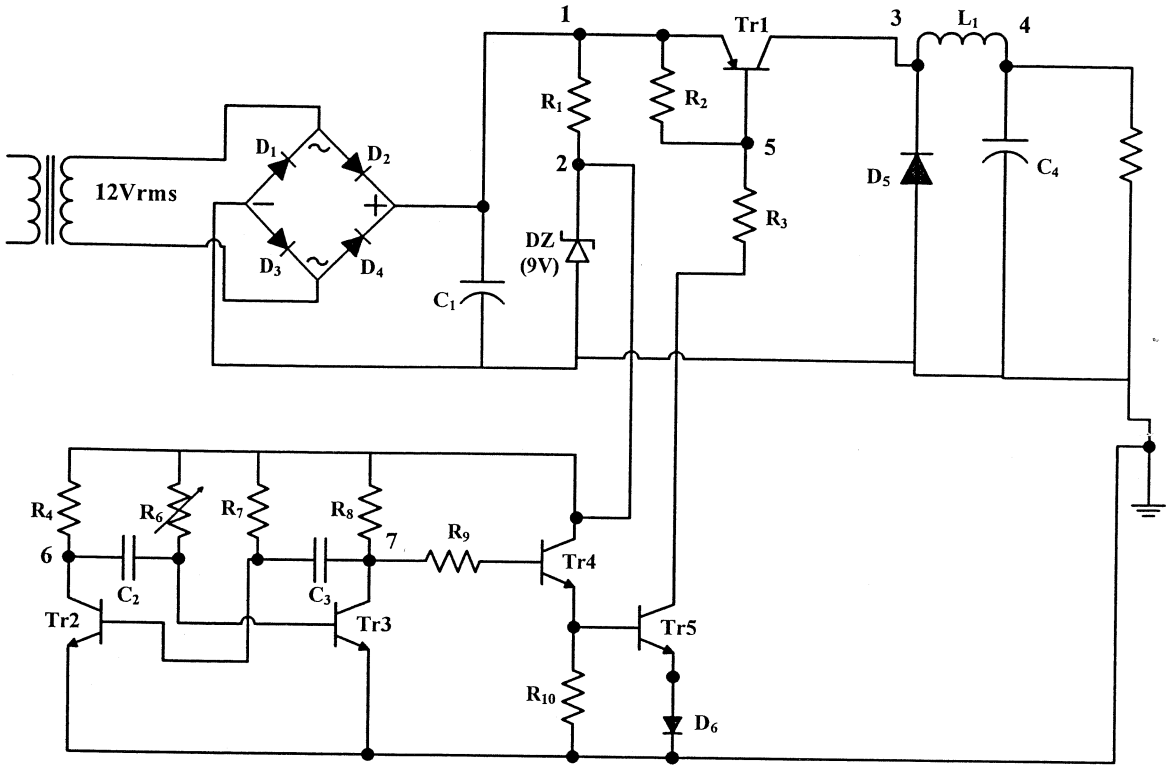

Figure 5

a. Indicate the current path via the load for the two cases when V5 is high and low. [4 marks]
b. What is the function of L1 and D5? [3 marks]
c. State the effect on the output voltage when R6 is
   i. increases
   ii. decreased. [4 marks]
d. State the difference between D1 and D5. [2 marks]
e. Draw the waveforms at test points 5, 6 and 7 on a common time scale with clear indication of voltage levels. [4 marks]
f. Consider following fault cases and determine the fault, faulty components giving the reasons. [3 marks]

Case	1	2	3	4	5	6	7
A	15.5	9	10.5	10	16.2	0	0
B	16.3	9	11	10.5	16.2	0	9

6. A circuit of a digital counter is shown in figure 6.

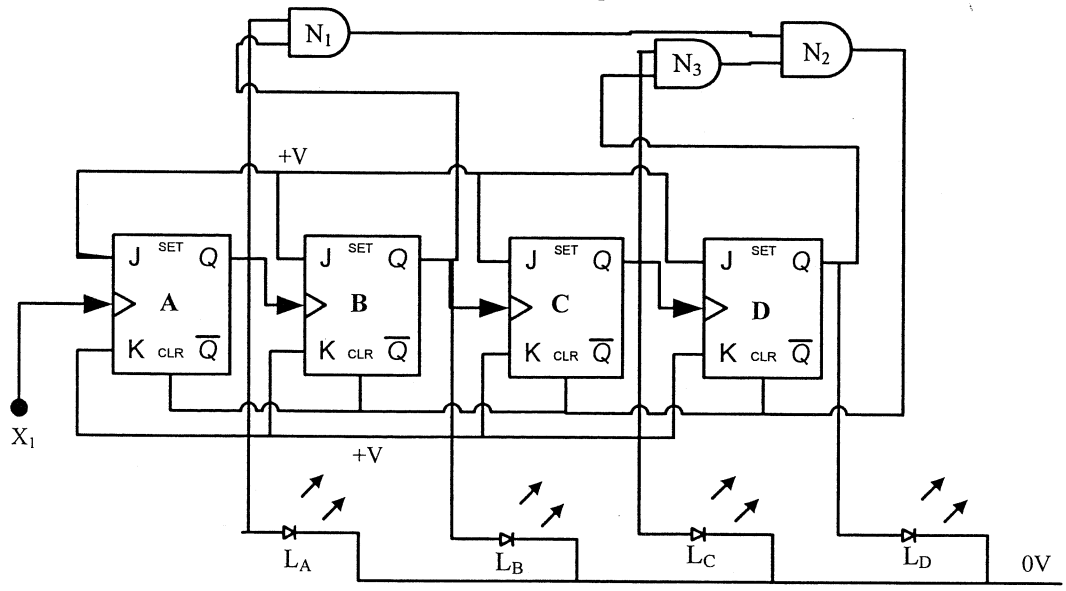

Figure 6

a. What is the maximum number that can count using this counter? [3 marks]
b. 5V/ 1Hz pulse stream is given to the input of X1. Draw the binary pattern of the outputs of A, B, C and D with the given input. [8 marks]
c. State the faulty component/s for the following cases giving reasons. The input is given pulses of 5V. Output is indicated by DCBA binary number.
   i. When the input pulses are given the output is 0000, 0001, 0000, 0001..... The pattern repeats. [3 marks]
   ii. The 0000,0001,0010,0011 numbers are not shown in the counter. [3 marks]
   iii. All the LEDs are not working, but the logic probe indicates working status at A,B,C,D outputs. [3 marks]

7. The circuit shown in figure 7 is an FET operated amplifier. The drain current of the JFET is given by $I_D = 0.3\ (V_{GS} - V_P)^2$ with V_P = -5V.

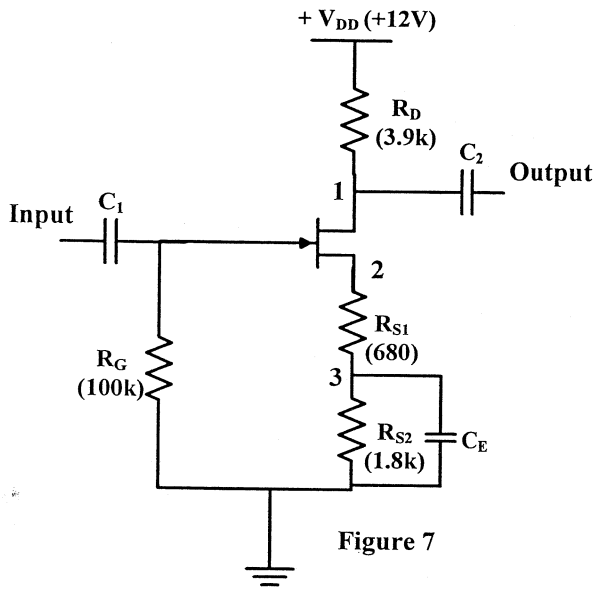

Figure 7

a. Find the drain current, transconductance of the FET and the test point voltages at no signal. [7marks]
b. Find an expression for the voltage gain and calculate its value. [5 marks]
c. Find the maximum input voltage applicable for a distortion free output. [2 marks]
d. Find the faulty component/s giving fault type with reasons for the following cases. [6 marks]

Case	1	2	3	
A	7.29	2.99	2.17	Output is 1.18V when the input is 1V.
B	3.50	3.00	2.17	-ve half of the output is clipped
C	9.66	3.58	3.17	+ve peak of the ouput is clipped for maximum input signal

8. Power control circuit is shown in figure 8. The pulse generator has pulse voltage Vp with a internal resistance of Rp.

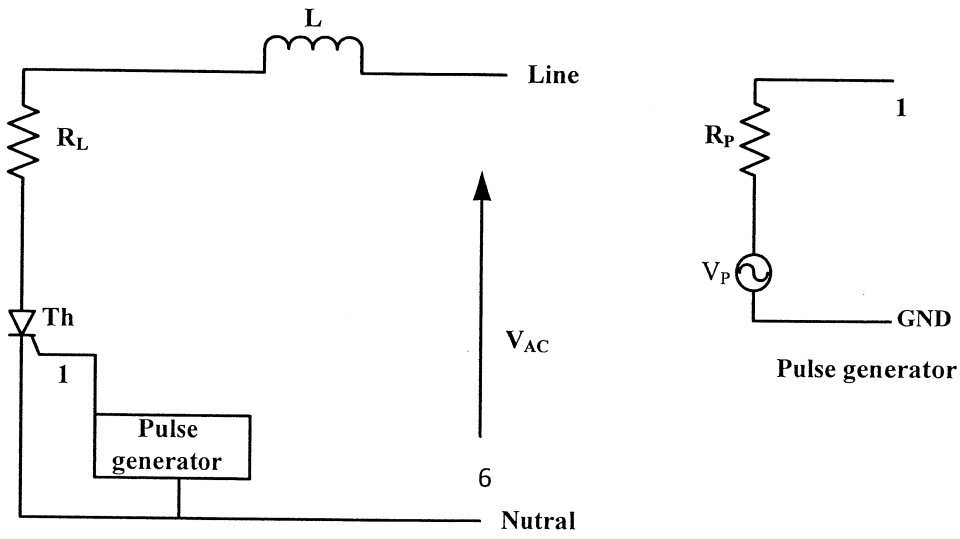

Figure 8

The power device specifications are given below.

Repetitive peak off state voltage : 350V
On state current RMS : 20A
On state voltage : 2V
Peak gate voltage : 2V
Peak gate current : 2A
Minimum gate voltage : 2V
Minimum gate current : 30mA
Holding current : 50mA

a. Select a suitable voltage for Vp and calculate the Rp value. [4 marks]
b. Calculate the maximum and minimum usable values of the load R_L.[4 marks]
c. If the pulse generator generates a signal with a 1ms pulse width, draw the voltage variation signal via the load with reference to the line voltage of the signal. [4 marks]
d. Locate the fault, if the load is getting the maximum power which cannot be changed by controlling the pulse repetition rate of the pulse generator. [4 marks]
e. Comment on the operation of the circuit, when the supply voltage is increased by 10%. [4 marks]