The Open University of Sri Lanka
Department of Electrical and Computer Engineering
Final Examination -2011
ECX4230 – Fault Diagnosis in Electronic Circuits

Date:17.03.2012 **Time: 1400 -1700 hrs**

Answer any five questions.

1) A two stage amplifier is shown in figure 1. Test points are marked as 1,2,3,4 and 5 in the circuit.

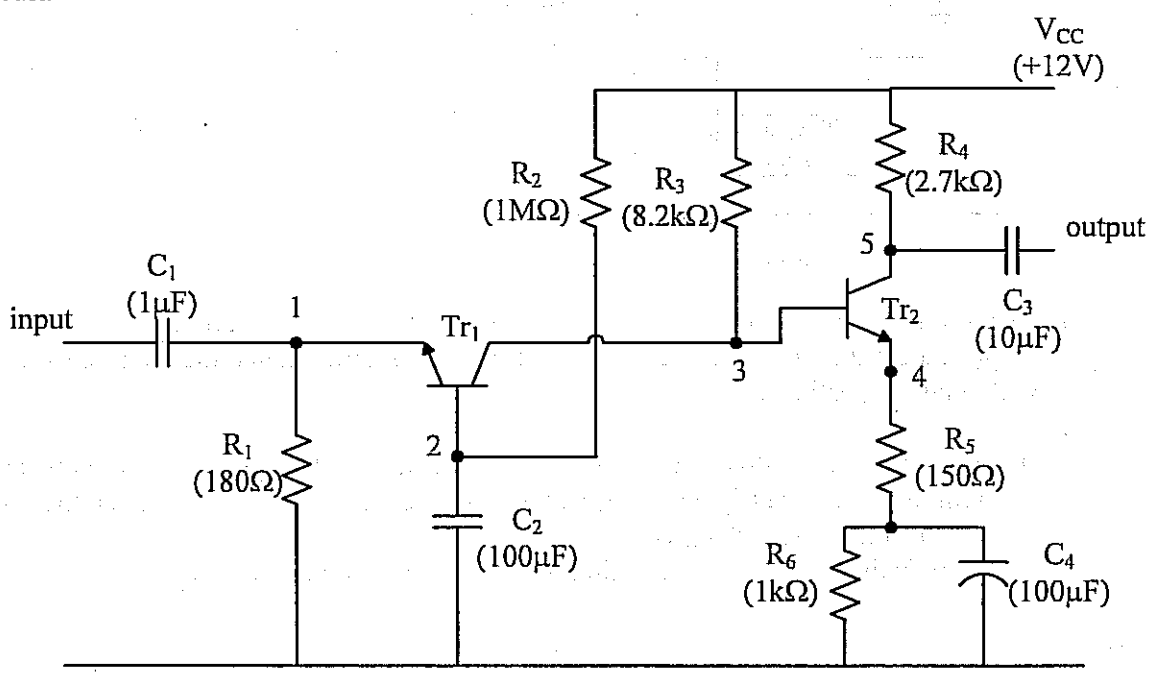

Figure 1

a) Current gain of Tr_1 and Tr_2 transistors are 100 and 75 respectively, calculate the test point voltages at no signal. Do not assume for maximum output swing.
b) Calculate the amplitude of the signal at the output, if the voltage of the signal at test point 3 is 0.23V peak to peak. (Assume the capacitors offers negligible reactance at the signal frequency)
c) Identify the faulty component/s with fault type giving reasons.

Case	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5	output
A	0.2	0.8	2.82	0	12.00	No output
B	0.2	0.8	2.7	2.19	11.46	Positive clipped
C	0.2	0.8	1.036	0.436	0.630	No output

2) Figure 2 shows a circuit employing two thyristors with a trigger module. The trigger module triggers the two thyristors sequentially.

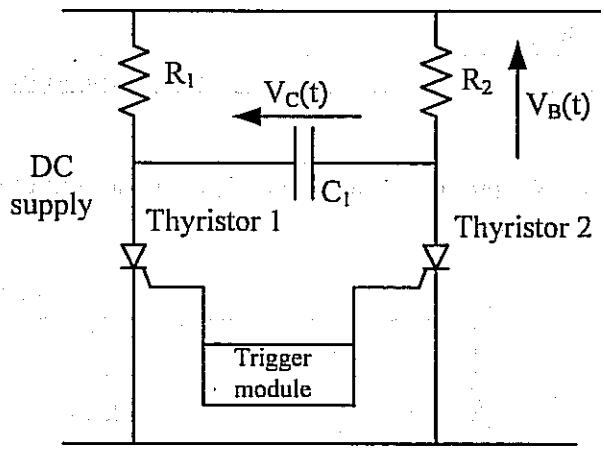

Figure 2

a) Explain the operation of this circuit and give one possible application.
b) Suggest a circuit which can be used as the trigger module, sketch the complete circuit with your suggestions.
c)
   i) If two identical bulbs B_1 and B_2 are used o replace of R_1 and R_2 respectively, and if both thyristors are triggered sequentially at same trigger voltages, sketch the voltage waveforms $V_C(t)$ and $V_B(t)$.
   ii) Identify the fault/s with reasoning, if the B_1 bulb is on and B_2 is off.

3)
a) An amplifier of open loop A_0 is supplied with positive feedback. If the feedback ratio is β, find an expression for the overall gain.
   i) What will happen when $\beta A_0 = 1$?
b) The circuit shown in figure 3 is a blocking oscillator. Test points are marked as 1,2,3 and 4 in the circuit.

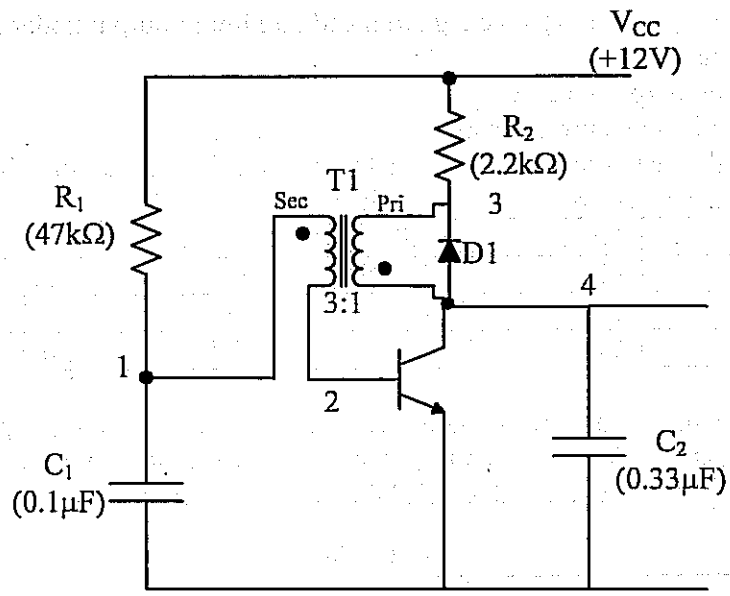

Figure 3

i) Explain the operation and, sketch the waveforms at the output.
ii) What is the function of D_1?
iii) State the faulty component/s and the fault type with reasons for the following.

Fault	T.P 1	T.P 2	T.P 3	T.P 4	Symptom
A	0	0	12	12	Oscillator fails
B	0.7	0.7	0.1	0.1	Oscillator fails
C	9.7	0	12	12	Oscillator fails

4) A DC regulator circuit is shown in figure 4. The Tr_2 has a high current gain and the Tr_1 has following specifications. Test points are marked as 1,2,3,4 and 5 in the circuit.
Current gain – 25, Minimum voltage across collector and emitter – 1.5V, Maximum power dissipation - 3w.

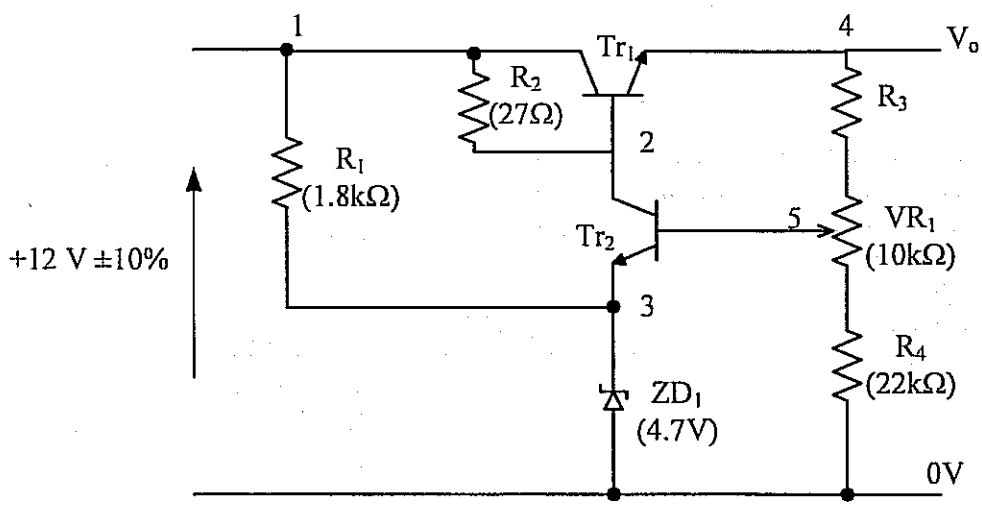

Figure 4

a) Find a suitable value for R_3 resistor to give a guaranteed maximum output under the specified input conditions.
b) Calculate the range of the output voltage.
c) What is the maximum safe load current ensuring safe operation?
d) Following table shows the test point voltage under faulty condition. Determine the faulty component/s giving reasons. Assume VR_1 is set to its maximum.

Case	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5
A	12	11	4.7	0	5.3
B	12	0	4.7	0	5.3
C	12	6.8	0	5.4	0.6

5) A transistor amplifier is shown in figure 5. The Drain current of the transistor Tr_1 is given by $I_D = 0.2(V_{GS} - V_P)$, where I_D is in mA, V_{GS} in Volts and $V_P = -4V$. Current gain of the Tr_2 transistor is very high. Test points are marked as 1,2,3,4 and 5 in the circuit.

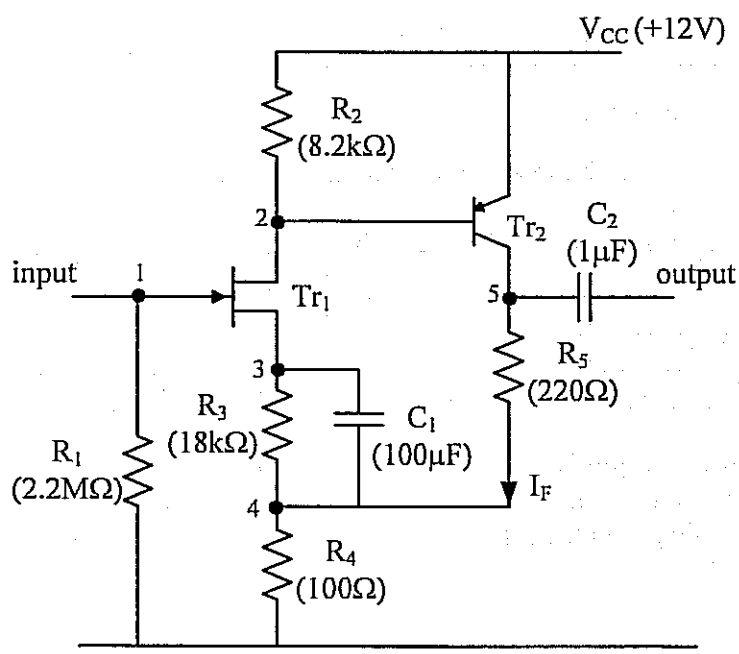

Figure 5

a) Calculate the current I_F and then find the voltages at Test points when no signal is applied. Do not assume maximum swing at the output.
b) What is the phase relationship between input and the output?
c) Calculate the test point voltages.
d) State the faulty component/s and the fault type with reasons for the following

Fault	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5	Symptom
A	0	11.9	3.3	2	0	No output
B	0	11.4	3	0.6	7.4	Very low gain
C	0	11.4	0	0	0.1	No output

6) Consider the circuit shown in figure 6. A narrow width pulse train of 250 Hz frequency and +2V height is applied to the input. Test points are marked as 1,2,3and 4 in the circuit.

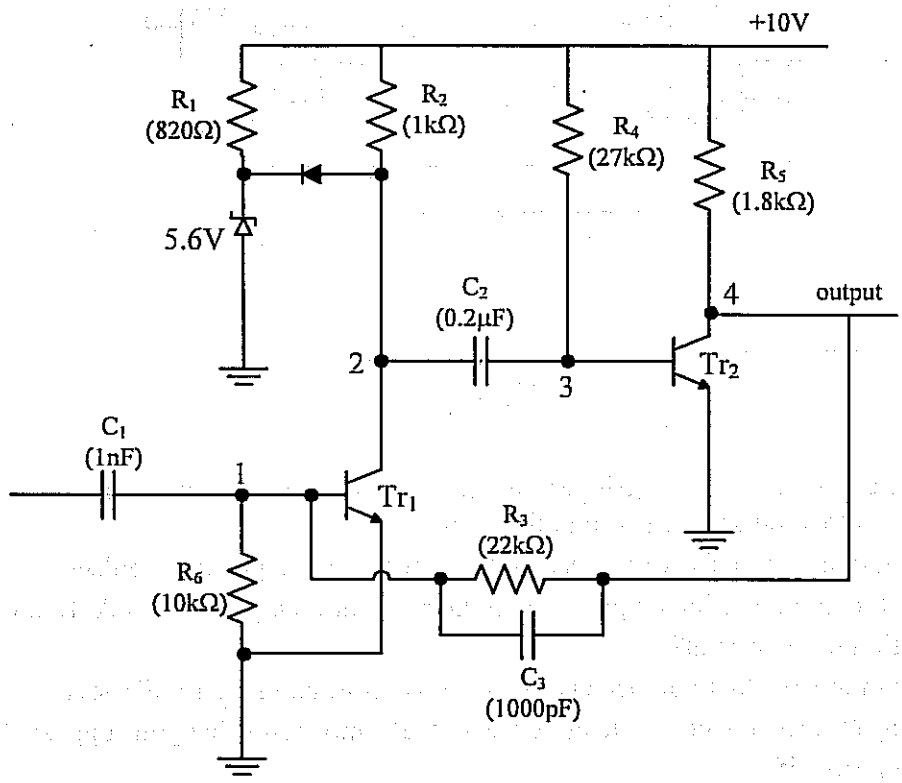

Figure 6

a) Draw the waveforms at each test point to a common time scale with the input
b) Calculate the parameters of the output waveform.
c) Calculate the voltages at test points when no signal is applied.
d) The output is not available under the following fault conditions. Find the faulty component/s and the fault type giving reasons for the following

Fault	T.P 1	T.P 2	T.P 3	T.P 4
A	0.2	6.2	0.6	0.2
B	0.2	0.6	0.6	0.2
C	0.6	0.2	0.6	10

7) Consider the logic circuit shown in Figure-Q7.

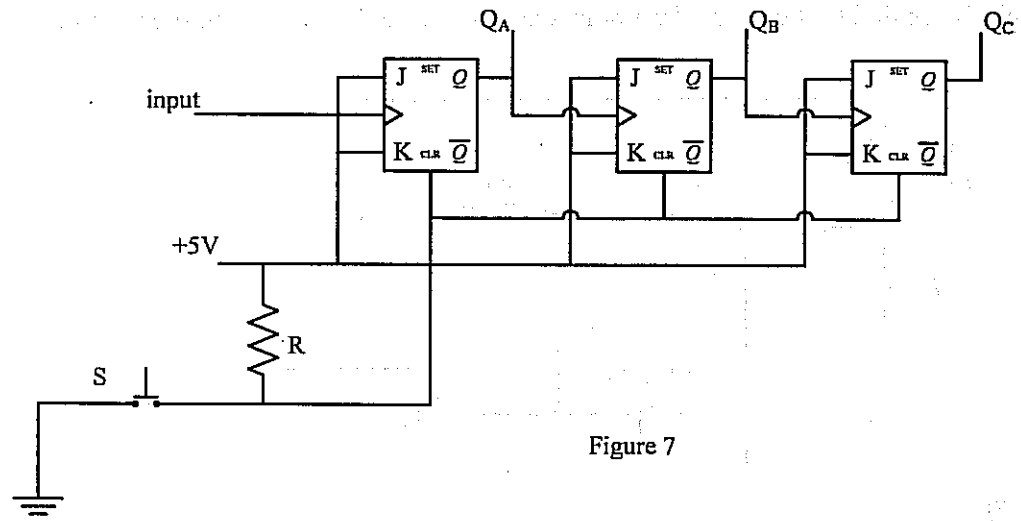

Figure 7

The JK flip-flops are +ve edge trigger (triggers on the +ve edge of the clock) type. After pressing S, clock pulses are given to the input.

a) Draw the timing diagram to show Q_A, Q_B, and Q_C for the first eight clock pulses.
b) Hence tabulate the number of clock pulses with the relevant binary values of A, B, and C.
c) Write the function of the circuit?
d) What are the components that you need to display this information in a SSD(Seven Segment Display)? Draw the complete circuit with the components that you suggested
e) Explain the operation, if
   i) R is open ,
   ii) Second JK flip flop is faulty

8)

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

b)
   i) Compare the R.F and A.F amplifiers in radio receiver.
   ii) Draw the block diagram of a superheterodyne receiver.
   iii) A defective radio receiver gives a distorted audio. If an oscilloscope is given to you explain how you find the faulty section.