

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)
 ECX4230: Fault diagnosis in Electronic circuits

Date: 10th November 2017 (Friday)

Time: 9:30 am – 12:30 am

Answer any five questions. All symbols and notation have their usual meaning.

Q1. Consider the amplifier shown in Fig-Q1. The Q1, Q2 and Q3 are of high gain transistors. The current gain of Q4 is 50.

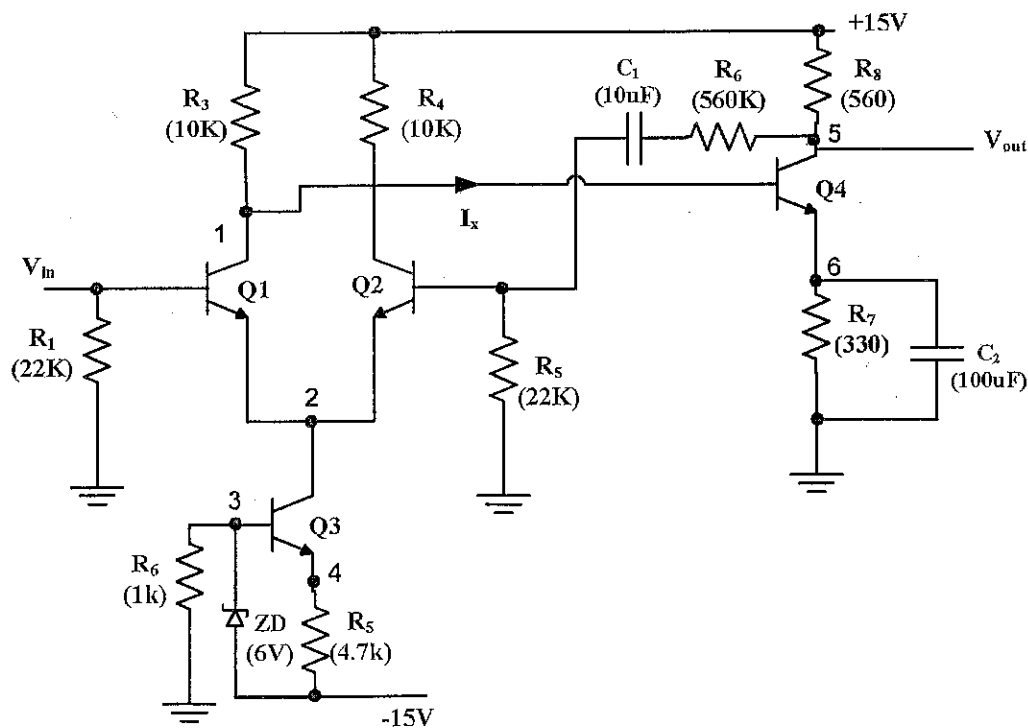


Fig-Q1

- a) Calculate the I_x and the test point voltages at no signal. Do not assume any voltage for a test point. [8 marks]

- b) A sine wave signal of 1kHz with 145 mV amplitude is applied to the input. Sketch the output signal with the input to a common time scale. Mark the time and voltage values where necessary. [4 marks]
- c) Following table shows the test point voltages (T.P) under faulty conditions. Identify the faulty component/s with fault type by giving reasons. [8 marks]

Case	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5	T.P 6	Output
A	5.4	-0.6	-9	-9.6	15	4.8	No output
B	5.4	-0.6	0	-0.6	15	4.8	No output
C	4.8	-0.6	-9	-9.6	15	4.2	No output
D	3.2	-0.6	-9	-9.6	7	2.6	No output

Q2.

- a) State the advantages and the disadvantages of linear regulators over switch mode regulators. [5 marks]
- b) A DC power supply is shown in Fig-Q2.

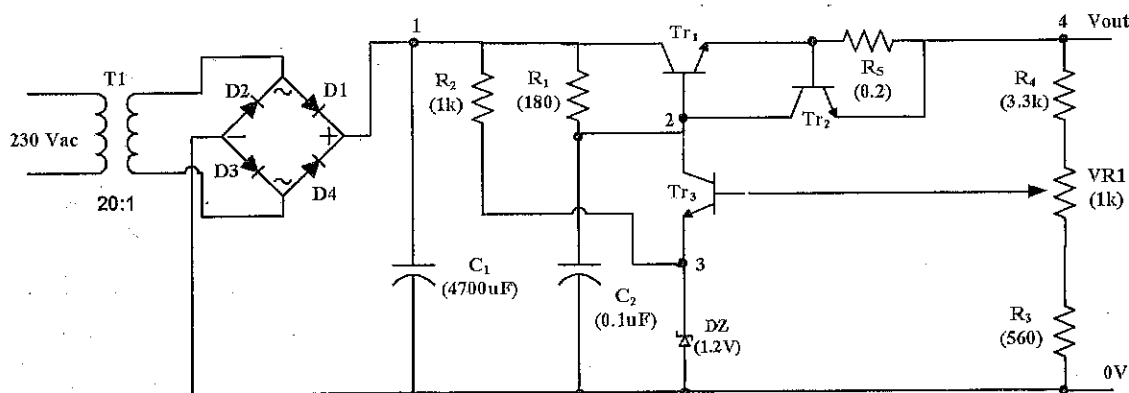


Fig-Q2

- i. Calculate the range of the output voltage. [4 marks]
- ii. Is it possible to use this supply for a 27W load at 9V? Justify your answer. If your answer is 'No', Show how you are going to modify the circuit to achieve the requirement. [3 marks]
- iii. Following table shows the voltages at the test points under fault conditions. Find the faulty component/s and the fault type by giving reasons. Assume VR1 is set to give the output 9V. [8 marks]

Case	T.P 1	T.P 2	T.P 3	T.P 4
A	11.5	3	1.2	1.8
B	11.5	0	1.2	0
C	11.5	10	0	0
D	8	6.2	1.2	5

Q3.

- a) State the use of Schmitt trigger in electronic circuits. [2 marks]
- b) The circuit shown in Fig-Q3 uses a Schmitt trigger with a JFET.

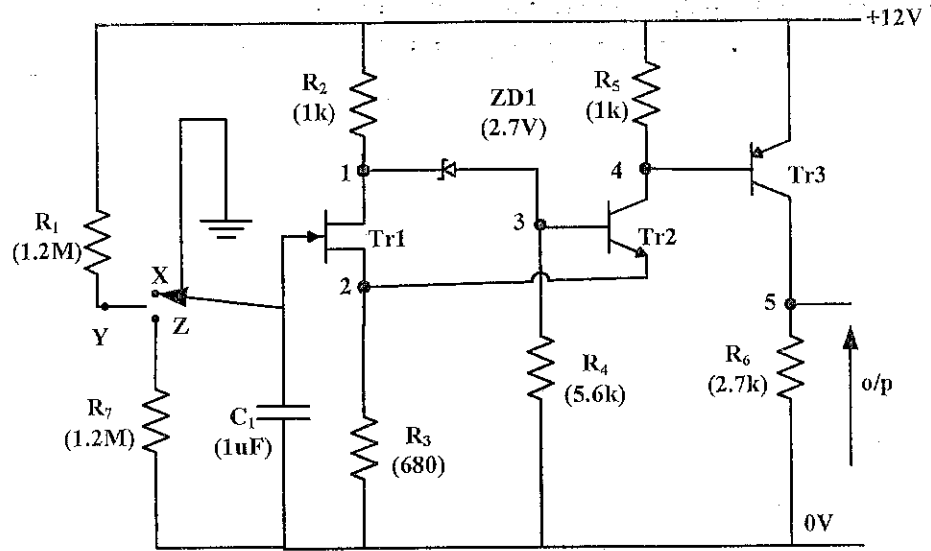


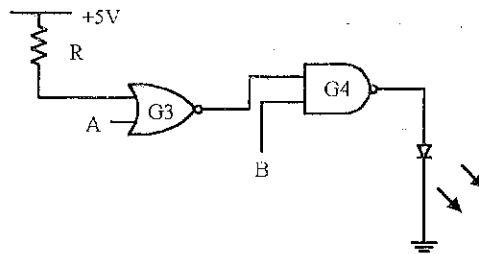
Fig-Q3

- i. Assume the JFET starts to conduct when $V_{GS} > -1$ and when the JFET is 'ON', its V_{DS} is 1V. Calculate the threshold voltages of V_G at which the output of the circuit will change. [4 marks]
- ii. Calculate the test point voltages for the two states of the output. Assume $V_{CE sat}$ for Tr2 and Tr3 is 0.2V. [4 marks]
- iii. The switch is initially at position X. If it is turned to position Y for one second and then turned to position Z, Calculate the width of output signal. [4 marks]
- iv. Following table shows three fault cases with the measured test point voltages when the switch is at position A. State faulty component/s with fault type by giving reasons. [6 marks]

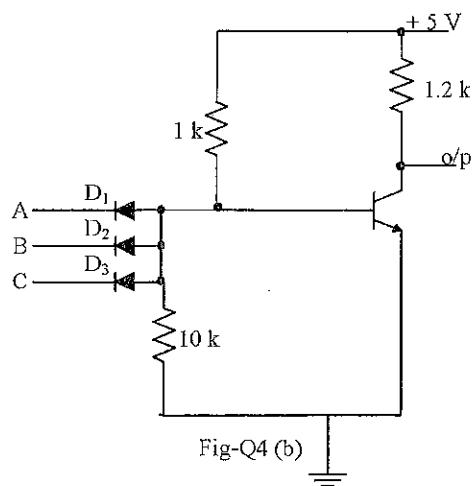
Case	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5
A	10.1	6.8	7.4	2.0	0
B	6.3	3.5	4.1	11.4	11.8
C	6.5	3.2	3.8	12.0	0

Q4.

- a) Explain the use of logic probe and logic pulsar to test the circuit shown in Fig-Q4(a). [4 marks]



- b) Consider the logic circuit shown in Fig-Q4 (b).



- i. Give the truth table of the circuit shown in Fig-Q4 (b). [8 marks]
- ii. State the logic function of the circuit. [2 marks]
- iii. Indicate the corresponding observations of the logic probe on the output Q for the following faults for the input conditions. [6 marks]
- Fault 1: D_1 open circuited
- Fault 2: 1 k resistor open circuited
- Fault 3: D_3 short circuited

Q5. A two-stage amplifier is shown in Fig -Q5.

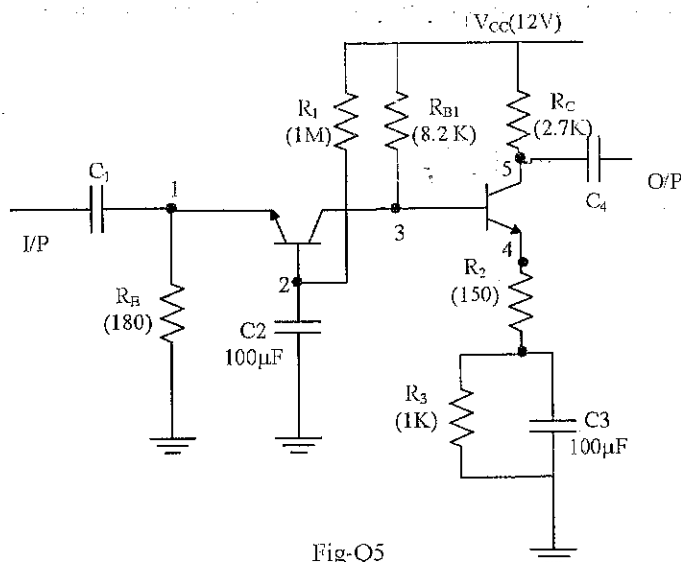


Fig-Q5

- If the value of β for both transistors is 100, calculate the test point voltages at no signal. Do not assume for maximum output swing. [7 marks]
- When 1 mV peak to peak sine wave input is fed to the amplifier, the signal observed at test point 3 is 0.238V peak to peak. Calculate the amplitude of the signal voltage observed at the output. [5 marks]
- Following voltages readings of the test points are observed from a DVM under faulty conditions. Identify the faulty component/s with fault type giving reasons. The readings are in volts unless otherwise stated. [8 marks]

Case	T.P 1	T.P 2	T.P 3	T.P 4	T.P 5	Output
A	2.1 mV	0.6	4.1	3.5	3.7	No output
B	0.2	0.8	1.0	0.4	0.6	No output
C	0.2	0.8	1.2	0.6	0.8	No output
D	0.2	0.8	2.8	0	12	No output

Q6.

- 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. What will happen when $\beta A_0 = 1$? [5 marks]

- b) The circuit shown in Fig-Q6 is a blocking oscillator.

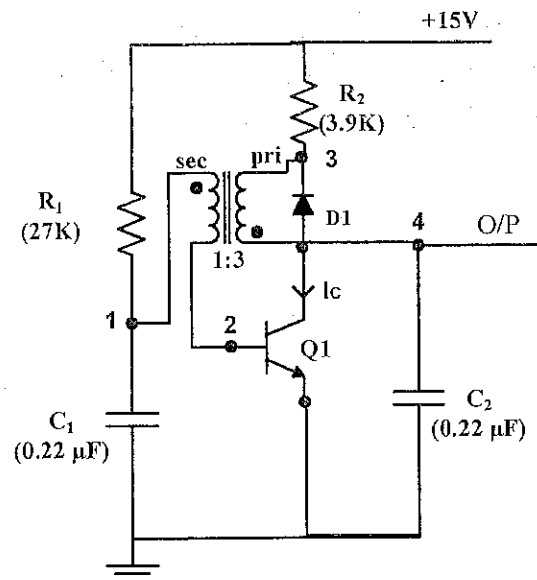


Fig-Q6

- i. When transistor is switched on, sketch the waveforms V_{34} , V_2 and V_4 on a common time scale for two cycles. [6 marks]
- ii. Estimate the approximate lowest frequency of the output signal. [3 marks]
- iii. State the faulty component/s and fault type with reasons for the following.
 - A. If the oscillator produces negative going pulses of short period.
 - B. If the frequency of oscillation is correct but the amplitude of the output pulse is small.
 - C. If the observed voltages of the test points are ,

Case	T.P 1	T.P 2	T.P 3	T.P 4	output
A	0.7	0.7	0.4	0.2	No output
B	0.7	0.7	15	15	No output

[6 marks]

Q7.

- a) Explain how the detected Y and colour component signals are used to recover the colour signals R G and B in a PAL receiver. [5 marks]
- b) How does the receiver colour decode carrier signal is kept in phase with the transmitter colour encoder carrier signal. [5 marks]
- c) What are the main sections of a tuner in a TV receiver? Explain the function of each section. [5 marks]
- d) In a defective TV receiver sound signal is receiving. Explain what sections are likely to be faulty and method that you are going to follow to identify the faulty section.[5 marks]

- Q8. A thyristor power control circuit is shown in Fig-Q8. The trigger circuit (TG) produces a pulse train V_x synchronized to V_{AC} . The current in load is sensed by the device CT and V_{CT} is proportional to the load current. Forward voltage drop of the thyristor and gate power dissipation are 2V and 300mW respectively. The specifications of the trigger circuit are,
- Pulse height – 12 V
 Maximum pulse current – 70 mA
 Pulse width – 100 μ s

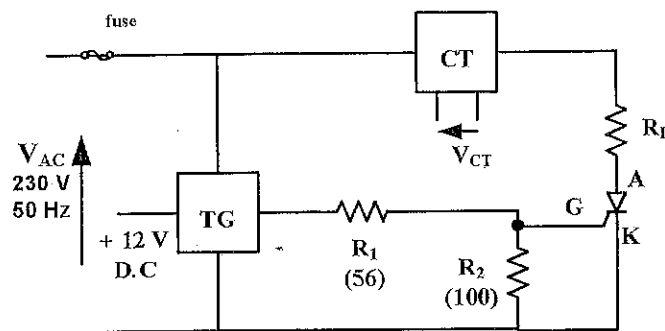


Fig-Q8

- a) If the load R_L can vary between 100 Ω to 10 $K\Omega$, Find following specifications for the thyristor
- i. Maximum values of
 - Forward rms current
 - Gate pulse current
 - Gate pulse voltage
 - ii. Minimum value of
 - Peak reverse voltage
 - Forward rms current

[6 marks]

- b) Under a faulty condition, following observations are made. Determine the most obvious fault and state reasons for your answer.

[5 marks]

$$V_{AK} = 230 \text{ V}$$

$$V_X(\text{pulse height}) = 12 \text{ V}$$

$$V_g(\text{pulse height}) = 3 \text{ V}$$

- c) Design a circuit which can be used to produce a pulse train to trigger the thyristor. Sketch the voltages at V_{AC} , V_{CT} .

[8 marks]