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

FINAL EXAMINATION - 2013/2014

ECX3230 – ELECTRONICS **(Closed Book)**

Date: 12.08.2014 Time: 1330 – 1630 hrs

Answer any five questions

1.

a. Draw the Characteristic curve of a Germanium (Ge) diode. [4 marks]
b. Differentiate between Tunnel diode, Zenner diode and Varactor diode. [3 marks]
c. A diode application and the capacitance characteristic curve of that diode are shown in figure 1.1and figure 1.2 respectively.

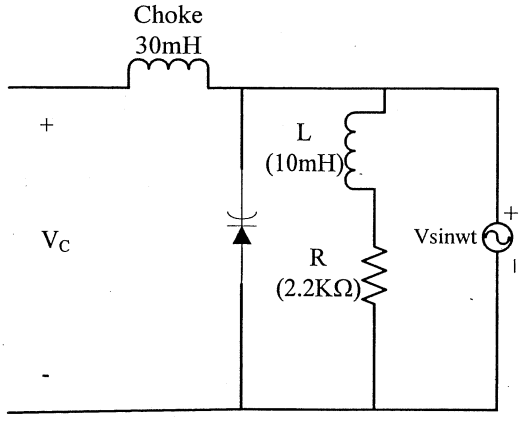

Figure 1.1

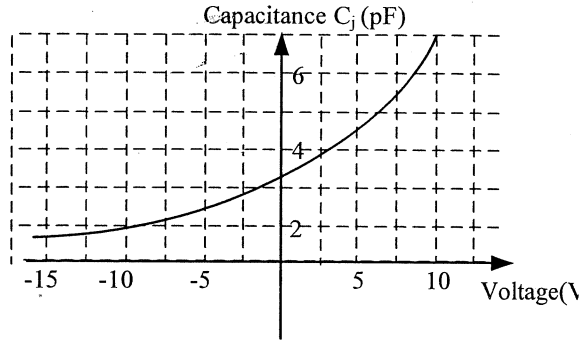

Figure 1.2

i. Identify the special purpose diode used in figure 1.1. [1 marks]
ii. Write the purpose of choke and the function of the diode. [2 marks]
iii. What is the capacitance value, if the biased voltage is 10V? [2 marks]

d. A thyristor circuit is shown in figure 1.3. Thyristor specifications are as follows.
Gate voltage 3V
Gate current 10mA
Forward voltage of the thyristor 1V

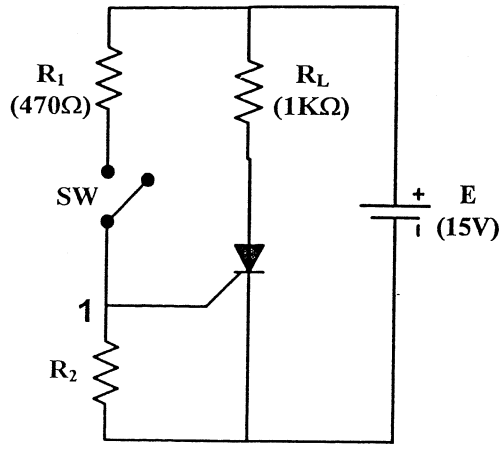

Figure 1.3

i. Explain the operation of the circuit when the switch (SW) is closed. [3 marks]

Calculate,

ii. the R_2 resistor. [3 marks]

iii. the power consumption of R_L. [2 marks]

2. A student is working with a single phase line. He needs to make a stabilized power supply.

a. Name the basic methods of rectification. [2 marks]

b. Differentiate between capacitor filter, inductor filter and inductor-capacitor filter. (note: ripple factor is also needed to be considered) [6 marks]

c. A regulator circuit is given in figure 2. Circuit consists with a Si transistor and a 7V Zenner diode. Current gain of the transistor is 40. Maximum dissipation of the Zenner and the minimum current via the Zenner is 0.125W and 0.1mA.

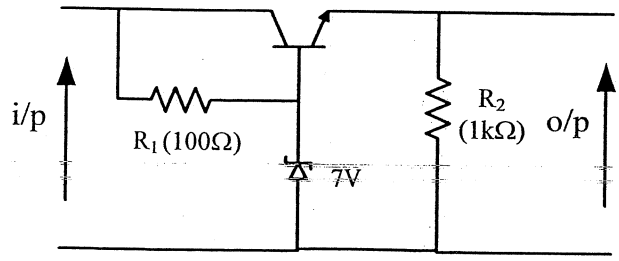

Figure 2

i. Explain the effect to the output voltage, if the input voltage varied to 10V – 15V. [4 marks]

ii. Write the purpose of R_1 resistor. [2 marks]

iii. Calculate the output current range for this circuit. [4 marks]

iv. Suggest a modification to change the output voltage to 5V. [2 marks]

3. An emitter follower circuit is shown in figure 3. A silicon transistor with a current gain of 100. (Note: equations and steps need to be included)

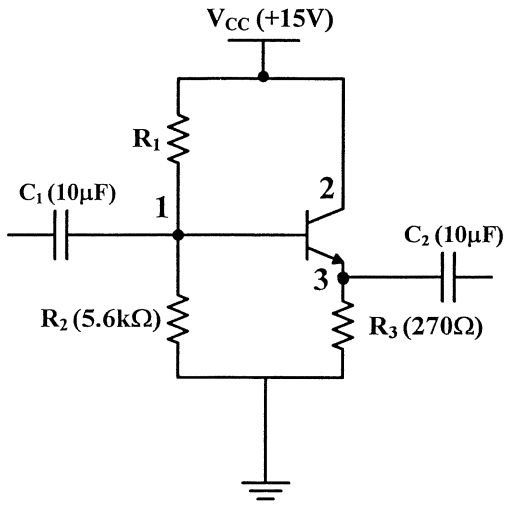

Figure 3

a. Write the configuration of the circuit shown in figure 3. [2 marks]
b. Calculate the R1 value, if the base voltage is 3V. [3 marks]
c. Find the voltages of test point 2 and 3 in the circuit. [2 marks]
d. Calculate the base current and the emitter current of the transistor. [4marks]
e. Draw the DC load line for the circuit. [4 marks]
f. Comment on the stability of the amplifier in figure 3. [5 marks]

4.

a. Write the output of the logic circuit shown in figure 4. [2 marks]

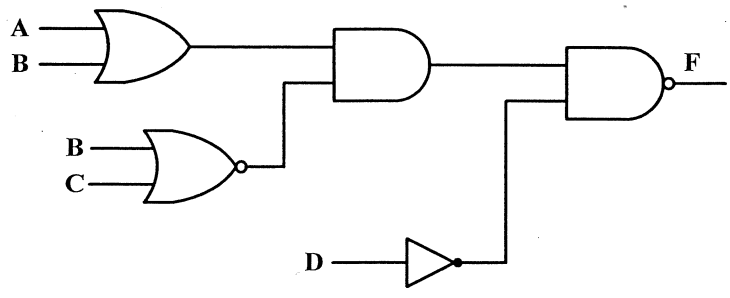

Figure 4

b. Simplify the Boolean function of the logic circuit shown in figure 4. [2 marks]
c. With a Karnough map simplify the function f(A,B,C,D) = {2,3,5,7,10,11,13,15} [5 marks]
d. Draw the circuit diagram using only NAND gates for the function obtained in 4. c. [5 marks]
e. Convert the followings,
   i. 2510 to binary
   ii. 15010 to hexadecimal
   iii. -20 to 1's complement
   iv. -45 to 2's complement [6 marks]

5.

a. What is the main difference between combinational logic and sequential logic? [2 marks]

b. Eight complimentary flip flops are connected in series to the form an electronic counter. Calculate the maximum number that the counter memorize.[3 marks]

c. A 5 kHz square pulse train clock signal is fed to the input X. Draw the outputs of the JK flip flops related to input signal (X) shown in figure 5. (Note : use a graph sheet) [6 marks]

d. Tabulate the truth table for the design and suggest a method to reset the circuit after all the LED bulbs light together. [9marks]

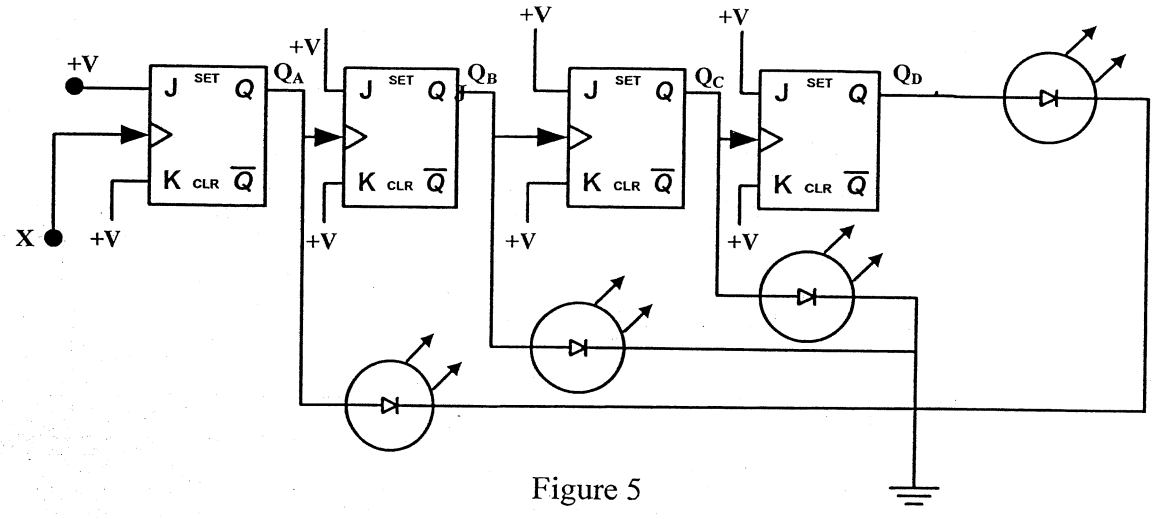

Figure 5

6. A Single stage transistor amplifier circuit is shown in figure 6.

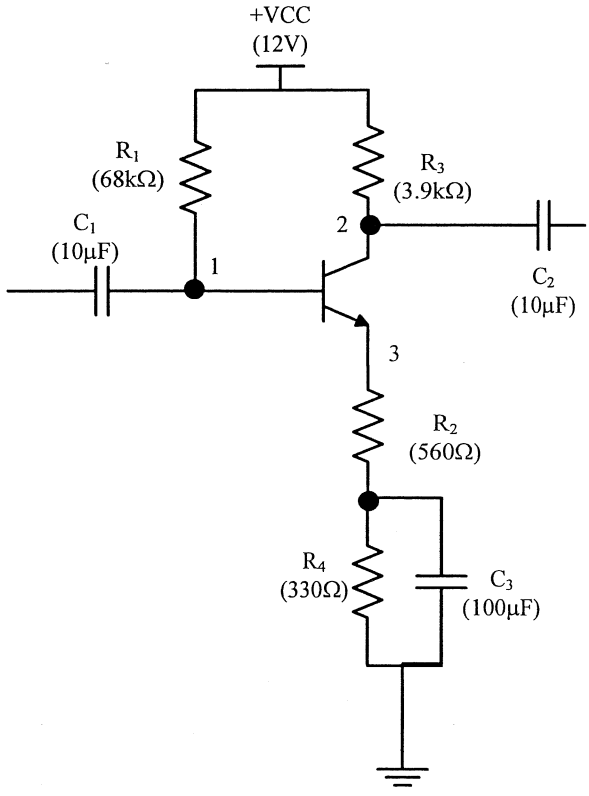

Figure 6

a. Draw the h parameter model for the transistor considering the following parameters. h_{ie} =2.2kΩ, h_{fe} = 50 and neglect the effect of h_{re} and h_{oe}. [3 marks]
b. Using the above drawn transistor model, draw an AC equivalent circuit for the amplifier circuit shown in figure 6. [5 marks]
c. Derive an expression for
   i. Input impedance
   ii. Current gain
   iii. Voltage gain
   iv. Output impedance
   v. Power gain [12 marks]

7.

a. Compare and contrast the bipolar and unipolar transistors. [5 marks]
b. State the operating regions of JFET and give applications for each region. [4 marks]
c. A JFET amplifier is shown in figure 7. The drain current of the JFET can be obtained using the $I_{DSS}[5 + V_{GS}]^2$ equation. I_{DSS} =10mA.

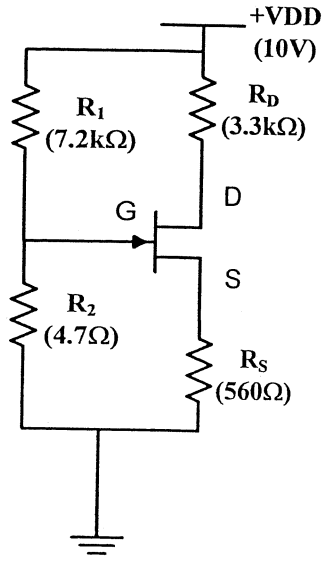

Figure 7

Calculate the,

i. Voltage at the Gate terminal [2 mark]
ii. Gate-Source voltage [6 marks]
iii. Drain current. [3 marks]

8.

a. An operational amplifier circuit is given in figure 8.1.

i. Derive the transfer function of the amplifier. [5 marks]
ii. Calculate the output voltage, if the V_{in} is a 2V sinusoidal signal. [2 marks]
iii. Draw the output waveform with reference to the input. [2 marks]
iv. Write the function of the circuit in figure 8.1. [1 marks]

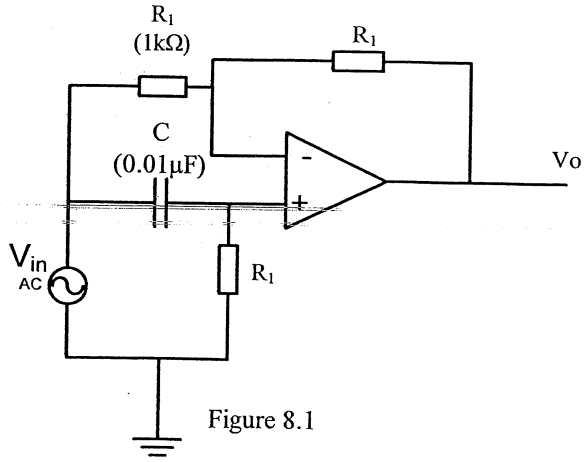

Figure 8.1

b. An uni junction transistor circuit is given in Figure 8.2.

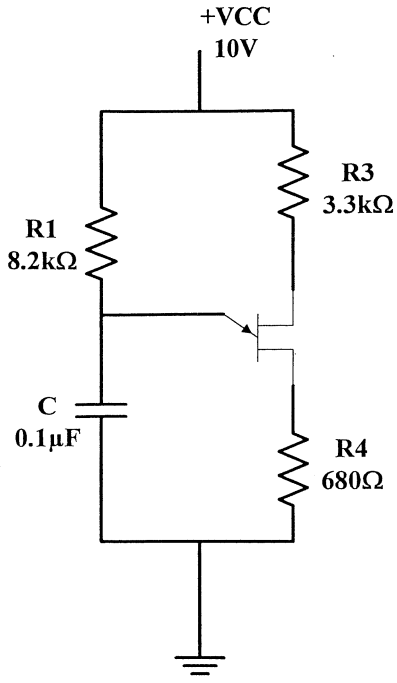

Figure 8.2

i) Calculate the frequency oscillation. [4 marks]

ii) Draw the output signal of the oscillator (Note: mark all the necessary voltages and the time period of the signal.) [6 marks]