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)

ECX3150: Electronics I

Date: 08th November 2017 (Wednesday) **Time: 9:30 am – 12:30 am**

Answer only five questions

Q1. The circuit shown in Fig-Q1 consists of a Ge transistor ($Vbe = 0.3V$) with a current gain, $\beta = 75$.

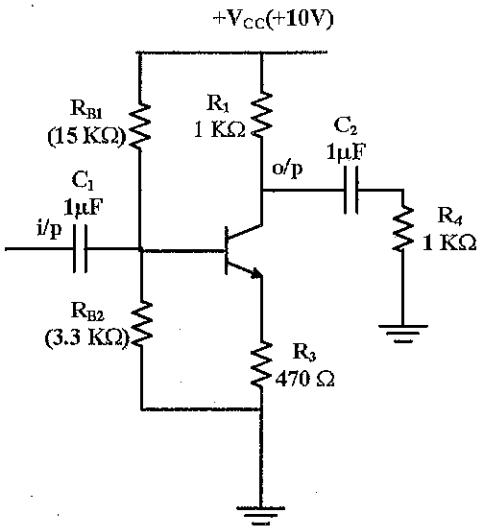

Fig-Q1

a) Write the bias configuration of the circuit shown in Fig-Q1. [2 marks]

b) Calculate the base current of the transistor. [4 marks]

c) Calculate the collector and emitter currents. [4 marks]

d) Hence calculate the VCE voltage. [4 marks]

e) Draw the DC load line for the circuit. [6 marks]

Q2.

Consider a power supply unit employed for generating a 15V constant DC voltage output from a sinusoidal input signal of 110V/60Hz. All the diodes and transistors are made of silicon.

a) Explain the function of required circuit blocks for the given scenario. [4 marks]

b) Draw the output waveform of the rectifier. Calculate and clearly mark the different voltage and time values. [3 marks]

c) The output of the rectifier bridge is fed in to a simple capacitive smoothing filter. Let the capacitance of the capacitor be 10 μF. Draw the output waveform of the smoothing filter. Calculate and clearly mark the different voltages and time values. [3 marks]

d) Consider the regulator circuit in Fig-Q2 which is fed with the output signal from the smoothing filter in part c). The transistor current gain is 50 and the minimum Zener current is 2mA,

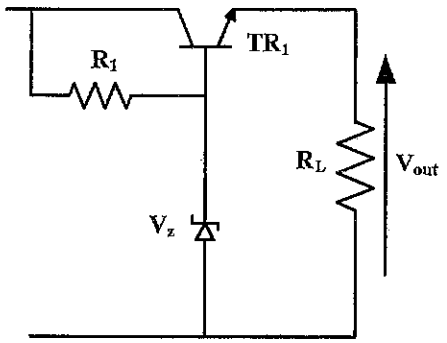

Fig-Q2

i. What is the voltage of the Zener diode? [3 marks]

ii. If a 1A load current is required to operate the load, calculate the maximum power dissipation of the Zener diode and the Transistor TR_1? [7 marks]

Q3.

a) Differentiate between bipolar and unipolar transistors. [5 marks]

b) Name two applications of Junction Field effect transistors (JFET) [2 marks]

c) A Junction Field effect transistor (JFET) amplifier is shown in Fig- Q3. The saturated drain current is 10mA and the pinch off voltage of the device is -6V.

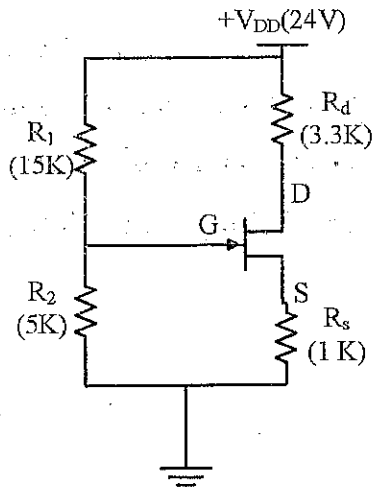

Fig- Q3

Calculate, the

(1) gate voltage. [3 marks]

(2) drain current. [5 marks]

(3) gate source voltage. [5 marks]

Q4.

a) Show the conversion of the following
   i) 28_{10} to binary
   ii) 10101011_2 to decimal
   iii) 1101_2 to octal
   iv) 1111_2 to hexadecimal
   v) -42 in 1's complement
   vi) -45 in 2's complement [6×1.5 marks]

b) Simplify the following logic functions using Boolean algebra.
   i) $X1 = \overline{ABC} + \overline{ABC} + \overline{ABC} + \overline{ABC} + AB\overline{C} + ABC$ [3 marks]
   ii) $X2 = [(AB + \overline{AB}) + AB] + \overline{AB}$ [3 marks]

c) Determine the output expression for the logic circuit shown in Fig-Q4. [5 marks]

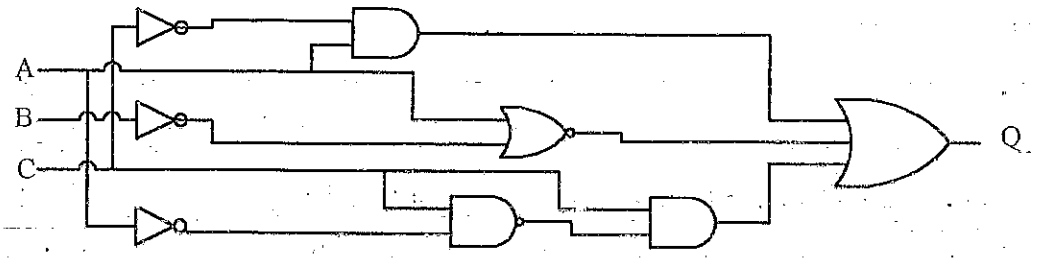

Fig-Q4

Q5.

a) List the characteristics of an ideal operational amplifier. [3 marks]

b) Fig-Q5 shows a Wien bridge oscillator circuit. Frequency of the oscillation is given by the equation $\frac{1}{2\pi RC}$.

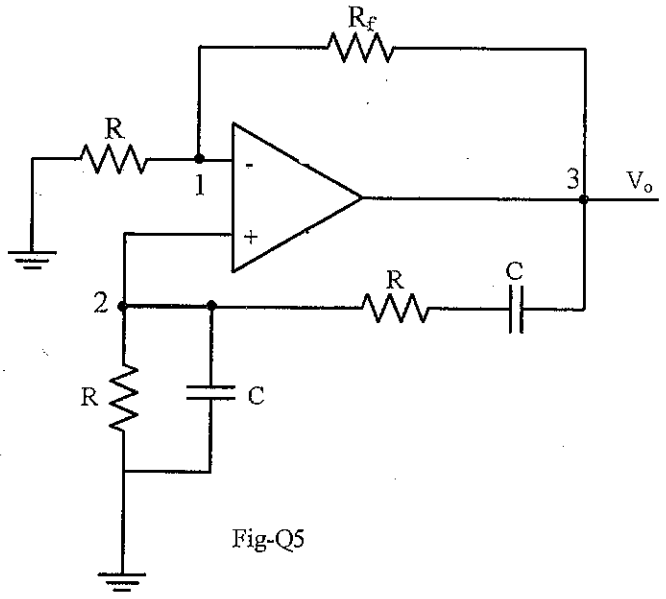

Fig-Q5

a. Write the equations at node 1, 2 and 3 using kirchoff's current law. [6 marks]

b. Obtain the transfer function of circuit shown in Fig-Q5 using the above equations. [7 marks]

c. Calculate the amplitude and the frequency of oscillation of the Wien bridge circuit in Fig-Q5, if R =10KΩ and C = 0.001μF. [4 marks]

Q6.

a) Simplify the output functions using karnaugh maps.

i) $F_{(P,Q,R)} = 1,3,4,5,6$ [2 marks]

ii) $F_{(P,Q,R,S)} = 0,4,6,7,8,9,12,15$ [3 marks]

b) Draw the logic circuit using only 2-input NAND gates for the simplified outputs given in Q6 part a). [6 marks]

c)

i) What do you understand by a half adder and a full adder? [3marks]

ii) A full adder circuit is shown in Fig- Q6. Write the truth table for this circuit.[6 marks]

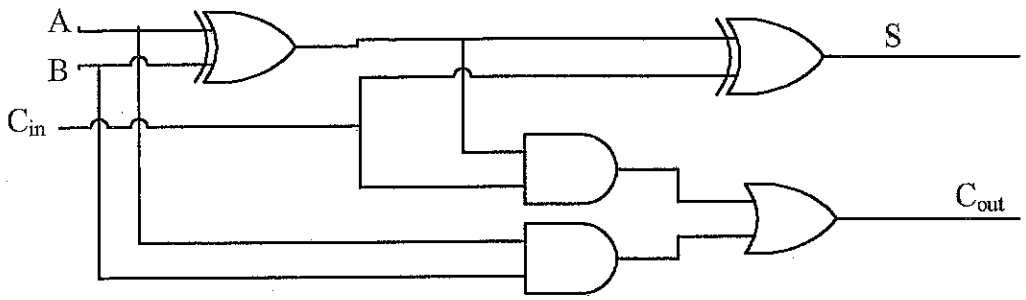

Fig-Q6

Q7.

a) A Germanium diode when forward biased at 25^0C carries a 3mA current at 0.2V. Assume V_T is 25mV at 25^0C.

i) Calculate the diode current when this diode is reversed biased by 10V. [3 marks]

ii) Find the diode current when this diode is forward biased and at a temperature of 50^0C.(η=1 for Ge) [3 marks]

c) A certain PN junction was designed to use as a voltage controlled capacitor which is shown in Fig-Q7.1. The ohmic resistance and reverse resistance of the diode are negligible.

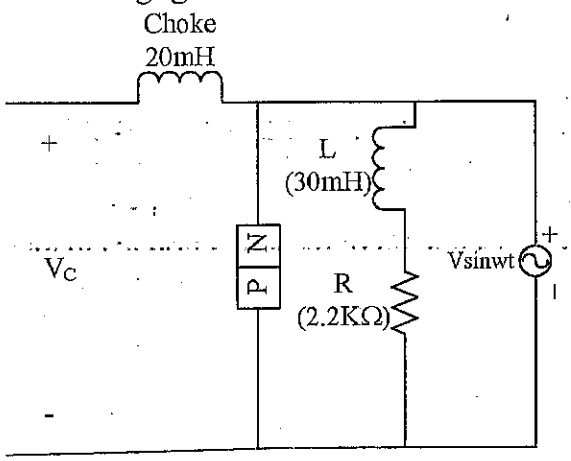

Fig-Q7.1

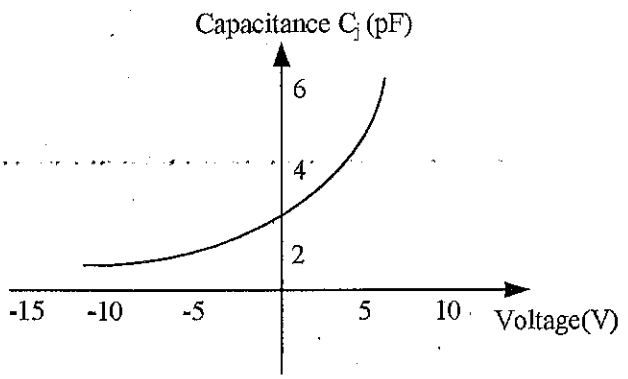

Fig-Q7.2

i) Derive an expression for the resonant frequency of the circuit in Fig-Q7.1. [7 marks]

ii) Calculate the capacitance of the diode if the circuit resonates at 30 MHz. [4 marks]

iii) What is the required D.C voltage for this circuit to resonate at 30 MHz? [3 marks]

Q8.

a) A 100 mH relay coil having a resistance of 10 Ω is connected in series with a 50 Ω resistance across a 12V battery. The relay operates at 20 mA.

i) Derive an expression for the current - time relationship of the circuit. [5 marks]

ii) Calculate the time taken to operate the relay after switching on the power. [5 marks]

b)

i) Explain the operation of clipper and clamper circuit including an example for each. [5 marks]

ii) If the signal voltage (Vs) is 10sin(1000t) V, sketch the output waveform of the circuit shown in Fig-Q8. [5 marks]

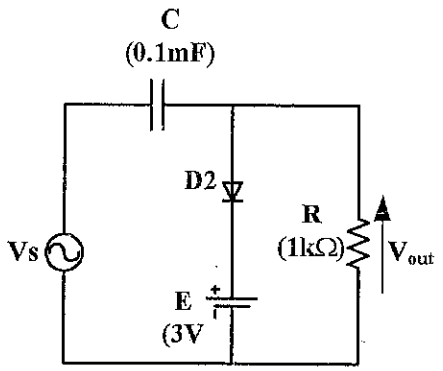

Fig-Q8