UNIVERSITY OF GHANA

BACHELOR OF SCIENCE IN ENGINEERING
SECOND SEMESTER EXAMINATIONS: 2014/2015
CPEN 306: MICROELECTRONICS DEVICES AND CIRCUITS [3 Credits]

INSTRUCTIONS: *Answer ALL questions.*
TIME ALLOWED: *TWO AND HALF HOURS*

Q1 (a) Consider the common-emitter (CE) NPN transister ampifier shown in the figure 1 and state the function of each component in the circuit. **[4marks]**

(b) Given that the values of R_1=1kΩ, R_2=45kΩ, R_L=40kΩ, R_E=50kΩ and V_{CC}=10V, Calculate the:

(i) the base voltage **[2marks]**

(ii) the base current **[2marks]**

(iii) the emitter current **[2marks]**

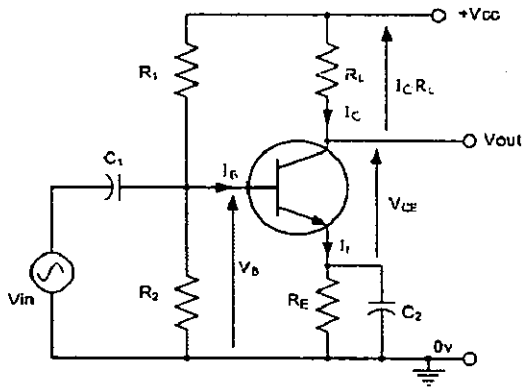

Figure 1

(c) If the input signal frequency ranges from 200Hz to 50kHz, calculate the required capacitance of the capacitor needed at the emitter terminal to ensure **d.c** stabilization. **[4marks]**

(d) Draw a frequency response curve of a resistance-capacitance coupled amplifier and explain the causes of the sudden drop in amplification at the low and high frequency ranges. **[4marks]**

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(e) Define the term **-3dB** Bandwidth of an amplifier. **[2marks]**

Q2.(a) Draw the static I-V characteristics of a diode and use it to explain the Zener breakdown phenomenon associated with semiconductor diodes. **[4marks]**

(b) A 12V stabilized voltage needed to run a d.c motor is to be produced from a full-wave bridge rectifier with an unregulated output of 25V d.c. If a Zener diode with a maximum power rating of 6W is connected across the output of the full-wave rectifier through a series resistor R_S to achieve the required voltage, calculate,

(i) The current that will flow through the Zener diode if a load resister of 20kΩ is connected across it **[3marks]**

(ii) The value of the series current-limiting resistor(R_S) **[3marks]**

(iii) The total load current(I_L) **[3marks]**

(iv) The total supply current(I_S) **[3marks]**

(c)A switching NPN silicon transister has a forward current gain β=100 and maximum collector current $I_{c(max)}$=25mA.If the input voltage is 24V, calculate, the base resistor needed to switch the load "fully on". **[4marks]**

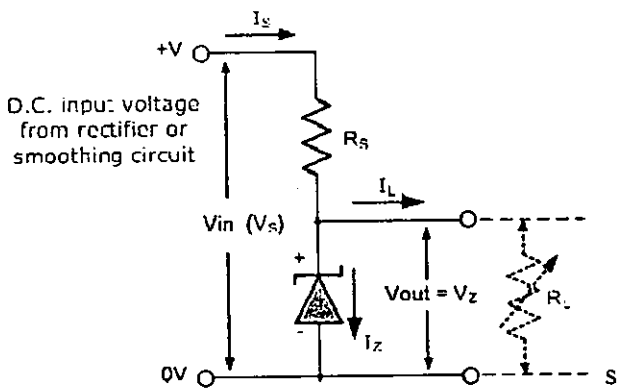

Figure 2

Q3 (a) Define the following parameters of power supply systems:

(i) Efficiency of rectification. **[1 mark]**

(ii) Ripple factor. **[1 mark]**

(iii) Peak inverse voltage(PIV) **[1 mark]**

(b) Draw a full-wave bridge rectifier with a capacitor input filter **[2marks]**

(c) With the aid of input and output wavesforms briefly explain how the Q3(b) works. [3marks]

(d) A full-wave rectifier whose secondary voltage is 230V r.m.s has a load resistor of 200kΩ.Determine the following:

(i) d.c output voltage [4marks]

(ii) ripple voltage [4marks]

(iii) PIV [4marks]

Q4 (a) State three general oscillator requirements [2marks]

(b) Explain briefly with the aid of diagram how oscillation is maintained in a simple LC tuned circuit. [3marks]

(c) Draw a circuit diagram of a crystal oscillator and explain how it works. [5marks]

(d)The electrical equivalent circuit of a crystal has a series inductance of 5H and a series capacitance of 25μF. If the shunt capacitance is 100μF, calculate the series and parallel resonant frequencies [4marks]

(e) Draw a circuit diagram of an Astable Multivibrator using Op Amp to generate the output signal [2marks]

(f) If the values of the external components are given as R=24kΩ, C=65μF and the regenerative feedback factor β=0.01, calculate the time period of the output waveform. [4marks]

Q5(a)The class of operation of an amplifier is very important. State the two bases upon which amplifiers are classified as class A , class B and class C. [2marks]

(b)Compare class A, class B and class C amplifiers in terms of:

(i) Overall Efficiency. [2marks]

(ii) Conduction Angle. [2marks]

(iii) Signal Distortion. [2marks]

(c) Give three typies of Distortions associated with amplifies [3marks]

(d) State in each case how the Distortion can be minimized [3marks]

(e) A amplifier has a gain of 60dB. If the input resistance of the amplifier is 75Ω and its output terminals feed a matched load of 140Ω,calculate the current that will follow in the load when a voltage of 100μV r.m.s is applied to the input terminals [6marks]