**TRC2400 Computer Programming**
**ECE2071 Computer Organisation and Programming**

Laboratory Session 2

Week 3 – Semester 1 2011

**IMPORTANT – MARKING**

You will receive marks for preliminary work and lab completion by completing quizzes on Blackboard
All quizzes receive equal marks and these will be scaled to give a final lab mark worth 10% of your final assessment.
You MUST complete the preliminary work quiz BEFORE midnight of the day before your lab otherwise you will receive a zero mark for the lab exercise (both preliminary and completion mark)
You must start the completion quiz before the end of your laboratory period (you will need the demonstrator to enter a password which will only be provided when you complete the lab)

## 1. Objectives

This laboratory gives you practice and develops understanding to the following C instructions that alter the 'flow of control' in a program to produce loops or branches:

- Use of **if .. else**, **switch** and **break** statements for branching and decision making.
- Use of **while** and **do .. while** statements.
- Use of **for** loop constructs.
- Problem solving.

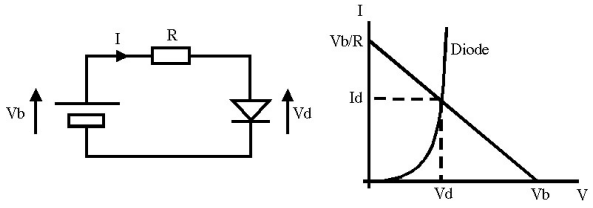
In those exercises where you are asked to write a program you should sketch your program on paper first and only enter it into the computer when you are sure that you have the logic right.

## 2. Preliminary work

Before coming to the lab you should complete the preliminary work quiz on Blackboard. This week's quiz will cover your understanding of the bullet points above and also the exercises in this prac.

## 3. First Exercise

In the following diode resistor circuit the value of the diode voltage $V_d$ and hence circuit current I ( = $I_d$) cannot be calculated directly because the diode characteristic is non-linear.




The current in the circuit is:

$$I = \frac{V_b - V_d}{R}$$

The Shockley diode model gives:

$$I_d = I_s\left(e^{\left(\frac{qV_d}{\eta kT}\right)} - 1\right)$$

By combining these two equations we have:

$$V_d = \frac{\eta kT}{q}\ln\left(\frac{\left(\frac{V_b - V_d}{R}\right)}{I_s} + 1\right)$$

This equation has $V_d$ on both sides of the equation but can be used iteratively by substituting a 'guess' into the right hand side (RHS) finding the resulting left hand side (LHS). Then repeatedly substituting the LHS into the RHS until there is little change in the LHS value.

Here is a program to calculate diode voltage using the above procedure. This program has both semantic and syntax errors. This program is available on Blackboard. Do not copy and paste from this pdf document. Work out how the program is supposed to work and correct the errors.

```
// Lab2_1.cpp : Defines the entry point for the console application.
//

#include "stdio.h"
#include "math.h"

int main(int argc, char* argv[])
(
        const double q=1.60e-19;              //charge on an electron
        const double k=1.38e-23;              //Boltzmann's constant
        const double eta=1.5;                 //diode identity factor 1.5 in our case
        const double Is=1e-12;                //diode reverse saturation current

        double T;                             //absolute temperature
        double R;                             //series resistance
        double Vb;                            //battery voltage
        double Vd,Vdold;                      //diode voltage

// you can use conditional statements to check that reasonable values have
// been input by the user

        printf("Enter the diode temperature in degrees Kelvin:");
        while(scanf("%lf",&T)&&(T<200))
        {printf("Don't forget degrees Kelvin. Try again\n");}

        printf("Enter the series resistance in Ohms:");
        scanf("%lf",R);
        if(R<=0){
                printf("Incorrect resistor value, try again:");
                scanf("%lf",&R);
        }

        do{
                printf("Enter the battery voltage:");
                scanf("%lf",&Vb);
        } while(Vb<=0);

        printf("Enter an initial guess for the diode voltage:");
        scanf("%lf",&Vd);

        printf("Diode voltage is:%-10.7lf\n",Vd);

        do{
                Vdold==Vd;
                Vd=((eta*k*T)/q)*log(((Vb-Vd)/R)/Is+1);
                printf("Diode voltage is:%-10.7lf\n",Vd);
```

```
        } while(sqrt((Vdold-Vd)*(Vdold-Vd))<0.0000001);

        printf("\n");

        return 0;
}
```

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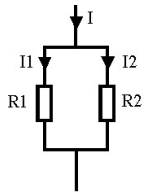
For a temperature of 300˚K, a series resistance of 1000Ω a battery voltage of 5 volts and a guess of 2V the diode voltage is 0.8594675V.

## 4. The Second Exercise

In this exercise you are to write a program that makes use of a **for** loop. Your program will investigate the following simple circuit:




Given the values of R1, R2 and I you should be able to calculate the values of I1 and I2 using Ohm's law and Kirchhoff's laws. However, what would happen to the power dissipation of the circuit if the current did not obey these circuit laws?

Write a program which requests the user to input values of I, R1 and R2 together with an integer n. Your program then prints a table of n rows showing values of I1, I2 and the total power dissipation in the resistors. Each row considers a different division of the current between the two resistors starting from all of the current flowing in R1 through to all of the current flowing in R2. Your table should also indicate the row that correspond to the maximum power dissipation and minimum power dissipation. You should be able to work out if your program is giving the correct answer.

## 5. The Third Exercise

The following program calculates the price of electronic components ordered from a shop. Analyse the program first and understand the loop construct used. Then modify the program by adding other components such as analog to digital converter ADC (unit price is $2.50) and light emitting diode LED (unit price $0.15)

---

```
#include <stdio.h>

const float THE 0.22   // price of thermistor
const float PHO 0.15   // price of Photodiode

int main(void)
{
  char key;                   // key pressed
  int items = 0;              // number of electronic components
  int done = 0;               // order complete?
  float total = 0.00;  // total price

  /* Output information: */
  puts("ELECTRONIC DEVICES MENU SYSTEM");
  puts("==============================\n");
  puts(" [T]hermistor - press T (then Enter)");
  puts(" [P]hoto diode - press P (then Enter)");
  puts(" E[X]it -press X(then Enter) when ordering is complete\n");

  /* Handle key presses: */
  do {
    fflush(stdin);            // flush keyboard
    key = getchar();   // read key
    switch (key)
```

```
        {
        case 'T': case 't':
                printf(" Thermistor $%4.2f\n", THE);
                items++;
                total += THE;
                break;
        case 'P': case 'p':
                printf(" Photo diode $%4.2f\n", PHO);
                items++;
                total += PHO;
                break;
        case 'X': case 'x':
                printf("\nOrder complete - ");
                printf("%i items - total $%4.2f\n", items, total);
                done = 1;
                break;
        default:
                puts(" Invalid key! Try again.");
                break;
        }
  } while (!done);

  /* Output information: */
  printf("\n\"Thank you! Total amount will be $%4.2f\"\n", total);
  puts("\"Thanks for shopping! Come again!\"");
}
```

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Please note that marks will not be allocated to people who do not attend their allocated lab and complete the appropriate quizzes by their deadline. Under no circumstances will marks be recorded after the laboratory period is finished.

RAR 17/2/2009
WHL 10/03/2010
RAR 18/02/2011