Benha University
Faculty of Engineering at Shoubra

Electrical Engineering and Control (EEC) Department,
EEC380: Industrial Training (1)
Summer 2020

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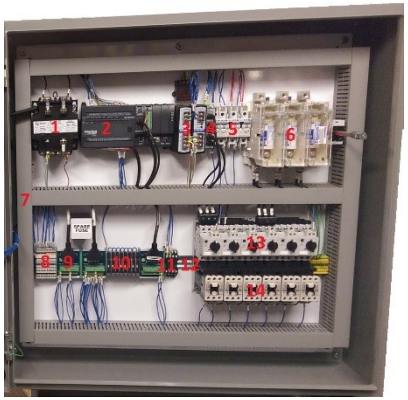

MATLAB

Industrial Control

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Outline

- Exercises
- Project

Exercise 1

A vector is given by: $x = [15\ \ -6\ \ 0\ \ 8\ \ -2\ \ 5\ \ 4\ \ -10\ \ 0.5\ \ 3]$. Using conditional statements and loops write a program that determines the sum of the positive elements in the vector.

```
sum=0; %initial value
for i=1:length(x)
   if x(i)>0
      sum=sum+x(i);
   end
end
disp(['the summation of positive value='
num2str(sum)])
```

Exercise 2

A vector is given by: $V = [5, 17, -3, 8, 0, -1, 12, 15, 20, -6, 6, 4, -7, 16]$. Write a program as a script file that doubles the elements that are positive and are divisible by 3 and/or 5, and raise to the power of 3 the elements that are negative but greater than –5.

```
V = [5, 17, -3, 8, 0, -7, 12, 15, 20 -6, 6, 4, -2, 16];
n = length(V);
for k = 1:n
    if V(k) > 0 & (rem(V(k),3) == 0 | rem(V(k),5) == 0)
        V(k) = 2*V(k);
    elseif V(k) < 0 & V(k) > -5
        V(k) = V(k)^3;
    end
end
V
```

Setting n to be equal to the number of elements in V.

for-end loop.

if-elseif-end statement.

Exercise 3

Write a MATLAB function for the following sequence sequence 1,2,4,8,… Given the first two elements and number of the next elements, the program will generate and printout the next (a) elements the Fibonacci sequence .

```
function [ Seq ] = SEQ(a,b,c)
Seq(1)=a;
Seq(2)=b;
for i=3:c
Seq(i)=Seq(i-1)*2;
end
```

Exercise 4

3-The following sequence is called a Fibonacci sequence 1,1,2,3,5,8,13,21,34,55 after the first two elements each element of the sequence is the sum of the pervious two elements . Write a MATLAB function Fibonacci which given the first two elements and number of the next elements, the program will generate and printout the next (a) elements the Fibonacci sequence .

```
function [ Seq ] = Fibonacci(a,b,c)
 Seq(1)=a;
 Seq(2)=b;
for i=3:c
Seq(i)=Seq(i-1)+Seq(i-2);
end
```

Exercise 5

When n electrical resistors are connected in parallel, their equivalent resistance REq can be determined from:1/req=1/r1+….1/rn. Write a user-defined MATLAB function that calculates REq· For the function name and arguments use Req = REQ(R). The input to the function is a vector in which each element is a resistor value, and the output from the function is Req. Use the function to calculate the equivalent resistance when the following resistors are connected in parallel: 50, 75, 300, 60, 500, 180, and 200 ohms.

```
function Req=REQ(R)
%calculate the equ. resistance
of number of resistors
%connected in parallel
sum=0;
 for i=1:length(R)
     if R(i)<0
       error('Please enter
correct value of R')
       break
     elseif R(i)==0
         error('one of a resistor
is short circuit')
         break
     end
     sum=sum+1/R(i);
end
Req=1/sum;
```

Exercise 6

Write a MATLAB function to calculate the total cost of a home, if the customer pay X$ at the beginning of contract, monthly installment M$ and the annual interest rate R for number of years Y.

```
function Total_cost =
HOME(X,M,R,Y)
%X:Money at contract
%M:monthly installment
%R: Annual interst rate
%Y: Number of year
cost_y(1)=M*12;
for i=2:Y
    M_r=R*M+M;
    M=M_r;
cost_y(i)=M*12;
end
Total_cost=X+sum(cost_y);
end
```

Exercise 7

Write a program in a script file that determines e^x by using the Taylor series representation. The program calculates e^x by adding terms of the series and stopping when the absolute value of the term that was added last is smaller than 0.0001. Use a `while-end` loop, but limit the number of passes to 30. If in the 30^{th} pass the value of the term that is added is not smaller than 0.0001, the program stops and displays a message that more than 30 terms are needed.

Use the program to calculate e^2, e^{-4}, and e^{21}.

The first few terms of the Taylor series are:

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots$$

```
x = input('Enter x ');
n = 1; an = 1; S = an;
while abs(an) >= 0.0001 & n <= 30        Start of the while loop.
   an = x^n/factorial(n);                Calculating the nth term.
   S = S + an;                           Adding the nth term to the sum.
   n = n + 1;                            Counting the number of passes.
end                                      end of the while loop.
if n >= 30                               if-else-end loop.
   disp('More than 30 terms are needed')
else
fprintf('exp(%f) = %f',x,S)
fprintf('\nThe number of terms used is: %i',n)
end
```

Exercise 8

Write a temperature system converting MATLAB function f2c(), The converting formula is $C = 5/9(F - 32)$. Round the result to the nearest integer.

Exercise 9

Use MATLAB in the two different ways, described below, to plot the function:

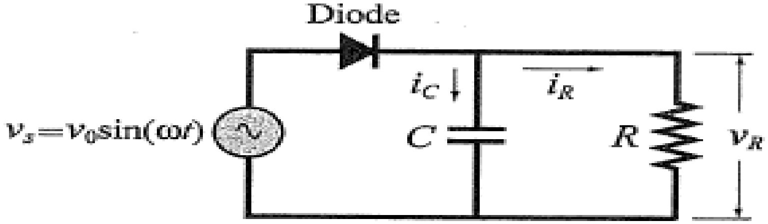
$$f(x) = \begin{cases} 4e^{x+2} & \text{for} \quad -6 \le x \le -2 \\ x^2 & \text{for} \quad -2 \le x \le 2 \\ (x+62)^{1/3} & \text{for} \quad 2 \le x \le 6 \end{cases}$$

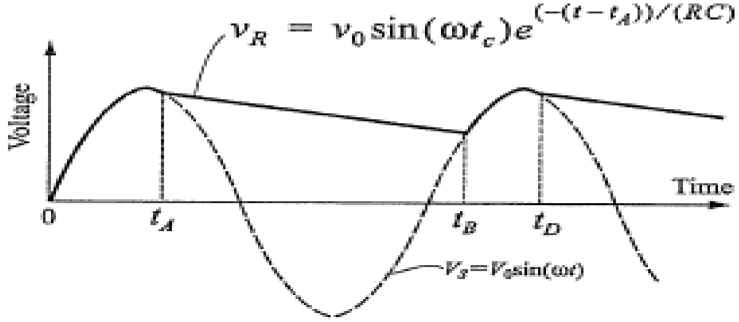
a) Write a program in a script file, using conditional statements and loops.

b) Create a user-defined function for $f(x)$, and then use the function in a script file to make the plot.

Project

A half-wave diode rectifier is an electrical circuit that converts AC voltage to DC voltage. A rectifier circuit that consists of an AC voltage source, a diode, a capacitor, and a load (resistor) is shown in the figure. The voltage of the source is $v_s = v_0 \sin(\omega t)$, where $\omega = 2\pi f$, in which f is the frequency. The operation of the circuit is illustrated in the diagram on the right where the dashed line shows the source voltage, and the solid line shows the voltage across the resistor. In the first cycle, the diode is on (conducting current) from $t = 0$ until $t = t_A$. At this time the diode turns off and the power to the resistor is supplied by the discharging capacitor. At $t = t_B$ the diode turns on again and continues to conduct current until $t = t_D$. The cycle continues as long as the voltage source is on. In a simplified analysis of this circuit, the diode is assumed to be ideal and the capacitor is assumed to have no charge initially (at $t = 0$). When the diode is on, the resistor's voltage and current are given by:





$$v_R = v_0 \sin(\omega t) \quad \text{and} \quad i_R = v_0 \sin(\omega t)/R$$

The current in the capacitor is:

$$i_C = \omega C v_0 \cos(\omega t)$$

When the diode is off, the voltage across the resistor is given by:

Project

$$v_R = v_0 \sin(\omega t_A) e^{(-(t-t_A))/(RC)}$$

The times when the diode switches off (t_A, t_D, and so on) are calculated from the condition $i_R = -i_C$. The diode switches on again when the voltage of the source reaches the voltage across the resistor (time t_B in the figure).

Write a MATLAB program that plots the voltage across the resistor v_R and the voltage of the source v_s as a function of time for $0 \le t \le 70$ ms. The resistance of the load is 1800 Ω, the voltage source $v_0 = 12$ V, and $f = 60$ Hz. To examine the effect of the capacitor size on the voltage across the load, execute the program twice; once with $C = 45$ μF, and once with $C = 10$ μF.

Project

```
V0 = 12; C = 45e-6; R = 1800; f = 60;
Tf = 70e-3; w = 2*pi*f;
clear t VR Vs
t = 0:0.05e-3:Tf;
n = length(t);
state = 'on'
for i = 1:n
    Vs(i) = V0*sin(w*t(i));
    switch state
        case 'on'
        VR(i) = Vs(i);
        iR = Vs(i)/R;
        iC = w*C*V0*cos(w*t(i));
        sumI = iR + iC;
        if sumI <= 0
            state = 'off';
            tA = t(i);
        end
```

Assign `'on'` to the variable `state`.

Calculate the voltage of the source at time t.

Diode is on.

Check if $i_R - i_C \leq 0$.

If true, assign `'off'` to `state`.

Assign value to t_A.

Project

```
        case 'off'
        VR(i) = V0*sin(w*tA)*exp(-(t(i) - tA)/(R*C));
        if Vs(i) >= VR(i)
          state = 'on';
        end
    end
end
plot(t,Vs,':',t,VR,'k','linewidth',1)
xlabel('Time (s)'); ylabel('Voltage (V)')
```

Diode is off.

Check if $v_s \geq v_R$.

If true, assign `'on'` to the variable `state`.

End of Lecture

Thank you for attention!
Any questions?

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