B.Sc. Semester-III Examination, 2022-23

ELECTRONICS [Honours]

Course ID : 31715 Course Code : SH/ELC/305/SEC-1(T)

Course Title : Programming with MATLAB

Time : 2 Hours Full Marks : 40

The figures in the right-hand margin indicate marks.

Candidates are required to give their answers in their own words as far as practicable.

1. Answer any **five** of the following questions: $2\times5=10$

a) How many keywords are there in MATLAB? Name any four of them. 2

b) Name four predefined variables in MATLAB with their meaning. 2

c) What will happen if the following commands are executed in MATLAB? $\frac{1}{2}+\frac{1}{2}+\frac{1}{2}+\frac{1}{2}=2$

i) clear

ii) clear x y z

iii) who

iv) whos

d) Mention the difference between script file and function file. 2

e) Create a variable y that is a row vector with the following elements: 2

$\sqrt{5.2^3}$, 6.71×10^3, $\left(3+5.1^2\right)\cos 53^o$, 15.8, $\sqrt[3]{60}$ and $\frac{\sin\frac{\pi}{3}}{\tan 20^o}$.

f) i) Using the colon operator, create a variable named 'Sevens' that is a row vector of seven elements that are all 7.

ii) Write a MATLAB command to subtract the polynomial $a = 3s^3 + 2$ from b=s+7. $1+1=2$

g) Let, A=[l 3 5 7 9 11; 2 4 6 8 10 12; 3 6 9 12 15 18; 4 8 12 16 20 24; 5 10 15 20 25 30]. What will be the output of the following MATLAB command?

```
B=A(:,3)
C=A(2,:)
E=A(2:4,:)
F=A(1:3,2:4)
```

2

h) What will be the output of the following MATLAB command?

```
>>A=[10:–l:4; ones(l,7); 2:2:14; zeros(l,7)]
>>B=A([1,3], [1,3,5:7])
```

2

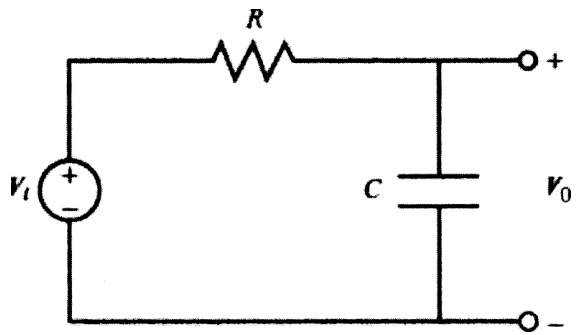
2. Answer any **four** of the following questions: 5×4=20

a) Write a script file to print the following table using for-end loop.

x	x^2	x^3	x^4
1	1	1	1
2	4	8	16
3	9	27	81
4	16	64	256
5	25	125	625
6	36	216	1296
7	49	343	2401
8	64	512	4096
9	81	729	6561

b) A simple low-pass filter circuit is shown in figure below. This circuit consists of a resistor and capacitor in series, and the ratio of the output voltage V_0 to the input voltage V_i is given by the equation:

$$\frac{V_0}{V_i} = \frac{1}{1 + j2\pi fRC}$$



Assume that R= 16 kΩ and C = 1 μF. Write a MATLAB script to calculate and plot the amplitude and phase response of this filter as a function of frequency $0 \le f \le 10^5$ Hz.

c) A 3-bit A/D converter, with an analog input x and digital output y, is represented by the equation:

$$\begin{aligned} y &= 0, && x < -2.5 \\ &= 1, && -2.5 < x < -1.5 \\ &= 2, && -1.5 \le x < -0.5 \\ &= 3, && -0.5 \le x < 0.5 \\ &= 4, && 0.5 \le x < 1.5 \\ &= 5, && 1.5 \le x < 2.5 \\ &= 6, && 2.5 \le x < 3.5 \\ &= 7, && x \ge 3.5 \end{aligned}$$

Write a MATLAB program to convert analog signal x to digital signal y.

d) Write a program that asks the user to input a vector of integers of arbitrary length. The program examines each element of the vector. The program displays the vector that was entered, the number of elements, number of positive elements and number of elements that are negative but divisible by 3.

e) Write the MATLAB command to create a mesh plot of the function $z=2/(x^2+y^2+1)$ over the interval $-5 \le x \le 5$ and $-5 \le y \le 5$.

f) Write a MATLAB script file that divide the figure window into four sub-windows and plot the following functions using different styles:

i) Plot v vs i where $v = 4 * i$ and i=1, 2, 3, 4 on the upper left portion

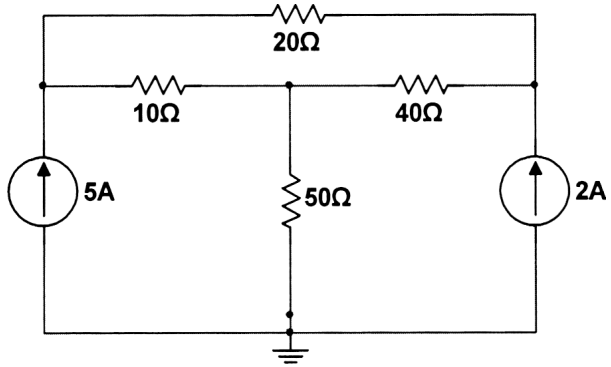
ii) Plot y vs x where $y = x^2$ and x = 1,2,3,4 on the upper right portion

iii) Plot sin(t) vs t for $t = 0:2\pi$ in step $t = \pi/60$ on the lower left portion

iv) Plot cos(t) vs t for $t = 0:\frac{\pi}{30}:2\pi$ on the lower right portion

3. Answer any **one** of the following questions: $10\times1=10$

a) Write a MATLAB script file to find the node voltages using the nodal analysis.



b) The current flowing through the semiconductor diode is given by the equation

$$i_D = I_0\left(e^{\frac{qv}{KT}} - 1\right)$$

where v is the voltage across the diode, in volts, i is the current flow through the diode, in amps, I_0 is the leakage current of the diode, in amps, q is the charge on an electron, 1.602×10^{-19} coulombs, k is Boltzmann's constant, 1.38×10^{-23} joule/K, T is temperature, in kelvin (K).

The leakage current I_0 of the diode is 2.0 μA. Write a program to calculate the current flowing through this diode for all voltages from –1.0 V to + 0.6 V, in 0.1 V steps. Repeat this process for the following temperatures: 75°F, 100°F, and 125°F. Create a plot of the current as a function of applied voltage, with the curves for the three different temperatures appearing as different colours.

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