Assignment 1

Review of Matlab Calculations

Due date Sept 17

This assignment is a review of ENEL101.

For this assignment fill out this word template with your answers.

Submit a PDF version of your assignment on D2L.

In all assignment questions, angles are in radians unless explicitly indicated otherwise.

……

Q1. Give the Matlab expression to calculate $x = 0.2^{5.7}\left(\csc\left(0.2\right)\right)^3 e^{2.7} + \sinh(0.1)$ and the resulting value of x

(Matlab input)

```
x = ((0.2^5.7)*((csc(0.2))^3)*exp(2.7)) + sinh(0.1);
```

(Matlab Response)

```
x = 0.2970
```

……

Q2 Define the variables $x = \sqrt{3}$ and $y = 0.3x^2 + \sqrt{x}$, $z = \sqrt{e} + x - \ln(x) - \log_{10}(x)$ and then compute $v = \sqrt{\tanh\left(xyz\right)}$

(Matlab input)

```
x = sqrt(3);
y = (0.3*(x^2)) + sqrt(x);
z = sqrt(exp(1)) + x - log(x) - log10(x);
v = sqrt(tanh(x*y*z));
```

(Matlab Response)

```
 v = 1.0000
```

……

Q3. Let $x = -2$ and $y = 0 + j3$ (that is y is a complex number with $j = \sqrt{-1}$). Determine the vector of $z = \left[x^y \quad xy^2 \quad \exp\left(\sqrt{x}\right) \right]$.

(Matlab input)

```
x = -2;
y = 0 + 3j;
z = [x^y x*(y^2) exp(sqrt(x))];
```

(Matlab Response)

```
z =  -0.0000 + 0.0001i  18.0000 + 0.0000i   0.1559 + 0.9878i
```

……

Q4. Determine the magnitude and angle (in degrees) of the array of values z in **Q3**.

(Matlab input)

```
x = -2;
y = 0 + 3j;
z = [x^y x*(y^2) exp(sqrt(x))];
mag = abs(z);
theta = (180/pi) .* angle(z);
```

(Matlab Response)

```
mag =

    0.0001   18.0000    1.0000

theta =

    119.1432       0      81.0285
```

……

Q5. A matrix is given as

$$x = \begin{bmatrix} 1 & 2 & 0 \\ 2 & 7 & 1 \\ 0 & 0 & 5 \end{bmatrix}$$

Determine the matrix $z = 3x + x^2$

(Matlab input)

```
x = [1 2 0; 2 7 1; 0 0 5];
z = (3.*x) + (x.^2);
```

(Matlab Response)

```
z =

     4    10     0

    10    70     4

     0     0    40
```

……

Q6. Assume that

$$x = \begin{bmatrix} 1 & 2 & 0 \\ 2 & 7 & 1 \\ 0 & 0 & 5 \end{bmatrix} \quad y = \begin{bmatrix} 1 \\ 2 \\ 3 \end{bmatrix}$$

Determine $z = y^T xy$ and $w = yy^T$

(Matlab input)

```
x = [1 2 0; 2 7 1; 0 0 5];
y = [1;2;3];
z = (y.').*x.*y;
w = y.*(y.');
```

(Matlab Response)

```
z =

     1     4     0

     4    28     6

     0     0    45

w =

     1     2     3

     2     4     6

     3     6     9
```

……

Q7. Assume a row vector of samples given as $x = [-50, -49, ..., 30]$. Also assume a rowvector y calculated with the elements of x given as

$$[y]_i = 3\ [x]_i^2 + 2$$

where the subscript 'i' denotes the element index. Finally we have a matrix $Q = \begin{bmatrix} x \\ y \end{bmatrix}$. Determine

$$z = Q\,Q^T$$

(Matlab input)

```
x = -50:1:30;
y = (3.*(x.^2)) + 2;
Q = [x;y];
z = Q*(Q.');
```

(Matlab Response)

```
z =

       52380    -4229820

    -4229820   639094860
```

……

Q8. Three vectors are given as

$$\mathbf{u} = -3\mathbf{i} + 4\mathbf{j} - 2\mathbf{k}$$
$$\mathbf{v} = 2\mathbf{i} - 5\mathbf{j} - 4\mathbf{k}$$
$$\mathbf{w} = \mathbf{i} - \mathbf{j} - \mathbf{k}$$

Use dot() and cross() to compute the vector of $\mathbf{Q} = (\mathbf{u} \bullet \mathbf{v})^2 ((\mathbf{u} \times \mathbf{v}) \times \mathbf{w})$

(ans)

(Matlab input)

```
u = [-3 4 -2];
v = [2 -5 -4];
w = [1 -1 -1];
Q = ((dot(u,v))^2)*(cross(cross(u,v),w));
```

(Matlab Response)

```
Q =

        7452       -6156       13608
```

……

Q9. Use Matlab to determine the approximate value of the sum of the infinite series

$$x = \sum_{n=1}^{\infty} \frac{\cos\left(\frac{1}{n}\right)}{n^3 + 2}$$

your answer should be accurate to about 8 significant figures.

(Matlab input)

```
syms n
digits(8);
x = vpa(symsum((cos(1/n))/((n^3)+2), n, 1, Inf));
```

(Matlab Response)

```
x = 0.33902846
```

……

Q10. Two matrices are given as

$$X = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 7 & 7 \\ 1 & 2 & 1 \end{bmatrix} \text{ and } Y = \begin{bmatrix} 2 & 2 & 3 \\ 7 & 6 & 0 \\ 1 & 2 & 1 \end{bmatrix}$$

Determine $Q = X^{-1}\left(Y + X^2\right)$

(Matlab input)

```
X = [1 2 3; 0 7 7; 1 2 1];
Y = [2 2 3; 7 6 0; 1 2 1];
Q = inv(X).*(Y+(X.^2));
```

(Matlab Response)

```
Q =

    1.5000   -1.7143    6.0000

   -3.5000    7.8571   24.5000

    1.0000         0   -1.0000
```

……

Q11. Solve the linear set of equations using the \ operator in Matlab

$$4x + y + z = 3$$
$$2x + 2 + 13z = 4 - y$$
$$3x - z + 3y = 11 + 3y$$

Let $Q = \begin{bmatrix} x & y & z \end{bmatrix}$, be a column vector of the results.

(Matlab input)

```
A = [4 1 1; 2 1 13; 3 0 -1];
B = [3;2;11];
Q = A\B;
```

(Matlab Response)

```
Q =

    3.8529

  -12.9706

    0.5588
```

……

Q12. A recursive series is formed as

$$x_n = 3x_{n-1} - 2x_{n-2} + 1$$

with $x_1 = x_0 = 0$. Write a for loop in matlab that determines the value of x_{200}.

(Matlab input)

```
x0 = 0;
x1 = x0;
      for n=2:200
            x = (3*x1) - (2*x0) + 1;
            x0 = x1;
            x1 = x;
      end
```

(Matlab Response)

```
x =

   1.6069e+60
```

……

Q13 Plot the sequence of

$$x_n = 3x_{n-1} - 2x_{n-2} + 1$$

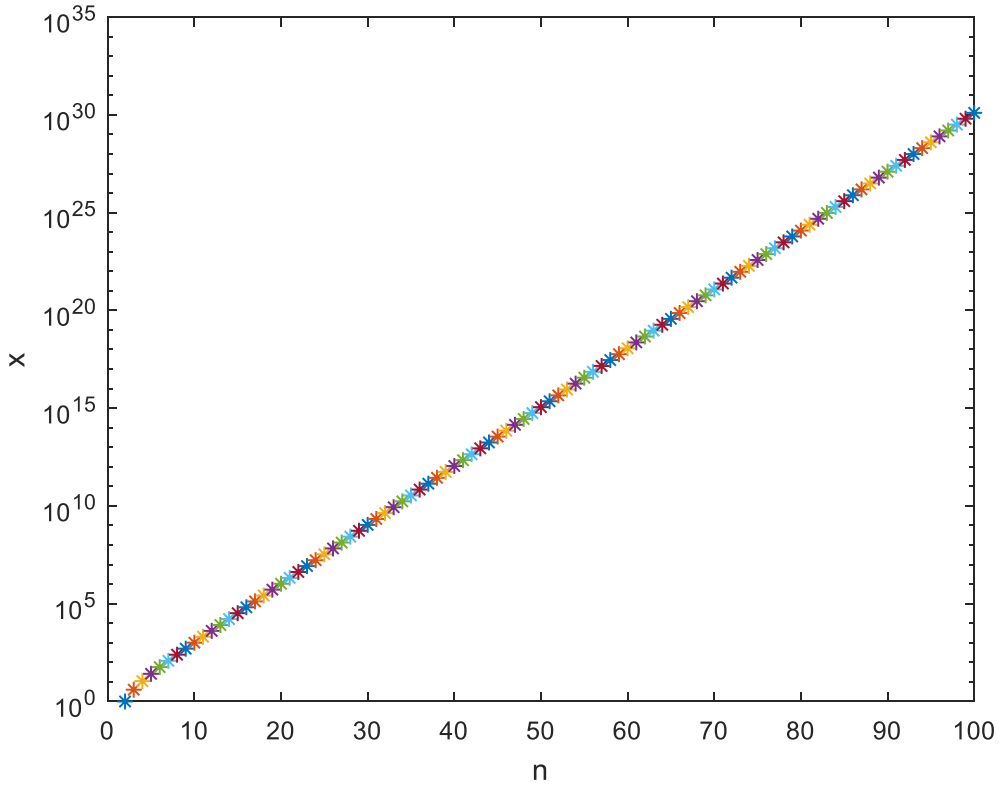
with $x_1 = x_0 = 0$

using semilogy() for n=2 to 100

(Matlab input)

```
x0 = 0;
x1 = x0;
for n=2:100
    x = (3*x1) - (2*x0) + 1;
    x0 = x1;
    x1 = x;
    semilogy(n,x,'-*');
    hold on;
end
xlabel('n');
ylabel('x');
```

(Matlab Response)



.....

Q14. A parametric equation is given by

$$x = \frac{3t^{1.3}}{1+t^3}$$

$$y = \frac{3t^{2}}{1+t^3}$$

for a range of t given as $0 < t < 10$. Produce two plots. In the first plot x(t) and y(t) are superimposed. In the second plot assume x along the abscissa and y along the ordinate. Use subplot() to generate the two plots stacked vertically.

(Matlab input)

```
t = linspace(0, 10);
x = 3*(t.^1.3) ./ (1 + (t.^3));
y = 3*(t.^2) ./ (1 + (t.^3));
subplot(2,1,1);
plot(t,x);
hold on;
plot(t,y);
xlabel('t');
ylabel('x(t) and y(t)');
legend('x(t)','y(t)');
subplot(2,1,2);
plot(x, y);
xlabel('x');
ylabel('y');
```

(Matlab Response)