

## Engineering Measurements Assignment 3

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### Problem 1

```
%%Arjun Posarajah 104980541
%Question 1
%%Data
t = [0, 0.4, 0.8, 1.2, 1.6, 2, 2.4, 2.8, 3.2, 3.6, 4];
y1 = [0, 11.76, 19.02, 19.02, 11.76, 0, -11.76, -19.02, -19.02, -11.76, 0];
y2 = [0, 15.29, 24.73, 24.73, 15.29, 0, -15.29, -24.73, -24.73, -15.29, 0];

%part A
disp(mean(y1))
disp(mean(y2))
disp(rms(y1))
disp(rms(y2))

>> A3Q1arjunposarajah
-1.6149e-16

-3.2297e-16

13.4848

17.5329
```

### Problem 1

b)  $\text{avg } y_1 = 0$   
 $\text{avg } y_2 = 0$

c) Matlab gives the most precise value, as with a calculator it rounds it to 0, however on matlab it goes to the  $10^{-16}$ .

## Problem 2

```
%%%Arjun Posarajah 104980541
%%Problem 2
```

```
syms x
```

```
%Part A
```

```
a = x^3 + 4*x^2 + 3*x + 8 ;
partadiff1=diff(a);
partadiff2 = diff (a, 2);
disp(partadiff1)
disp(partadiff2)
```

```
%Part B
```

```
b = (x^2 + 2*x + 1)/(x-1);
partbdiff1=diff(b);
partbdiff2 = diff(b, 2);
disp(partbdiff1)
disp(partbdiff2)
```

```
%Part C
```

```
c = cos(2*x)*sin(x);
partcdiff1=diff(c);
partcdiff2 = diff(c, 2);
disp(partcdiff1)
disp(partcdiff2)
```

```
%Part D
```

```
d = 3*x*exp(4*x^2);
partddiff1=diff(d);
partddiff2 = diff(d, 2);
disp(partddiff1)
disp(partddiff2)
```

```
>> A3Q2arjunposarajah
```

```
3*x^2 + 8*x + 3
```

```
6*x + 8
```

```
(2*x + 2)/(x - 1) - (x^2 + 2*x + 1)/(x - 1)^2
```

```
2/(x - 1) + (2*(x^2 + 2*x + 1))/(x - 1)^3 - (2*(2*x + 2))/(x - 1)^2
```

```
cos(2*x)*cos(x) - 2*sin(2*x)*sin(x)
```

```
- 5*cos(2*x)*sin(x) - 4*sin(2*x)*cos(x)
```

```
3*exp(4*x^2) + 24*x^2*exp(4*x^2)
```

```
72*x*exp(4*x^2) + 192*x^3*exp(4*x^2)
```

### Problem 3

```
%%%Arjun Posarajah 104980541 >> A3Q3arjunposarajah
%%Problem 3

syms x y a b c
%Part A
eqna= x^2 + x;
intA=int(eqna)
|
intA =
(x^2*(2*x + 3))/6

%Part B
eqnb= x^2 + x;
intB=int(eqna,0.3,1.3)
intB =
457/300

%Part C
eqnc= x^2 + y^2;
intC=int(eqnc,x)
intC =
x^3/3 + x*y^2

%Part D
d= a*x^2 + x*b + c;
intD=int(d,x,3.5,24)
intD =
(110249*a)/24 + (2255*b)/8 + (41*c)/2
```

### Problem 4

```
%%%Arjun Posarajah 104980541
%%Problem 4

syms x(t) c m k
ODE = diff(x,t,2) + (c/m)*diff(x,t) + (k/m)*x == 0;

%Part A
GeneralSol(t) = dsolve(ODE);
disp(GeneralSol)

%Part B
dx(t) = diff(x,t);
BC1 = x(0)==1;
BC2 = dx(0) == 0;
BCS = [BC1 BC2];
ConditionSol(t) = dsolve(ODE, BCS);
disp(ConditionSol)

%Part C
SubEqn = subs(ODE, [c m k], [0.5, 1, 0.5]);
SubstitutionSol(t) = dsolve(SubEqn, BCS);
disp(SubstitutionSol)

%Part D
ezplot(real(SubstitutionSol))
```

```
>> A3Q4arjunposarajah
C2*exp(-(t*(c + (c^2 - 4*k*m)^(1/2)))/(2*m)) + C1*exp(-(t*(c - (c^2 - 4*k*m)^(1/2)))/(2*m))
symbolic function inputs: t
```

b)

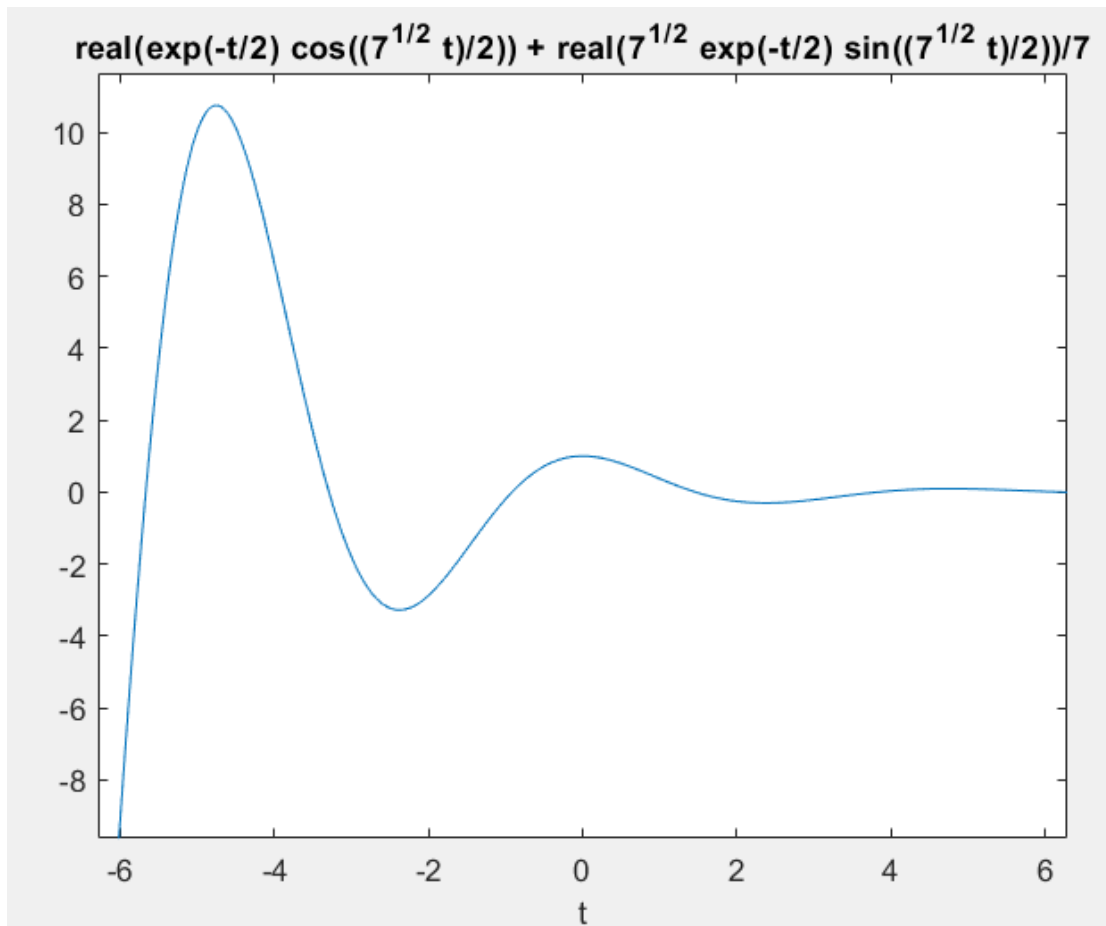
```
(exp(-(t*(c - (c^2 - 4*k*m)^(1/2)))/(2*m)))*(c + (c^2 - 4*k*m)^(1/2))/(2*(c^2 - 4*k*m)^(1/2))
symbolic function inputs: t
```

Continuation of the previous result

```
- (exp(-(t*(c + (c^2 - 4*k*m)^(1/2)))/(2*m)))*(c - (c^2 - 4*k*m)^(1/2))/(2*(c^2 - 4*k*m)^(1/2))
```

c)

```
exp(-t/2)*cos((7^(1/2)*t)/2) + (7^(1/2)*exp(-t/2)*sin((7^(1/2)*t)/2))/7
symbolic function inputs: t
```



### Problem 5

a)  $\lambda^2 + \omega^2 = 0$

$\lambda = \pm i\omega$

$\theta(t) = c_1 e^{-i\omega t} + c_2 e^{i\omega t}$

$$\begin{aligned}\theta(t) &= c_1 (\cos \omega t - i \sin \omega t) + c_2 (\cos \omega t + i \sin \omega t) \\ &= (c_1 + c_2) \cos \omega t + i (-c_1 + c_2) \sin \omega t \\ &= A \cos \omega t + B \sin \omega t\end{aligned}$$

b)  $\theta(0) = 1$        $\dot{\theta}(0) = 0$

$A = 1$        $B = 0$

$\theta(t) = \cos \omega t$

