

HNC Electrical and Electronic Engineering

PSDE4003 Engineering Mathematics

Level 4, Year 1

Class Test 3 (2017-18)

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Marks

1. If $x = 1.4$ and $y = 1.59$, evaluate using 'assignment statements':

a) $x^2 - y$ b) $(2y)^{x-y}$ c) e^{2xy} d) $\log_{10}(y^x - x)$

S.

[12]

2. If $Q = \begin{bmatrix} \frac{2}{\sqrt{8}} & \frac{2}{\sqrt{8}} \\ \frac{2}{\sqrt{8}} & -\frac{2}{\sqrt{8}} \end{bmatrix}$ and the matrix $X = \begin{bmatrix} 3 & 4 \\ -1 & 0 \end{bmatrix}$

- a) Show that $Q^T = Q^{-1}$
b) Show that $(QXQ^T)^6 = QX^6Q^T$

O.

[20]

3. On the same set of axes, plot the graphs of $y = 2\cos x$ and $y = 3\sin x$ for $-\pi \leq x \leq \pi$. Copy the figure window and your commands to your Word file. Zoom into each of the points of intersection, and copy the resultant figures into your Word file. Hence, give the coordinates of the two points of intersection, correct to 2 decimal places.

12.

[27]

4. If $y = 4e^x \sin x$, use Matlab to find $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and $\frac{d^4y}{dx^4}$

Show that $\left(\frac{d^4y}{dx^4}\right)^2 + 2\left(\frac{d^2y}{dx^2}\right)^2 + 4y^2 = -64e^{2x}(3\cos x^2 - 5)$ ①

[18]

5. x and y are related by the equation $y = mx + c$:

x	14	18	23	30	50
y	900	1200	1600	2100	3800

- (i) Input the data and use polyfit to find the best fit values of m and c .
(ii) Use polyval to find the estimated values of y
(iii) Draw a graph showing the data and the least squares regression line.

[12]

6. The table shows the time taken for 12 operatives to produce a component:

22.8	22.6	22.4	25.1	21.6	24.6
21.7	21.9	21.7	22.8	23.2	21.9

Find: (i) the mean (ii) the median (iii) the standard deviation

[11]

11

Jed Davies

Q1

a)

>> 1.4^2-1.59

ans =

0.3700 ✓

$1\frac{1}{2}$ ✓

not by assignment state marks ✓

b)

>> (2*1.4)^1.4-1.59

1.

ans =

2.6369 ✗

c)

>> exp(2*1.4*1.59)

ans =

85.7984 ✓

$1\frac{1}{2}$

$\frac{5}{12}$ ✓

d)

log10((1.59^1.4)-1.59)

1 ~~scribbles~~

ans =

-0.4894 ✗

Q3.

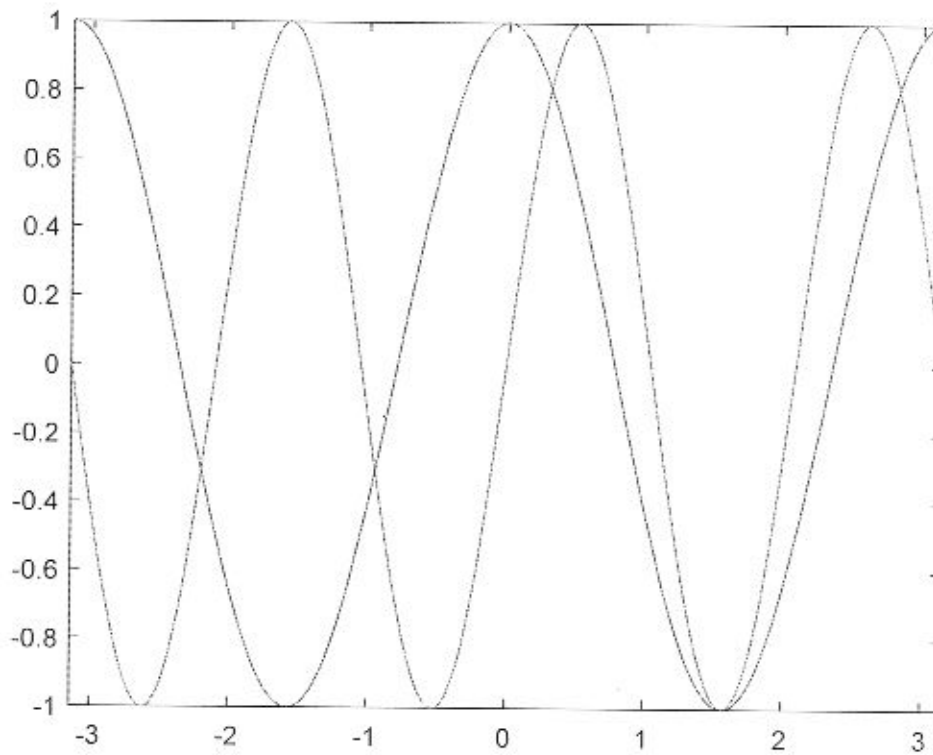
```
>> clf
```

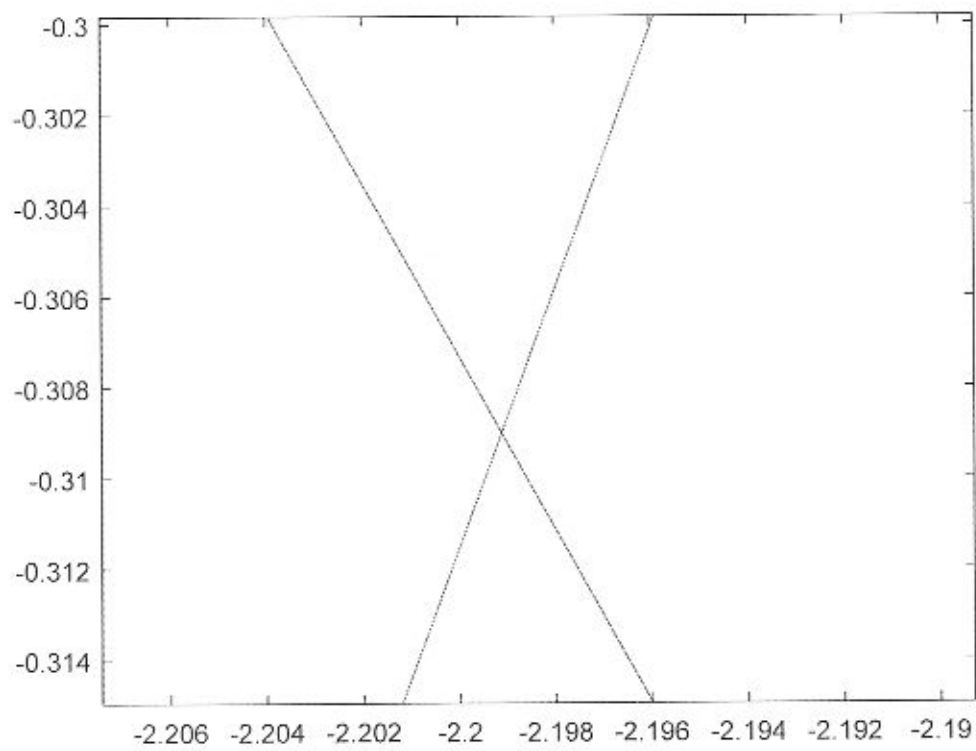
```
>> fplot('cos(2*x)', [-pi,pi])
```

```
>> hold
```

Current plot held

```
>> fplot('sin(3*x)', [-pi,pi])
```

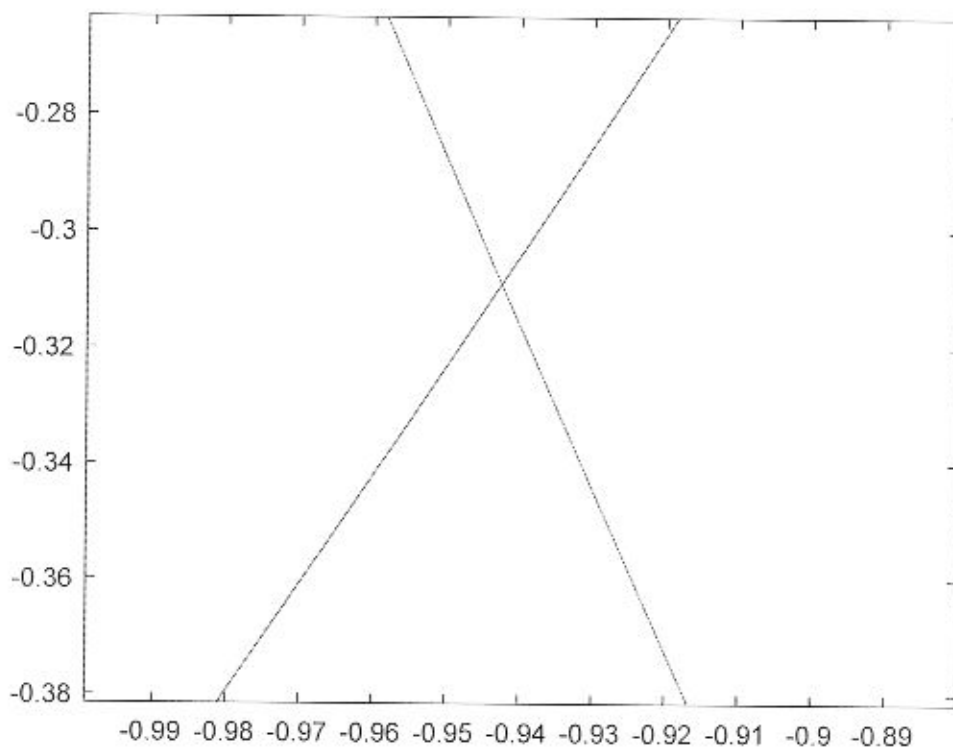




$$X = -2.19$$

$$Y = -0.31$$

$$(-2.19, -0.31)$$



$X = -0.94$

$Y = -0.31$

$(-0.31, -0.91)$

$\frac{12}{27}$

Q6.

`>> t = [22.8 22.6 22.4 25.1 21.6 24.6 21.7 21.9 21.7 22.8 23.2 21.9];`

`>> xbar=mean(t), m=median(t), s=std(t,1)`

i)

xbar =

22.6917

ii)

m =

22.5000

iii)

s =

1.0889



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Find: (i) the mean (ii) the median (iii) the standard deviation

[11]

1.

a)

>> x=1.4; y=1.59;

>> x^2-y

ans =

0.3700

b)

>> x=1.4; y=1.59;

>> (2*y)^(x-y)

ans =

0.8027

c)

>> x=1.4; y=1.59;

>> exp(2*x*y)

ans =

85.7984

d)

>> x=1.4; y=1.59;

>> log10(y^x-x)

ans =

-0.2890

2.

>> Q=[2/sqrt(8) 2/sqrt(8);2/sqrt(8) -2/sqrt(8)]

Q =

0.7071 0.7071

0.7071 -0.7071

>> X=[3 4;-1 0]

X =

3 4

-1 0

a)

>> Q'

ans =

0.7071 0.7071

0.7071 -0.7071

>> IQ=inv(Q)

IQ =

0.7071 0.7071

0.7071 -0.7071

b)

>> (Q*X*Q')^6

ans =

-91.0000 45.0000

-180.0000 44.0000

>> Q*X^6*Q'

ans =

-91.0000 45.0000

-180.0000 44.0000

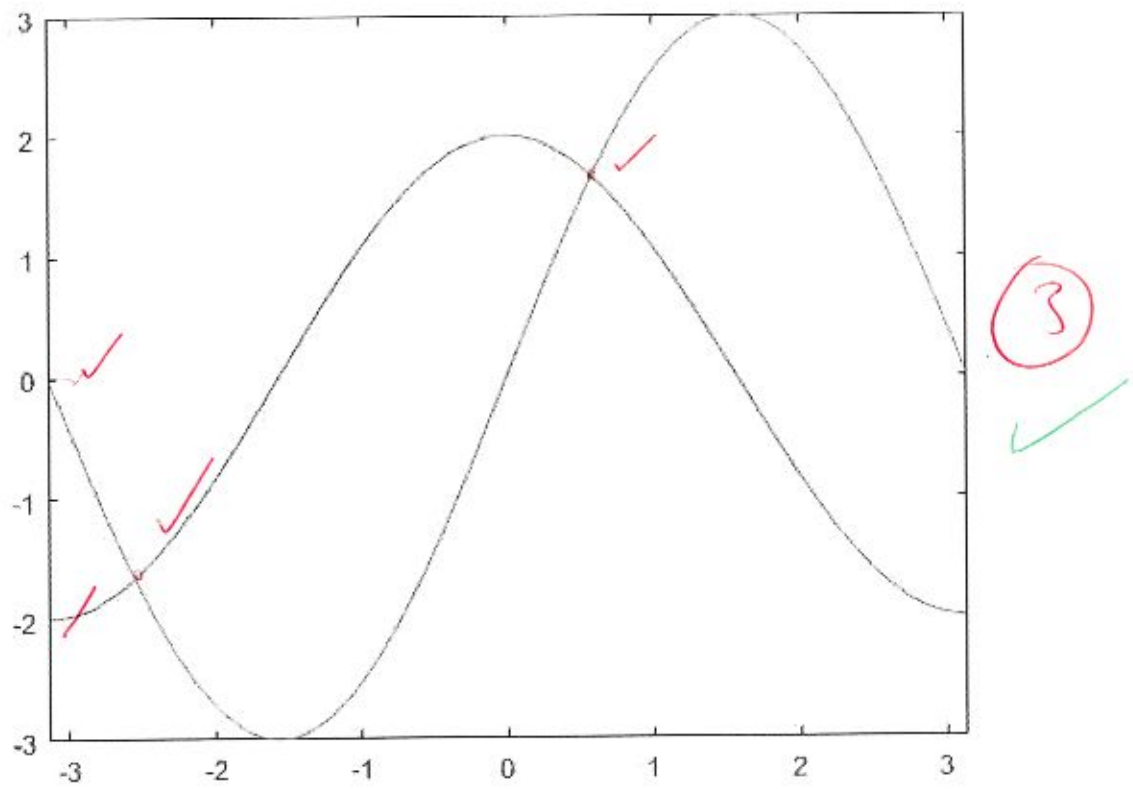
3.

>> fplot('2*cos(x)',[-pi,pi])

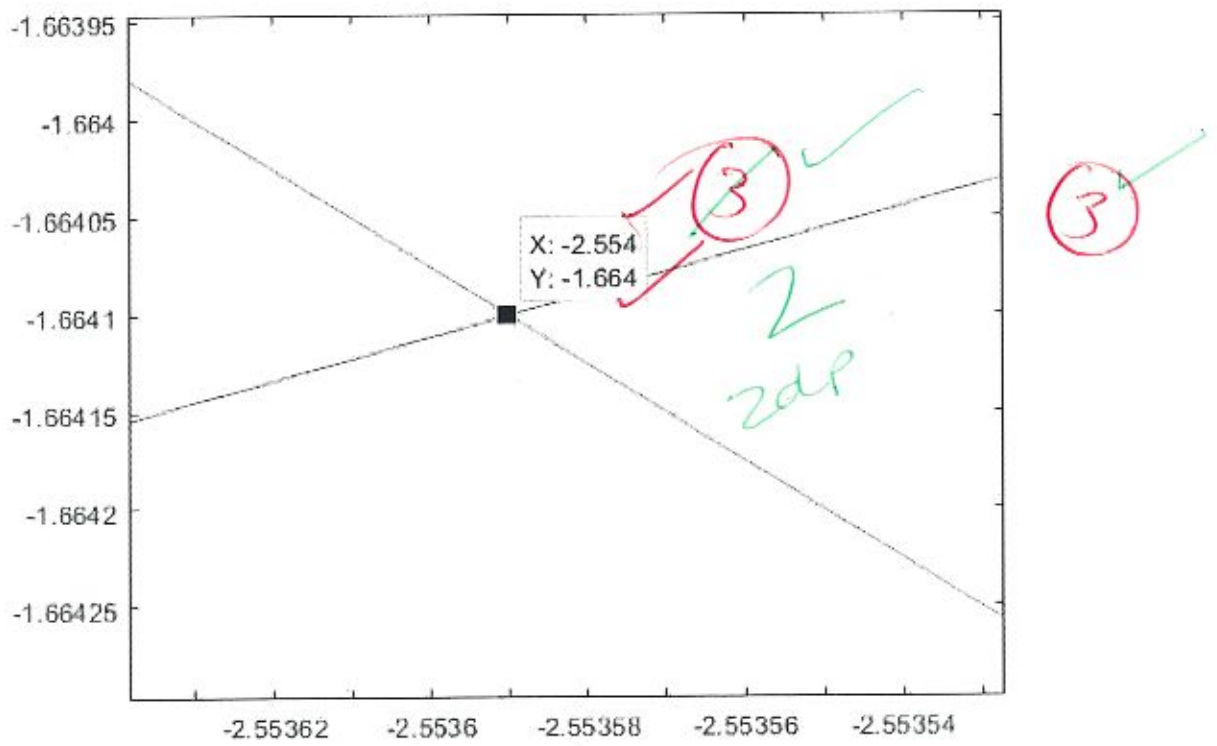
>> hold

Current plot held

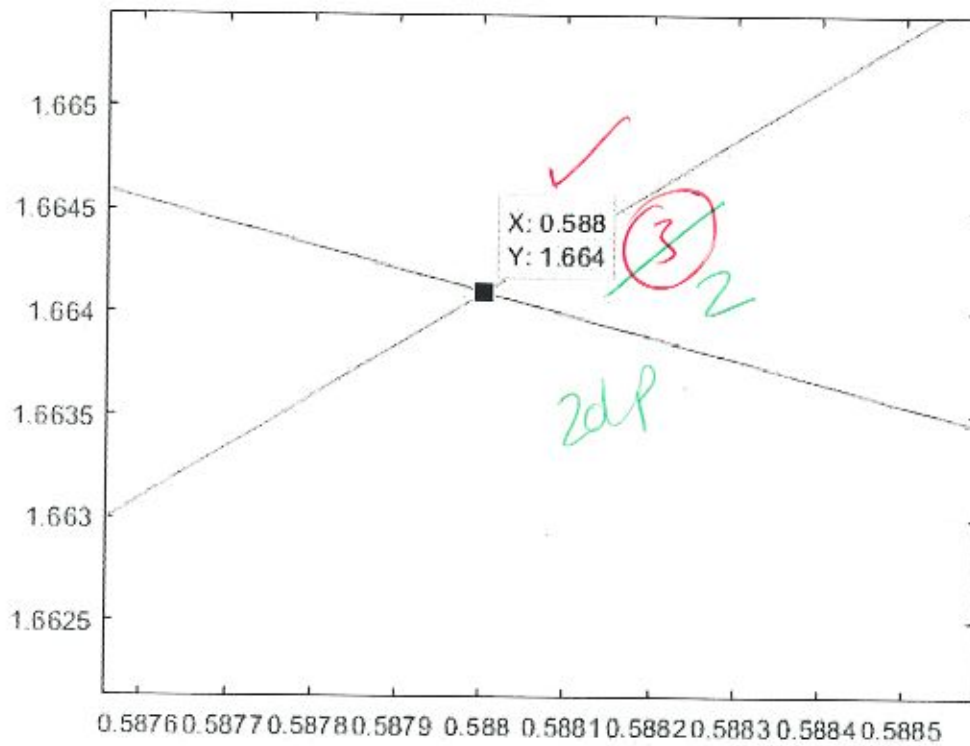
>> fplot('3*sin(x)',[-pi,pi])



The coordinates of the first point of intersection.



Second point of intersection



4.

>> syms x y ✓

>> y=4*exp(x)*sin(x) ✓

y = ✓

4*exp(x)*sin(x) ✓ (3)

>> y1=diff(y) ✓

y1 = ✓

4*exp(x)*cos(x) + 4*exp(x)*sin(x) ✓ (3)

>> y2=diff(y,2) ✓

y2 = ✓

8*exp(x)*cos(x) ✓ (3)

```
>> y4=diff(y,4)
```

```
y4 =
```

```
-16*exp(x)*sin(x)
```

```
>> y4^2+2*y2^2+4*y^2
```

```
ans =
```

```
128*exp(2*x)*cos(x)^2 + 320*exp(2*x)*sin(x)^2
```

```
>> simplify(ans)
```

```
ans =
```

```
64*exp(2*x)*(3*sin(x)^2 + 2)
```

5.

```
>> p=polyfit(x,y,1)
```

```
p =
```

```
80.5970 -256.1194
```

```
>> f=polyval(p,x)
```

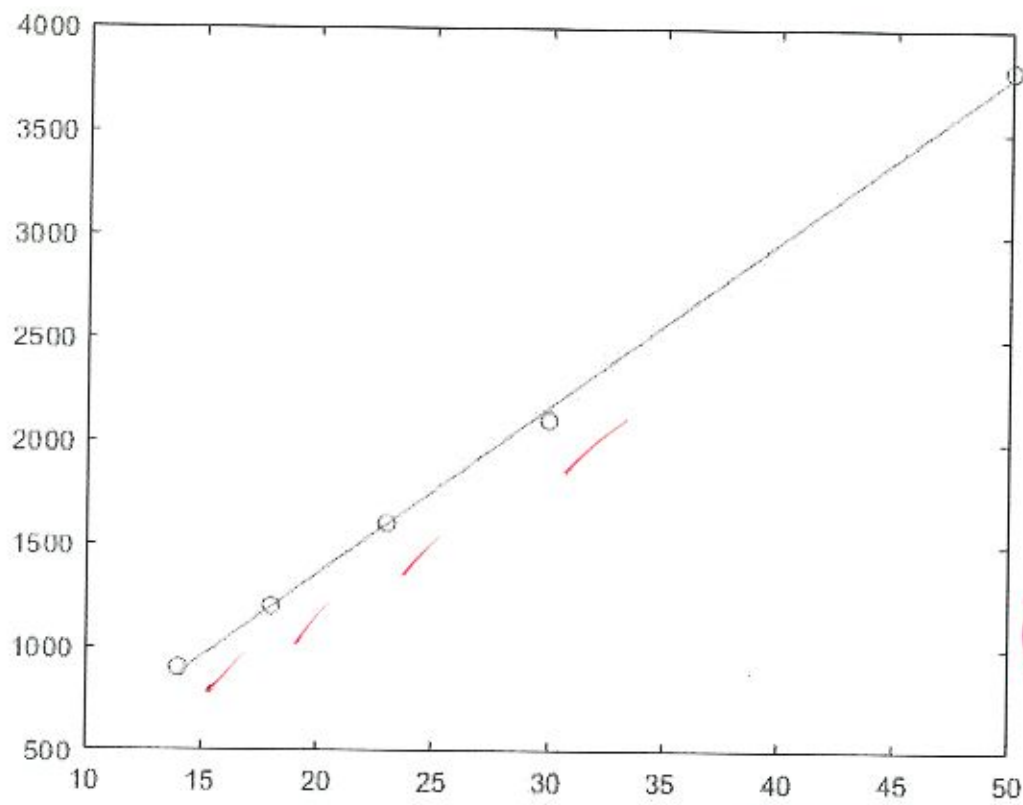
```
f =
```

```
1.0e+03 *
```

```
0.8722 1.1946 1.5976 2.1618 3.7737
```

```
>> plot(x,y,'o',x,f,'-')
```

data set?



9/12 ✓

6.

```
>> clear all
```

```
>> syms t m s xbar
```

```
>> t=[22.8 22.6 22.4 25.1 21.6 24.6 21.7 21.9 21.7 22.8 23.2 21.9]
```

```
t =
```

```
Columns 1 through 6
```

```
22.8000 22.6000 22.4000 25.1000 21.6000 24.6000
```

```
Columns 7 through 12
```

```
21.7000 21.9000 21.7000 22.8000 23.2000 21.9000
```

5

```
>> xbar=mean(t),m=median(t),s=std(t,1)
```

xbar = (the mean)

22.6917

m = (the median)

22.5000

s = (the standard deviation)

1.0889

6

11
/ 11

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70% ✓

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Find: (i) the mean (ii) the median (iii) the standard deviation

[11]

1

>> x=1.4;y=2.85;

>> x^2-y

ans =

-0.8900

>> (2*y)^(x-y)

ans =

0.0802

>> exp(2*x*y)

ans =

2.9219e+03

>> log10(y^x-x)

ans =

0.4673

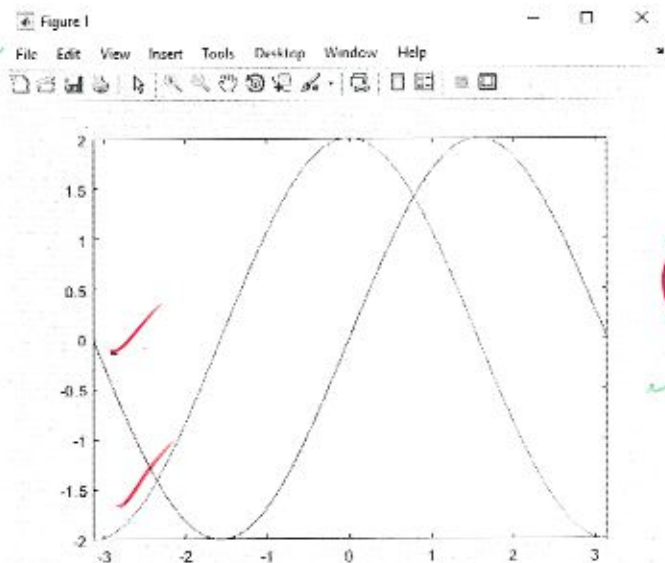
3

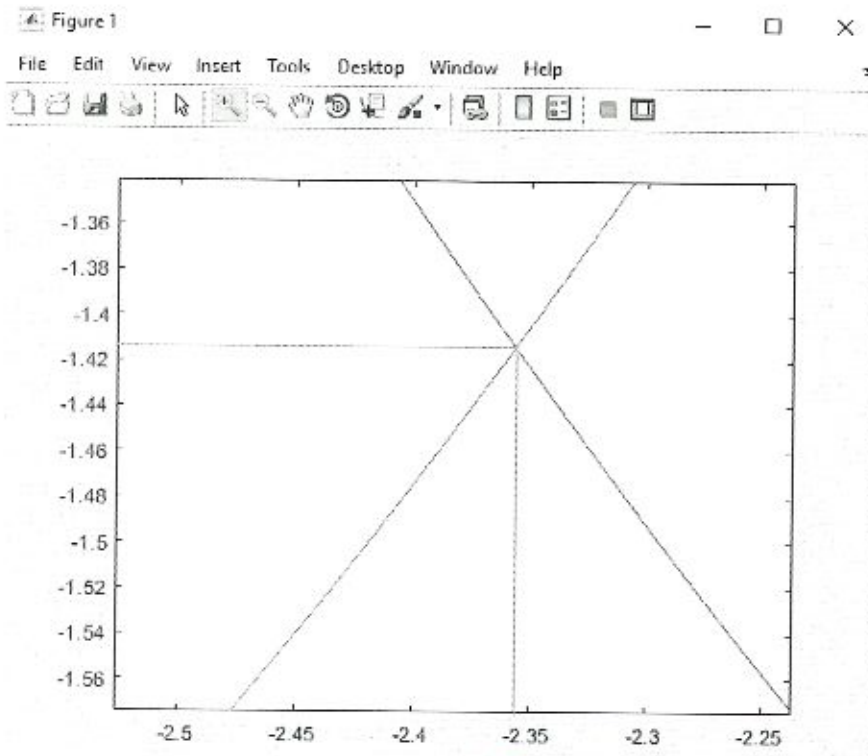
>> fplot('2*sin(x)',[-pi,pi])

>> hold

Current plot held

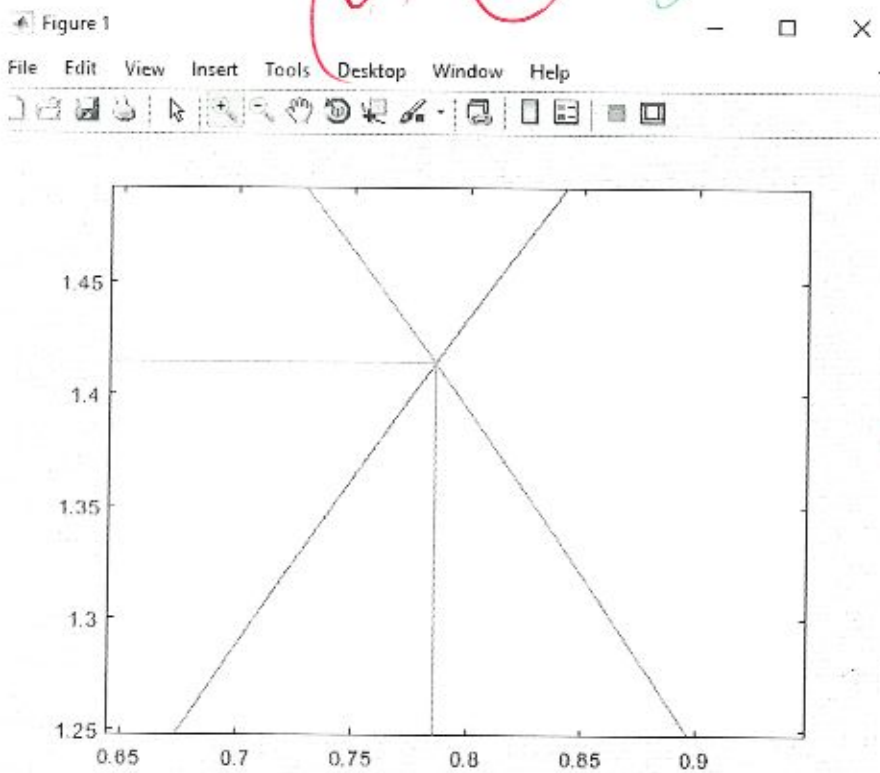
>> fplot('2*cos(x)',[-pi,pi])





3 ✓

Intersection (-2.36, -1.41)



1 ✓
x

Intersection (1.41, 0.79)

x

21
27
2 ✓

4

>> clear all

syms x y

 $y = 4 \cdot \exp(x) \cdot \sin(x)$, $y_1 = \text{diff}(y)$, $y_2 = \text{diff}(y, 2)$, $y_4 = \text{diff}(y, 4)$

y =

 $4 \cdot \exp(x) \cdot \sin(x)$

y1 =

 $4 \cdot \exp(x) \cdot \cos(x) + 4 \cdot \exp(x) \cdot \sin(x)$

y2 =

 $8 \cdot \exp(x) \cdot \cos(x)$

y4 =

 $-16 \cdot \exp(x) \cdot \sin(x)$ >> $4 \cdot y^2 + 2 \cdot y_2^2 + 4 \cdot y^2$

ans =

 $128 \cdot \exp(2 \cdot x) \cdot \cos(x)^2 + 128 \cdot \exp(2 \cdot x) \cdot \sin(x)^2$

>> simplify(ans)

ans =

 $128 \cdot \exp(2 \cdot x)$ 5

>> x=[14 18 23 30 50];

>> y=[900 1200 1600 2100 3800];

>> p=polyfit(x,y,1)

p =

80.5970 -256.1194

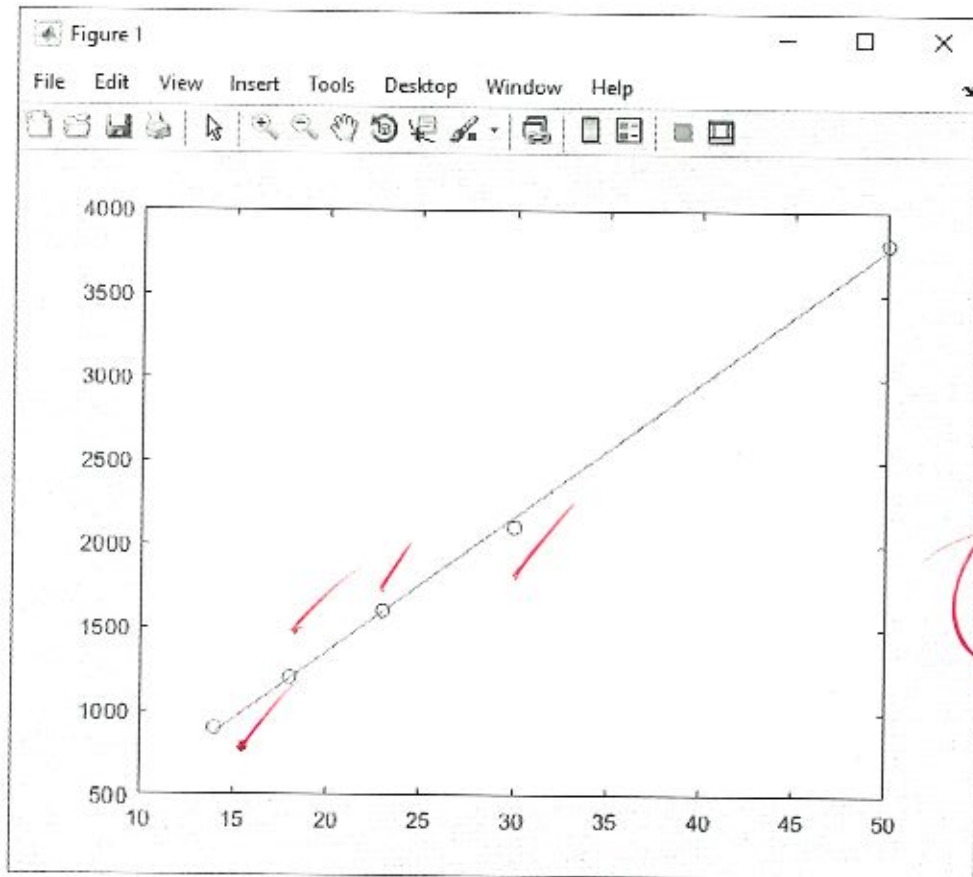
>> yfit=polyval(p,x)

yfit =

 $1.0 \times 10^3 \cdot$

0.8722 1.1946 1.5976 2.1618 3.7737

```
>> plot(x,y,'o',x,yfit)
```



6.

```
>> t=[22.8 21.7 22.6 21.9 22.4 21.7 25.1 22.8 21.6 23.2 24.6 21.9];
```

```
>> xbar=mean(t),m=median(t),s=std(t,1)
```

xbar =

22.6917

m =

22.5000

s =

1.0889

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60% ✓ - 60% (11/12)

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10 ✓

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0

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Find: (i) the mean (ii) the median (iii) the standard deviation

9

[11]

1)a)

>> x = 1.4

x =

1.4000

>> y=1.59

y =

1.5900

>> x^2-y

ans =

0.3700

b)

$(2*y)^x - y$

ans =

3.4612

c)

>> exp(2*x*y)

ans =

85.7984

d) >> log10(y^x-x)

ans =

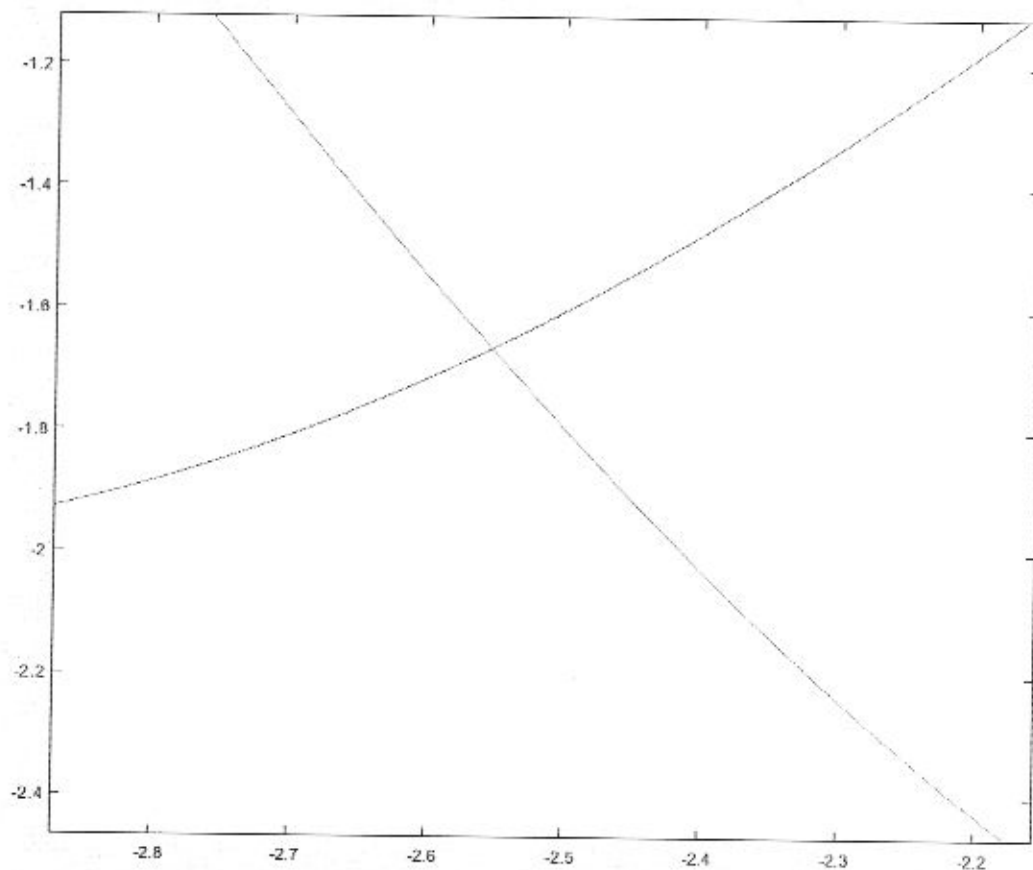
-0.2890

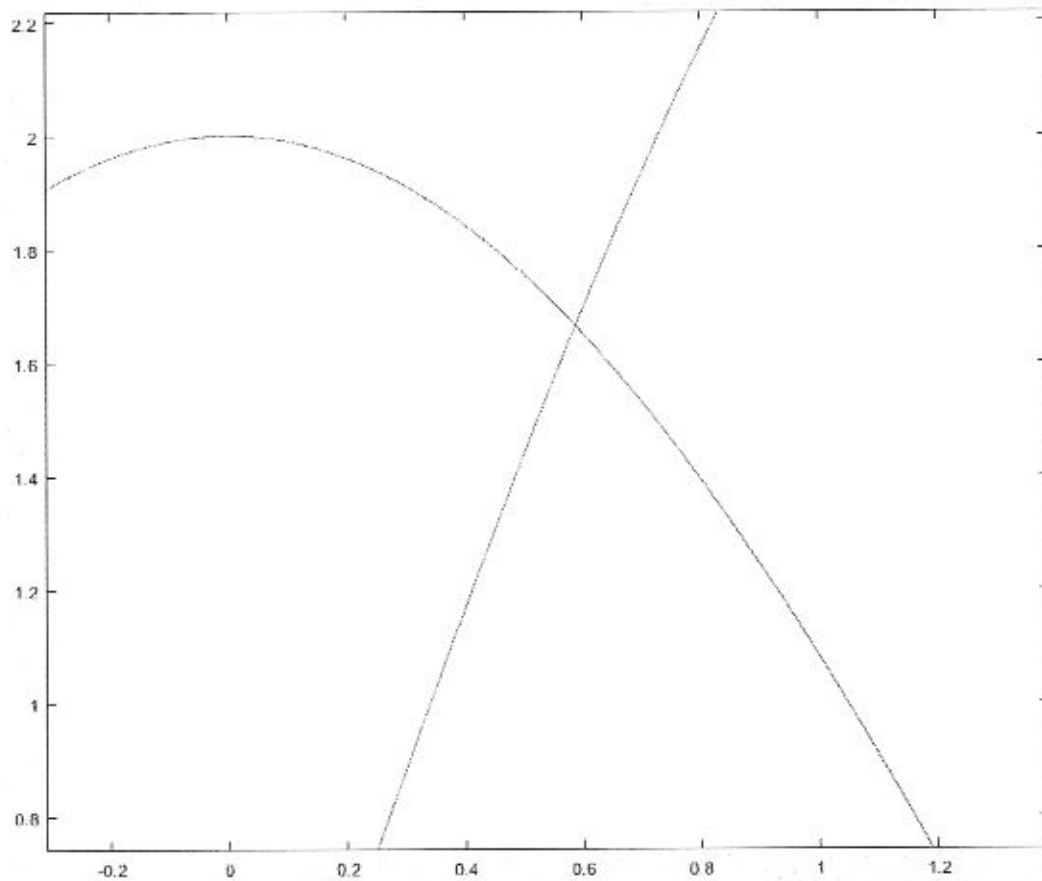
3)

fplot('3*sin(x)',[-pi,pi])

fplot('2*cos(x)',[-pi,pi])

Point of intersection -2.57, 1.7





Point of intersection: 0.55, 1.7

4)

>> clear all

>> syms x y

>> y=exp(x)*cos(x),y1=diff(y),y2=diff(y,2),y4=diff(y,4)

y =

$\exp(x) \cdot \cos(x)$

y1 =

$\exp(x) \cdot \cos(x) - \exp(x) \cdot \sin(x)$

y2 =

-2*exp(x)*sin(x)

3

y4 =

-4*exp(x)*cos(x)

3

✓
11/18 ✓

5) >> clear all

>> x=[14,18,23,30,50];

>> y=[900,1200,1600,2100,3800];

>> p=polyfit(x,y,1)

✓

✓

p =

80.5970 -256.1194

✓

✓

>> yfit=polyval(p,x)

yfit =

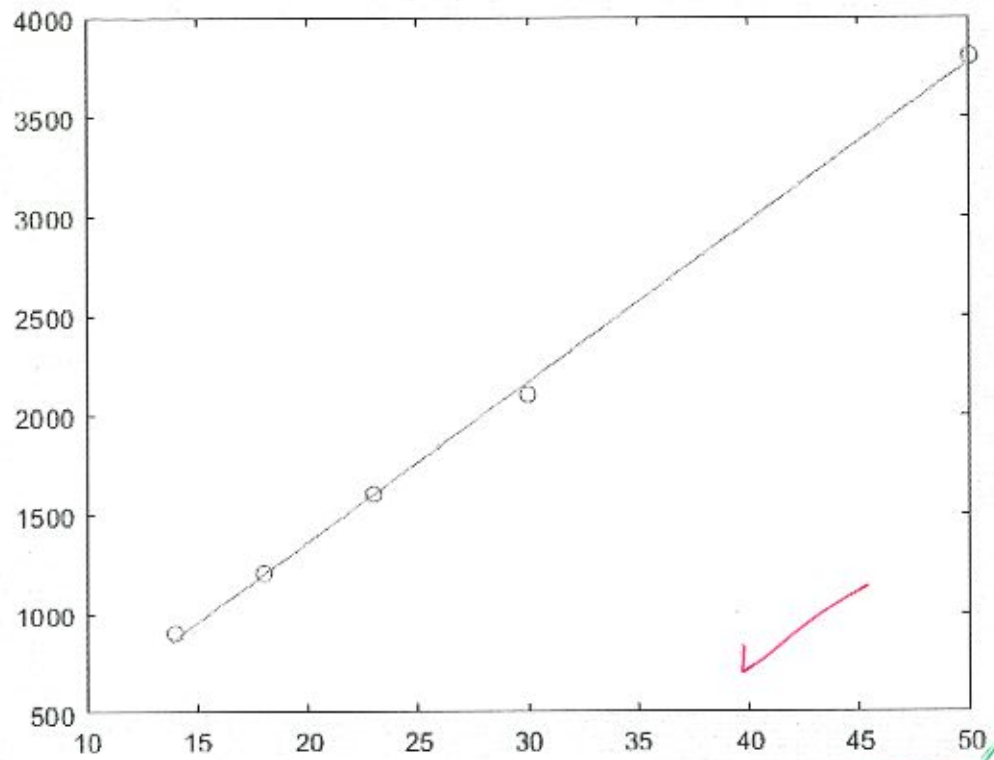
1.0e+03 *

0.8722 1.1946 1.5976 2.1618 3.7737

✓

✓

>> plot(x,y,'o',x,yfit)



$\frac{12}{12}$

6)

t=22.8, 22.6, 22.4, 25.1, 21.6, 24.6, 21.7, 21.9, 21.7, 22.8, 23.2, 21.9

>> xbar=mean(t),m=median(t),s=std(t,1)

xbar =

22.8000

m =

22.8000

s =

0

$\frac{9}{11}$

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11

✓ [11]

Question 1.

A)

>> x = 1.4



x =

1.4000



>> y=1.59

y =

1.5900

>> x^2 - y



ans =

0.3700



B)

>> (2*y)^(x-y)



ans =

0.8027



C)

>> exp(2*x*y)



ans =

85.7984



D

>> log10(y^x - x)

ans =

-0.2890

✓ 3 ✓ $\frac{12}{12}$ ✓

Question 2

Question 3

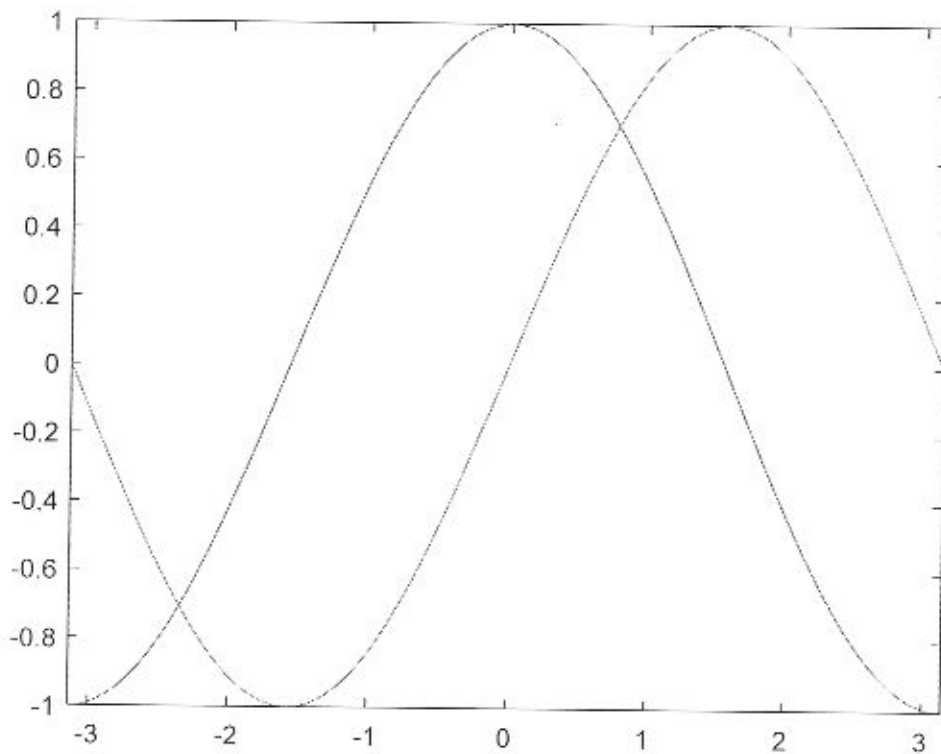
>> fplot('cos(x)',[-pi,pi])

>> hold

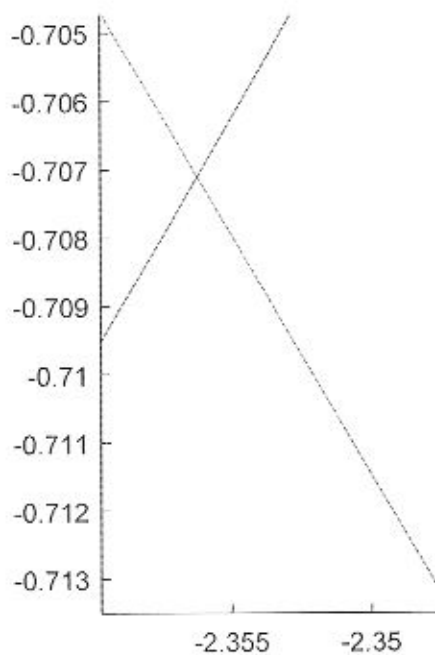
Current plot held

>> fplot('sin(x)',[-pi,pi])

2 ✓ 3 ✓

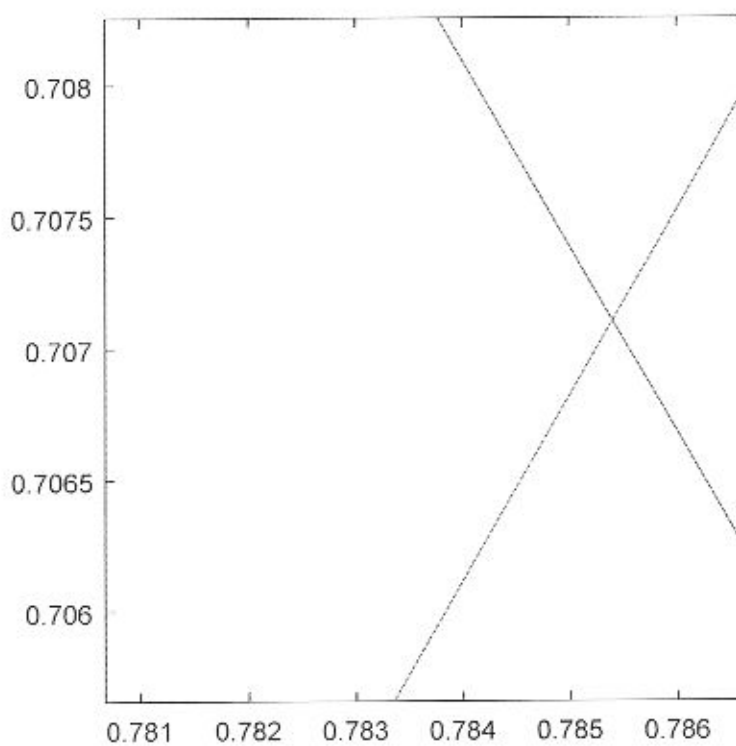


3 ✓



Point of intersection = $[-0.7073, -2.357]$

Point of intersection = $[-0.71, -2.36]$ correct to 2 decimal places.



Point of intersection = $[0.7072, 0.7855]$

Point of intersection = $[0.71, 0.79]$ correct to 2 decimal places.

$\frac{13}{27}$

Question 4

>> syms x y

Y=

>> y = 4*exp(x)*sin(x), y1=diff(y), y2=diff(y,2), y4=diff(y,4)

y =

4*exp(x)*sin(x)

y1 =

4*exp(x)*cos(x) + 4*exp(x)*sin(x)

y2 =

8*exp(x)*cos(x)

y4 =

-16*exp(x)*sin(x)

12
18

Question 5

```
>> x=[14 18 23 30 50];
```

```
>> y=[900 1200 1600 2100 3800];
```

```
>> p=polyfit(x,y,1)
```

p =

80.5970 -256.1194

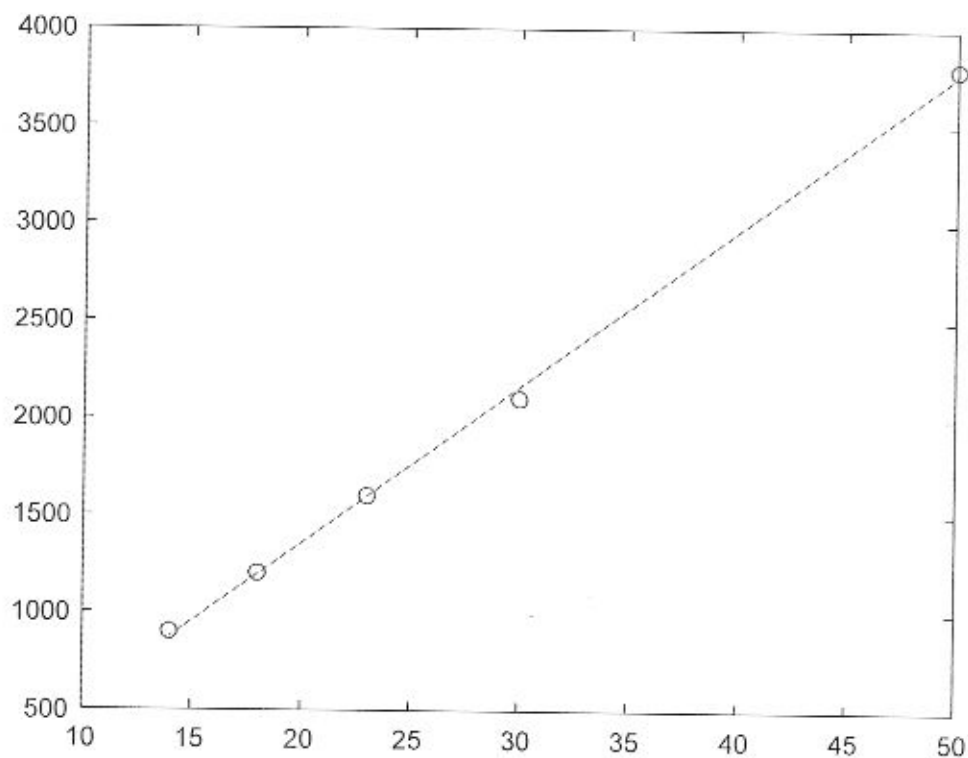
```
>> Yfit=polyval(p,x)
```

Yfit =

1.0e+03 *

0.8722 1.1946 1.5976 2.1618 3.7737

Plot (x,y 'o' x,yfit) needed ✓



3.

$\frac{9}{12}$

Question 6

```
>> t=[22.8 22.6 22.4 25.1 21.6 24.6 21.7 21.9 21.7 22.8 23.2 21.9];
```

```
>> xbar=mean(t),m=median(t),s=std(t,1)
```

xbar =

22.6917

m =

22.5000

s =

1.0889

$\frac{11}{11}$

HNC Electrical and Electronic Engineering PSDE4003 Engineering Mathematics

Level 4, Year 1

Class Test 3 (2017-18)

This is an open book test, worth 15% of the module mark and addresses Module Intended Learning Outcome 3.

Date of test =

Time allowed = 1 hour

Answer all questions

Open a Word file, put your name in a header and at the end of the exam copy your Matlab commands and output to the file.

Either

- Print off your Word document and hand in before leaving the exam room, or
- email your Word file as an attachment to me at: ainsley.thomas@colegsirgar.ac.uk

Please keep a copy of your work in case of any problems with your email.

Marks

1. If $x = 1.4$ and $y = 1.59$, evaluate using 'assignment statements':

a) $x^2 - y$ b) $(2y)^{x-y}$ c) e^{2xy} d) $\log_{10}(y^x - x)$

[12]

2. If $Q = \begin{bmatrix} \frac{2}{\sqrt{8}} & \frac{2}{\sqrt{8}} \\ \frac{2}{\sqrt{8}} & -\frac{2}{\sqrt{8}} \end{bmatrix}$ and the matrix $X = \begin{bmatrix} 3 & 4 \\ -1 & 0 \end{bmatrix}$

- a) Show that $Q^T = Q^{-1}$
b) Show that $(QXQ^T)^6 = QX^6Q^T$

[20]

3. On the same set of axes, plot the graphs of $y = 2\cos x$ and $y = 3\sin x$ for $-\pi \leq x \leq \pi$. Copy the figure window and your commands to your Word file. Zoom into each of the points of intersection, and copy the resultant figures into your Word file. Hence, give the coordinates of the two points of intersection, correct to 2 decimal places.

24 ✓ [27]

4. If $y = 4e^x \sin x$, use Matlab to find $\frac{dy}{dx}$, $\frac{d^2y}{dx^2}$ and $\frac{d^4y}{dx^4}$

Show that $\left(\frac{d^4y}{dx^4}\right)^2 + 2\left(\frac{d^2y}{dx^2}\right)^2 + 4y^2 = -64e^{2x}(3\cos x^2 - 5)$

18. ✓ [18]

5. x and y are related by the equation $y = mx + c$:

x	14	18	23	30	50
y	900	1200	1600	2100	3800

- Input the data and use polyfit to find the best fit values of m and c .
- Use polyval to find the estimated values of y
- Draw a graph showing the data and the least squares regression line.

9 ✓

[12]

6. The table shows the time taken for 12 operatives to produce a component:

22.8	22.6	22.4	25.1	21.6	24.6
21.7	21.9	21.7	22.8	23.2	21.9

Find: (i) the mean (ii) the median (iii) the standard deviation

11

[11]

Q1

$x=1.4, y=1.59$

$x =$

1.4000

$y =$

1.5900

$\gg x^2 - y$

ans =

0.3700

$\gg (2*y)^{(x-y)}$

ans =

0.8027

$\gg \exp(3*x*y)$

ans =

794.7281

$\gg \log_{10}(y^{x-x})$

ans =

-0.2890

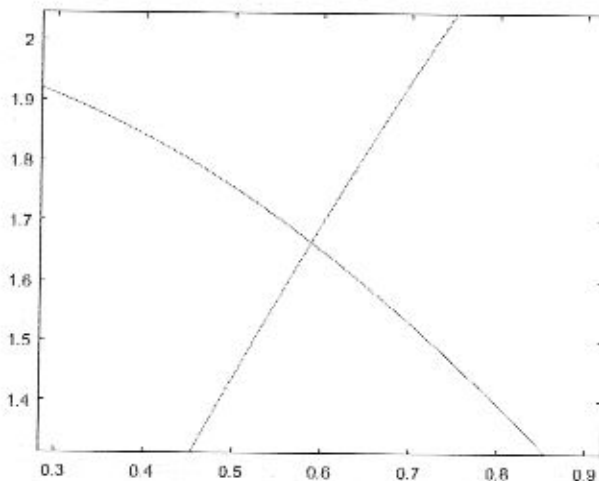
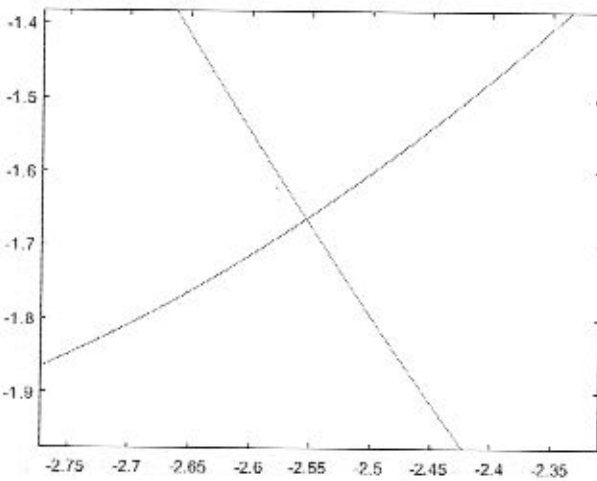
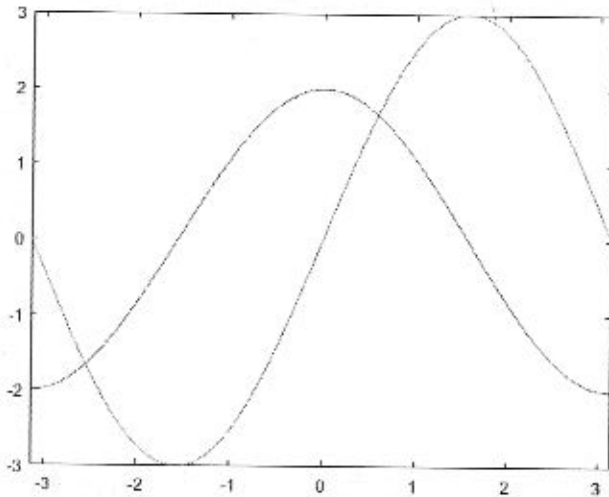
Q3

fplot('2*cos(x)',[-pi,pi])

>> hold

Current plot held

>> fplot('3*sin(x)',[-pi,pi])



(0.6,1.65)

Q4

>> syms x y

>> y=4*exp(x)*sin(x), y1=diff(y),y2=diff(y,2),y4=diff(y,4)

y =

 $4 \cdot \exp(x) \cdot \sin(x)$

y1 =

 $4 \cdot \exp(x) \cdot \cos(x) + 4 \cdot \exp(x) \cdot \sin(x)$

y2 =

 $8 \cdot \exp(x) \cdot \cos(x)$

y4 =

 $-16 \cdot \exp(x) \cdot \sin(x)$

>> y4^2+2*y2^2+4*y^2

ans =

 $128 \cdot \exp(2 \cdot x) \cdot \cos(x)^2 + 320 \cdot \exp(2 \cdot x) \cdot \sin(x)^2$

>> simplify(ans)

ans =

 $64 \cdot \exp(2 \cdot x) \cdot (3 \cdot \cos(x)^2 - 5)$

Q5

A)

```
>> x=[14 18 23 30 50];
>> y=[900 1200 12600 2100 3800];
>> p=polyfit(x,y,1)
```

```
p =
1.0e+03 *
0.0259 3.4215
```

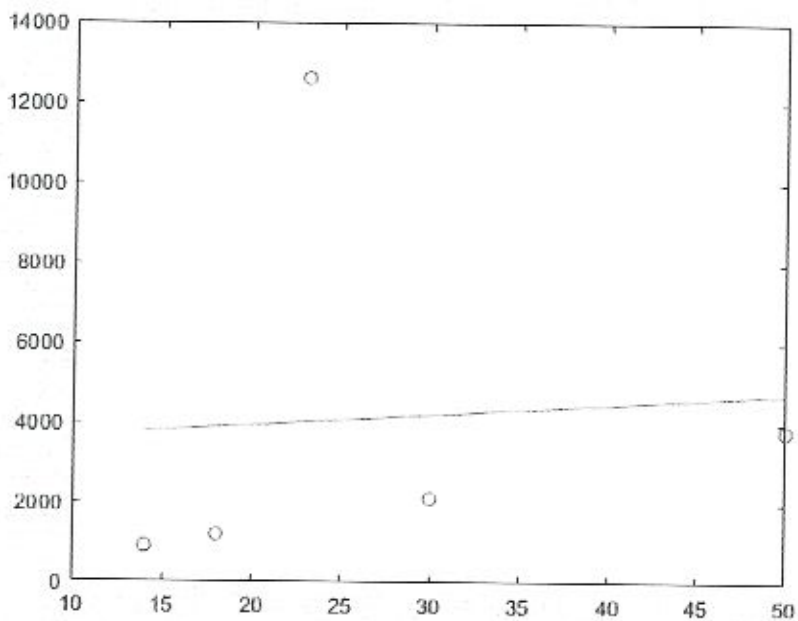
B)

```
>> yfit=polyval(p,x)
```

```
yfit =
1.0e+03 *
3.7837 3.8872 4.0165 4.1976 4.7150
```

C)

```
>> plot(x,y,'o',x,yfit)
```



Q6

```
>> t=[22.8 22.6 22.4 25.1 21.6 24.6 21.7 21.9 21.7 22.8 23.2 21.9];
```

```
>> xbar=mean(t),m=median(t),s=std(t,1)
```

xbar =

22.6917

m =

22.5000

s =

1.0889

