



HNC Electrical and Electronic Engineering PSDE5008 Further Engineering Mathematics Level 5, Year 2

Class Test 3 (2017-18)

54%

This is an open book test, worth **10%** of the module mark and addresses Module Intended Learning Outcome2.

Date of test =

Time allowed = 1 hour

Instructions to candidates:

- Use Matlab to solve the following questions
- Copy and paste your work into a word file, which should include your name in the header
- Print out your word file to allow you to include your hand written solutions
- Answer all questions

1. Solve the following differential equations and obtain plots in each case:

Note: For plot, take t axis from 0.1 to 5

In each case write out, by hand, the mathematical equivalent of the printout solution.

- a) $5ty' = 2t + 4y, y(1) = 2$
- b) $3y' - 6ty = t^2, y(2) = 3$
- c) $2y'' - 2y' - 7y = 0, y(3) = 4, y'(2) = 3$

23.
(60 Marks)

2. Determine the Laplace Transforms of the following:

In each case write out, *after simplifying your answer*, by hand, the mathematical equivalent of the printout solution.

- a) $f(x) = -2x^2 \cos^2(3x) \quad (x > 0)$
- b) $f(x) = 3x^3 \sin^2(2x) \quad (x > 0)$

23.
(30 Marks)

3. Determine the Fourier Transform of the following:

$$f(x) = 3e^{-2x^2}$$

and write out, by hand, the mathematical equivalent of the printout solution.

8.
(10 Marks)

1a)

>> dsolve('5*t*Dy=2*t+4*y','y(1)=2')

✓

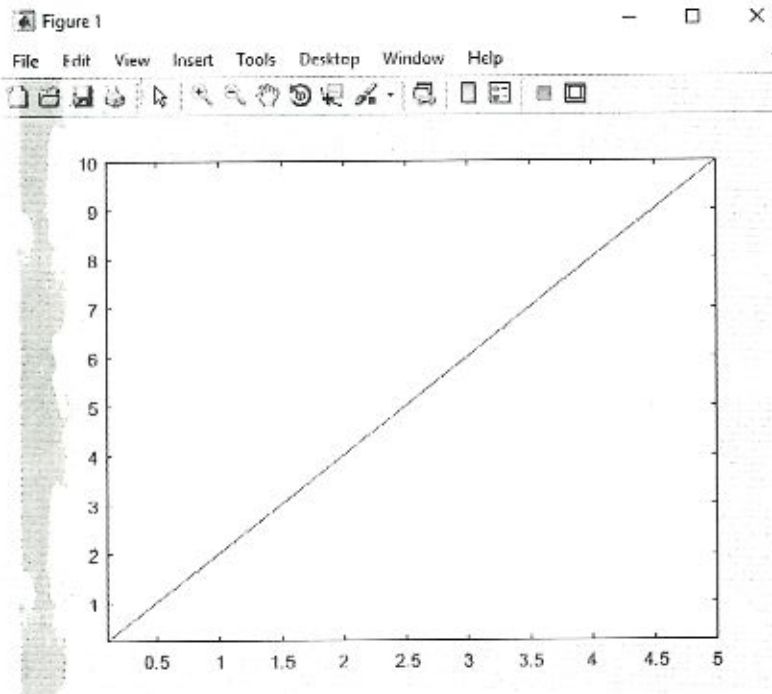
ans =

2*t

2t

✓

>> fplot('2*t',[0.1,5])



✓ 20.

1b)

>> dsolve('3*dy-6*t*Dy=t^2','y(2)=3')

3

ans =

(dy*log(t))/2 - (dy*log(2))/2 - t^2/12 + 10/3

X

>> simplify(ans)

ans =

(dy*log(t/2))/2 - t^2/12 + 10/3

23/60

$$\frac{\int d\log\left(\frac{t}{2}\right) dy}{2} - \frac{t^2}{12} + \frac{10}{3}$$

X

2a)

>> x=sym('x')

x =

x

>> f=-2*x^2*cos(3*x)^2

f =

-2*x^2*cos(3*x)^2

>> laplace(f)

ans =

$(6*s)/(s^2 + 36)^2 - (8*s^3)/(s^2 + 36)^3 - 2/s^3$

>> simplify(ans)

ans =

$-(4*(s^6 + 1944*s^2 + 23328))/(s^3*(s^2 + 36)^3)$

$-\frac{4(s^6 + 1944s^2 + 23328)}{s^3(s^2 + 36)^3}$

2b)

>> f=3*x^3*sin(2*x)

f =

Sean jones

$$3*x^3*\sin(2*x)$$

>> laplace(f)

ans =

$$(288*s^3)/(s^2 + 4)^4 - (144*s)/(s^2 + 4)^3$$

>> simplify(ans)

ans =

$$(144*s*(s^2 - 4))/(s^2 + 4)^4$$

$$\frac{144s(s^2 - 4)}{(s^2 + 4)^4}$$

3)

>> f=3*exp(-2*x^2)

f =

$$3*\exp(-2*x^2)$$

>> fourier(f)

ans =

$$(3*2^{1/2}*pi^{1/2}*exp(-w^2/8))/2$$

$$\frac{(3(2)^{1/2}\pi^{1/2})e^{-w^2/8}}{2}$$



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c) $2y'' - 2y' - 7y = 0, y(3) = 4, y'(2) = 3$

41.
(60 Marks)

2. Determine the Laplace Transforms of the following:

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- a) $f(x) = -2x^2 \cos^2(3x) \quad (x > 0)$
b) $f(x) = 3x^3 \sin^2(2x) \quad (x > 0)$

30.
(30 Marks)

3. Determine the Fourier Transform of the following:

$$f(x) = 3e^{-2x^2}$$

and write out, by hand, the mathematical equivalent of the printout solution.

8.
(10 Marks)

79% ✓

1a)

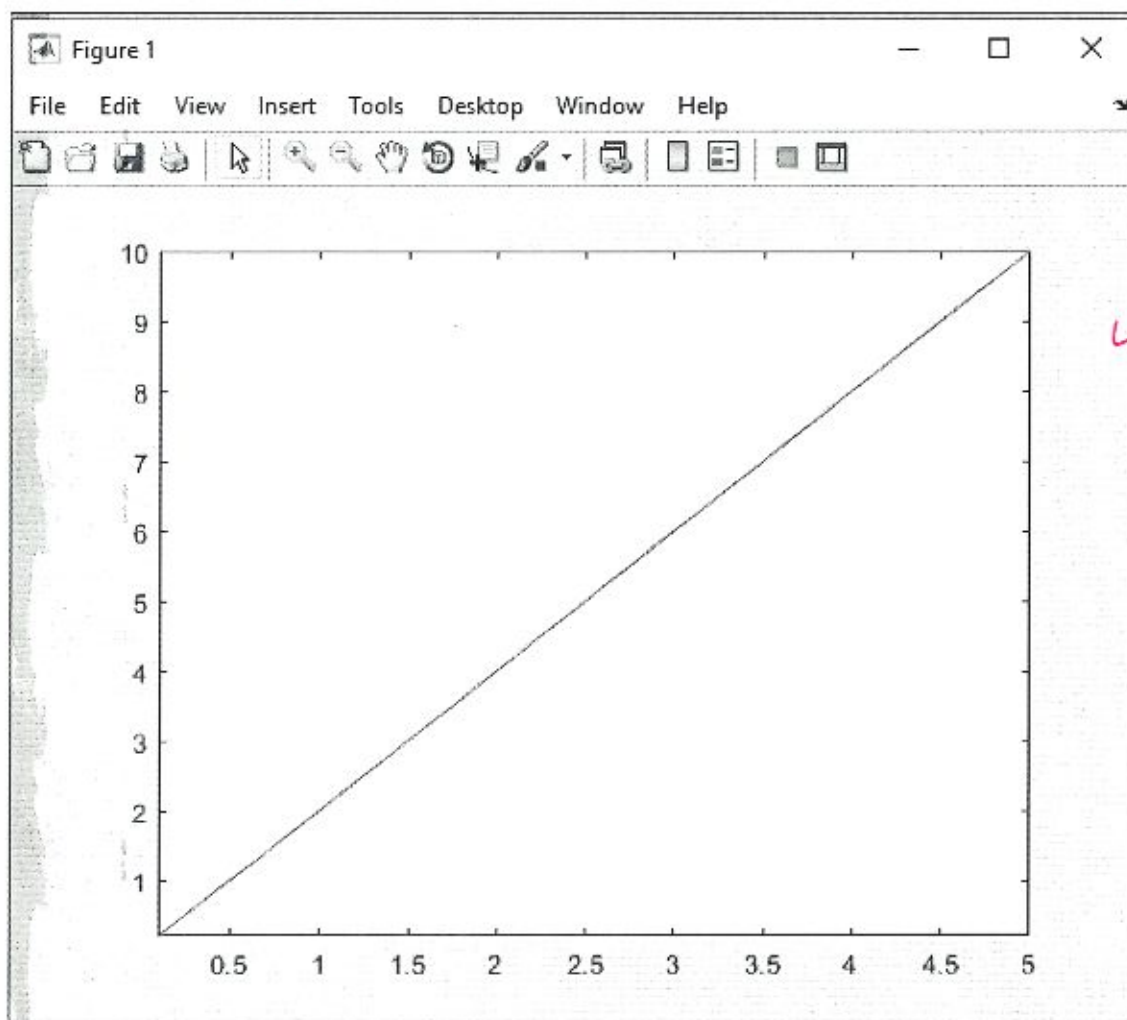
```
>> dsolve('5*t*Dy=2*t+4*y','y(1)=2')
```

ans =

$2*t$

Hand written answer = $2t$

```
fplot('2*t',[0.1,5])
```



20

Matlab test – Phillip Rowe

1b)

>> dsolve('t^2*Dy=3*y-6*ty','y(2)=3')

ans =

2*ty - exp(3/2)*exp(-3/t)*(2*ty - 3)

>> simplify(ans)

ans =

2*ty - exp(3/2)*exp(-3/t)*(2*ty - 3)

Hand written answer = $2ty - e^{1.5} \times e^{-3/t} \times 2ty - 3$

>> fplot('2*ty - exp(3/2)*exp(-3/t)*(2*ty - 3)',[0.1,5])

1c)

```
>> dsolve('2*D2y-2*Dy-7*y=0','y(3)=4,Dy(2)=3')
```

4

ans =

$$\begin{aligned} & (2*\exp(t*(15^{1/2})/2 + 1/2))*(3*\exp(3/2 - (3*15^{1/2})/2) - 2*\exp(1 - 15^{1/2}) + 2*15^{1/2}*\exp(1 - \\ & 15^{1/2}))/(\exp(15^{1/2}) + 1)*\exp(3/2 - (3*15^{1/2})/2) - \exp(1 - 15^{1/2})*\exp((3*15^{1/2})/2 + \\ & 3/2) + 15^{1/2}*\exp(15^{1/2} + 1)*\exp(3/2 - (3*15^{1/2})/2) + 15^{1/2}*\exp(1 - \\ & 15^{1/2})*\exp((3*15^{1/2})/2 + 3/2)) + (2*\exp(-t*(15^{1/2})/2 - 1/2))*(2*\exp(15^{1/2} + 1) - \\ & 3*\exp((3*15^{1/2})/2 + 3/2) + 2*15^{1/2}*\exp(15^{1/2} + 1))/(\exp(15^{1/2}) + 1)*\exp(3/2 - \\ & (3*15^{1/2})/2) - \exp(1 - 15^{1/2})*\exp((3*15^{1/2})/2 + 3/2) + 15^{1/2}*\exp(15^{1/2} + 1)*\exp(3/2 \\ & - (3*15^{1/2})/2) + 15^{1/2}*\exp(1 - 15^{1/2})*\exp((3*15^{1/2})/2 + 3/2)) \end{aligned}$$

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

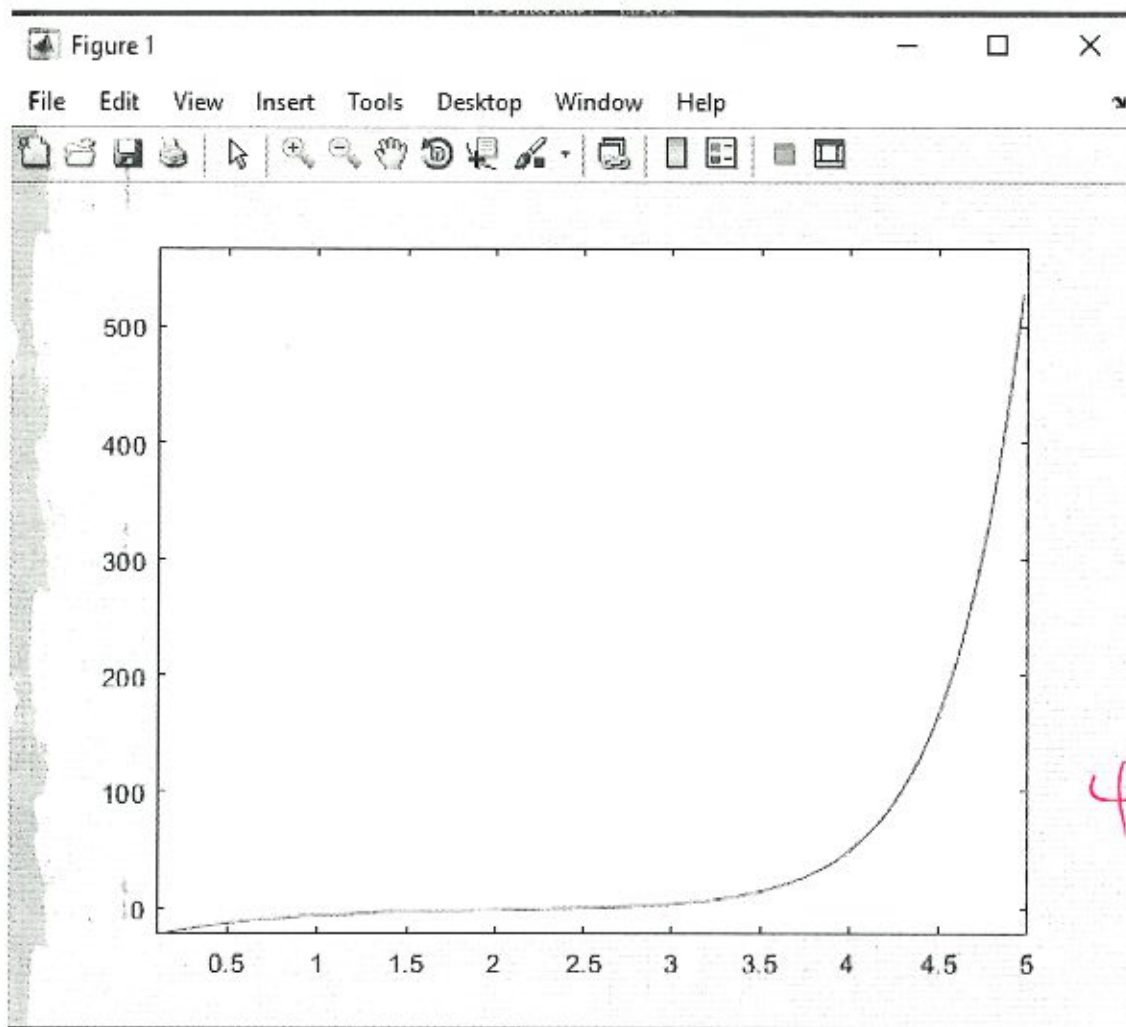
4

ans =

$$\begin{aligned} & (2*\exp(-t*(15^{1/2})/2 - 1/2))*(2*\exp(15^{1/2} + 1) - 3*\exp((3*15^{1/2})/2 + 3/2) + \\ & 2*15^{1/2}*\exp(15^{1/2} + 1))/(\exp(5/2 - 15^{1/2}/2) - \exp(15^{1/2}/2 + 5/2) + 15^{1/2}*\exp(5/2 - \\ & 15^{1/2}/2) + 15^{1/2}*\exp(15^{1/2}/2 + 5/2)) + (2*\exp(t*(15^{1/2})/2 + 1/2))*(3*\exp(3/2 - \\ & (3*15^{1/2})/2) - 2*\exp(1 - 15^{1/2}) + 2*15^{1/2}*\exp(1 - 15^{1/2}))/(\exp(5/2 - 15^{1/2}/2) - \\ & \exp(15^{1/2}/2 + 5/2) + 15^{1/2}*\exp(5/2 - 15^{1/2}/2) + 15^{1/2}*\exp(15^{1/2}/2 + 5/2)) \end{aligned}$$

```
>> fplot('2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) + 2*15^(1/2)*exp(15^(1/2) + 1))/(\exp(5/2 - 15^(1/2)/2) - \exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2)) + (2*exp(t*(15^(1/2)/2 + 1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 - 15^(1/2)))/(\exp(5/2 - 15^(1/2)/2) - \exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2))',[0.1,5])
```

4



$$\frac{41}{60}$$

✓

2a)

>> x=sym('x')

x =

x

>> f=-2*x^2*cos(3*x)^2

f =

-2*x^2*cos(3*x)^2

>> laplace(f)

ans =

(6*s)/(s^2 + 36)^2 - (8*s^3)/(s^2 + 36)^3 - 2/s^3

>> simplify(ans)

ans =

-(4*(s^6 + 1944*s^2 + 23328))/(s^3*(s^2 + 36)^3)

Hand written answer = ~~$-\frac{4s^6}{s^3} +$~~ $-\frac{4(s^6 + 1944s^2 + 23328)}{s^3(s^2 + 36)^3}$

15

2b)

>> x=sym('x')

x =

x

>> f=3*x^3*sin(2*x)^2

f =

3*x^3*sin(2*x)^2

>> laplace(f)

ans =

$(72*s^2)/(s^2 + 16)^3 - 9/(s^2 + 16)^2 - (72*s^4)/(s^2 + 16)^4 + 9/s^4$

>> simplify(ans)

ans =

$(288*(5*s^6 + 40*s^4 + 512*s^2 + 2048))/(s^4*(s^2 + 16)^4)$

Hand written answer = $\frac{288(5s^6 + 40s^4 + 512s^2 + 2048)}{s^4(s^2 + 16)^4}$

15

30
30

Matlab test – Phillip Rowe

3)

>> clear all

>> x=sym('x')

x =

x

>> f=3*exp(-2*x^2)

f =

3*exp(-2*x^2)

>> fourier(f)

ans =

$(3 \cdot 2^{1/2} \cdot \pi^{1/2} \cdot \exp(-w^2/8))/2$

Hand written answer =

~~$\sqrt{6\pi}$~~ $\frac{\sqrt{6\pi} e^{(-\frac{w^2}{8})}}{2}$

$\frac{8}{10}$



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47.
(60 Marks)

2. Determine the Laplace Transforms of the following:

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30.
(30 Marks)

3. Determine the Fourier Transform of the following:

$$f(x) = 3e^{-2x^2}$$

and write out, by hand, the mathematical equivalent of the printout solution.

10.
(10 Marks)

87% ✓

1a

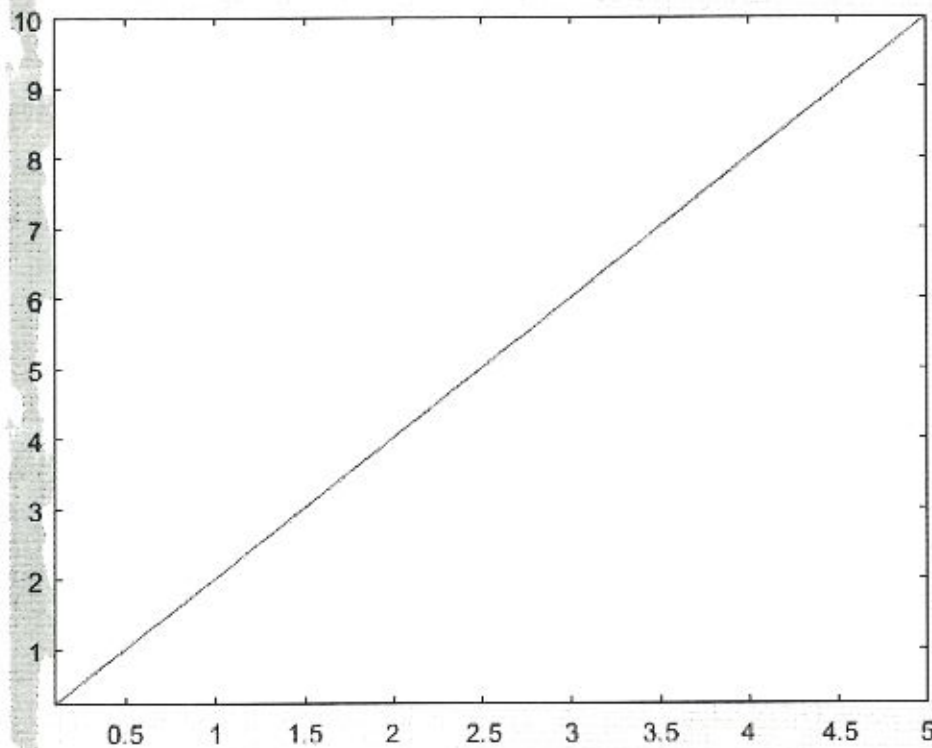
>> dsolve('5*t*Dy=2*t+4*y','y(1)=2')

ans =

2*t

2t

>> fplot('2*t',[0.1,5])



20

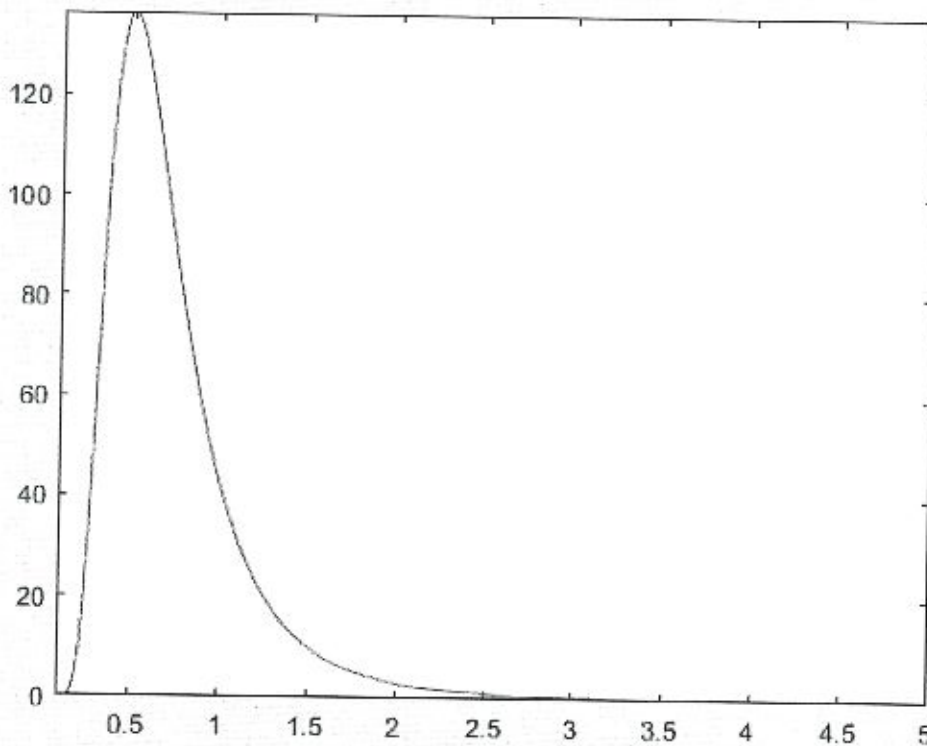
b

>> dsolve('t^2*Dy=3*y-6*t*y', 'y(2)=3')

ans =

(192*exp(3/2)*exp(-3/t))/t^6

>> fplot('(192*exp(3/2)*exp(-3/t))/t^6',[0.1,5])



$$\left(\frac{192 e^{(3/2)} e^{(-3/t)}}{t^6} \right)$$

C

```
>> dsolve('2*D2y-2*Dy-7*y=0','y(3)=4,Dy(2)=3')
```

ans =

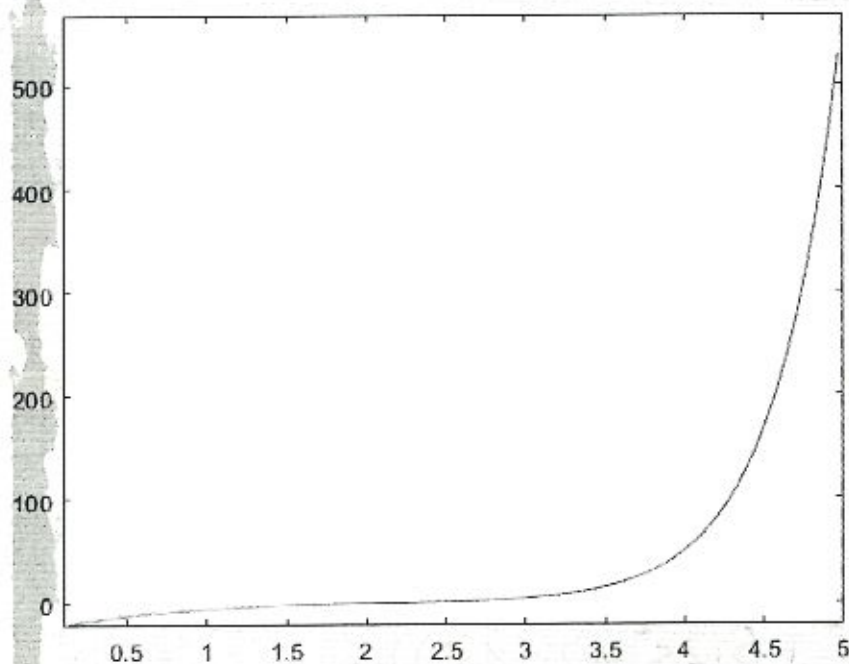
```
(2*exp(t*(15^(1/2)/2 + 1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 - 15^(1/2))))/(exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) - exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2) + 15^(1/2)*exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) + 15^(1/2)*exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2)) + (2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) + 2*15^(1/2)*exp(15^(1/2) + 1)))/(exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) - exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2) + 15^(1/2)*exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) + 15^(1/2)*exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2))
```

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

ans =

```
(2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) + 2*15^(1/2)*exp(15^(1/2) + 1)))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2)) + (2*exp(t*(15^(1/2)/2 + 1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 - 15^(1/2))))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2))
```

```
>> fplot('(2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) + 2*15^(1/2)*exp(15^(1/2) + 1)))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2)) + (2*exp(t*(15^(1/2)/2 + 1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 - 15^(1/2))))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2))',[0,1,5])
```



Chris Milner

$$\frac{(2e^{t(\frac{-\sqrt{15}}{2} - \frac{1}{2})}) \times (2e^{(\frac{\sqrt{15}}{2} + 1)}) - 3e^{(\frac{(3 \times \sqrt{15})}{2} + \frac{3}{2})} + 2 \times \sqrt{15} e^{(\frac{\sqrt{15}}{2} + 1)})}{(e^{(\frac{(s/2 - \sqrt{15})}{2})} - e^{(\frac{(\sqrt{15}}{2} + \frac{1}{2})})}) \times (3e^{(3/2 - (\frac{3 \times \sqrt{15}}{2})})})}$$

2

$$\frac{47}{60}$$

2a

>> f = -2*x^2*cos(3*x)^2

f =

-2*x^2*cos(3*x)^2

>> laplace(f)

ans =

(6*s)/(s^2 + 36)^2 - (8*s^3)/(s^2 + 36)^3 - 2/s^3

>> simplify(ans)

ans =

-(4*(s^6 + 1944*s^2 + 23328))/(s^3*(s^2 + 36)^3)

$$\frac{-(4(s^6 + 1944s^2 + 23328))}{(s^3 \times (s^2 + 36)^3)}$$

15

b

>> f = 3*x^3*sin(2*x)^2

f =

3*x^3*sin(2*x)^2

>> laplace(f)

ans =

(72*s^2)/(s^2 + 16)^3 - 9/(s^2 + 16)^2 - (72*s^4)/(s^2 + 16)^4 + 9/s^4

>> simplify(ans)

ans =

(288*(5*s^6 + 40*s^4 + 512*s^2 + 2048))/(s^4*(s^2 + 16)^4)

$$\frac{(288(5s^6 + 40s^4 + 512s^2 + 2048))}{(s^4(s^2 + 16)^4)}$$

$$\frac{30}{30}$$

15

3

>> f=3*exp(-2*x^2)

f=

3*exp(-2*x^2)

>> fourier(f)

ans =

(3*2^(1/2)*pi^(1/2)*exp(-w^2/8))/2

$$\frac{(3 \times \sqrt{2} \times \sqrt{\pi} e^{\frac{-w^2}{8}})}{2}$$





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36.
(60 Marks)

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- b) $f(x) = 3x^3 \sin^2(2x) \quad (x > 0)$

16.
(30 Marks)

3. Determine the Fourier Transform of the following:

$$f(x) = 3e^{-2x^2}$$

and write out, by hand, the mathematical equivalent of the printout solution.

8.
(10 Marks)

60%

1

a)

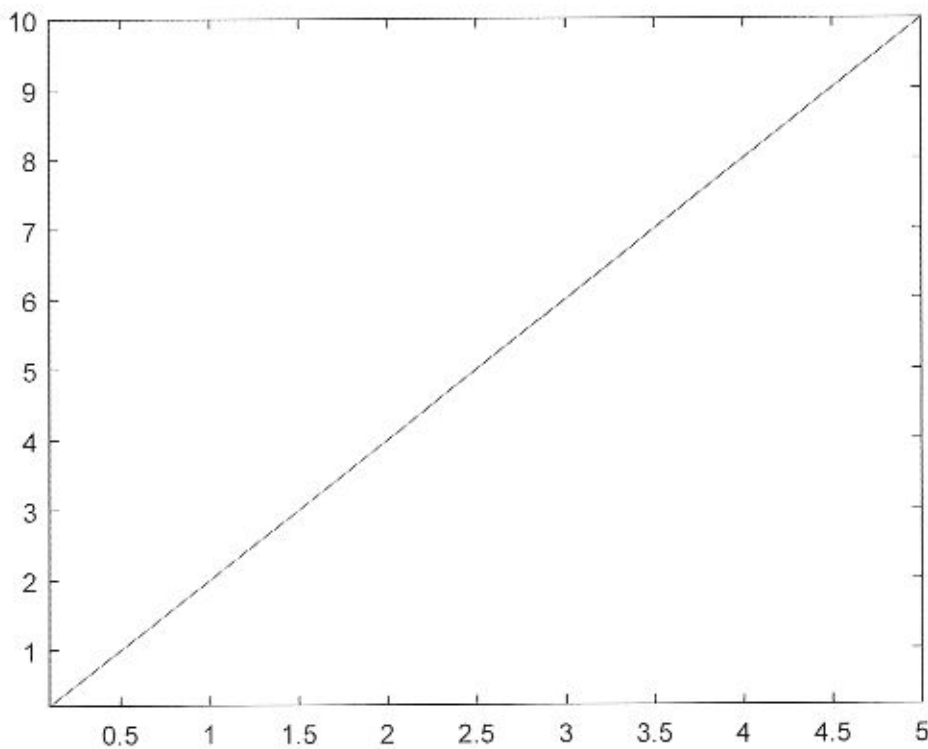
```
>> dsolve('5*t*Dy=2*t+4*y','y(1)=2')
```

ans =

2*t

= 2t

```
>> fplot('2*t',[0.1,5])
```



b)

```
>> dsolve('3*Dy-6*t*y=t^2','y(2)=3')
```

ans =

$\exp(t^2) * ((10 * \exp(-4))/3 + (\pi^{1/2} * \operatorname{erfi}(2i) * 1i)/12) - \exp(t^2) * ((\pi^{1/2} * \operatorname{erfi}(t * 1i) * 1i)/12 + (t * \exp(-t^2))/6)$

>> simplify(ans)

ans =

$$(10 \exp(t^2 - 4))/3 - t/6 + (\pi^{1/2} \exp(t^2) \operatorname{erf}(t))/12 - (\pi^{1/2} \operatorname{erf}(2) \exp(t^2))/12$$

c)

>> dsolve('2*D2y-2*Dy-7*y=0', 'y(3) = 4', 'Dy(2)=3')

4

ans =

$$\begin{aligned} & (2 \exp(t(15^{1/2}/2 + 1/2)) (3 \exp(3/2 - (3 \cdot 15^{1/2})/2) - 2 \exp(1 - 15^{1/2}) + 2 \cdot 15^{1/2} \exp(1 - 15^{1/2}))) / (\exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) - \exp(1 - 15^{1/2}) \exp((3 \cdot 15^{1/2})/2 + 3/2) + 15^{1/2} \exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) + 15^{1/2} \exp(1 - 15^{1/2}) \exp((3 \cdot 15^{1/2})/2 + 3/2)) \\ & + (2 \exp(-t(15^{1/2}/2 - 1/2)) (2 \exp(15^{1/2} + 1) - 3 \exp((3 \cdot 15^{1/2})/2 + 3/2) + 2 \cdot 15^{1/2} \exp(15^{1/2} + 1))) / (\exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) - \exp(1 - 15^{1/2}) \exp((3 \cdot 15^{1/2})/2 + 3/2) + 15^{1/2} \exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) + 15^{1/2} \exp(1 - 15^{1/2}) \exp((3 \cdot 15^{1/2})/2 + 3/2)) \end{aligned}$$

>> simplify(ans)

4

$\frac{36}{60}$

ans =

$$\begin{aligned} & (2 \exp(-t(15^{1/2}/2 - 1/2)) (2 \exp(15^{1/2} + 1) - 3 \exp((3 \cdot 15^{1/2})/2 + 3/2) + 2 \cdot 15^{1/2} \exp(15^{1/2} + 1))) / (\exp(5/2 - 15^{1/2}/2) - \exp(15^{1/2}/2 + 5/2) + 15^{1/2} \exp(5/2 - 15^{1/2}/2) + 15^{1/2} \exp(15^{1/2}/2 + 5/2)) \\ & + (2 \exp(t(15^{1/2}/2 + 1/2)) (3 \exp(3/2 - (3 \cdot 15^{1/2})/2) - 2 \exp(1 - 15^{1/2}) + 2 \cdot 15^{1/2} \exp(1 - 15^{1/2}))) / (\exp(5/2 - 15^{1/2}/2) - \exp(15^{1/2}/2 + 5/2) + 15^{1/2} \exp(5/2 - 15^{1/2}/2) + 15^{1/2} \exp(15^{1/2}/2 + 5/2)) \end{aligned}$$

2

a)

>> x=sym('x')

✓

✓

Trystan Daniels

x =

x

>> f = -2*x^2*cos(3*x)^2

f =

-2*x^2*cos(3*x)^2

>> laplace(f)

ans =

$(6*s)/(s^2 + 36)^2 - (8*s^3)/(s^2 + 36)^3 - 2/s^3$

b)

>> f = 3*x^3*sin(2*x)^2

f =

3*x^3*sin(2*x)^2

>> laplace(f)

ans =

$(72*s^2)/(s^2 + 16)^3 - 9/(s^2 + 16)^2 - (72*s^4)/(s^2 + 16)^4 + 9/s^4$

$$\frac{72s^2}{(s^2+16)^3} - \frac{9}{(s^2+16)^2} - \frac{72s^4}{(s^2+16)^4} + \frac{9}{s^4}$$

$$\frac{16}{30}$$

3

>> clear all

>> x=sym('x')

x =

x

>> f=3*exp(-2*x^2)

f =

3*exp(-2*x^2)

>> fourier(f)

ans =

$(3 \cdot 2^{1/2} \cdot \pi^{1/2} \cdot \exp(-w^2/8))/2$

$$\frac{(3)(2^{\frac{1}{2}})(\pi^{\frac{1}{2}})(e^{-w^2/8})}{2}$$

✓ 6
2

8/10



colegsirgâr

Daniel Ince.



PRIFYSGOL CYMRU
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UNIVERSITY OF WALES
Trinity Saint David

HNC Electrical and Electronic Engineering PSDE5008 Further Engineering Mathematics Level 5, Year 2

Class Test 3 (2017-18)

This is an open book test, worth **10%** of the module mark and addresses Module Intended Learning Outcome2.

Date of test =

Time allowed = 1 hour

Instructions to candidates:

- Use Matlab to solve the following questions
- Copy and paste your work into a word file, which should include your name in the header
- Print out your word file to allow you to include your hand written solutions
- Answer all questions

1. Solve the following differential equations and obtain plots in each case:

Note: For plot, take t axis from 0.1 to 5

In each case write out, by hand, the mathematical equivalent of the printout solution.

- a) $5ty' = 2t + 4y, y(1) = 2$
- b) $3y' - 6ty = t^2, y(2) = 3$
- c) $2y'' - 2y' - 7y = 0, y(3) = 4, y'(2) = 3$

56.
(60 Marks)

2. Determine the Laplace Transforms of the following:

In each case write out, *after simplifying your answer*, by hand, the mathematical equivalent of the printout solution.

- a) $f(x) = -2x^2 \cos^2(3x) \quad (x > 0)$
- b) $f(x) = 3x^3 \sin^2(2x) \quad (x > 0)$

16.
(30 Marks)

3. Determine the Fourier Transform of the following:

$$f(x) = 3e^{-2x^2}$$

and write out, by hand, the mathematical equivalent of the printout solution.

8
(10 Marks)

80% ✓

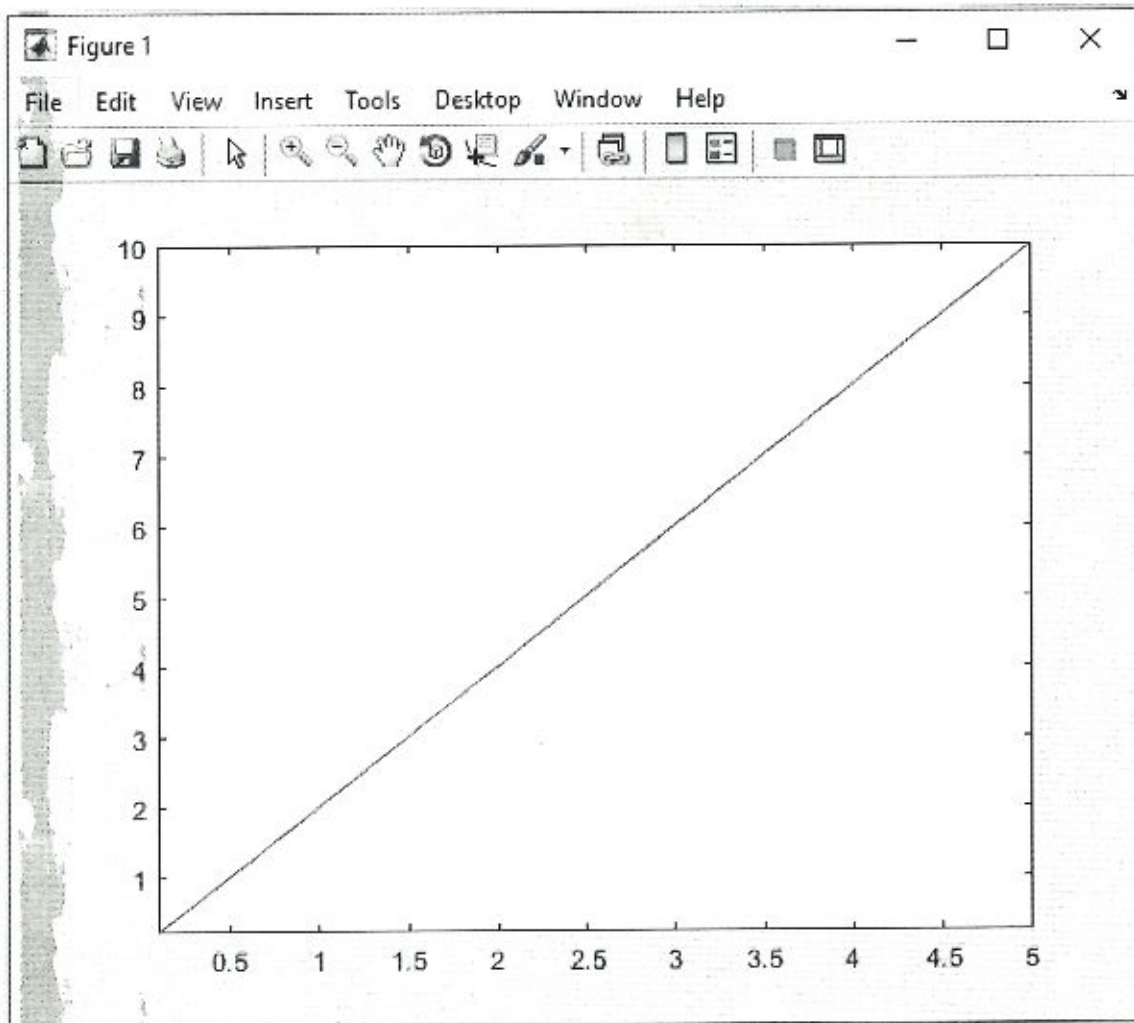
Question 1, a.

```
>>dsolve('5*t*Dy=2*t+4*y','y(1)=2')
```

ans =

$2*t \rightarrow 2t$

```
>> fplot('2*t',[0.1,5])
```



20

Q1, b.

```
>> dsolve('t^2=3*Dy-6*t*y','y(2)=3')
```

ans =

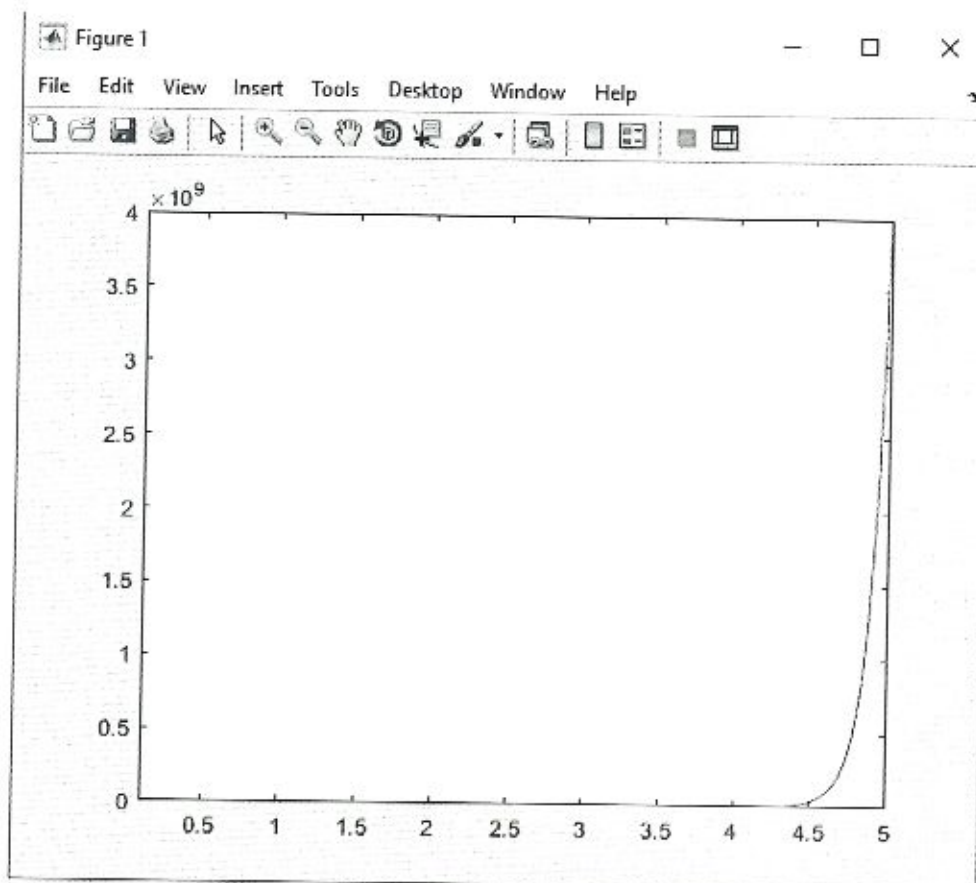
```
exp(t^2)*((10*exp(-4))/3 + (pi^(1/2)*erfi(2i)*1i)/12) - exp(t^2)*((pi^(1/2)*erfi(t*1i)*1i)/12 + (t*exp(-t^2))/6)
```

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

ans =

$$\rightarrow \frac{(10e^{t^2-4})}{3} - \frac{t}{6} + \frac{\pi^{\frac{1}{2}} \times e^{t^2} \times \text{erfi}(t)}{12} - \frac{\pi^{\frac{1}{2}} \times \text{erfi}(2) \times e^{t^2}}{12}$$

```
>> fplot('exp(t^2)*((10*exp(-4))/3 + (pi^(1/2)*erfi(2i)*1i)/12) - exp(t^2)*((pi^(1/2)*erfi(t*1i)*1i)/12 + (t*exp(-t^2))/6)',[0.1,5])
```



19

Q1, c.

```
>> dsolve('2*D2y-2*Dy-7*y=0','y(3)=4,Dy(2)=3')
```

4

ans =

$$\begin{aligned} & (2 \exp(t(15^{1/2}/2 + 1/2)) (3 \exp(3/2 - (3 \cdot 15^{1/2})/2) - 2 \exp(1 - 15^{1/2})) + 2 \cdot 15^{1/2} \exp(1 - 15^{1/2})) / (\exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) - \exp(1 - 15^{1/2})) \exp((3 \cdot 15^{1/2})/2 + 3/2) + 15^{1/2} \exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) + 15^{1/2} \exp(1 - 15^{1/2}) \exp((3 \cdot 15^{1/2})/2 + 3/2)) + (2 \exp(-t(15^{1/2}/2 - 1/2)) (2 \exp(15^{1/2} + 1) - 3 \exp((3 \cdot 15^{1/2})/2 + 3/2) + 2 \cdot 15^{1/2} \exp(15^{1/2} + 1))) / (\exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) - \exp(1 - 15^{1/2})) \exp((3 \cdot 15^{1/2})/2 + 3/2) + 15^{1/2} \exp(15^{1/2} + 1) \exp(3/2 - (3 \cdot 15^{1/2})/2) + 15^{1/2} \exp(1 - 15^{1/2}) \exp((3 \cdot 15^{1/2})/2 + 3/2)) \end{aligned}$$

4

>> simplify(ans)

ans =

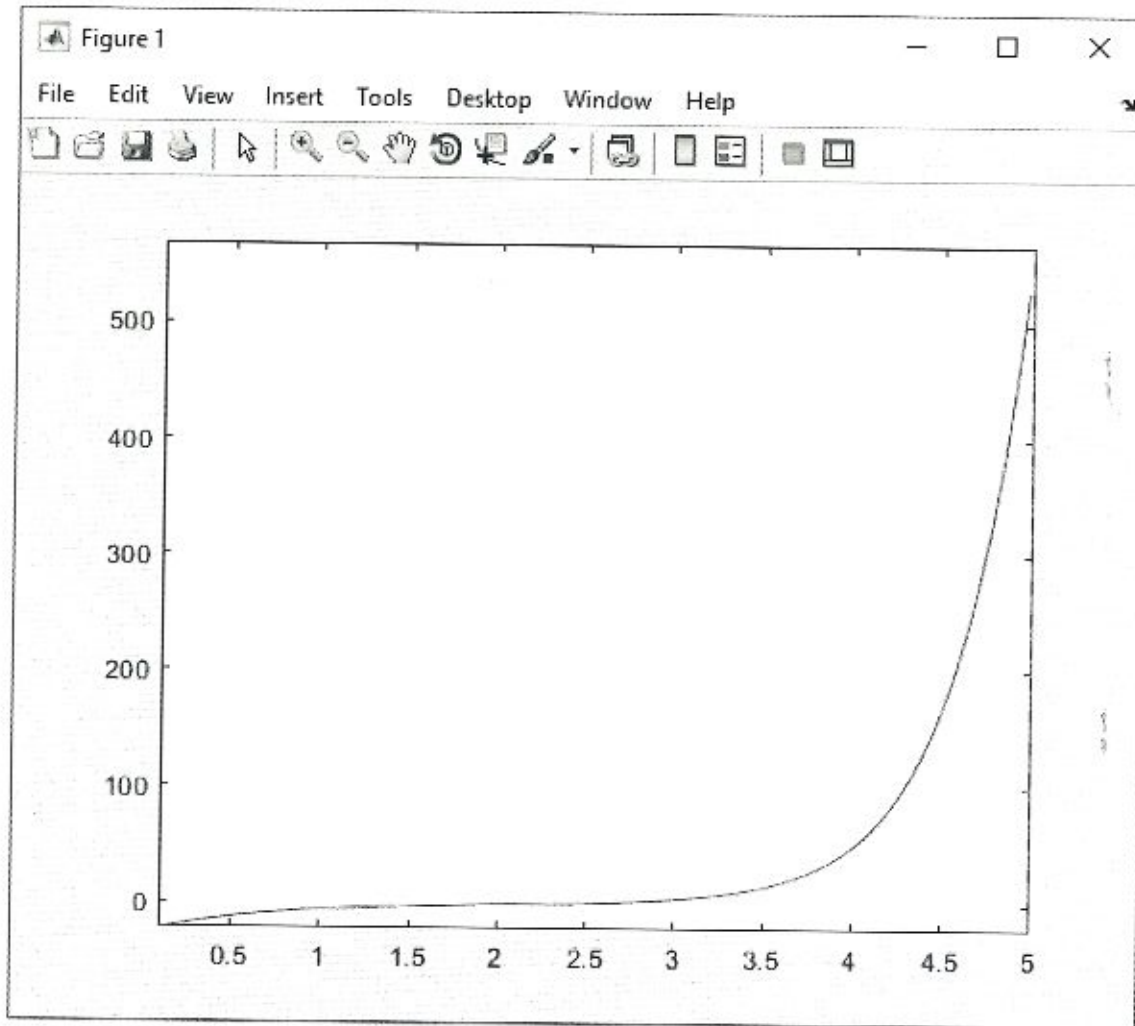
$$\begin{aligned} & (2 \exp(-t(15^{1/2}/2 - 1/2)) (2 \exp(15^{1/2} + 1) - 3 \exp((3 \cdot 15^{1/2})/2 + 3/2) + 2 \cdot 15^{1/2} \exp(15^{1/2} + 1))) / (\exp(5/2 - 15^{1/2}/2) - \exp(15^{1/2}/2 + 5/2) + 15^{1/2} \exp(5/2 - 15^{1/2}/2) + 15^{1/2} \exp(15^{1/2}/2 + 5/2)) + (2 \exp(t(15^{1/2}/2 + 1/2)) (3 \exp(3/2 - (3 \cdot 15^{1/2})/2) - 2 \exp(1 - 15^{1/2}) + 2 \cdot 15^{1/2} \exp(1 - 15^{1/2}))) / (\exp(5/2 - 15^{1/2}/2) - \exp(15^{1/2}/2 + 5/2) + 15^{1/2} \exp(5/2 - 15^{1/2}/2) + 15^{1/2} \exp(15^{1/2}/2 + 5/2)) \end{aligned}$$

```
>> fplot('2*exp(t*(15^(1/2)/2 + 1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 - 15^(1/2)))/(exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) - exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2) + 15^(1/2)*exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) + 15^(1/2)*exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2)) + (2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) + 2*15^(1/2)*exp(15^(1/2) + 1)))/(exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) - exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2) + 15^(1/2)*exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) + 15^(1/2)*exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2))',[0,1,5])
```

4

$$\text{ans} = 2e^{(-t \times (\frac{15^{\frac{1}{2}}}{2} - \frac{1}{2}))} \times 2e^{(15^{\frac{1}{2}} + 1)} - 3e^{(\frac{(3 \times 15^{\frac{1}{2}})}{2} + \frac{3}{2})} + 2 \times 15^{\frac{1}{2}} \times e^{(15^{\frac{1}{2}} + 1)} \dots$$

1



4

56
—
60

Question 2, a.

>> clear all

>> x=sym('x')

x =

x

>> f=-2*x^2*(cos(3*x)^2)

$$f = -2x^2 \times \cos^2(3x)$$

$$-2x^2 \cos^2(3x)$$

>> laplace(f)

ans =

$$(6s)/(s^2 + 36)^2 - (8s^3)/(s^2 + 36)^3 - 2/s^3$$

$$\rightarrow \frac{(6s)}{(s^2 + 36)^2} - \frac{(8s^3)}{(s^2 + 36)^3} - 2s^3$$

simplify

Q2, b.

$$>> f = 3*x^3*\sin(2*x)^2$$

f =

$$3*x^3*\sin(2*x)^2$$

$$>> \text{laplace}(f)$$

ans =

$$(72*s^2)/(s^2 + 16)^3 - 9/(s^2 + 16)^2 - (72*s^4)/(s^2 + 16)^4 + 9/s^4$$

>>

$$\rightarrow \frac{(72s^2)}{(s^2+16)^3} - \frac{9}{(s^2+16)^2} - \frac{(72s^4)}{(s^2+16)^4} + \frac{9}{s^4}$$

simplify

8

$$\frac{16}{30}$$

Question 3.

>> clear all

>> x=sym('x')

x =

x

>> f=3*exp(-2*x^2)

f =

3*exp(-2*x^2)

>> fourier(f)

ans =

$(3 \cdot 2^{1/2} \cdot \pi^{1/2} \cdot \exp(-w^2/8))/2$

>>

$$\rightarrow \frac{3 \times 2^{\frac{1}{2}} \times \pi^{\frac{1}{2}} \times e^{(-w^2/8)}}{2}$$



HNC Electrical and Electronic Engineering PSDE5008 Further Engineering Mathematics Level 5, Year 2

Class Test 3 (2017-18)

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Date of test =

Time allowed = 1 hour

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- Copy and paste your work into a word file, which should include your name in the header
- Print out your word file to allow you to include your hand written solutions
- Answer all questions

1. Solve the following differential equations and obtain plots in each case:

Note: For plot, take t axis from 0.1 to 5

In each case write out, by hand, the mathematical equivalent of the printout solution.

- a) $5ty' = 2t + 4y, y(1) = 2$ ✓
- b) $3y' - 6ty = t^2, y(2) = 3$ ✓
- c) $2y'' - 2y' - 7y = 0, y(3) = 4, y'(2) = 3$ ✓

55.
(60 Marks)

2. Determine the Laplace Transforms of the following:

In each case write out, *after simplifying your answer*, by hand, the mathematical equivalent of the printout solution.

- a) $f(x) = -2x^2 \cos^2(3x) (x > 0)$ ✓
- b) $f(x) = 3x^3 \sin^2(2x) (x > 0)$ ✓

23.
(30 Marks)

3. Determine the Fourier Transform of the following:

$$f(x) = 3e^{-2x^2}$$

and write out, by hand, the mathematical equivalent of the printout solution.

8
(10 Marks)

86% ✓

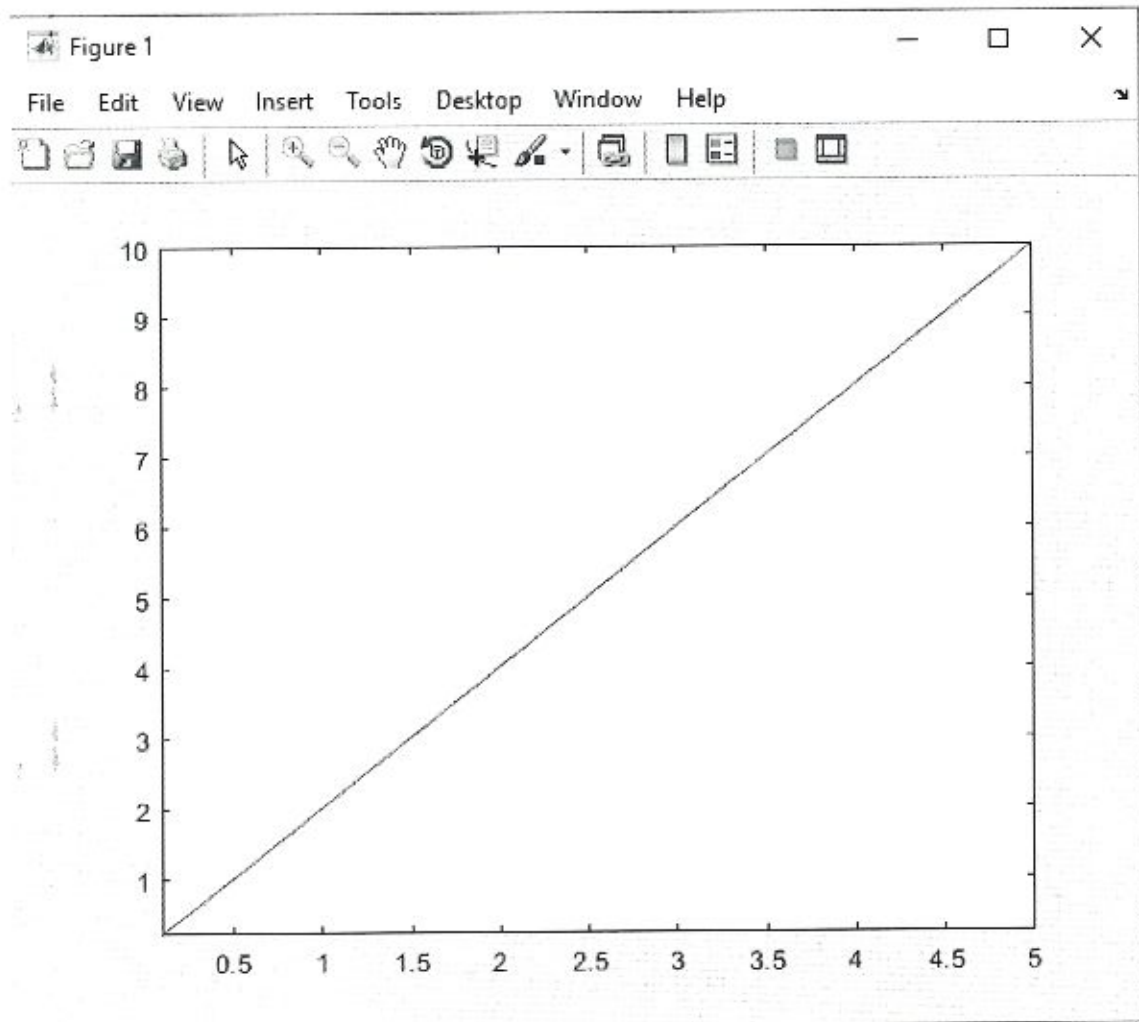
1. Differential equations

a)

```
>> dsolve('5*t*Dy=2*t+4*y','y(1)=2')
```

```
ans = 2*t
```

```
>> fplot('2*t',[0.1,5])
```



Mathematical equivalent $y = 2t$

b)

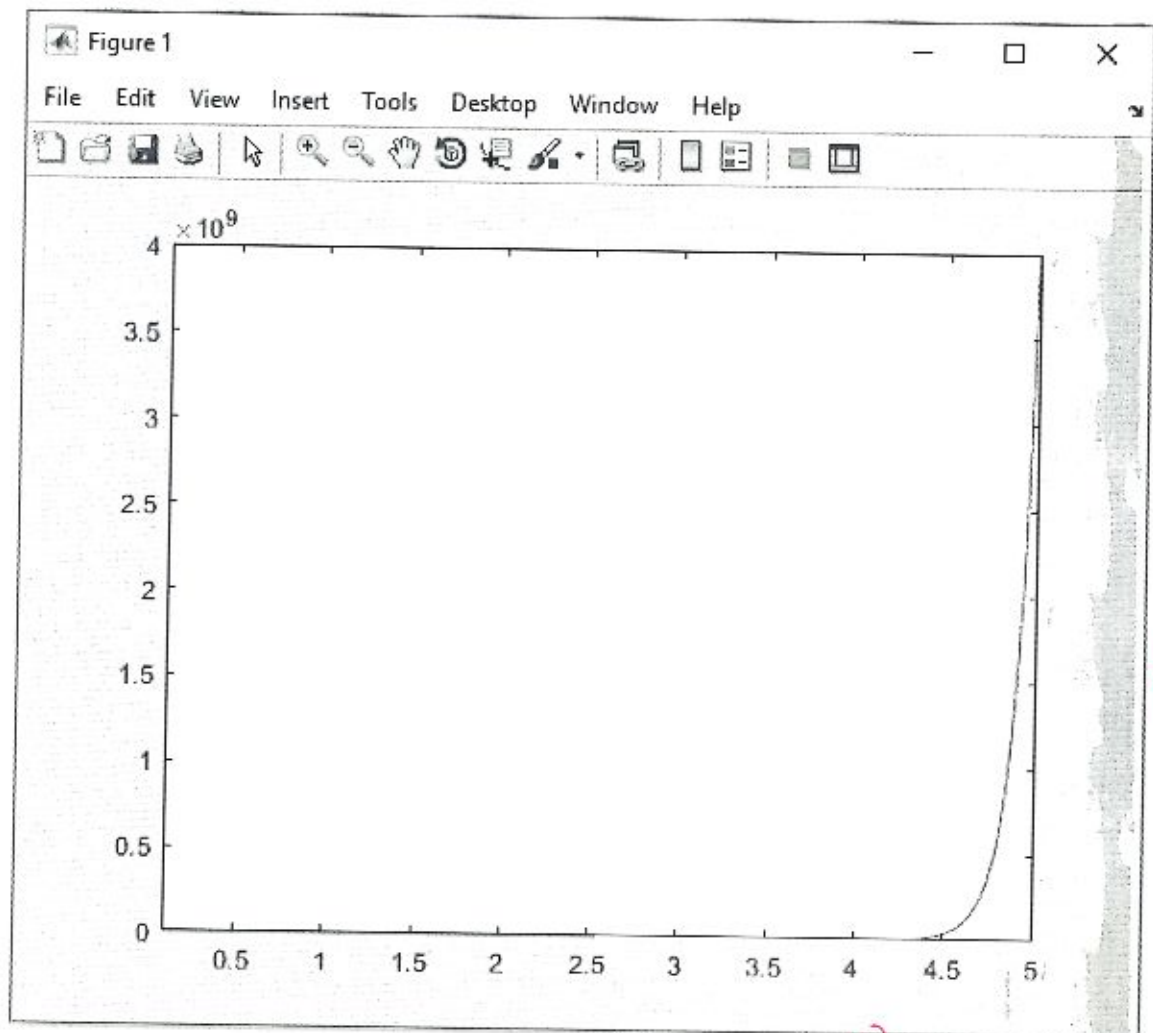
```
>> dsolve('3*Dy-6*t*y=t^2','y(2)=3')
```

```
ans = exp(t^2)*((10*exp(-4))/3 + (pi^(1/2)*erfi(2i)*1i)/12) -  
exp(t^2)*((pi^(1/2)*erfi(t*1i)*1i)/12 + (t*exp(-t^2))/6)
```

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

```
ans = (10*exp(t^2 - 4))/3 - t/6 + (pi^(1/2)*exp(t^2)*erf(t))/12 - (pi^(1/2)*erf(2)*exp(t^2))/12
```

```
>> fplot('(10*exp(t^2 - 4))/3 - t/6 + (pi^(1/2)*exp(t^2)*erf(t))/12 -  
(pi^(1/2)*erf(2)*exp(t^2))/12',[0.1,5])
```



Mathematical equivalent = $y = \frac{10e^{t^2-4}}{3} - \frac{t}{6} + \frac{\pi^{\frac{1}{2}} \times e^{t^2} \times \text{erf}(t)}{12}$

$- \frac{\pi^{\frac{1}{2}} \times \text{erf}(2) \times e^{t^2}}{12}$

c)

```
>> dsolve('2*D2y-2*Dy-7*y=0','y(3)=4','Dy(2)=3')
```

4

```
ans = (2*exp(t*(15^(1/2)/2 + 1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) +
2*15^(1/2)*exp(1 - 15^(1/2)))/(exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) - exp(1 -
15^(1/2))*exp((3*15^(1/2))/2 + 3/2) + 15^(1/2)*exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2)
+ 15^(1/2)*exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 + 3/2)) + (2*exp(-t*(15^(1/2)/2 -
1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) + 2*15^(1/2)*exp(15^(1/2) +
1)))/(exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) - exp(1 - 15^(1/2))*exp((3*15^(1/2))/2 +
3/2) + 15^(1/2)*exp(15^(1/2) + 1)*exp(3/2 - (3*15^(1/2))/2) + 15^(1/2)*exp(1 -
15^(1/2))*exp((3*15^(1/2))/2 + 3/2))
```

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

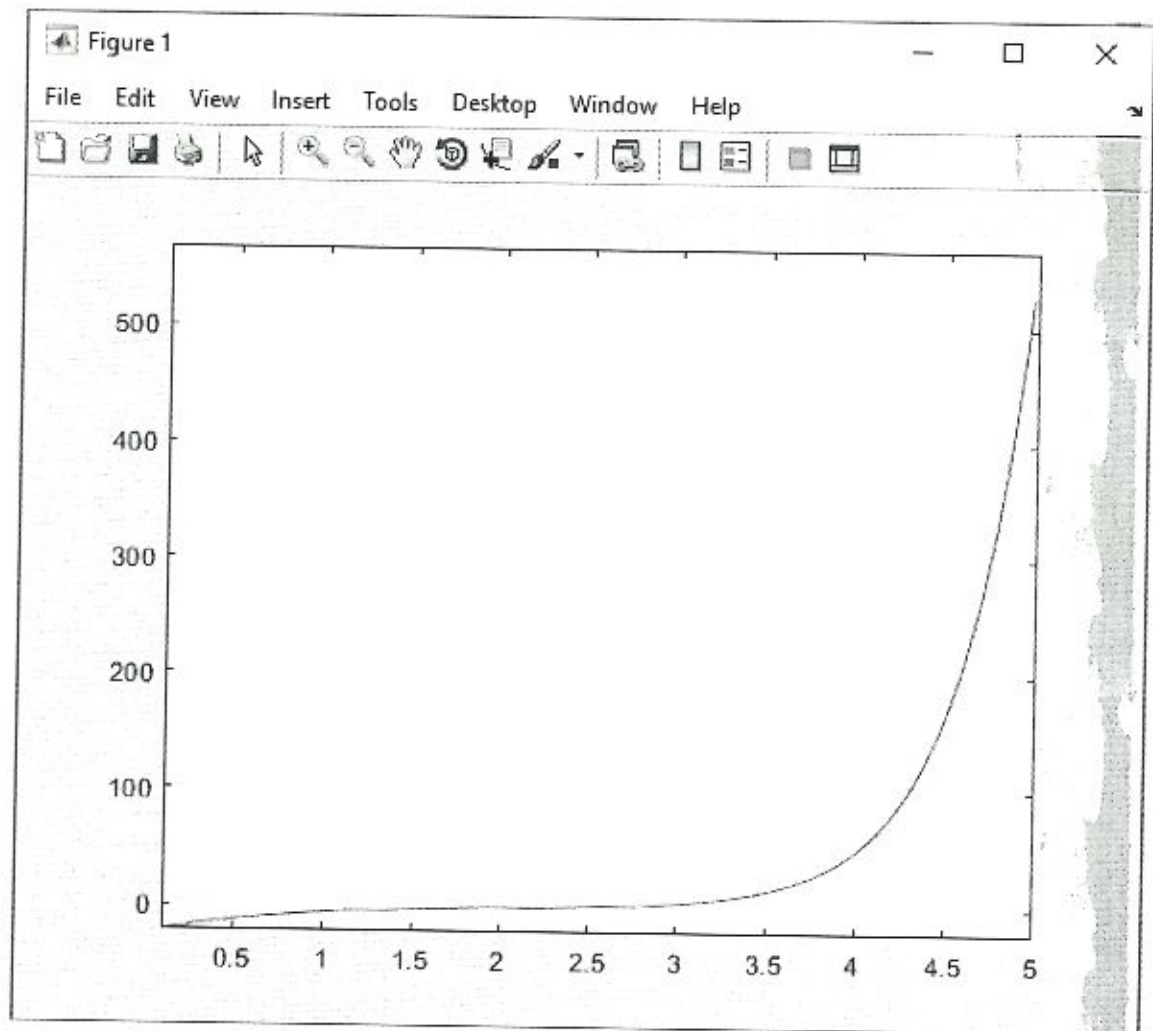
4

```
ans = (2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) +
2*15^(1/2)*exp(15^(1/2) + 1))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) +
15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2)) + (2*exp(t*(15^(1/2)/2 +
1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 -
15^(1/2)))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) +
15^(1/2)*exp(15^(1/2)/2 + 5/2))
```

```
>> fplot('(2*exp(-t*(15^(1/2)/2 - 1/2))*(2*exp(15^(1/2) + 1) - 3*exp((3*15^(1/2))/2 + 3/2) +
2*15^(1/2)*exp(15^(1/2) + 1))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) +
15^(1/2)*exp(5/2 - 15^(1/2)/2) + 15^(1/2)*exp(15^(1/2)/2 + 5/2)) + (2*exp(t*(15^(1/2)/2 +
1/2))*(3*exp(3/2 - (3*15^(1/2))/2) - 2*exp(1 - 15^(1/2)) + 2*15^(1/2)*exp(1 -
15^(1/2)))/(exp(5/2 - 15^(1/2)/2) - exp(15^(1/2)/2 + 5/2) + 15^(1/2)*exp(5/2 - 15^(1/2)/2) +
15^(1/2)*exp(15^(1/2)/2 + 5/2))', [0,1,5])
```

4

Mathematical equivalent =
$$y = \frac{2e^{-t(15^{1/2}/2 - 1/2)} \left(2e^{15^{1/2} + 1} - 3e^{(3 \times 15^{1/2})/2 + 3/2} + 2 \times 15^{1/2} e^{15^{1/2} + 1} \right) + 2e^{t(15^{1/2}/2 + 1/2)} \left(3e^{3/2 - (3 \times 15^{1/2})/2} - 2e^{1 - 15^{1/2}} + 2 \times 15^{1/2} e^{1 - 15^{1/2}} \right)}{e^{5/2 - 15^{1/2}/2} - e^{15^{1/2}/2 + 5/2} + 15^{1/2} e^{5/2 - 15^{1/2}/2} + 15^{1/2} e^{15^{1/2}/2 + 5/2}}$$



4

55/60

✓

2. Laplace Transforms

a)

>> x=sym('x')

x = x

>> f=-2*x^2*cos(3*x)^2

f = -2*x^2*cos(3*x)^2

>> laplace(f)

ans = (6*s)/(s^2 + 36)^2 - (8*s^3)/(s^2 + 36)^3 - 2/s^3

Mathematical equivalent = $f = \frac{6s}{(s^2 + 36)^2} - \frac{8s^3}{(s^2 + 36)^3} - \frac{2}{s^3}$

8

b)

>> x=sym('x')

x = x

f = 3*x^3*sin(2*x)^2

>> laplace(f)

ans = (72*s^2)/(s^2 + 16)^3 - 9/(s^2 + 16)^2 - (72*s^4)/(s^2 + 16)^4 + 9/s^4

>> simplify(ans)

ans = (288*(5*s^6 + 40*s^4 + 512*s^2 + 2048))/(s^4*(s^2 + 16)^4)

Mathematical equivalent = $f = \frac{288(5s^6 + 40s^4 + 512s^2 + 2048)}{s^4(s^2 + 16)^4}$

15

23
30

3. Fourier Transforms

a)

`>> f=3*exp(-2*x^2)``f = 3*exp(-2*x^2)``>> fourier(f)``ans = (3*2^(1/2)*pi^(1/2)*exp(-w^2/8))/2`

mathematical equivalent =
$$f = \frac{3 \times 2^{\frac{1}{2}} \times \pi^{\frac{1}{2}} \times e^{-\frac{w^2}{8}}}{2}$$

$$\frac{8}{10}$$