

MATH.2360 Engineering Differential Equations

Some Useful MATLAB Commands for Symbol Manipulation

Type the following command in the command window, which will open a new window called a mupad notebook:

```
>>mupad
```

A. Algebra

1. MATLAB will factor polynomials. Type the following command in the mupad notebook next to the [symbol, then hit the Enter key.

```
factor(x^4 - 5*x^2 + 4)
```

2. MATLAB can solve single equations. Try

```
solve(x^4 - 5*x^2 + 4 = 0)
```

3. MATLAB can also solve systems of equations:

```
solve({2*x + y = 5, x + 2*y = 4})
```

4. MATLAB can simplify expressions.

Try these commands to simplify $\frac{x}{2x+1} + \frac{1}{x}$ and $\cos^3(x) + \cos(x)\sin^2(x)$

```
simplify(x/(2*x + 1) + 1/x)
```

```
simplify((cos(x))^3 + cos(x)*(sin(x))^2)
```

B. Calculus

MATLAB can find limits, derivatives, and integrals symbolically. Try the following commands to find $\lim_{x \rightarrow 0} \frac{\sin(x)}{x}$, $\lim_{x \rightarrow \infty} e^{-x}$, $\frac{d}{dx} [x^3]$, $\frac{d^2}{dx^2} [x^3]$, $\int \frac{1}{x^2+1} dx$, and $\int \frac{x}{(x^2+1)^{3/2}} dx$, respectively.

```
limit(sin(x)/x, x=0)
```

```
limit(exp(-x), x=infinity)
```

```
diff(x^3, x)
```

```
diff(x^3, x$2)
```

```
int(1/(x^2+1), x)
```

```
int(x/(x^2+1)^(3/2), x)
```

OVER

C. Differential Equations

MATLAB can even solve differential equations symbolically. Here are some examples:

1. To solve the d.e. $x^2y' + 2xy = 3x^2$, type the command

```
solve(ode(x^2*y'(x) + 2*x*y(x) = 3*x^2, y(x)))
```

2. You can also solve initial value problems, such as $y' = y^2$, $y(1) = 1$:

```
solve(ode({y'(x) = y(x)^2, y(1) = 1}, y(x)))
```

3. You can name the solution of an initial value problem, and you can even calculate the value of the solution at any x . First enter this command:

```
y1:=solve(ode({y''(x) - y(x) = 0, y(0) = 1, y'(0) = 2}, y(x)))
```

and then enter this command:

```
float(y1 | x=2)
```

D. Exercises (These are from the homework for section 1.5.)

1. Solve the initial value problem $y' + y = 2$, $y(0) = 0$.
2. Solve the initial value problem $xy' - y = x$, $y(1) = 7$.