BIL 108E Intr. to Sci. & Eng.Computing

Res.Asst.Çiğdem Toparlı

EXERCISES -4

Example-1

Find the solution to $e^{2x}=3y$

```
>> syms x y;  eq = 'exp(2*x) = 3*y',
[x] = solve(eq, x)
```

Example-2

Find the solution to the following set of linear equations:

$2x-3y+4z = 5$

$y+4z+x = 10$

$-2z+3x+4y = 0$

Solution-2

```
>> clear, clc, syms x y z;
>> eq1 = '2*x-3*y+4*z = 5'
>> eq2 = 'y+4*z+x = 10'
>> eq3 = '-2*z+3*x+4*y = 0'
>> [x,y,z] = solve(eq1,eq2,eq3,x,y,z)
```

Example-3

Take the derivative of the function by using symbolic math;

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

Solution-3

```
>> syms x
>> f=x^3-cos(x);
>> g=diff(f)

g =

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

Example-4

Take the derivative of the function by using symbolic math;

$$f(x,y) = x^2 + (y+5)^3$$

Solution-4

Matlab command entries:

```
>> syms x y
>> f=x^2+(y+5)^3;
>> diff(f,y)
```

Matlab returns:

```
ans =

3*(y+5)^2
```

Note that in this case, the command **diff(f,y)** is equivalent to

$$\frac{\partial f(x,y)}{\partial y}$$

Example-5

Integrate the function by using symbolic math;

$$f(x,y) = x^2 + (y+5)^3$$

Solution-5

>> int(f,x)

Matlab returns:

ans =

1/3*x^3+(y+5)^3*x

The syntax of the integral command can be viewed by typing **>> help int** in Matlab command window.

If we wish to perform the following definite integral:

$$\int_0^{10} f(x, y)dy$$

Matlab command entry:

>> int(f,y,0,10)

Matlab returns:

ans =

12500+10*x^2

Example-6

Consider the following polynomial:

$$f(x) = 2x^2 + 4x - 8$$

Suppose we wish to find the roots of this polynomial.

Solution-6

```
>> syms x
>> f=2*x^2 + 4*x -8;
>> solve(f,x)
```

Matlab returns:

```
ans =

5^(1/2)-1
-1-5^(1/2)
```

Alternately, you may use the following lines in Matlab to perform the same calculation:

```
>> f=[2 4 -8];
>> roots(f)
```

Matlab returns:

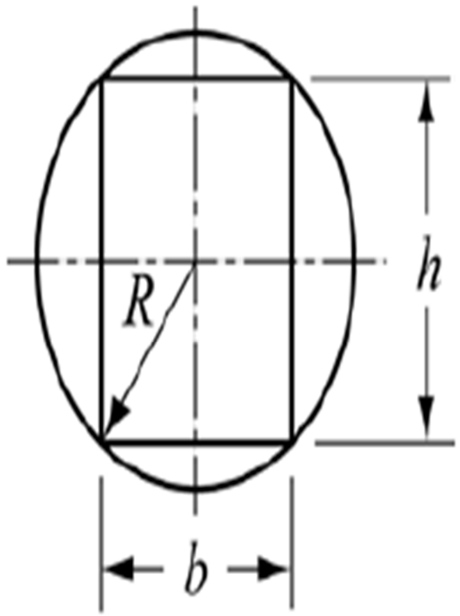
```
ans =

-3.2361
1.2361
```

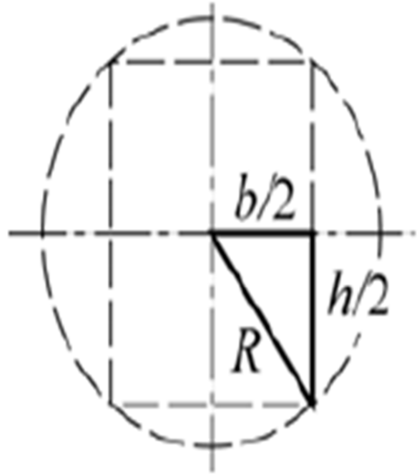
Note that the results from both approaches are the same.

Example-7

The bending resistance of a rectangular beam of width b and height h is proportional to the beam's moment of inertia I, defined by $I = \frac{1}{12}bh^3$. A rectangular beam is cut out of a cylindrical log of radius R. Determine b and h (as a function of R) such that the beam will have maximum I.



Solution-7



The problem is solved by following these steps:

1. Write an equation that relates R, h, and b.
2. Derive an expression for I in terms of h.
3. Take the derivative of I with respect to h.
4. Set the derivative equal to zero and solve for h.
5. Determine the corresponding b.

The first step is carried out by looking at the triangle in the figure. The relationship between R, h, and b is given by the Pythagorean theorem as $\left(\frac{b}{2}\right)^2 + \left(\frac{h}{2}\right)^2 = R^2$. Solving this equation for b gives $b = \sqrt{4R^2 - h^2}$.

The rest of the steps are done using MATLAB:

Solution-7

```
>> syms b h R
>> b=sqrt(4*R^2-h^2);
```

Create a symbolic expression for b.

```
>> I=b*h^3/12
```

Step 2: Create a symbolic expression for I.

```
I =
(h^3*(4*R^2-h^2)^(1/2))/12
```

MATLAB substitutes b in I.

```
>> ID=diff(I,h)
```

Step 3: Use the `diff(R)` command to differentiate `I` with respect to h.

```
ID =
(h^2*(4*R^2-h^2)^(1/2))/4-h^4/(12*(4*R^2-h^2)^(1/2))
```

The derivative of I is displayed.

```
>> hs=solve(ID,h)
```

Step 4: Use the `solve` command to solve the equation $ID = 0$ for h. Assign the answer to hs.

```
hs =
          0
  3^(1/2)*R
 -3^(1/2)*R
```

MATLAB displays three solutions. The positive non zero solution $\sqrt{3}R$ is relevant to the problem.

```
>> bs=subs(b,hs(2))
```

Step 5: Use the `subs` command to determine b by substituting the solution for h in the expression for b.

```
bs =
(R^2)^(1/2)
```

The answer for b is displayed. (The answer is R, but MATLAB displays $(R^2)^{1/2}$.)