MATLAB.4
Plotting Solutions to ODEs

Consider \[ z'' + 4z = g(x) \]
\[ z(0) = 0 = z'(0) \]

where \( g(x) = \begin{cases} 0 & \text{if } x < 5, \\ (x-5)/5 & \text{if } 5 \leq x < 10, \\ 1 & \text{if } 10 \leq x. \end{cases} \)

First we make a M.file for the step function \( u(x) \)

```
function w=u(x)
if x<0
    w=0;
else
    w=1;
end
```

Next we make a M.file for \( g(x) \)

```
function w=g(x)
if x<5
    w=0;
elseif x<10
    w=(x-5)/5;
else
    w=1;
end
```

The operations we use for conditions on \( x \) (e.g. \( x < 5 \)) in an if-elseif-else-end loop are \( < \) (less than), \( \leq \) (less than or equal), \( = \) (equal), \( > \) (greater than or equal), \( > \) (greater than), \( \neq \) (not equal).

Using Laplace transforms we solve for \( z \) by hand:
\[ z(x) = u(x-5) \left( (x-5)/20 - \sin(2\cdot(x-5))/10 \right) - u(x-10) \left( (x-10)/20 - \sin(2\cdot(x-10))/10 \right) \]

We make a M.file for \( z \)

```
function w=z(x)
w= u(x-5)*((x-5)/20-sin(2*(x-5))/10) - u(x-10)*((x-10)/20-sin(2*(x-10))/10);
```

Notice how one M.file calls another. Now we plot \( g(x) \) and \( z(x) \) on the same graph

Go to the command window and type:

```
fplot('g',[0,25],'-');
```
hold on
fplot('z', [0, 25])
grid
gtext('g(x)')
gtext('z(x)')

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We can rescale the graph so that it will be a little inside the frame. Type:

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axis([0, 25, -.1, 1.1])

ASSIGNMENT 4:

Do problem 16 in Section 6.4 of Boyce & DiPrima