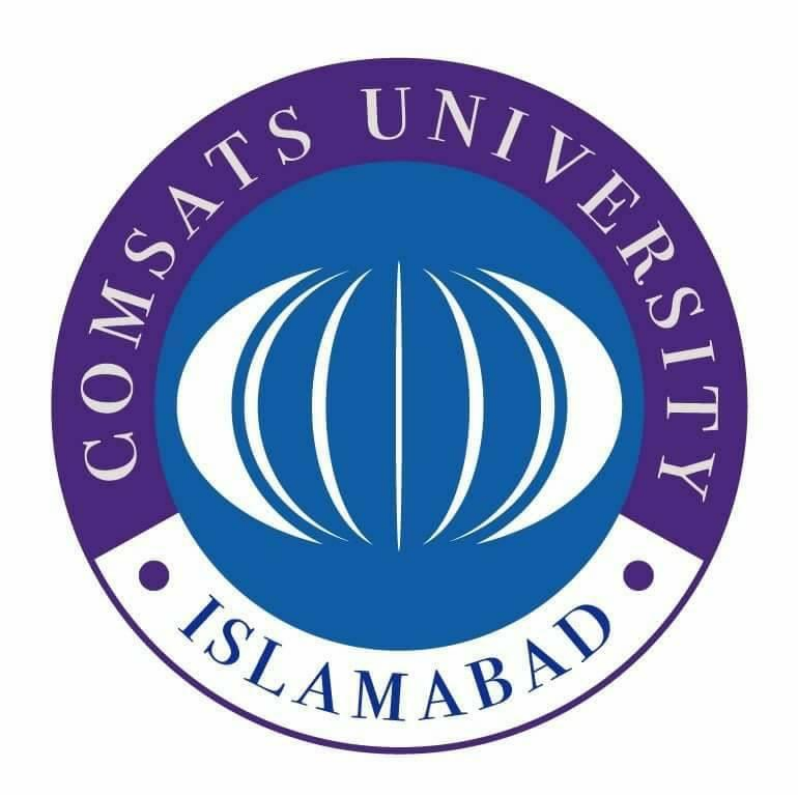

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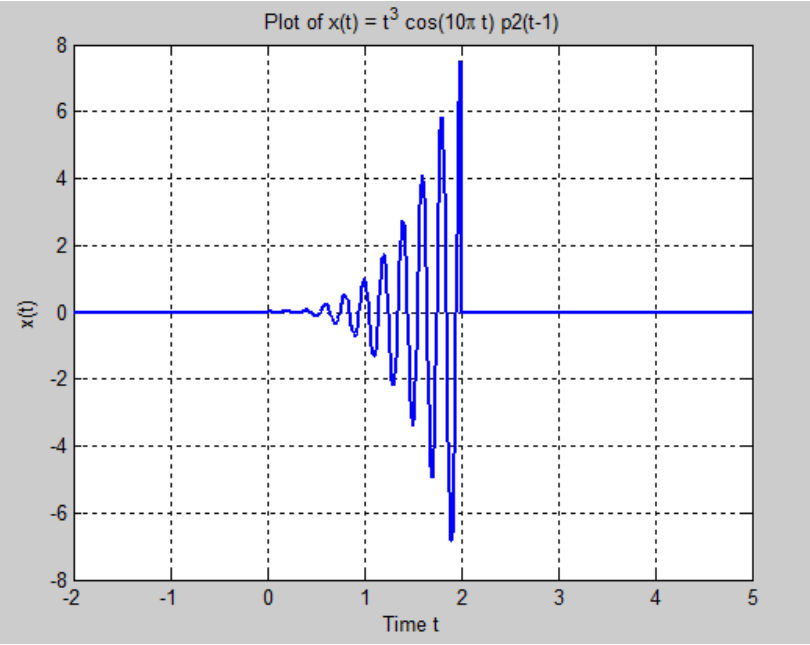
LAB 4

Signal Transformations (Scaling, Shifting and Reversal)

Task 01: Plot the signal $x(t) = t^3 \cos(10\pi t)\, p2(t-1)$ **for** $-2 \le 5$, **where** $pT(t)$ **is a rectangular pulse of duration T, denoted by** $p2(t-1) = u(t-1+2/2) - u(t-1-2/2) = u(t) - u(t-2)$.

```
t = -2:0.01:5;

p2 = (t >= 0) & (t < 2);

x = (t.^3) .* cos(10*pi*t) .* p2;

plot(t, x, 'LineWidth', 1.5);

xlabel('Time t');

ylabel('x(t)');

title('Plot of x(t) = t^3 cos(10\pi t) p2(t-1)');

grid on;
```



Task 02: Suppose that $x(t) = t\cos(2\pi t), 0 \le t \le 5.$ **Plot the signals**

(a) $x(t)$

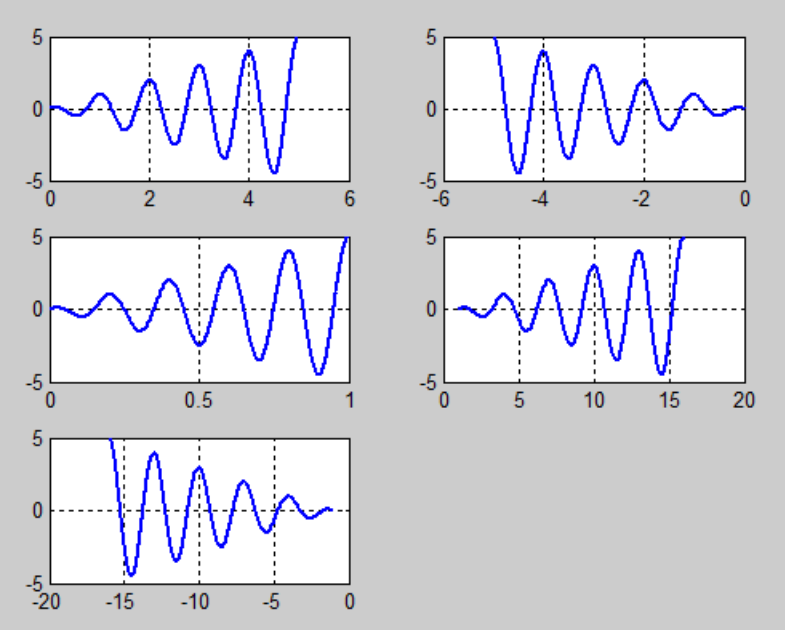
(b) $x(-t)$

(c) $x(t/5)$

(d) $x(1+3t)$

(e) $x(-1-3t)$

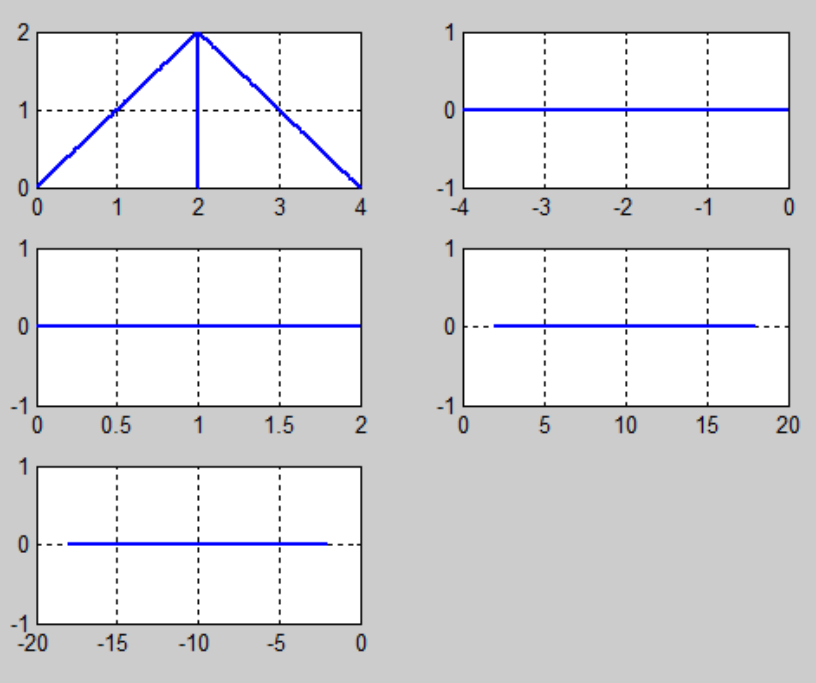
```
t = 0:0.001:5;

x_t = t .* cos(2*pi*t);

subplot(3,2,1);

plot(t, x_t, 'LineWidth', 1.5); grid on;

subplot(3,2,2);

plot(-t, x_t, 'LineWidth', 1.5); grid on;

subplot(3,2,3);

plot(t/5, x_t, 'LineWidth', 1.5); grid on;

subplot(3,2,4);

plot(1+3*t, x_t, 'LineWidth', 1.5); grid on;

subplot(3,2,5);

plot(-1-3*t, x_t, 'LineWidth', 1.5); grid on;
```



Task 03: Suppose that $x(t) = \begin{cases} t & 0 \le t \le 2 \\ 4-t & 2 < t \le 4 \end{cases}$**. Plot the signals**

(f) $x(t)$
(g) $x(-t)$
(h) $x(t/2)$
(i) $x(2+4t)$
(j) $x(-2-4t)$

```
t = 0:0.01:4;

x=zeros(size(t));

x(t >= 0 & t < 2) = t(t >= 0 & t < 2);

x(t > 2 & t <= 4) = 4 - t(t > 2 & t <= 4);

subplot(3,2,1);

plot(t,x,'LineWidth',1.5); grid on;

x=zeros(size(t));

subplot(3,2,2);

plot(-t,x,'LineWidth',1.5); grid on;

x=zeros(size(t));

subplot(3,2,3);

plot(t/2,x,'LineWidth',1.5); grid on;

x=zeros(size(t));

subplot(3,2,4);

plot(2 + 4*t,x,'LineWidth',1.5); grid on;

x=zeros(size(t));

subplot(3,2,5);

plot(-2-4*t,x,'LineWidth',1.5); grid on;
```



Task 04: Write a function that accepts a sequence $x[n]$, the discrete time n and a number n_0, a, b as input arguments, and returns the signals $x[n-n_0], x[-n], x[an]$ and $x[bn]$. Where $x[an]$ represents the time compressed version of $x[n]$ and $x[bn]$ is the time expanded version of $x[n]$.

```
function y = sequence(x, n, n0, a, b)
    x = x(:);
    n = n(:);
    subplot(5, 1, 1);
    stem(n, x, 'LineWidth', 2);
    title('Original Sequence'); grid on;
    subplot(5, 1, 2);
    stem(n + n0, x, 'LineWidth', 2);
    title('Shifted Sequence'); grid on;
    subplot(5, 1, 3);
    stem(-n, x, 'LineWidth', 2);
    title('Time-Reversed Sequence');  grid on;
    x1 = downsample(x, a);
```

```
n1 = n(1:a:end);

subplot(5, 1, 4);

stem(n1, x1, 'LineWidth', 2);

title('Downsampled Sequence');  grid on;

x2 = upsample(x, b);

i = (length(x2) - 1) / 2;

n2 = -i:i;

subplot(5, 1, 5);

stem(n2, x2, 'LineWidth', 2);

title('Upsampled Sequence');

grid on;
```

Post-lab Task

Critical Analysis / Conclusion

These tasks help us understand basic signal transformations like scaling, shifting, and reversal. By practicing with MATLAB, we learn how signals change and visualize these effects easily. This improves our problem-solving skills and prepares us for real-world engineering challenges. Such exercises connect theory with practice, making complex concepts easier to grasp.

Lab Assessment		
Lab Task Evaluation	**/6**	**/10**
Lab Report	**/4**	
Instructor Signature and Comments		