<<< Only Problem 1, 4 and 9 will be graded >>>

In [ ]:
```
import matplotlib.pyplot as plt
import numpy as np
%matplotlib inline
import IPython.display as ipd
import os
from scipy import signal,fftpack
from skimage.io import imread
import cv2
```

Problem 1

Sketch the following signals

1.

$x(t) = \sin(\frac{\pi}{4}t + 20^{\circ})$

2.

$$x(t) = \begin{cases} t+2, t \leq -2 \\ 0, -2 \leq t \leq 2 \\ t-2, t \geq 2 \end{cases}$$

3.

$x(t) = 2e^{-t}, 0 \leq t < 1$ and $x(t+1) = x(t)$ for all t

4.

$x(t) = u(t) + 5u(t-1) - 2u(t-2)$

5.

$x(t) = r(t) - r(t-1) - u(t-2)$

Problem 2

Determine whether each of following signals is periodic, and if so, find its period.

1.

$x(t) = \sin(\frac{\pi}{3}t) + \cos(\frac{8\pi}{3}t)$ 2. $x(t) = \exp(j\frac{7\pi}{6}t) + \exp(j\frac{5\pi}{6}t)$

3.

$x(t) = \exp(j\frac{7\pi}{6}t) + \exp(\frac{5\pi}{6}t)$

Problem 3

Determine whether the following signals are power or energy signals or neither. Justify your answers

1. $x(t) = A\sin(t), -\infty < t < \infty$
2. $x(t) = A(u(t-a) - u(t+a)),\ a > 0$
3. $x(t) = \exp(-at)u(t),\ a > 0$
4. $x(t) = A\exp(bt)u(t),\ b > 0$

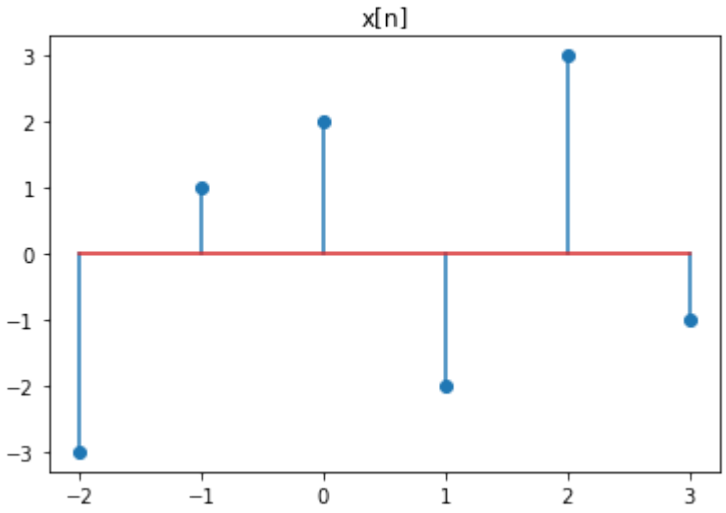
Problem 4

For the discrete time signal x[n] shown in Figure below, sketch each of the following

1. $x[2-n]$
2. $x[3n-4]$
3. $x\left[\frac{2}{3}n+1\right]$
4. $x\left[-\frac{n+8}{4}\right]$
5. $x[n^3]$
6. $x[2-n] + x[3n-4]$

In [ ]:
```
# x[n]
t = np.arange(-2,4)
x_t = np.array([-3,1,2,-2,3,-1])
plt.stem(t, x_t)
plt.title('x[n]')
plt.show()
```

```
/usr/local/lib/python3.7/dist-packages/ipykernel_launcher.py:4: UserWarnin
g: In Matplotlib 3.3 individual lines on a stem plot will be added as a Li
neCollection instead of individual lines. This significantly improves the
performance of a stem plot. To remove this warning and switch to the new b
ehaviour, set the "use_line_collection" keyword argument to True.
  after removing the cwd from sys.path.
```



Problem 5

Determine whether each of following signals is periodic, and if so, find its period.

1.

$$x[n] = \sin(\frac{\pi n}{4} + \frac{\pi}{8})$$

2.

$$x[n] = \sin(\frac{3\pi n}{4}) + \sin(\frac{\pi}{3}n)$$

3.

$$x[n] = \sin(\frac{3\pi n}{4}) \sin(\frac{\pi}{3}n)$$

4.

$$x[n] = \exp(\frac{6\pi}{5}n)$$

5.

$$x[n] = \exp(j\frac{5\pi}{6}n)$$

6.

$$x[n] = \sum_{m=-\infty}^{\infty} [\delta[n-2m] + 2\delta[n-3m]]$$

Problem 6

[python] Signal transformations : Study the sawtooth function in the figure below. Apply reflection, scaling, shifting operations to the signal and plot the transformed signals compared with the original sawtooth signal.

In [ ]:
```
import numpy as np
from scipy import signal
import matplotlib.pyplot as plt
%matplotlib inline
```

In [ ]:
```
# t = np.linspace(-1, 1, 500)
# plt.plot(t, signal.sawtooth(2 * np.pi * 5 * t))
# plt.show()
```

In [ ]:
```
# t = np.linspace(-1, 1, 500)
# plt.plot(t, signal.sawtooth(2 * np.pi * 5 * t))

# scaling factor = 3 and 1/3
## TODO : writing code for time scaling
```

In [ ]:
```
# t = np.linspace(-1, 1, 500)
# plt.plot(t, signal.sawtooth(2 * np.pi * 5 * t))

# shifting t to the left and right 0.05 units

## TODO : writing code for time shifting
```

In [ ]:
```
# plt.plot(t, signal.sawtooth(2 * np.pi * 5 * t))

## TODO : writing code for time Reflection
```

Problem 7

[python] Elementary signals: study the ramp signal plotted in the example below. \
TODO : plot these signals

1. Unit step function
2. Unit impulse function

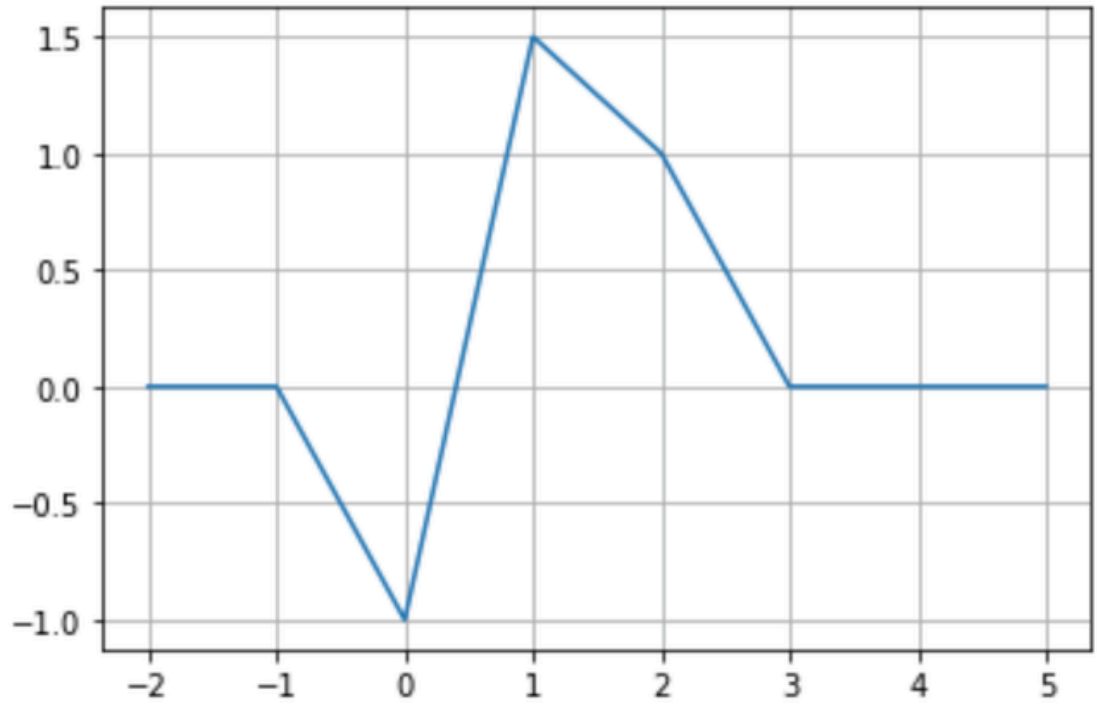
In [ ]:
```
# t = np.linspace(-1, 1, 500)
# ramp_t = t.copy()
# ramp_t[ramp_t < 0 ] = 0
# plt.plot(t, ramp_t)
# plt.show()
```

In [ ]:
```
## TODO : writing code for plotting unit step function
```

In [ ]:
```
## TODO : writing code for plotting unit impulse function
```

Problem 8

Express the signal that shown in Figure below using Unit-ramp functions



In [ ]:

Problem 9

Evaluate the following integrals

1. $\int_{-\infty}^{\infty} (\frac{2}{3}t - \frac{3}{2})\,\delta(t-1)\,dt$
2. $\int_{-\infty}^{\infty} (t-1)\delta\,(\frac{2}{3}t - \frac{3}{2})\;dt$
3. $\int_{-3}^{-2} [e^{(-t+1)} + \sin(\frac{2\pi t}{3})]\,\delta\,(t - \frac{3}{2})\;dt$
4. $\int_{-3}^{2} [e^{(-t+1)} + \sin(\frac{2\pi t}{3})]\,\delta\,(t - \frac{3}{2})\;dt$