# LAB2

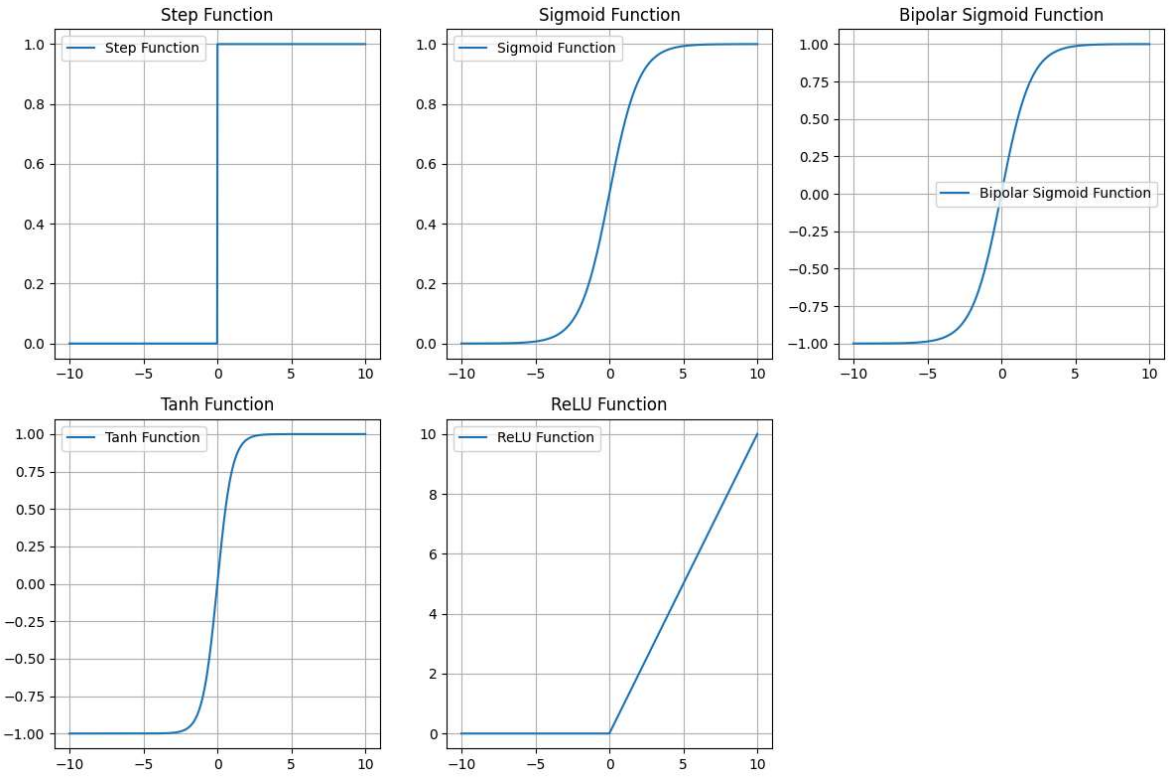
Objective: To explore and compare different activation functions used in artificial neural networks and understand their impact on the output of a neural network.

Name: Kushal Sourav B

Regno: 2347125

Activation Functions and Their Visualization

In [3]:
```
import numpy as np
import matplotlib.pyplot as plt

# Activation Functions
def step_function(x):
    return np.where(x >= 0, 1, 0)

def sigmoid_function(x):
    return 1 / (1 + np.exp(-x))

def bipolar_sigmoid_function(x):
    return (2 / (1 + np.exp(-x))) - 1

def tanh_function(x):
    return np.tanh(x)

def relu_function(x):
    return np.maximum(0, x)


x = np.linspace(-10, 10, 1000)

activation_functions = {
    "Step Function": step_function,
    "Sigmoid Function": sigmoid_function,
    "Bipolar Sigmoid Function": bipolar_sigmoid_function,
    "Tanh Function": tanh_function,
    "ReLU Function": relu_function
}

plt.figure(figsize=(12, 8))

for i, (name, func) in enumerate(activation_functions.items(), start=1):
    plt.subplot(2, 3, i)
    plt.plot(x, func(x), label=name)
    plt.title(name)
    plt.grid(True)
    plt.legend()

plt.tight_layout()
plt.show()
```




Simple Neural Network for AND Problem

AND Truth Table

| Input 1 | Input 2 | Output |
|---|---|---|
| 0 | 0 | 0 |
| 0 | 1 | 0 |
| 1 | 0 | 0 |
| 1 | 1 | 1 |

In [8]:
```
import numpy as np
import tensorflow as tf
from sklearn.metrics import accuracy_score

X = np.array([[0, 0], [0, 1], [1, 0], [1, 1]])
y = np.array([0, 0, 0, 1])

def create_model(activation_function):
    model = tf.keras.models.Sequential([
        tf.keras.layers.InputLayer(input_shape=(2,)),
        tf.keras.layers.Dense(8, activation=activation_function),
        tf.keras.layers.Dense(1, activation='sigmoid')
    ])
    model.compile(optimizer='adam', loss='binary_crossentropy', metrics=['accura
    return model

activation_funcs = ['sigmoid', 'tanh', 'relu']
results = {}


for func in activation_funcs:
    print(f"\nTraining with {func} activation function:")
```

```
    model = create_model(func)
    model.fit(X, y, epochs=1000, verbose=0)

    predictions = np.round(model.predict(X))
    accuracy = accuracy_score(y, predictions)

    print(f"Accuracy with {func}: {accuracy:.4f}")
    results[func] = accuracy


print("\nComparison of Activation Functions:")
for func, acc in results.items():
    print(f"Activation Function: {func} -> Accuracy: {acc:.4f}")
```

```
Training with sigmoid activation function:
c:\Users\USER\AppData\Local\Programs\Python\Python311\Lib\site-packages\keras\src
\layers\core\input_layer.py:26: UserWarning: Argument `input_shape` is deprecate
d. Use `shape` instead.
  warnings.warn(
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 71ms/step
Accuracy with sigmoid: 1.0000

Training with tanh activation function:
c:\Users\USER\AppData\Local\Programs\Python\Python311\Lib\site-packages\keras\src
\layers\core\input_layer.py:26: UserWarning: Argument `input_shape` is deprecate
d. Use `shape` instead.
  warnings.warn(
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 69ms/step
Accuracy with tanh: 1.0000

Training with relu activation function:
c:\Users\USER\AppData\Local\Programs\Python\Python311\Lib\site-packages\keras\src
\layers\core\input_layer.py:26: UserWarning: Argument `input_shape` is deprecate
d. Use `shape` instead.
  warnings.warn(
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 66ms/step
Accuracy with relu: 1.0000

Comparison of Activation Functions:
Activation Function: sigmoid -> Accuracy: 1.0000
Activation Function: tanh -> Accuracy: 1.0000
Activation Function: relu -> Accuracy: 1.0000
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 66ms/step
Accuracy with relu: 1.0000

Comparison of Activation Functions:
Activation Function: sigmoid -> Accuracy: 1.0000
Activation Function: tanh -> Accuracy: 1.0000
Activation Function: relu -> Accuracy: 1.0000
```

- Sigmoid: Works very well for binary classification and can easily handle the AND problem.
- Tanh: Equally effective in this case because it's a simple binary classification task.
- ReLU: Despite being designed for deeper networks, ReLU can also solve the AND gate but may not be as efficient for binary classification tasks compared to sigmoid

and tanh