In [1]:
```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
from sklearn.tree import DecisionTreeClassifier, plot_tree
from sklearn.decomposition import PCA
```

In [2]:
```
train_dataset = pd.read_csv(r'C:\Users\hp\Desktop\Decision Tree (CODE)\train.csv')
print(train_dataset.head(10))
```

```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3
5            6         0       3
6            7         0       1
7            8         0       3
8            9         1       3
9           10         1       2

                                                Name     Sex   Age  SibSp  \
0                            Braund, Mr. Owen Harris    male  22.0      1
1  Cumings, Mrs. John Bradley (Florence Briggs Th...  female  38.0      1
2                             Heikkinen, Miss. Laina  female  26.0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                           Allen, Mr. William Henry    male  35.0      0
5                                   Moran, Mr. James    male   NaN      0
6                            McCarthy, Mr. Timothy J    male  54.0      0
7                     Palsson, Master. Gosta Leonard    male   2.0      3
8  Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg)  female  27.0      0
9                Nasser, Mrs. Nicholas (Adele Achem)  female  14.0      1

   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
5      0            330877   8.4583   NaN        Q
6      0             17463  51.8625   E46        S
7      1            349909  21.0750   NaN        S
8      2            347742  11.1333   NaN        S
9      0            237736  30.0708   NaN        C
```

In [3]:
```
test_dataset = pd.read_csv(r'C:\Users\hp\Desktop\Decision Tree (CODE)\test.csv')
print(test_dataset.head(11))
```

```
    PassengerId  Pclass                                          Name     Sex  \
0           892       3                              Kelly, Mr. James    male
1           893       3              Wilkes, Mrs. James (Ellen Needs)  female
2           894       2                     Myles, Mr. Thomas Francis    male
3           895       3                              Wirz, Mr. Albert    male
4           896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)  female
5           897       3                    Svensson, Mr. Johan Cervin    male
6           898       3                          Connolly, Miss. Kate  female
7           899       2                  Caldwell, Mr. Albert Francis    male
8           900       3     Abrahim, Mrs. Joseph (Sophie Halaut Easu)  female
9           901       3                       Davies, Mr. John Samuel    male
10          902       3                              Ilieff, Mr. Ylio    male

     Age  SibSp  Parch     Ticket     Fare Cabin Embarked
0   34.5      0      0     330911   7.8292   NaN        Q
1   47.0      1      0     363272   7.0000   NaN        S
2   62.0      0      0     240276   9.6875   NaN        Q
3   27.0      0      0     315154   8.6625   NaN        S
4   22.0      1      1    3101298  12.2875   NaN        S
5   14.0      0      0       7538   9.2250   NaN        S
6   30.0      0      0     330972   7.6292   NaN        Q
7   26.0      1      1     248738  29.0000   NaN        S
8   18.0      0      0       2657   7.2292   NaN        C
9   21.0      2      0  A/4 48871  24.1500   NaN        S
10   NaN      0      0     349220   7.8958   NaN        S
```

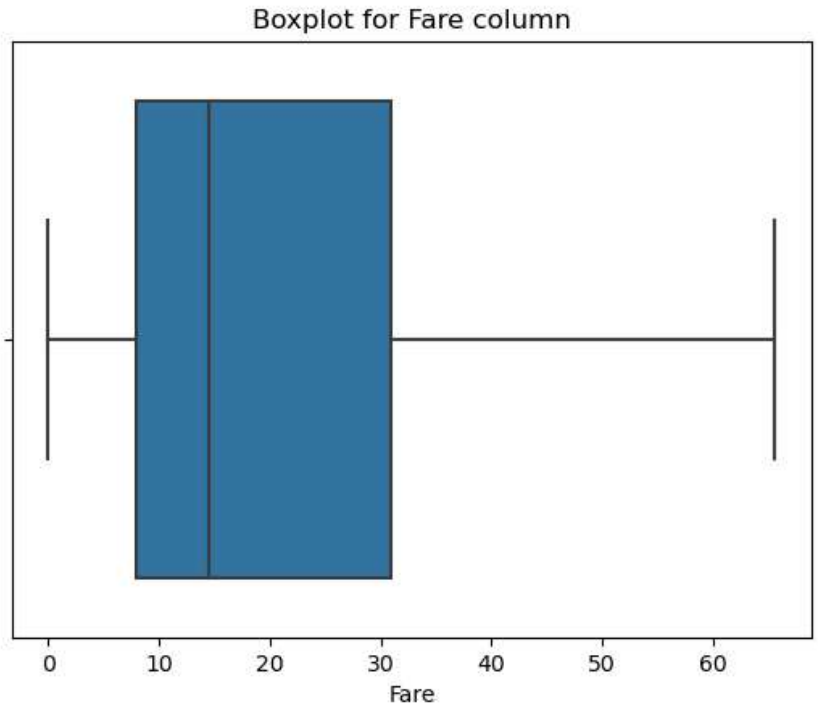
In [4]:
```
#fill missing value in the training dataset
#calculate the median for Age column and fill missing value
train_dataset['Age'].fillna(train_dataset['Age'].median(), inplace=True)
#calculate the mode for Embarked column and fill missing value
train_dataset['Embarked'].fillna(train_dataset['Embarked'].mode()[0], inplace=True)
#Then print the first 8 rows
print(train_dataset.head(8))
```

```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3
5            6         0       3
6            7         0       1
7            8         0       3

                                                Name     Sex   Age  SibSp  \
0                            Braund, Mr. Owen Harris    male  22.0      1
1  Cumings, Mrs. John Bradley (Florence Briggs Th...  female  38.0      1
2                             Heikkinen, Miss. Laina  female  26.0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)  female  35.0      1
4                           Allen, Mr. William Henry    male  35.0      0
5                                   Moran, Mr. James    male  28.0      0
6                            McCarthy, Mr. Timothy J    male  54.0      0
7                     Palsson, Master. Gosta Leonard    male   2.0      3

   Parch            Ticket     Fare Cabin Embarked
0      0         A/5 21171   7.2500   NaN        S
1      0          PC 17599  71.2833   C85        C
2      0  STON/O2. 3101282   7.9250   NaN        S
3      0            113803  53.1000  C123        S
4      0            373450   8.0500   NaN        S
5      0            330877   8.4583   NaN        Q
6      0             17463  51.8625   E46        S
7      1            349909  21.0750   NaN        S
```

In [5]:
```
#fill missing value in the test dataset
#calculate the median for Age column and fill missing value
test_dataset['Age'].fillna(test_dataset['Age'].median(), inplace=True)
#calculate the median for Fare column and fill missing value
test_dataset['Fare'].fillna(test_dataset['Fare'].median(), inplace=True)
#Then print the first 11 rows
print(test_dataset.head(11))
```

```
    PassengerId  Pclass                                          Name     Sex  \
0           892       3                              Kelly, Mr. James    male
1           893       3              Wilkes, Mrs. James (Ellen Needs)  female
2           894       2                     Myles, Mr. Thomas Francis    male
3           895       3                              Wirz, Mr. Albert    male
4           896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)  female
5           897       3                    Svensson, Mr. Johan Cervin    male
6           898       3                          Connolly, Miss. Kate  female
7           899       2                  Caldwell, Mr. Albert Francis    male
8           900       3     Abrahim, Mrs. Joseph (Sophie Halaut Easu)  female
9           901       3                       Davies, Mr. John Samuel    male
10          902       3                              Ilieff, Mr. Ylio    male

     Age  SibSp  Parch     Ticket     Fare Cabin Embarked
0   34.5      0      0     330911   7.8292   NaN        Q
1   47.0      1      0     363272   7.0000   NaN        S
2   62.0      0      0     240276   9.6875   NaN        Q
3   27.0      0      0     315154   8.6625   NaN        S
4   22.0      1      1    3101298  12.2875   NaN        S
5   14.0      0      0       7538   9.2250   NaN        S
6   30.0      0      0     330972   7.6292   NaN        Q
7   26.0      1      1     248738  29.0000   NaN        S
8   18.0      0      0       2657   7.2292   NaN        C
9   21.0      2      0  A/4 48871  24.1500   NaN        S
10  27.0      0      0     349220   7.8958   NaN        S
```

In [6]:
```
#HANDLING OUTLIERS
# Calculate the IQR (Interquartile Range) for Fare column
Q1 = train_dataset['Fare'].quantile(0.25) # find the 1st quartile (25%)
Q3 = train_dataset['Fare'].quantile(0.75) #find the 3rd quartile (75%)
IQR = Q3 - Q1

# Define outlier boundaries
lower_bound = Q1 - 1.5 * IQR
upper_bound = Q3 + 1.5 * IQR

# Cap outliers in Fare column
train_dataset['Fare'] = train_dataset['Fare'].clip(lower_bound, upper_bound)
test_dataset['Fare'] = test_dataset['Fare'].clip(lower_bound, upper_bound)

#boxplot for fare column after handling outliers
sns.boxplot(x=train_dataset['Fare'])
plt.title("Boxplot for Fare column")
plt.show()
```



In [7]:
```
#convert from categorical data to numerical value for test
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
test_dataset['Sex'] = le.fit_transform(test_dataset['Sex'])
test_dataset['Embarked'] = le.fit_transform(test_dataset['Embarked'])
print(test_dataset.head())
```

```
   PassengerId  Pclass                                          Name  Sex  \
0          892       3                              Kelly, Mr. James    1
1          893       3              Wilkes, Mrs. James (Ellen Needs)    0
2          894       2                     Myles, Mr. Thomas Francis    1
3          895       3                              Wirz, Mr. Albert    1
4          896       3  Hirvonen, Mrs. Alexander (Helga E Lindqvist)    0

    Age  SibSp  Parch   Ticket     Fare Cabin  Embarked
0  34.5      0      0   330911   7.8292   NaN         1
1  47.0      1      0   363272   7.0000   NaN         2
2  62.0      0      0   240276   9.6875   NaN         1
3  27.0      0      0   315154   8.6625   NaN         2
4  22.0      1      1  3101298  12.2875   NaN         2
```

In [8]:
```
#convert from categorical data to numerical value for train
from sklearn.preprocessing import LabelEncoder
le = LabelEncoder()
train_dataset['Sex'] = le.fit_transform(train_dataset['Sex'])
train_dataset['Embarked'] = le.fit_transform(train_dataset['Embarked'])
print(train_dataset.head())
```

```
   PassengerId  Survived  Pclass  \
0            1         0       3
1            2         1       1
2            3         1       3
3            4         1       1
4            5         0       3

                                                Name  Sex   Age  SibSp  Parch  \
0                            Braund, Mr. Owen Harris    1  22.0      1      0
1  Cumings, Mrs. John Bradley (Florence Briggs Th...    0  38.0      1      0
2                             Heikkinen, Miss. Laina    0  26.0      0      0
3       Futrelle, Mrs. Jacques Heath (Lily May Peel)    0  35.0      1      0
4                           Allen, Mr. William Henry    1  35.0      0      0

             Ticket     Fare Cabin  Embarked
0         A/5 21171   7.2500   NaN         2
1          PC 17599  65.6344   C85         0
2  STON/O2. 3101282   7.9250   NaN         2
3            113803  53.1000  C123         2
4            373450   8.0500   NaN         2
```

In [9]:
```
#Normalization using MinMaxScaler
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler()
train_dataset[['Age', 'Fare']] = scaler.fit_transform(train_dataset[['Age', 'Fare']])
print(train_dataset[['Age', 'Fare']].head())
```

```
        Age      Fare
0  0.271174  0.110460
1  0.472229  1.000000
2  0.321438  0.120745
3  0.434531  0.809027
4  0.434531  0.122649
```

In [10]:
```
X = train_dataset[['Pclass', 'Sex', 'Age', 'SibSp', 'Parch', 'Fare', 'Embarked']] #independent variable
Y = train_dataset['Survived']  # dependent  variable
X.head()
```

Out[10]:

	Pclass	Sex	Age	SibSp	Parch	Fare	Embarked
0	3	1	0.271174	1	0	0.110460	2
1	1	0	0.472229	1	0	1.000000	0
2	3	0	0.321438	0	0	0.120745	2
3	1	0	0.434531	1	0	0.809027	2
4	3	1	0.434531	0	0	0.122649	2

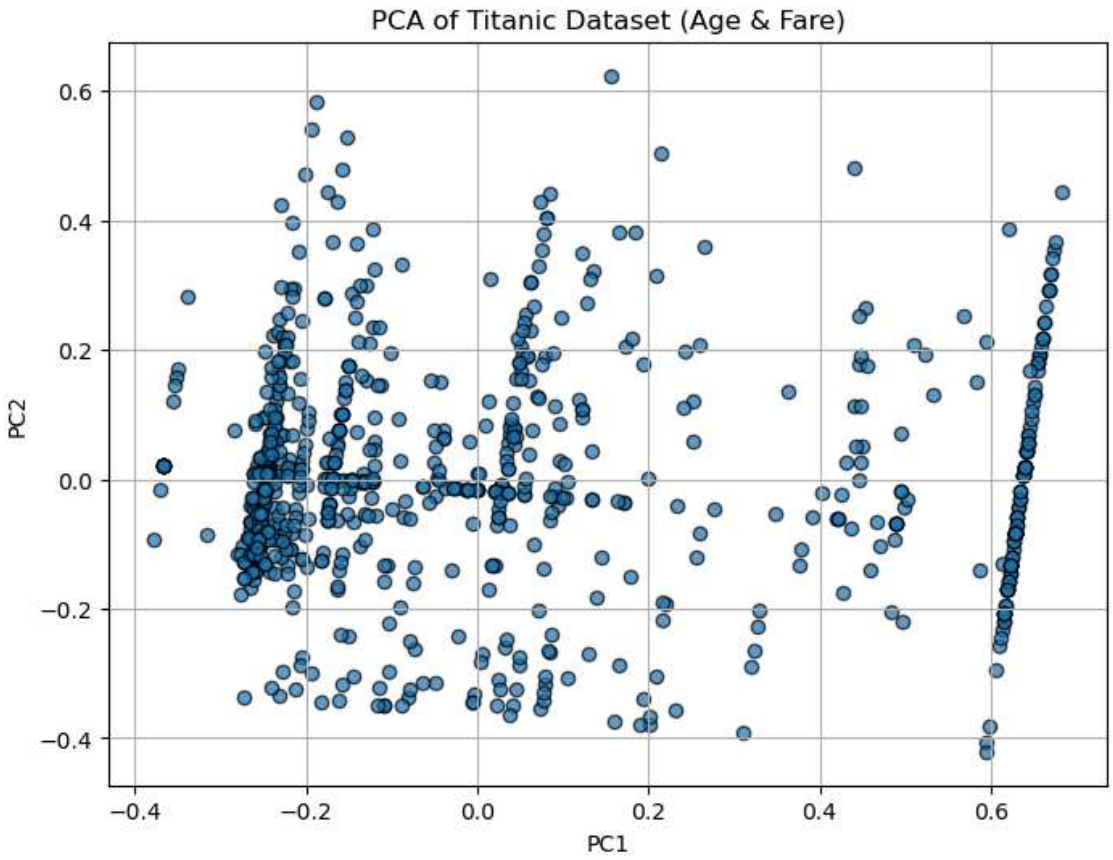
In [11]:
```
Y.head()
```

Out[11]:
```
0    0
1    1
2    1
3    1
4    0
Name: Survived, dtype: int64
```

In [12]:
```
#Apply PCA for Train dataset
pca = PCA(n_components=2)  #Reduce to 2 components for visualization
X_pca = pca.fit_transform(train_dataset[['Age', 'Fare']])  # Apply PCA for Age and Fare column
print("variance ratio PC1, PC2:", pca.explained_variance_ratio_) #Then get variance ratio for PC1 and PC
```

```
variance ratio PC1, PC2: [0.79051065 0.20948935]
```

In [13]:
```
# Create a scatter plot of the 2 principal components
plt.figure(figsize=(8, 6))
plt.scatter(X_pca[:, 0], X_pca[:, 1], alpha=0.7, edgecolor='k')
plt.xlabel('PC1')
plt.ylabel('PC2')
plt.title('PCA of Titanic Dataset (Age & Fare)')
plt.grid(True)
plt.show()
```

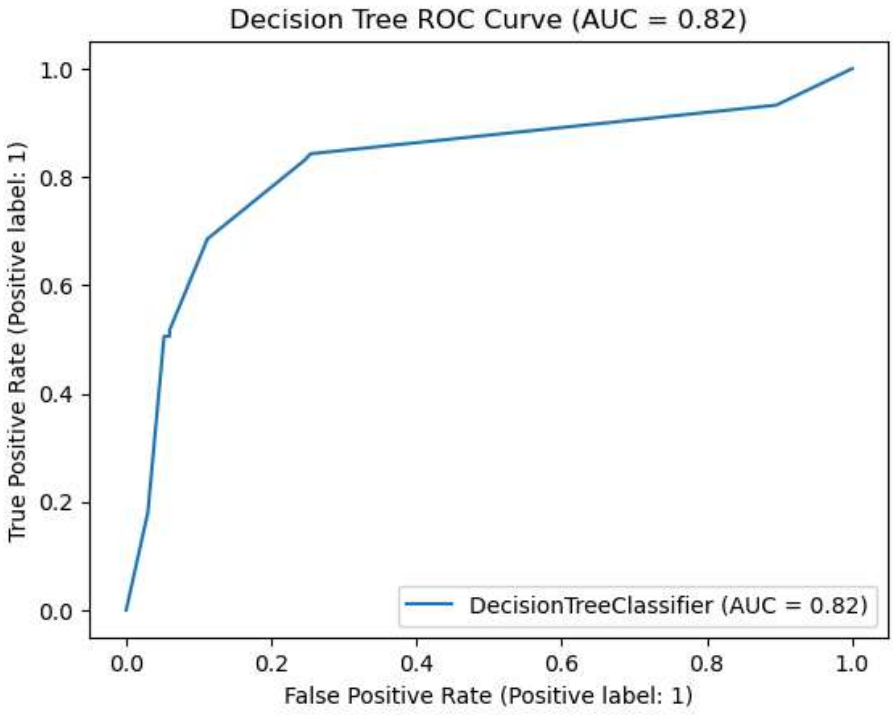


In [14]:
```
#split data into train and valdation sets
from sklearn.model_selection import train_test_split
X_train, X_val, Y_train, Y_val = train_test_split(X, Y, test_size=0.25, random_state=42)
print(f"X_train shape: {X_train.shape}")
print(f"X_val shape: {X_val.shape}")
print(f"Y_train shape: {Y_train.shape}")
print(f"Y_val shape: {Y_val.shape}")
```

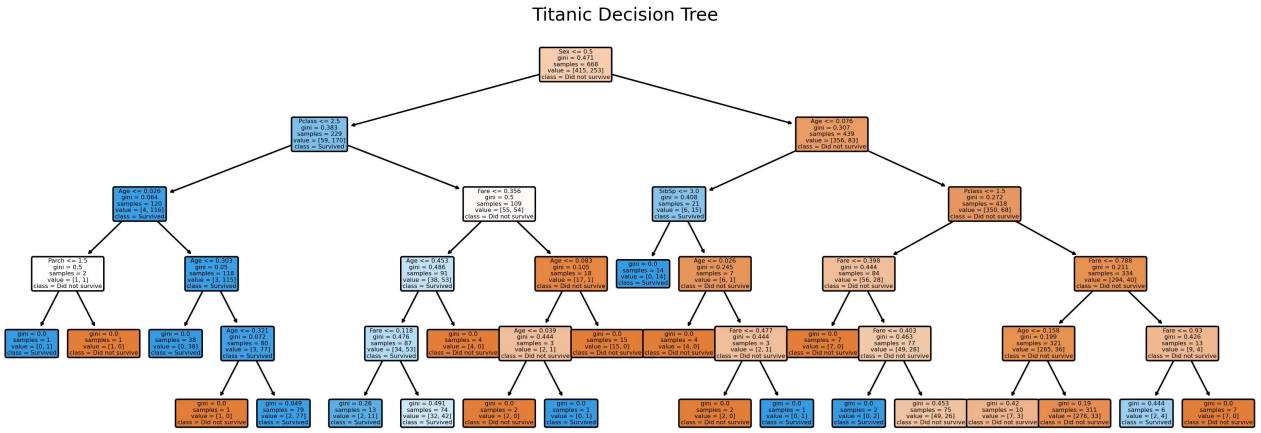
```
X_train shape: (668, 7)
X_val shape: (223, 7)
Y_train shape: (668,)
Y_val shape: (223,)
```

In [15]:
```
from sklearn.tree import DecisionTreeClassifier
from sklearn.metrics import confusion_matrix, classification_report, accuracy_score
from sklearn.tree import plot_tree
from sklearn.metrics import roc_auc_score, RocCurveDisplay

# Create the DecisionTreeClassifier with the default criterion (GINI Index)
classifier = DecisionTreeClassifier(max_depth=5, random_state=42)
classifier.fit(X_train, Y_train)
# Predictions on validation data
y_pred = classifier.predict(X_val)
# Evaluation Metrics for DT
print("\nClassification Report:")
print(classification_report(Y_val, y_pred))

print("\nConfusion Matrix:")
print(confusion_matrix(Y_val, y_pred))

print("\nAccuracy Score:")
print('Accuracy:', accuracy_score(Y_val, y_pred))

# ROC Curve for DT
y_pred_prob_dt = classifier.predict_proba(X_val)[:, 1]  # calculating the predicted Probabilities for su
roc_auc_dt = roc_auc_score(Y_val, y_pred_prob_dt) #calculate the AUC score
# Plot the ROC curve using the classifier
RocCurveDisplay.from_estimator(classifier, X_val, Y_val)
#Added title for the graph with AUC score
plt.title(f"Decision Tree ROC Curve (AUC = {roc_auc_dt:.2f})")
plt.show()
```

```
Classification Report:
              precision    recall  f1-score   support

           0       0.81      0.89      0.85       134
           1       0.80      0.69      0.74        89

    accuracy                           0.81       223
   macro avg       0.81      0.79      0.79       223
weighted avg       0.81      0.81      0.80       223


Confusion Matrix:
[[119  15]
 [ 28  61]]

Accuracy Score:
Accuracy: 0.8071748878923767
```

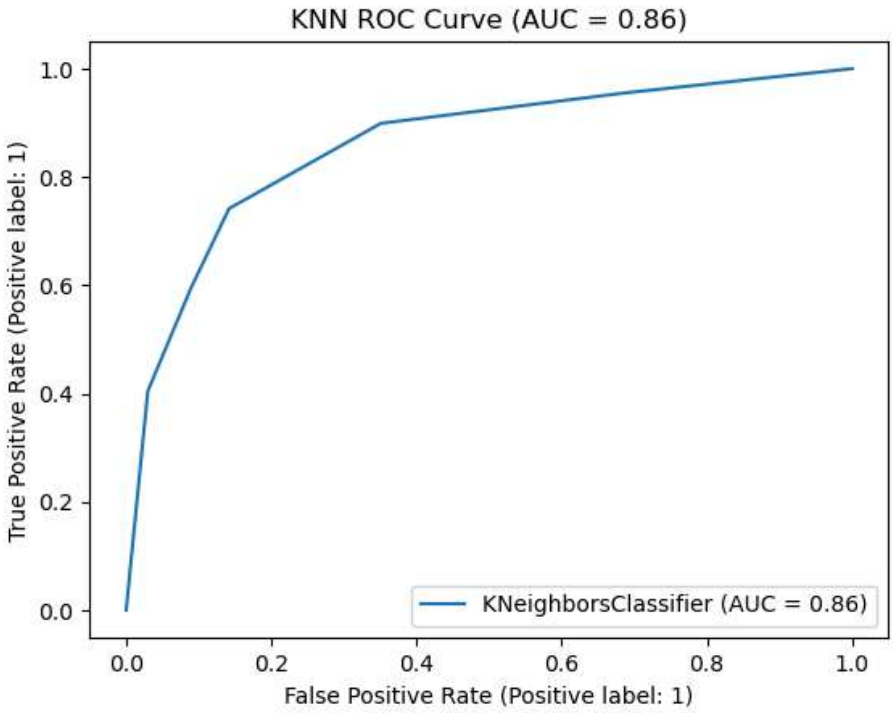


In [16]:
```
#print Decision Tree
plt.figure(figsize=(15, 5), dpi=300) #dpi is dots per inch, so used 300 for Very high resolution
plot_tree(classifier,
          feature_names=['Pclass', 'Sex', 'Age', 'SibSp', 'Parch', 'Fare', 'Embarked'],
          class_names=['Did not survive', 'Survived'],
          filled=True,
          rounded=True)
plt.title("Titanic Decision Tree")
plt.show()
```



In [17]:
```
from sklearn.neighbors import KNeighborsClassifier
from sklearn.metrics import RocCurveDisplay

# Create KNN classifier with k=5
classifier_KNN = KNeighborsClassifier(n_neighbors=5)
classifier_KNN.fit(X_train, Y_train)

# Predictions on validation data
y_pred_knn = classifier_KNN.predict(X_val)

# Evaluation Metrics for KNN
print("\nClassification Report for KNN:")
print(classification_report(Y_val, y_pred_knn))

print("\nConfusion Matrix for KNN:")
print(confusion_matrix(Y_val, y_pred_knn))

print("\nAccuracy Score for KNN:")
print('Accuracy:', accuracy_score(Y_val, y_pred_knn))

# ROC Curve for KNN
y_pred_prob_knn = classifier_KNN.predict_proba(X_val)[:, 1]  # calculating the predicted Probabilities f
roc_auc_knn = roc_auc_score(Y_val, y_pred_prob_knn) #calculate the AUC score
# Plot the ROC curve using the KNN classifier
RocCurveDisplay.from_estimator(classifier_KNN, X_val, Y_val)
#Added title for the graph with AUC score
plt.title(f"KNN ROC Curve (AUC = {roc_auc_knn:.2f})")
plt.show()
```

```
Classification Report for KNN:
              precision    recall  f1-score   support

           0       0.83      0.86      0.85       134
           1       0.78      0.74      0.76        89

    accuracy                           0.81       223
   macro avg       0.80      0.80      0.80       223
weighted avg       0.81      0.81      0.81       223


Confusion Matrix for KNN:
[[115  19]
 [ 23  66]]

Accuracy Score for KNN:
Accuracy: 0.8116591928251121
```


KNN ROC Curve (AUC = 0.86)
True Positive Rate (Positive label: 1)
False Positive Rate (Positive label: 1)
KNeighborsClassifier (AUC = 0.86)
0.0
0.2
0.4
0.6
0.8
1.0

In [ ]: