In [27]:
```
import os
print(os.getcwd())
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
```

```
C:\Users\HP\Desktop\college\sem 5\ML\codes
```

In [28]:
```
df = pd.read_csv(r'C:\Users\HP\Desktop\college\sem 5\ML\car_evaluation.csv', header = None)
```

In [29]:
```
df.head()
```

Out[29]:

	0	1	2	3	4	5	6
0	vhigh	vhigh	2	2	small	low	unacc
1	vhigh	vhigh	2	2	small	med	unacc
2	vhigh	vhigh	2	2	small	high	unacc
3	vhigh	vhigh	2	2	med	low	unacc
4	vhigh	vhigh	2	2	med	med	unacc

In [30]:
```
col_names = ['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety', 'class']
df.columns = col_names
col_names
```

Out[30]:
```
['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety', 'class']
```

In [31]:
```
df.head()
```

Out[31]:

	buying	maint	doors	persons	lug_boot	safety	class
0	vhigh	vhigh	2	2	small	low	unacc
1	vhigh	vhigh	2	2	small	med	unacc
2	vhigh	vhigh	2	2	small	high	unacc
3	vhigh	vhigh	2	2	med	low	unacc
4	vhigh	vhigh	2	2	med	med	unacc

In [32]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1728 entries, 0 to 1727
Data columns (total 7 columns):
 #   Column     Non-Null Count  Dtype 
---  ------     --------------  ----- 
 0   buying     1728 non-null   object
 1   maint      1728 non-null   object
 2   doors      1728 non-null   object
 3   persons    1728 non-null   object
 4   lug_boot   1728 non-null   object
 5   safety     1728 non-null   object
 6   class      1728 non-null   object
dtypes: object(7)
memory usage: 94.6+ KB
```

In [33]:
```
for i in col_names:
    print(df[i].value_counts())
```

```
vhigh    432
low      432
med      432
high     432
Name: buying, dtype: int64
vhigh    432
low      432
med      432
high     432
Name: maint, dtype: int64
4       432
2       432
5more   432
3       432
Name: doors, dtype: int64
4       576
2       576
more    576
Name: persons, dtype: int64
big     576
small   576
med     576
Name: lug_boot, dtype: int64
low     576
med     576
high    576
Name: safety, dtype: int64
unacc    1210
acc       384
good       69
vgood      65
Name: class, dtype: int64
```

In [34]:
```
df.shape
```

Out[34]:
```
(1728, 7)
```

In [35]:
```
X = df.drop(['class'],axis = 1)
y = df['class']
```

In [36]:
```
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X,y,test_size=0.3,random_state=42)
```

In [37]:
```
from sklearn.preprocessing import OrdinalEncoder
enc = OrdinalEncoder()
X_train = enc.fit_transform(X_train)
X_test = enc.transform((X_test))
```

Gini index as criterion

In [38]:
```
from sklearn.tree import DecisionTreeClassifier
```

In [39]:
```
clf_gini = DecisionTreeClassifier(criterion='gini', max_depth=3, random_state=42)
clf_gini.fit(X_train, y_train)
```

Out[39]:
```
DecisionTreeClassifier(max_depth=3, random_state=42)
```

In [40]:
```
y_pred = clf_gini.predict(X_test)
```

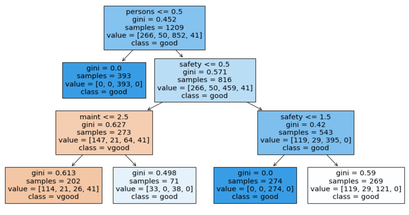
Grid Search CV

In [41]:
```
from sklearn.model_selection import GridSearchCV
option = ['gini', 'entropy']
weight_options =[{'auto', 'sqrt', 'log2'}
param_grid = {'criterion': option, 'max_features': [2,3,4,5,6], 'max_depth': [4,5,6,7], 'min_samples_split': [2,3,4,5]}
grid = GridSearchCV(clf_gini, param_grid, cv=3, scoring = 'accuracy')
grid.fit(X_train, y_train)

print(grid.best_score_)
print(grid.best_params_)
```

```
0.9247311827956989
{'criterion': 'gini', 'max_depth': 7, 'max_features': 6, 'min_samples_split': 2}
```

In [42]:
```
from sklearn import tree
plt.figure(figsize=(15,8))
tree.plot_tree(clf_gini,
               feature_names=['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety'],
               class_names= list(set(y_train)),
               filled = True)
plt.show()
```



In [43]:
```
# Check for underfitting

print(f'Training set score: {clf_gini.score(X_train,y_train)}')
print(f'Test set score: {clf_gini.score(X_test,y_test)}')
```

```
Training set score: 0.7775020678246485
Test set score: 0.7572254335260116
```

Model after we do GridSearch

In [46]:
```
dtc = DecisionTreeClassifier(criterion = 'gini', max_depth= 7, max_features= 6, min_samples_split= 2)
dtc.fit(X_train, y_train)
```

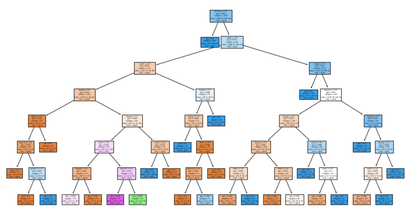
Out[46]:
```
DecisionTreeClassifier(max_depth=7, max_features=6)
```

In [47]:
```
y_pred = dtc.predict(X_test)

print (f'Training Set Score: {dtc.score(X_train, y_train)}')
print (f'Test Set Score: {dtc.score(X_test, y_test)}')
```

```
Training Set Score: 0.9330024813895782
Test Set Score: 0.9344894026974951
```

In [48]:
```
from sklearn import tree
plt.figure(figsize=(15,8))
tree.plot_tree(dtc,
               feature_names=['buying', 'maint', 'doors', 'persons', 'lug_boot', 'safety'],
               class_names= list(set(y_train)),
               filled = True)
plt.show()
```



Cross Validation

In [50]:
```
# For Train

from sklearn.model_selection import cross_val_score

score = cross_val_score(dtc, X_train, y_train, cv=10, scoring='accuracy')
score.mean()
```

Out[50]:
```
0.9205647382920011
```

In [51]:
```
# For Test

from sklearn.model_selection import cross_val_score

score = cross_val_score(dtc, X_test, y_test, cv=10, scoring='accuracy')
score.mean()
```

Out[51]:
```
0.8959653092006032
```

In [53]:
```
from sklearn.metrics import confusion_matrix, classification_report

cm = confusion_matrix(y_test, y_pred)

print(cm)
```

```
[[109   4   1   4]
 [ 10   6   0   3]
 [ 11   0 346   1]
 [  0   0   0  24]]
```

In [54]:
```
print(classification_report(y_test, y_pred))
```

```
              precision    recall  f1-score   support

         acc       0.84      0.92      0.88       118
        good       0.60      0.32      0.41        19
       unacc       1.00      0.97      0.98       358
       vgood       0.75      1.00      0.86        24

    accuracy                           0.93       519
   macro avg       0.80      0.80      0.78       519
weighted avg       0.94      0.93      0.93       519
```

In [ ]:
```
```