In [36]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
from sklearn.preprocessing import PolynomialFeatures
from sklearn import linear_model
from sklearn.metrics import r2_score

df = pd.read_excel('D:\\1\\co2.xlsx')
print(df)
p_df = df[['ENGINESIZE','CYLINDERS','FUELCONSUMPTION','CO2EMISSIONS']]
x = df['ENGINESIZE']
y = df['CO2EMISSIONS']
print('=============================================================================')
print(p_df.head(10))

#mission values with respect to Engine size scatter plot
plt.figure(figsize=(5,5))
plt.plot(x,y,marker='o',markersize=2,linestyle=' ') #just another way of scatter plt ,
plt.xlabel('ENGINESIZE')
plt.ylabel('CO2EMISSIONS')
plt.show()

print('=============================================================================')

#data spliting

split = np.random.rand(len(p_df))>0.8
train_data = p_df[split]
test_data  = p_df[~split]

print('train_data: ', train_data)
print('=============================================================================')
print('test_data: ', test_data)
print('***==========================================================================')

train_x = np.asanyarray(train_data[['ENGINESIZE']])
train_y = np.asanyarray(train_data[['CO2EMISSIONS']])
print('train_x: ',train_x)
print('=============================================================================')
print('train_y: ',train_y)
print('*****=======================================================================')

print('=============================================================================')

test_x = np.asanyarray(test_data[['ENGINESIZE']])
test_y = np.asanyarray(test_data[['CO2EMISSIONS']])
print('test_x: ',test_x)
print('=============================================================================')
print('test_y: ',test_y)
print('*****=======================================================================')

poly = PolynomialFeatures(degree=2)
train_x_poly = poly.fit_transform(train_x)
print(train_x_poly)
print('============================================================')
linear_reg_prob = linear_model.LinearRegression()
train_y_ = linear_reg_prob.fit(train_x_poly, train_y)
# The thetas  and y-intercept
print ('thetas: ', linear_reg_prob.coef_,'y_Intercept: ',linear_reg_prob.intercept_)
print ('============================================================')

# plotting fitting results
plt.scatter(train_data.ENGINESIZE, train_data.CO2EMISSIONS,  color='#c20641')
X_ = np.arange(0, 20, 0.1)
y_ = linear_reg_prob.intercept_[0]+ linear_reg_prob.coef_[0][1]*X_+ linear_reg_prob.coef_[0][2]*np.power(X_, 2)
plt.plot(X_, y_, '#e635e6' )
plt.xlabel("Enginesize")
plt.ylabel("Emission")
plt.grid()
plt.show()
print ('============================================================')
# (5) observe the error


test_poly = poly.fit_transform(test_x)
test_y_ = linear_reg_prob.predict(test_poly)

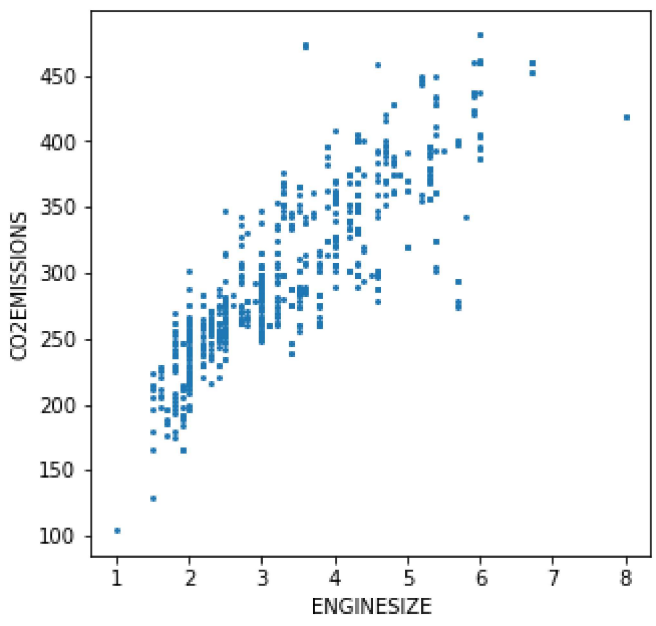
print("MSR: %.2f" % np.mean(np.absolute(test_y_ - test_y)),"MSE: %.2f" % np.mean((test_y_ - test_y) ** 2),"R2-score:
%.2f" % r2_score(test_y_ , test_y) )
```

```
     MODEL   MAKE             MODEL.1             VEHICLE CLASS  ENGINESIZE  \
0     2002  ACURA               1.7EL                   COMPACT         1.7
1     2002  ACURA               1.7EL                   COMPACT         1.7
2     2002  ACURA               3.2CL                   COMPACT         3.2
3     2002  ACURA               3.2TL                  MID-SIZE         3.2
4     2002  ACURA               3.5RL                  MID-SIZE         3.5
..     ...    ...                 ...                       ...         ...
735   2002  VOLVO  V70 T5 WAGON TURBO  STATION WAGON - MID-SIZE         2.3
736   2002  VOLVO  V70 T5 WAGON TURBO  STATION WAGON - MID-SIZE         2.3
737   2002  VOLVO           V70 WAGON  STATION WAGON - MID-SIZE         2.4
738   2002  VOLVO           V70 WAGON  STATION WAGON - MID-SIZE         2.4
739   2002  VOLVO    V70 XC AWD TURBO                       SUV         2.4

     CYLINDERS TRANSMISSION FUEL  FUELCONSUMPTION  Unnamed: 9  Unnamed: 10  \
0            4           A4    X              9.5         7.3          8.5
1            4           M5    X              8.8         7.2          8.1
2            6          AS5    Z             13.6         8.8         11.4
3            6          AS5    Z             13.5         8.8         11.4
4            6           A4    Z             15.0        10.7         13.1
..         ...          ...  ...              ...         ...          ...
735          5          AS5    Z             13.4         9.9         11.8
736          5           M5    Z             12.9         9.5         11.3
737          5           A5    Z             12.7         9.1         11.1
738          5           M5    Z             12.5         9.3         11.0
739          5          AS5    Z             14.2        10.5         12.5

     Unnamed: 11  CO2EMISSIONS
0             33           196
1             35           186
2             25           262
3             25           262
4             22           301
..           ...           ...
735           24           271
736           25           260
737           25           255
738           26           253
739           23           288

[740 rows x 13 columns]
========================================================================
   ENGINESIZE  CYLINDERS  FUELCONSUMPTION  CO2EMISSIONS
0         1.7          4              9.5           196
1         1.7          4              8.8           186
2         3.2          6             13.6           262
3         3.2          6             13.5           262
4         3.5          6             15.0           301
5         3.5          6             15.5           311
6         3.0          6             15.3           306
7         3.2          6             15.6           308
8         2.0          4             11.1           221
9         2.0          4             10.1           209
```



```
======================================================================
train_data:       ENGINESIZE  CYLINDERS  FUELCONSUMPTION  CO2EMISSIONS
4            3.5          6            15.0           301
5            3.5          6            15.5           311
23           4.2          8            15.4           301
24           4.2          8            15.4           301
26           2.7          6            16.5           336
..           ...        ...             ...           ...
719          2.3          5            12.9           260
720          2.4          5            13.1           262
727          2.4          5            13.6           274
728          2.3          5            12.9           255
737          2.4          5            12.7           255

[149 rows x 4 columns]
======================================================================
test_data:       ENGINESIZE  CYLINDERS  FUELCONSUMPTION  CO2EMISSIONS
0            1.7          4             9.5           196
1            1.7          4             8.8           186
2            3.2          6            13.6           262
3            3.2          6            13.5           262
6            3.0          6            15.3           306
..           ...        ...             ...           ...
734          2.4          5            13.6           274
735          2.3          5            13.4           271
736          2.3          5            12.9           260
738          2.4          5            12.5           253
739          2.4          5            14.2           288

[591 rows x 4 columns]
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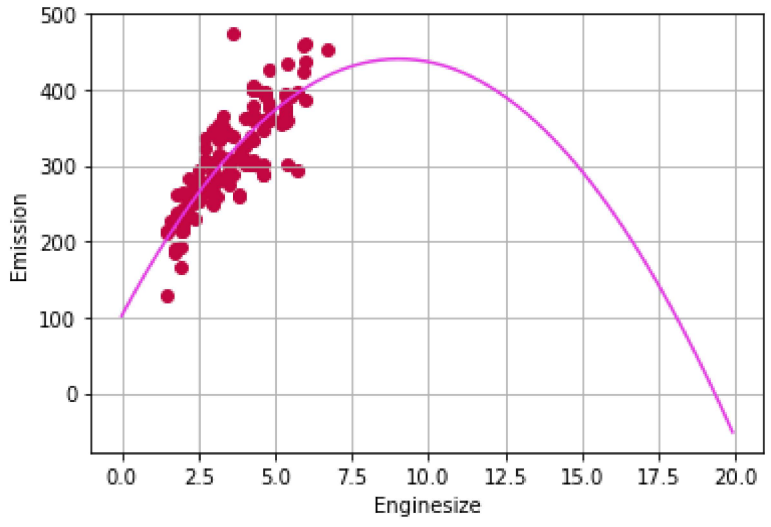


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