Import required libraries or packages

In [3]:

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
```

Import data set

In [4]:

```
customer = pd.read_csv("F:\dataset\Customermall.csv")
customer.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 200 entries, 0 to 199
Data columns (total 5 columns):
 #   Column                  Non-Null Count  Dtype 
---  ------                  --------------  ----- 
 0   CustomerID              200 non-null    int64 
 1   Gender                  200 non-null    object
 2   Age                     200 non-null    int64 
 3   Annual Income (k$)      200 non-null    int64 
 4   Spending Score (1-100)  200 non-null    int64 
dtypes: int64(4), object(1)
memory usage: 7.9+ KB
```

In [5]:

```
customer.head()
```

Out[5]:

	CustomerID	Gender	Age	Annual Income (k$)	Spending Score (1-100)
0	1	Male	19	15	39
1	2	Male	21	15	81
2	3	Female	20	16	6
3	4	Female	23	16	77
4	5	Female	31	17	40

To check if there is any null values

In [6]:

```
customer.isnull().sum(axis=0)
```

Out[6]:

```
CustomerID                0
Gender                    0
Age                       0
Annual Income (k$)        0
Spending Score (1-100)    0
dtype: int64
```

Selecting Number of features variables

In [7]:

```
df=customer.iloc[:,3:5]
df
```

Out[7]:

	Annual Income (k$)	Spending Score (1-100)
0	15	39
1	15	81
2	16	6
3	16	77
4	17	40
...	...	...
195	120	79
196	126	28
197	126	74
198	137	18
199	137	83

200 rows × 2 columns

In [8]:

```
X=df.values
X
```

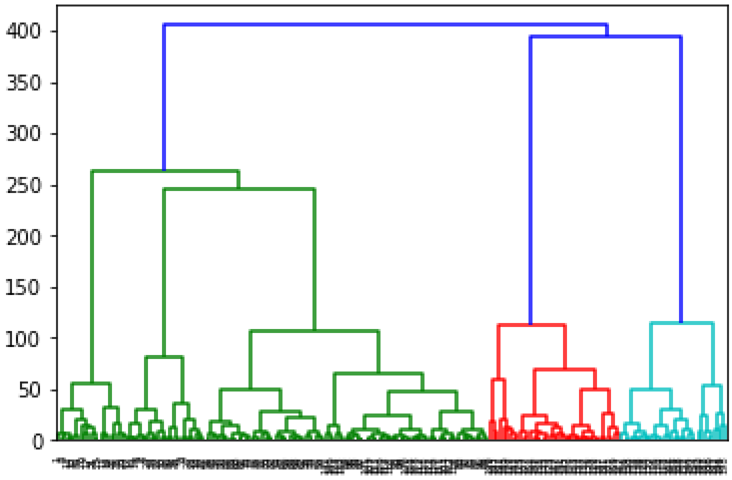
Out[8]:

```
array([[ 15,  39],
       [ 15,  81],
       [ 16,   6],
       [ 16,  77],
       [ 17,  40],
       [ 17,  76],
       [ 18,   6],
       [ 18,  94],
       [ 19,   3],
       [ 19,  72],
       [ 19,  14],
       [ 19,  99],
       [ 20,  15],
       [ 20,  77],
       [ 20,  13],
       [ 20,  79],
       [ 21,  35],
       [ 21,  66],
       [ 23,  29],
       [ 23,  98],
       [ 24,  35],
       [ 24,  73],
       [ 25,   5],
       [ 25,  73],
       [ 28,  14],
       [ 28,  82],
       [ 28,  32],
       [ 28,  61],
       [ 29,  31],
       [ 29,  87],
       [ 30,   4],
       [ 30,  73],
       [ 33,   4],
       [ 33,  92],
       [ 33,  14],
       [ 33,  81],
       [ 34,  17],
       [ 34,  73],
       [ 37,  26],
       [ 37,  75],
       [ 38,  35],
       [ 38,  92],
       [ 39,  36],
       [ 39,  61],
       [ 39,  28],
       [ 39,  65],
       [ 40,  55],
       [ 40,  47],
       [ 40,  42],
       [ 40,  42],
       [ 42,  52],
       [ 42,  60],
       [ 43,  54],
       [ 43,  60],
       [ 43,  45],
       [ 43,  41],
       [ 44,  50],
       [ 44,  46],
       [ 46,  51],
       [ 46,  46],
       [ 46,  56],
       [ 46,  55],
       [ 47,  52],
       [ 47,  59],
       [ 48,  51],
       [ 48,  59],
       [ 48,  50],
       [ 48,  48],
       [ 48,  59],
       [ 48,  47],
       [ 49,  55],
       [ 49,  42],
       [ 50,  49],
       [ 50,  56],
       [ 54,  47],
       [ 54,  54],
       [ 54,  53],
       [ 54,  48],
       [ 54,  52],
       [ 54,  42],
       [ 54,  51],
       [ 54,  55],
       [ 54,  41],
       [ 54,  44],
       [ 54,  57],
       [ 54,  46],
       [ 57,  58],
       [ 57,  55],
       [ 58,  60],
       [ 58,  46],
       [ 59,  55],
       [ 59,  41],
       [ 60,  49],
       [ 60,  40],
       [ 60,  42],
       [ 60,  52],
       [ 60,  47],
       [ 60,  50],
       [ 61,  42],
       [ 61,  49],
       [ 62,  41],
       [ 62,  48],
       [ 62,  59],
       [ 62,  55],
       [ 62,  56],
       [ 62,  42],
       [ 63,  50],
       [ 63,  46],
       [ 63,  43],
       [ 63,  48],
       [ 63,  52],
       [ 63,  54],
       [ 64,  42],
       [ 64,  46],
       [ 65,  48],
       [ 65,  50],
       [ 65,  43],
       [ 65,  59],
       [ 67,  43],
       [ 67,  57],
       [ 67,  56],
       [ 67,  40],
       [ 69,  58],
       [ 69,  91],
       [ 70,  29],
       [ 70,  77],
       [ 71,  35],
       [ 71,  95],
       [ 71,  11],
       [ 71,  75],
       [ 71,   9],
       [ 71,  75],
       [ 72,  34],
       [ 72,  71],
       [ 73,   5],
       [ 73,  88],
       [ 73,   7],
       [ 73,  73],
       [ 74,  10],
       [ 74,  72],
       [ 75,   5],
       [ 75,  93],
       [ 76,  40],
       [ 76,  87],
       [ 77,  12],
       [ 77,  97],
       [ 77,  36],
       [ 77,  74],
       [ 78,  22],
       [ 78,  90],
       [ 78,  17],
       [ 78,  88],
       [ 78,  20],
       [ 78,  76],
       [ 78,  16],
       [ 78,  89],
       [ 78,   1],
       [ 78,  78],
       [ 78,   1],
       [ 78,  73],
       [ 79,  35],
       [ 79,  83],
       [ 81,   5],
       [ 81,  93],
       [ 85,  26],
       [ 85,  75],
       [ 86,  20],
       [ 86,  95],
       [ 87,  27],
       [ 87,  63],
       [ 87,  13],
       [ 87,  75],
       [ 87,  10],
       [ 87,  92],
       [ 88,  13],
       [ 88,  86],
       [ 88,  15],
       [ 88,  69],
       [ 93,  14],
       [ 93,  90],
       [ 97,  32],
       [ 97,  86],
       [ 98,  15],
       [ 98,  88],
       [ 99,  39],
       [ 99,  97],
       [101,  24],
       [101,  68],
       [103,  17],
       [103,  85],
       [103,  23],
       [103,  69],
       [113,   8],
       [113,  91],
       [120,  16],
       [120,  79],
       [126,  28],
       [126,  74],
       [137,  18],
       [137,  83]], dtype=int64)
```

Hierarchical Clustering & Dendogram To determine number of clusters

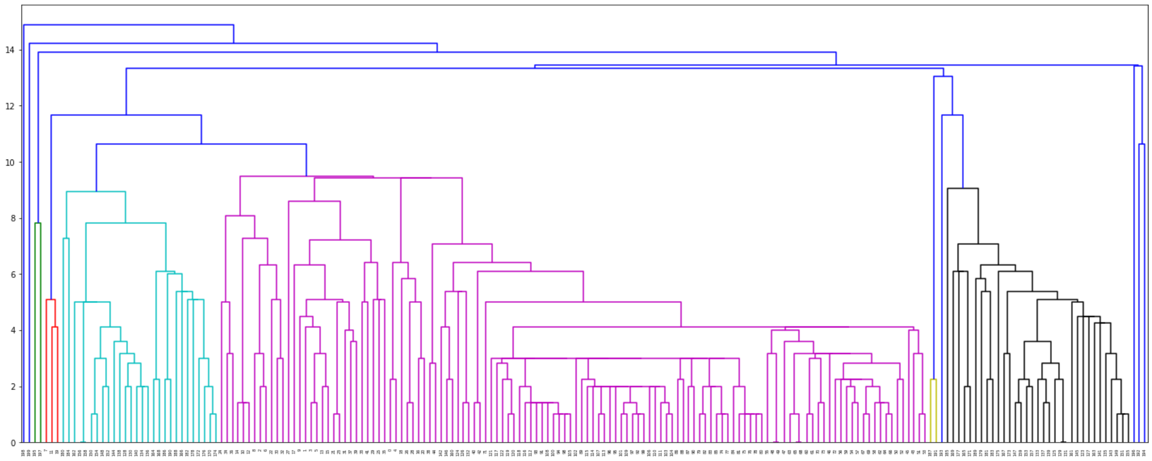
In [9]:

```
import scipy
from scipy.cluster import hierarchy
dendro=hierarchy.dendrogram(hierarchy.linkage(X,method='ward'))
```



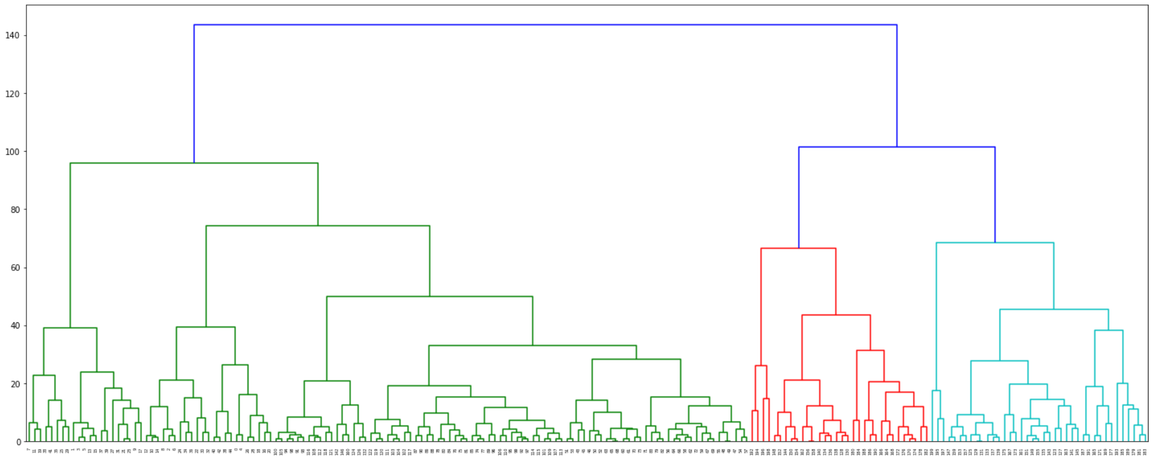
In [10]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
Z = linkage(X, 'single')
fig = plt.figure(figsize=(25, 10))
dn = dendrogram(Z)
plt.show()
```



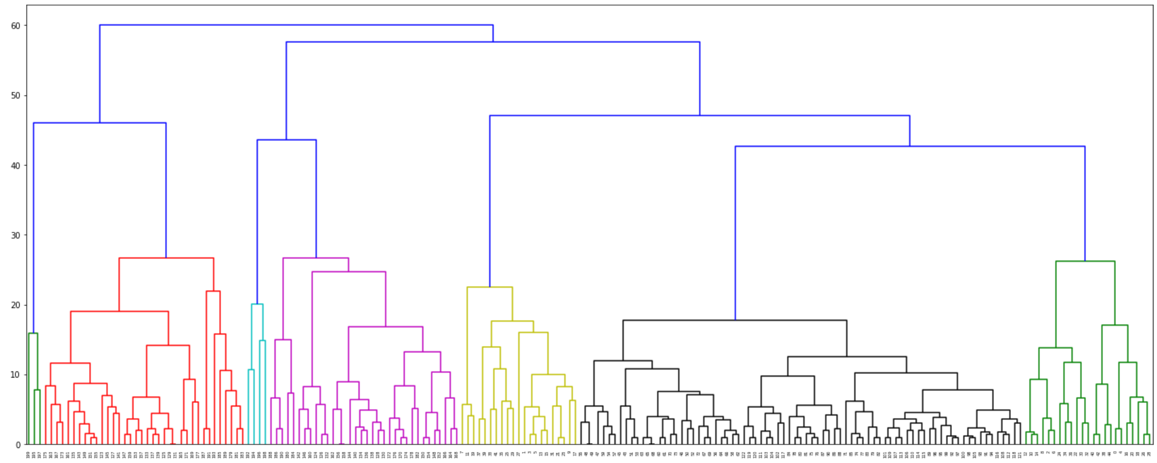
In [11]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
Z = linkage(X, 'complete')
fig = plt.figure(figsize=(25, 10))
dn = dendrogram(Z)
plt.show()
```



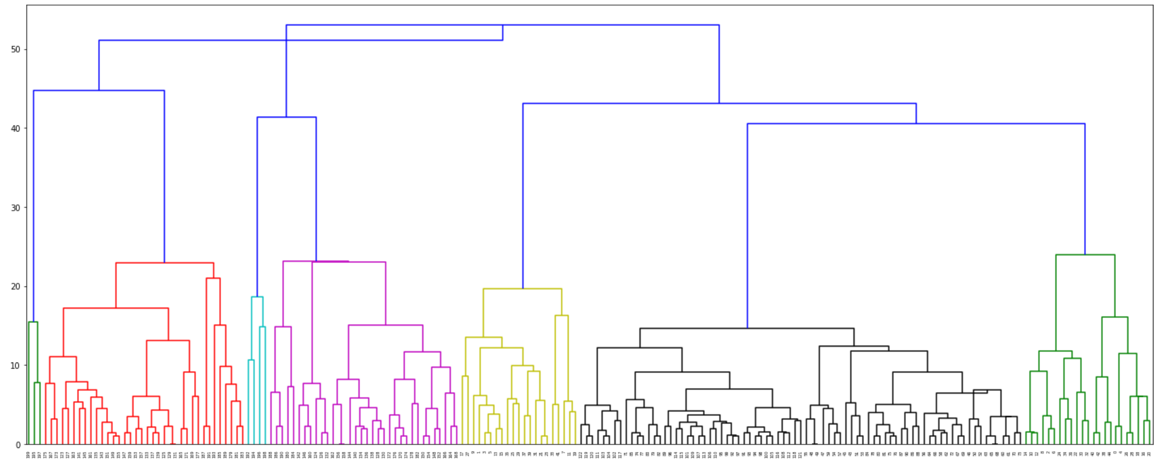
In [12]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
Z = linkage(X, 'average')
fig = plt.figure(figsize=(25, 10))
dn = dendrogram(Z)
plt.show()
```



In [13]:

```
from scipy.cluster.hierarchy import dendrogram, linkage
from matplotlib import pyplot as plt
Z = linkage(X, 'centroid')
fig = plt.figure(figsize=(25, 10))
dn = dendrogram(Z)
plt.show()
```



Elbow Method

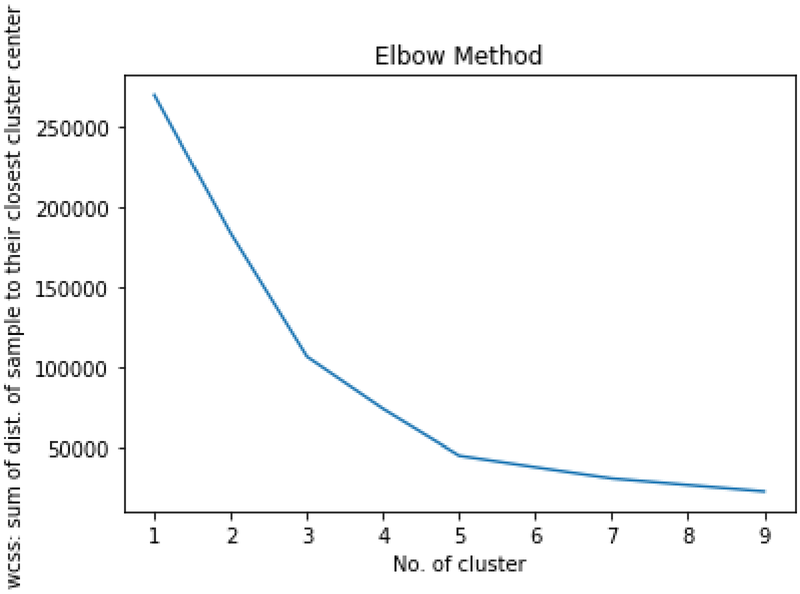
In [14]:

```
from sklearn.cluster import KMeans
wcss=[]
for i in range(1,10):
    kmeans=KMeans(n_clusters=i,init='k-means++',)
    kmeans.fit(X)
    wcss.append(kmeans.inertia_)

plt.plot(range(1,10),wcss)
plt.title('Elbow Method')
plt.xlabel('No. of cluster')
plt.ylabel('wcss: sum of dist. of sample to their closest cluster center' )
```

Out[14]:

```
Text(0, 0.5, 'wcss: sum of dist. of sample to their closest cluster cente
r')
```



K means clustering

In [15]:

```
kmeans_1=KMeans(n_clusters=5)
kmeans_1.fit(X)
cluster_pred=kmeans_1.predict(X)
cluster_pred_2=kmeans_1.labels_
cluster_center=kmeans_1.cluster_centers_
```

In [16]:

```
print(cluster_pred_2)
```

```
[4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4 2 4
 2 4 2 4 2 4 0 4 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
 0 0 0 0 0 0 0 0 0 0 0 0 1 3 1 0 1 3 1 3 1 0 1 3 1 3 1 3 1 3 1 0 1 3 1 3 1
 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1 3
 1 3 1 3 1 3 1 3 1 3 1 3 1 3 1]
```

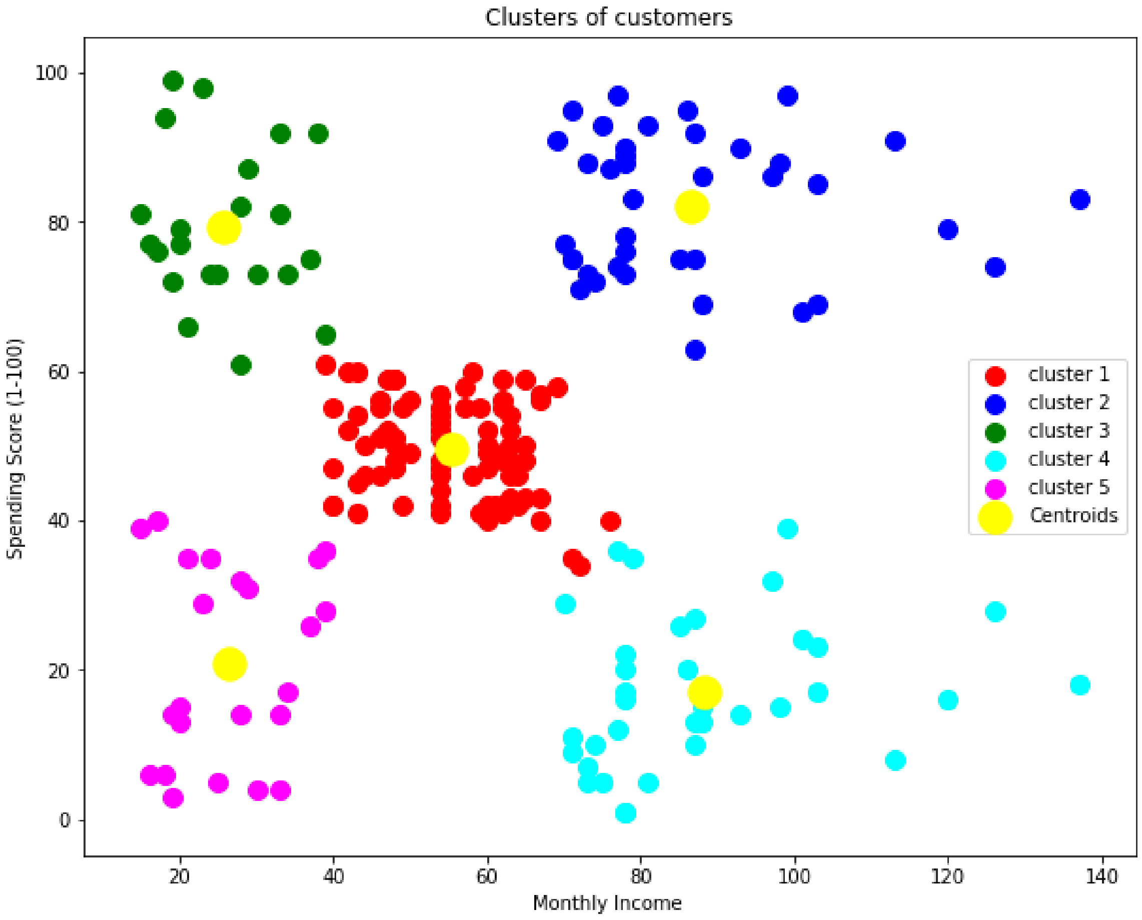
In [17]:

```
print(cluster_center)
```

```
[[55.2962963  49.51851852]
 [86.53846154 82.12820513]
 [25.72727273 79.36363636]
 [88.2        17.11428571]
 [26.30434783 20.91304348]]
```

In [18]:

```
# Visualising the clusters
plt.figure(figsize=(10,8))
plt.scatter(X[cluster_pred==0,0],X[cluster_pred==0,1], s = 100, c = 'red', label ='cluster 1' )
plt.scatter(X[cluster_pred==1,0],X[cluster_pred==1,1], s = 100, c = 'blue', label ='cluster 2' )
plt.scatter(X[cluster_pred==2,0],X[cluster_pred==2,1], s = 100, c = 'green', label ='cluster 3' )
plt.scatter(X[cluster_pred==3,0],X[cluster_pred==3,1], s = 100, c = 'cyan', label = 'cluster 4')
plt.scatter(X[cluster_pred==4,0],X[cluster_pred==4,1], s = 100, c = 'magenta', label = 'cluster 5')
plt.scatter(cluster_center[:,0],cluster_center[:,1], s = 300, c = 'yellow', label = 'Centroids')
plt.title('Clusters of customers')
plt.xlabel('Monthly Income ')
plt.ylabel('Spending Score (1-100)')
plt.legend()
plt.show()
```



In [ ]: