In [1]:

```
import numpy as np
import pandas as pd

from sklearn.model_selection import KFold
from sklearn.preprocessing import OneHotEncoder
from sklearn.compose import ColumnTransformer
from sklearn.pipeline import Pipeline

from sklearn.ensemble import RandomForestRegressor
```

In [2]:

```
data=pd.read_csv("chf.csv")
```

In [3]:

```
data
```

Out[3]:

	id	author	geometry	pressure [MPa]	mass_flux [kg/m2-s]	x_e_out [-]	D_e [mm]	D_h [mm]	length [mm]	chf_exp [MW/m2]
0	1	Inasaka	tube	0.39	5600	-0.1041	3.0	3.0	100	11.3
1	2	Inasaka	tube	0.31	6700	-0.0596	3.0	3.0	100	10.6
2	3	Inasaka	tube	0.33	4300	-0.0395	3.0	3.0	100	7.3
3	4	Inasaka	tube	0.62	6400	-0.1460	3.0	3.0	100	12.8
4	5	Inasaka	tube	0.64	4700	-0.0849	3.0	3.0	100	11.0
...	...	...	...	...	...	...	...	...	...	...
1860	1861	Richenderfer	plate	1.01	1500	-0.0218	15.0	120.0	10	9.4
1861	1862	Richenderfer	plate	1.01	1500	-0.0434	15.0	120.0	10	10.4
1862	1863	Richenderfer	plate	1.01	2000	-0.0109	15.0	120.0	10	10.8
1863	1864	Richenderfer	plate	1.01	2000	-0.0218	15.0	120.0	10	10.9
1864	1865	Richenderfer	plate	1.01	2000	-0.0434	15.0	120.0	10	11.5

1865 rows × 10 columns

In [4]:

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 1865 entries, 0 to 1864
Data columns (total 10 columns):
 #   Column               Non-Null Count  Dtype  
---  ------               --------------  -----  
 0   id                   1865 non-null   int64  
 1   author               1865 non-null   object 
 2   geometry             1865 non-null   object 
 3   pressure [MPa]       1865 non-null   float64
 4   mass_flux [kg/m2-s]  1865 non-null   int64  
 5   x_e_out [-]          1865 non-null   float64
 6   D_e [mm]             1865 non-null   float64
 7   D_h [mm]             1865 non-null   float64
 8   length [mm]          1865 non-null   int64  
 9   chf_exp [MW/m2]      1865 non-null   float64
dtypes: float64(5), int64(3), object(2)
memory usage: 145.8+ KB
```

In [5]:

```
data.head(5)
```

Out[5]:

	id	author	geometry	pressure [MPa]	mass_flux [kg/m2-s]	x_e_out [-]	D_e [mm]	D_h [mm]	length [mm]	chf_exp [MW/m2]
0	1	Inasaka	tube	0.39	5600	-0.1041	3.0	3.0	100	11.3
1	2	Inasaka	tube	0.31	6700	-0.0596	3.0	3.0	100	10.6
2	3	Inasaka	tube	0.33	4300	-0.0395	3.0	3.0	100	7.3
3	4	Inasaka	tube	0.62	6400	-0.1460	3.0	3.0	100	12.8
4	5	Inasaka	tube	0.64	4700	-0.0849	3.0	3.0	100	11.0

In [6]:

```
def preprocessing(df):
    df=df.copy()
    df=df.drop(['id','author'], axis=1)
    #split daatframe
    y=df['chf_exp [MW/m2]']
    x=df.drop(['chf_exp [MW/m2]'],axis=1)

    return x ,y
```

In [7]:

```
X,y=preprocessing(data)
```

In [9]:

```
X
```

Out[9]:

	geometry	pressure [MPa]	mass_flux [kg/m2-s]	x_e_out [-]	D_e [mm]	D_h [mm]	length [mm]
0	tube	0.39	5600	-0.1041	3.0	3.0	100
1	tube	0.31	6700	-0.0596	3.0	3.0	100
2	tube	0.33	4300	-0.0395	3.0	3.0	100
3	tube	0.62	6400	-0.1460	3.0	3.0	100
4	tube	0.64	4700	-0.0849	3.0	3.0	100
...	...	...	...	...	...	...	...
1860	plate	1.01	1500	-0.0218	15.0	120.0	10
1861	plate	1.01	1500	-0.0434	15.0	120.0	10
1862	plate	1.01	2000	-0.0109	15.0	120.0	10
1863	plate	1.01	2000	-0.0218	15.0	120.0	10
1864	plate	1.01	2000	-0.0434	15.0	120.0	10

1865 rows × 7 columns

In [12]:

```
def build_model():

    nominal_transformer = Pipeline(steps=[
        ('onehot', OneHotEncoder(sparse_output=False, handle_unknown='ignore'))
    ])

    preprocessor = ColumnTransformer(transformers=[
        ('nominal', nominal_transformer, ['geometry'])
    ], remainder='passthrough')

    model = Pipeline(steps=[
        ('preprocessor', preprocessor),
        ('regressor', RandomForestRegressor(random_state=1))
    ])

    return model
```

In [13]:

```
kf = KFold(n_splits=5)

rmses = []

for train_idx, test_idx in kf.split(X):

    X_train = X.iloc[train_idx, :]
    X_test = X.iloc[test_idx, :]
    y_train = y.iloc[train_idx]
    y_test = y.iloc[test_idx]

    model = build_model()
    model.fit(X_train, y_train)

    y_pred = model.predict(X_test)
    rmse = np.sqrt(np.mean((y_test - y_pred)**2))

    rmses.append(rmse)

final_rmse = np.mean(rmses)
```

In [14]:

```
print("RMSE: {:.2f}".format(final_rmse))
```

```
RMSE: 1.27
```

In [15]:

```
y_test.describe()
```

Out[15]:

	chf_exp [MW/m2]
count	373.000000
mean	3.574799
std	1.828745
min	0.900000
25%	2.500000
50%	3.300000
75%	4.100000
max	14.700000

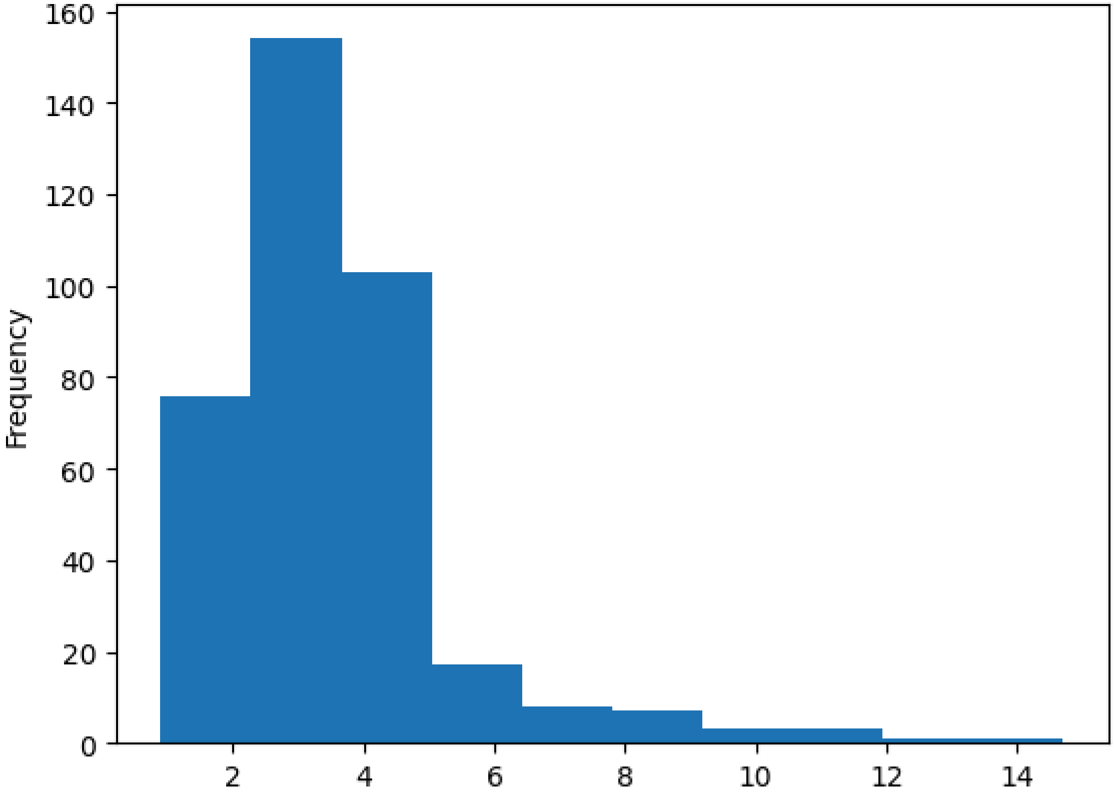
dtype: float64

In [16]:

```
y_test.plot(kind='hist')
```

Out[16]:

```
<Axes: ylabel='Frequency'>
```



In [ ]:

```
!jupyter nbconvert --to html /content/Assignment2_BT21MEC078.ipynb
```