```
In [1]:
import os
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
from phik import resources, report
# Загрузка данных
current_dir = os.getcwd()
file_path = os.path.join(current_dir, 'churn.csv')
df = pd.read_csv(file_path)
# Предобработка данных
# Исключаем customerID, поскольку он уникальный для каждого пользователя
df.drop('customerID', axis=1, inplace=True)
# Кодирование категориальных переменных
for col in df.select_dtypes(include=['object']).columns:
    if col != 'TotalCharges': # Исключаем TotalCharges из кодирования
        df[col], _ = pd.factorize(df[col])
# Преобразование TotalCharges из строки в числовой формат и обработка пус
df['TotalCharges'] = pd.to_numeric(df['TotalCharges'], errors='coerce')
df['TotalCharges'].fillna(0, inplace=True)
# Анализ взаимосвязей
# Определение колонок, которые следует рассматривать как интервальные
interval_cols = ['tenure', 'MonthlyCharges', 'TotalCharges']
# Вычисление корреляции Phik
phik_overview = df.phik_matrix(interval_cols=interval_cols)
# Визуализация через тепловую карту
plt.figure(figsize=(20, 15))
sns.heatmap(phik_overview, annot=True, cmap='coolwarm', fmt=".2f")
plt.title("Phik Correlation Matrix")
plt.show()
```

| Phik Correlation Matrix |          |                 |           |              |          |                |                 |                   |                  |                |                    |               |               |                   | - 1.0      |                    |                 |                  |                |         |  |     |
|-------------------------|----------|-----------------|-----------|--------------|----------|----------------|-----------------|-------------------|------------------|----------------|--------------------|---------------|---------------|-------------------|------------|--------------------|-----------------|------------------|----------------|---------|--|-----|
| gender -                | 1.00     | 0.00            | 0.00      | 0.00         | 0.00     | 0.00           | 0.00            | 0.00              | 0.00             | 0.00           | 0.00               | 0.00          | 0.00          | 0.00              | 0.00       | 0.00               | 0.00            | 0.01             | 0.00           | 0.00    |  |     |
| SeniorCitizen -         | 0.00     | 1.00            |           | 0.32         | 0.03     | 0.00           |                 |                   |                  |                |                    |               |               |                   |            | 0.24               | 0.29            | 0.30             |                |         |  |     |
| Partner -               | 0.00     | 0.02            | 1.00      | 0.65         | 0.49     | 0.02           |                 | 0.00              |                  |                |                    |               |               |                   |            | 0.01               | 0.24            |                  | 0.42           |         |  |     |
| Dependents -            | 0.00     | 0.32            | 0.65      | 1.00         | 0.21     | 0.00           |                 |                   |                  |                |                    |               |               |                   |            | 0.17               |                 |                  | 0.12           | 0.25    |  |     |
| tenure -                | 0.00     | 0.03            | 0.49      | 0.21         | 1.00     | 0.00           | 0.37            | 0.02              | 0.37             | 0.40           | 0.40               | 0.36          | 0.32          | 0.33              | 0.66       | 0.00               | 0.38            | 0.41             | 0.84           | 0.47    |  | - 0 |
| PhoneService -          | 0.00     | 0.00            | 0.02      | 0.00         | 0.00     | 1.00           | 1.00            | 0.28              | 0.11             | 0.10           | 0.10               | 0.11          | 0.11          | 0.11              | 0.00       | 0.02               | 0.00            | 0.83             | 0.20           | 0.00    |  |     |
| MultipleLines -         | 0.00     |                 |           | 0.01         | 0.37     | 1.00           | 1.00            | 0.74              | 0.54             | 0.56           | 0.56               | 0.54          | 0.59          | 0.59              | 0.24       | 0.10               | 0.17            | 0.71             | 0.49           | 0.02    |  |     |
| InternetService -       | 0.00     |                 | 0.00      |              | 0.02     | 0.28           | 0.74            | 1.00              | 0.95             | 0.94           | 0.94               | 0.95          | 0.95          | 0.95              | 0.51       | 0.23               | 0.32            | 0.92             | 0.51           | 0.20    |  |     |
| OnlineSecurity -        | 0.00     |                 | 0.09      | 0.12         | 0.37     | 0.11           | 0.54            | 0.95              | 1.00             |                |                    |               |               |                   | 0.64       |                    | 0.32            | 0.81             | 0.53           |         |  | - 0 |
| OnlineBackup -          | 0.00     |                 |           |              | 0.40     | 0.10           | 0.56            | 0.94              |                  | 1.00           |                    |               |               |                   | 0.58       |                    | 0.29            |                  | 0.57           | 0.18    |  |     |
| DeviceProtection -      | 0.00     |                 |           |              | 0.40     | 0.10           | 0.56            | 0.94              |                  | 0.95           | 1.00               |               |               |                   | 0.63       |                    | 0.30            |                  | 0.57           |         |  |     |
| TechSupport -           | 0.00     |                 |           |              | 0.36     |                | 0.54            | 0.95              |                  |                | 0.95               | 1.00          | 0.95          |                   | 0.67       |                    | 0.32            |                  | 0.54           | 0.21    |  |     |
| StreamingTV -           | 0.00     |                 |           |              | 0.32     |                | 0.59            | 0.95              |                  |                |                    | 0.95          | 1.00          |                   | 0.55       |                    | 0.28            |                  | 0.57           | 0.14    |  | - 0 |
| StreamingMovies -       | 0.00     |                 |           |              | 0.33     |                | 0.59            | 0.95              | 0.94             |                | 0.95               |               | 0.97          | 1.00              | 0.55       |                    | 0.29            |                  | 0.57           | 0.14    |  |     |
| Contract -              | 0.00     |                 |           |              | 0.66     | 0.00           | 0.24            | 0.51              | 0.64             | 0.58           | 0.63               | 0.67          | 0.55          | 0.55              | 1.00       | 0.11               | 0.28            | 0.39             | 0.51           | 0.25    |  |     |
| PaperlessBilling -      | 0.00     | 0.24            | 0.01      | 0.17         | 0.00     | 0.02           | 0.10            | 0.23              |                  | 0.20           |                    |               | 0.20          | 0.20              | 0.11       | 1.00               | 0.37            | 0.47             | 0.21           | 0.30    |  |     |
| PaymentMethod -         | 0.00     | 0.29            | 0.24      | 0.22         | 0.38     | 0.00           | 0.17            | 0.32              | 0.32             | 0.29           | 0.30               | 0.32          | 0.28          | 0.29              | 0.28       | 0.37               | 1.00            | 0.40             | 0.35           | 0.45    |  | - 0 |
| MonthlyCharges -        | 0.01     | 0.30            |           |              | 0.41     | 0.83           | 0.71            | 0.92              | 0.81             |                |                    |               | 0.86          |                   | 0.39       | 0.47               | 0.40            | 1.00             | 0.76           | 0.36    |  |     |
| TotalCharges -          | 0.00     | 0.15            | 0.42      | 0.12         | 0.84     |                | 0.49            | 0.51              | 0.53             | 0.57           | 0.57               | 0.54          | 0.57          | 0.57              | 0.51       | 0.21               | 0.35            | 0.76             | 1.00           | 0.28    |  |     |
| Churn -                 | 0.00     |                 | 0.23      | 0.25         | 0.47     | 0.00           | 0.02            | 0.20              | 0.21             | 0.18           | 0.17               | 0.21          | 0.14          | 0.14              | 0.25       | 0.30               | 0.45            | 0.36             | 0.28           | 1.00    |  |     |
|                         | gender - | SeniorCitizen - | Partner - | Dependents - | tenure - | PhoneService - | MultipleLines - | InternetService - | OnlineSecurity - | OnlineBackup - | DeviceProtection - | TechSupport - | StreamingTV - | StreamingMovies - | Contract - | PaperlessBilling - | PaymentMethod - | MonthlyCharges - | TotalCharges - | Churn - |  | - o |

In [ ]: