**Energy Demand Forecasting System using Machine Learning for Indian Power Grid**

**Project Synopsis**

**<Version 1.0>**

**<***Guideline: Change the Version No. inside document in Header also***>**

Course Name (Course Code)

Degree

**BACHELOR OF TECHNOLOGY (CSE)**

**BACHELOR OF COMPUTER APPLICATION**

**BACHELOR OF COMPUTER SCIENCE (Hons.)**

**MASTER OF COMPUTER APPLICATION**

|  |  |
| --- | --- |
| PROJECT GUIDE:  **Project Guide Name** | SUBMITTED BY:  **Student Name (Student ID)**  **Student Name (Student ID)**  **Student Name (Student ID)** |

Month, YYYY



**FACULTY OF ENGINEERING & COMPUTING SCIENCES**

**TEERTHANKER MAHAVEER UNIVERSITY, MORADABAD**

Table of Contents

[1 Project Title 3](#_Toc31139962)

[2 Domain 3](#_Toc31139963)

[3 Problem Statement 3](#_Toc31139964)

[4 Project Description 3](#_Toc31139965)

[4.1 Scope of the Work 3](#_Toc31139966)

[4.2 Project Modules 3](#_Toc31139967)

[5 Implementation Methodology 3](#_Toc31139968)

[6 Technologies to be used 4](#_Toc31139969)

[6.1 Software Platform 4](#_Toc31139970)

[6.2 Hardware Platform 4](#_Toc31139971)

[6.3 Tools 4](#_Toc31139972)

[7 Advantages of this Project 4](#_Toc31139973)

[8 Future Scope and further enhancement of the Project 4](#_Toc31139974)

[9 Team Details 4](#_Toc31139975)

[10 Conclusion 5](#_Toc31139976)

[11 References 5](#_Toc31139977)

# Project Title

*<Guidelines: Title should reflect the objectives of the study. It must be written after the whole synopsis has been written so that it is a true representative of the plan……>*

*Font: Calibri; Font Size: 12, Color Black*

# Artificial Intelligence, Machine Learning, Data Analytics, and Web Application Development

*<Guidelines: Mention domain, like: Database System, Networking, Mobile App, Retail Application, Banking, Travel etc.>*

*Font: Calibri; Font Size: 12, Color Black*

# The growing complexity of India’s energy sector has made demand forecasting critical for ensuring uninterrupted supply and efficient grid management. Traditional forecasting methods are often inaccurate and cannot account for external factors such as weather, seasonality, or holidays. This project addresses the challenge of predicting short-term and medium-term energy demand using machine learning models. By integrating historical load data with exogenous factors, the system provides more accurate forecasts that can support power utilities, policymakers, and industries in effective planning and energy distribution.

*<Guidelines: This section should contain brief background of the selected topic, why this topic is selected. What problem this will solve etc.>*

*Font: Calibri; Font Size: 12, Color Black*

# This project proposes an end-to-end Energy Demand Forecasting System that collects and processes historical grid load data from the Indian Power System (POSOCO/NLDC). Machine learning models such as Prophet, XGBoost, and LSTM will be trained to predict hourly and daily energy demand. The project will include an interactive dashboard for visualization of past consumption trends, real-time predictions, and scenario-based simulations (e.g., effect of temperature or holidays).

*<Guidelines: Describe the Scope of Work, Structure of the Project, it’s modules in brief. Give a high level Context Diagram to describe the project >*

*Font: Calibri; Font Size: 12, Color Black*

## Will be done: - Collecting, cleaning, and preprocessing historical energy demand datasets. - Integrating weather and holiday datasets to improve prediction accuracy. - Developing ML models for forecasting (baseline + advanced). - Creating an interactive frontend dashboard for visualization. - Deployment of the complete system on cloud platforms. Will not be done: - Integration with live SCADA/real-time smart meter feeds. - Long-term (yearly) forecasting or renewable energy forecasting.

*<Guidelines: Mention what will be done and what will not be done>*

## 1. Data Collection & Preprocessing Module – Collect data from POSOCO and weather APIs, clean and format datasets. 2. Feature Engineering Module – Extract features such as lag values, rolling averages, temperature, holidays, and seasonality. 3. Model Training & Evaluation Module – Train ML models (Prophet, XGBoost, LSTM) and evaluate using RMSE, MAE, and MAPE. 4. Forecasting API Module – Backend service (FastAPI) for model inference. 5. Visualization & Dashboard Module – Interactive frontend with KPIs, charts, and heatmaps for forecasts. 6. Deployment Module – End-to-end deployment on cloud (Render/Streamlit Cloud/Netlify).

*<Guidelines: Describe each module, which are part of the project>*

# Implementation Methodology

*<Guidelines: The process of the whole software system proposed, to be developed, should be mentioned in brief. This may be supported by DFD's / ER Diagram / Class Diagram / Data Models/ Use Case Diagrams/ Flowcharts etc. to explain the flow of the information. Mention how testing of the project will be done and maintenance of the Defect Log>*

# Technologies to be used

## Frontend: ReactJS / Streamlit with Plotly for visualizations. Backend: FastAPI (Python). ML Libraries: Scikit-learn, XGBoost, Prophet, TensorFlow/Keras. Database: PostgreSQL (for storing historical data & forecasts).

1. **Front-end**
2. **Back-end**

## Minimum 8 GB RAM, 500 GB HDD/SSD, Windows/Linux OS, Python 3.10+, Google Colab for training.

RAM, Hard Disk, OS, Editor, Browser etc.

## VS Code (development IDE). Git & GitHub (version control & defect tracking). Docker (containerization). Streamlit Cloud/Render/Vercel (deployment).

*<Guidelines: Mention if any tool is planned to be used in any phases of the life cycle of the project and purpose of using the tool. Mention tool Name, Vendor Name, version no. etc. >*

*Font: Calibri; Font Size: 12, Color Black*

# Advantages of this Project

*<Guidelines: Mention the advantage from this project, the audience/ users who will get benefitted >*

*Font: Calibri; Font Size: 12, Color Black*

# Future Scope and further enhancement of the Project

*<Guidelines: Explain how this project can be enhanced in terms of functions, usage etc.>*

*Font: Calibri; Font Size: 12, Color Black*

# Team Details

*<Guidelines: Team should not exceed 5 members >*

*Possible Roles are: Developer, Tester, and Designer*

*Font: Calibri; Font Size: 12, Color Black*

| **Project Name & ID** | **Course Name** | **Student ID** | **Student Name** | **Role** | **Signature** |
| --- | --- | --- | --- | --- | --- |
|  |  |  |  | Developer, Testing etc. |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# The proposed Energy Demand Forecasting System leverages machine learning to improve prediction accuracy and reliability of India’s energy grid demand forecasts. With an end-to-end deployment, user-friendly dashboard, and modular architecture, this project combines practical utility with academic rigor. Its innovations lie in integrating external features like weather and holidays, scenario simulation for what-if analysis, and deploying the system on a cloud environment for scalability.

*<****Guidelines****: The write-up must end with the concluding remarks-briefly describing innovations in the approach for implementing the Project, main achievements and also any other important feature that makes the system stands out from the rest. >*

# 1. POSOCO NLDC Official Data Portal – https://posoco.in 2. J. Brownlee, Introduction to Time Series Forecasting with Python, Machine Learning Mastery, 2020. 3. Kaggle Datasets – ASHRAE Great Energy Predictor III. 4. Facebook Prophet Documentation – https://facebook.github.io/prophet 5. XGBoost Documentation – https://xgboost.ai

*<****Guidelines****: Give references. Example: Books referred, website URL, any other >*