KIE4004 - Power System

Assignment (20% of Total Course Marks)

Title: Modeling and Analysis of IEEE Test Systems with Renewable Energy Integration

1. Objectives

This project aims to enable students to:

• Model and analyze standard IEEE distribution systems using MATLAB or Python.
• Apply Newton–Raphson and Fast Decoupled Load Flow (FDLF) techniques to perform power flow analysis.
• Assess the impact of renewable energy (RE) integration on system performance.
• Apply symmetrical component theory to perform unsymmetrical fault current analysis.
• Demonstrate technical understanding, code flexibility, and professional communication skills as a power system engineer.

2. Group Formation

• Each group shall consist of **not more than five (5) students.**
• **All members** must be familiar with the system modeling, coding, and results.
• During the presentation, **any member** may be required to explain or modify the model.

3. Required Test Systems

Each group **must** model and analyze three IEEE standard distribution systems:
1. IEEE 33-bus distribution system
2. IEEE 69-bus distribution system
3. IEEE 118-bus distribution system

Data may be obtained from public-domain sources such as the IEEE PES Test Feeder Database or MATPOWER. All data sources must be properly cited in the presentation slides.

4. Project Tasks

Task 1: System Modeling and Base Case Analysis

• Construct the IEEE 33-, 69-, and 118-bus distribution systems using MATLAB or Python.
• Perform load flow analysis **using both Newton–Raphson and Fast Decoupled Load Flow** methods.
• Compare convergence speed, computational efficiency, and numerical accuracy.
• Present base case results including bus voltage, power losses, and total system power balance.

Task 2: Renewable Energy (RE) Integration of Choice

• Integrate one renewable energy source of your choice—either dispatchable (e.g., small hydro, biomass) or non-dispatchable (e.g., solar PV, wind turbine).

• Select suitable location(s) and capacity for integration.
• Analyze and discuss the effects on voltage profile, system losses, and stability.
• Justify the RE type, capacity, and placement using engineering reasoning and literature support.

Task 3: Fault Analysis using Symmetrical Components

• Perform unsymmetrical fault analysis on two selected test system (e.g., 33-bus and 69-bus).
• Consider single line-to-ground, line-to-line, and double line-to-ground faults.
• Apply symmetrical component transformation to determine sequence networks, fault currents, and voltages.
• Validate analytical calculations through simulation.

5. Presentation and Evaluation

• Each group will present one randomly selected system (33, 69, or 118 bus) on presentation day.
• During evaluation, the examiner may instruct modifications (e.g., RE size, fault location) and request a live re-run.
• Codes must be modular and editable.
• Failure to modify or re-run successfully will result in mark deduction.

6. Deliverables and Weightage

Component	Description	Weightage
Technical Presentation & Live Validation	15-minute session with live Q&A. Students demonstrate understanding, justify modeling assumptions, and validate results.	15%
Recorded Video	5-minute video summarizing system modeling and RE integration process; applicable standards, guidelines, and regulations checked (e.g., IEEE Std 399, IEEE Std 1547, IEC 60909, Malaysia Grid Code); reflection from a system engineer's perspective.	5%

8. Assessment Criteria

Criteria	Description
Technical Accuracy (40%)	Correct modeling, implementation, and validation of results
Conceptual Understanding (25%)	Depth of understanding shown in presentation and Q&A

Engineering Insight (15%)	Ability to relate findings to standards, grid codes, and practical operation
Code Implementation (10%)	Flexibility, modular design, and clarity of code
Communication (10%)	Clarity of presentation and recorded video; ability to explain logically and professionally

9. Additional Notes

• Students are encouraged to verify configurations and assumptions against standards such as IEEE Std 399, IEEE Std 1547, IEC 60909, and the Malaysia Grid Code.
• Use of GitHub, Google Colab, or Jupyter Notebook is encouraged.
• All assumptions and data sources must be stated clearly in the presentation.