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# CERTIFICATE

We hereby certify that the work which is being presented in the B.Tech Project Report entitled **“Optimal placement of PMUs in deregulated power system”,** in partial fulfillment of the requirements for the award of the **Bachelor of Technology in Electrical and Electronics Engineering** and submitted to the Department of Electrical Engineering of National Institute of Technology Meghalaya is an authentic record of our own work carried out during a period from **August 2019 to June 2020** under the supervision of **Dr. Shaik Affijulla, Assistant Professor, NIT Meghalaya.**

The matter presented in this Project Report has not been submitted by me/us for the award of any other degree elsewhere.

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 **Date:** **Date: Date:**

This is to certify that the above statement made by the student(s) is correct to the best of my knowledge.

**Dr. Supriyo Das ` Here Write Name of the Supervisor**

**Head of the Department Here Write Designation**

**Department of Electrical Engineering Department of Electrical Engineering**

**NIT Meghalaya NIT Meghalaya**

**Date: Date:**

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**ABSTRACT**

Phasor Measurement Unit (PMU) is an essential measuring device for the monitoring, controlling and protecting of power system, providing extremely accurate synchronized phasor measurements. Due to the high cost of having a PMU at each bus in the power system, an Optimal PMU Placement (OPP) problem has become a vital and critical task for power system operations in on-line applications of Energy Management System. In this study, the OPP problem is solved by using genetic algorithm and a binary integer linear programming method. The proposed approach is applied and validated on various IEEE test power systems. The objective of the current work is to determine the strategic locations for PMUs so that the power system is made completely observable with minimum number of Phasor Measurement Units (PMU’s).

In this report, we have shown the implementation and work on the following algorithms for obtaining the optimal placement of PMUs:

* 1. Binary Integer Linear Programming (BILP)
	2. Particle Swarm Optimization (PSO)
	3. Genetic Algorithm (GA)
	4. Binary Gravitational Search Algorithm (BGSA)

Apart from their implementation, comparisons was also done for different IEEE bus systems.

**List of figures**

Figure 3.1:SLD for IEEE 14 bus system

Figure 3.2:SLD for IEEE 30 bus system

Figure 3.3:SLD for IEEE 57 bus system

Figure 4.1: Flowchart of Genetic Algorithm

Figure 4.2: Optimal no. of PMUs for IEEE 9 bus system using GA

Figure 4.3: Optimal no. of PMUs for IEEE 14 bus system using GA

Figure 4.4: Optimal no. of PMUs for IEEE 30 bus system using GA

Figure 4.5: Optimal no. of PMUs for IEEE 57 bus system using GA

Figure 6.1: Flowchart of BGSA

Figure 6.2: Optimal no. of PMUs for IEEE 9 bus system using BGSA

Figure 6.3: Optimal no. of PMUs for IEEE 14 bus system using BGSA

Figure 6.4: Optimal no. of PMUs for IEEE 30 bus system using BGSA

Figure 6.5: Optimal no. of PMUs for IEEE 57 bus system using BGSA

**List of Tables**

Table 3.1: OPP formulation output using BILP

Table 4.1: OPP formulation output using GA ( using ***ga*** solver)

Table 4.2: OPP formulation output using GA ( without using ***ga*** solver)

Table 5.1: OPP formulation output using PSO

Table 6.1: OPP formulation output using BGSA

**NOMENCLATURE**

A Binary Connectivity Matrix

X Binary decision variable vector

F(x) Observability constraint vector function

b Unit vector

**ABBREVIATIONS**

PMU Phasor Measurement Unit

ILP Integer Linear Programming

BILP Binary Integer Linear Programming

MILP Mixed Integer Linear Programming

GA Genetic Algorithm

PSO Particle Swarm Optimization

BGSA Binary Gravitational Search Algorithm

SORI System Observability Redundancy Index