**Optimization for Micro-Grid Power Management and Load Scheduling using Artificial Intelligent**

File Number : CRG/2021/007832

Submitted By : Dr. Marimuthu  P

Submission Date : 17-Mar-2021

Dr. Marimuthu  P

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Professor (EEE)

Malla Reddy Engineering College

Maisammaguda, dhulapally (post via. kompally), secunderabad, rangareddy dt, Hyderabad, Telangana-500100

**Technical Details :**

| | |
|---|---|
| **Scheme :** | Core Research Grant |
| **Research Area :** | Electrical  Electronics & Computer Engineering (Engineering Sciences) |

| | | | |
|---|---|---|---|
| **Duration :** | 36 Months | **Contact No :** | +919043872893 |
| **Date of Birth :** | 11-Jun-1977 | | |
| **Nationality :** | INDIAN | **Total Cost (INR) :** | 13,00,000 |

**Is PI from National Laboratory/Research Institution ?**            No

**Project Summary :**

A smart power management strategy is needed to economically manage local production and consumption while maintaining the balance between supply and demand. Finding the best-distributed generators set-points and the best city demand scheduling can be optimized with Artificial Intelligent (AI) techniques. This project aimed at applying the Artificial Intelligent (AI) to minimize the operating cost of the consumed energy in a smart city supplied by a micro-grid. The AI algorithms were developed to find the optimal operating set-points. The main advantages of the proposed methodology are the improvement in the local energy efficiency of the micro-grid and the reduction in the energy consumption costs.

**Objectives :**

The objective of this project is to improvement in the local energy efficiency of the micro-grid and the reduction in the energy consumption costs through optimal load scheduling.

**Keywords :**

Micro-Grid, Load Scheduling, Artificial Intelligent, Power Management

**Expected Output and Outcome of the proposal :**

1. The total cost of power generation is reduced through optimal load scheduling 2. The efficiency of the system is increased and losses are minimized 3. the system effetely controlled due to optimization for load variations in the consumers end.

**Any other relevant information:**

Nil

**Suitability of the proposed work in major national initiatives of the Government:**

Smart Cities, Smart Village

**Theme of Proposed Work:**

Energy

**Collaboration Details for last 5 Years :**

| S.No. | Name | Type of Collaboration |
|---|---|---|
| 1 | Dr. Sasidharan<br>Senior R<br>ABB<br>ABB Research<br>Algeria<br>[ 16-Jan-2019 to 17-Apr-2019 ] | Research |

**Planned Collaboration for the proposed work with any foreign scientist/ institution ?**            **No**

| S.No. | Name | Type of Collaboration |
|---|---|---|
| 1 | Dr. Palanivelu<br> Professor<br>Adama Science and Technology University<br>Department of Electrical and Electronics Engineering<br>Ethiopia | Research |

# Other Technical Details

1. **Origin of the Proposal:** *(Maximum 1 page)*

An elegant power management approach is looked-for to economically deal with local production and utilization while maintaining the balance between supply and demand. Finding the best-distributed generators' set-points and the best city demand scheduling can lead to moderate and judicious use out of critical moments without compromising smart city residents' comfort. This paper aimed at applying the Particle Swarm Optimization (PSO) to minimize the operating cost of the consumed energy in a smart city supplied by a micro-grid. Two PSO algorithms were developed in two steps to find the optimal operating set-points. The first PSO algorithm led to the optimal set-points powers of all micro-grid generators that can satisfy the non-shiftable needs of the smart city demand with a low operating cost. While the second PSO algorithm aimed at scheduling the shiftable city demand in order to avoid peak hours when the operating cost is high. The results showed that the operating costs during the day were remarkably reduced by using optimal distributed generators' set-points and scheduling shiftable loads out of peaks hours. To conclude, the main advantages of the proposed methodology are the improvement in the local energy efficiency of the micro-grid and the reduction in the energy consumption costs.

2. **Review of status of Research and Development in the subject**

   **2.1 International Status:** *(Maximum 2 pages)*

   1. Abdelfettah Kerboua et.al., (2021) smart power management strategy is needed to economically manage local production and consumption while maintaining the balance between supply and demand. Finding the best-distributed generators' set-points and the best city demand scheduling can lead to moderate and judicious use out of critical moments without compromising smart city residents' comfort. This paper aimed at applying the Particle Swarm Optimization (PSO) to minimize the operating cost of the consumed energy in a smart city supplied by a micro-grid.

   2. Sengthavy Phommixay et.al., (2019) This paper reviews the cost minimization performances of various economic models that are based on PSO with regard to MG operations and sizing. First, PSO is described, and its performance is analyzed. Second, various objective functions, constraints and cost functions that are used in MG optimizations are presented. Then, various applications of PSO for MG sizing and operations are reviewed. Additionally, optimal operation costs that are related to the energy management strategy, unit commitment, economic dispatch and optimal power flow are investigated.

   3. Makbul A.M. Ramli et.al., (2019) Substituting a single large power grid into various manageable micro-grids is the emerging form for maintaining power systems. A micro-grid is usually comprised

of small units of renewable energy sources, battery storage, combined heat and power (CHP) plants and most importantly, an energy management system (EMS). An EMS is responsible for the core functioning of a micro-grid, which includes establishing continuous and reliable communication among all distributed generation (DG) units and ensuring well-coordinated activities. This research focuses on improving the performance of EMS. The problem at hand is the optimal scheduling of the generation units and battery storage in a micro-grid. Therefore, EMS should ensure that the power is shared among different sources following an imposed scenario to meet the load requirements, while the operational costs of the micro-grid are kept as low as possible. This problem is formulated as an optimization problem. To solve this problem, this research proposes an enhanced version of the most valuable player algorithm (MVPA) which is a new metaheuristic optimization algorithm, inspired by actual sporting events. The obtained results are compared with numerous well-known optimization algorithms to validate the efficiency of the proposed EMS.

4. Mohamed A. Mohamed et.al., (2016) This paper introduces an optimal sizing algorithm for a hybrid renewable energy system using smart grid load management application based on the available generation. This algorithm aims to maximize the system energy production and meet the load demand with minimum cost and highest reliability. This system is formed by photovoltaic array, wind turbines, storage batteries, and diesel generator as a backup source of energy. Demand profile shaping as one of the smart grid applications is introduced in this paper using load shifting-based load priority. Particle swarm optimization is used in this algorithm to determine the optimum size of the system components. The results obtained from this algorithm are compared with those from the iterative optimization technique to assess the adequacy of the proposed algorithm. The study in this paper is performed in some of the remote areas in Saudi Arabia and can be expanded to any similar regions around the world. Numerous valuable results are extracted from this study that could help researchers and decision makers.

## 2.2 National Status: *(Maximum 1 page)*

1.Bishwajit Dey et. al., (2019) performs all ELD, emission dispatch and CEED on an islanded and renewable-integrated micro-grid separately using a recently developed novel Whale optimization Algorithm (WOA). Four various scenarios of load sharing among the DERs are studied. The results are then compared with other recently developed bio inspired algorithms to corroborate the effectiveness of the proposed technique. Further statistical analysis such as ANOVA test and Wilcoxon signed rank test are performed to prove the superiority of the proposed approach over the various other optimization techniques used.

2.Soumyadip Roy et. al., (2018) contains a 24 hours based economic/ environmental scheduling of micro grid with renewable energy sources connected with main grid has been proposed to optimize

cost and emission without shedding any load. The proposed framework has considered 24 hours based variable load demand and electricity pricing as well as forecasted output of photovoltaic and wind turbine. A complex micro grid consists of micro-turbine, fuel cell, photovoltaic, wind turbine and battery has been considered as a test system in this problem. In this paper, a modified Particle Swarm Optimization (mPSO) technique with weight aggregation method has been applied to solve this problem.

3.Ishan Gupta, G.N. Anandini et. al., (2016) a new approach has been explained for the demand side management strategy. The problem of load shifting in order to minimize the peak demand and reduce the utility cost has been approached in an hour wise manner, starting from the first hour till the last hour of the day. To fulfill the objective of load shifting through minimization problem, particle swarm optimization (PSO) algorithm has been modified foe the DSM problem and implemented in three area loads of smart grid i.e. residential, commercial and industrial.

### 2.3 Importance of the proposed project in the context of current status *(Maximum 1 page)*

Syed Saqib Ali et. al., (2020) State-of-the-Art Artificial Intelligence Techniques for Distributed Smart Grids: A Review. Based upon the literature review the AI techniques are not implemented to the specific problem.

### 2.4 If the project is location specific, basis for selection of location be highlighted:

Based upon the international and national literature review, the AI techniques is not applied to the specific problems of Optimization for Micro-Grid Power Management and Load Scheduling using Artificial Intelligent.

## 3. Work Plan:

### 3.1 Methodology: *(Maximum of 5 pages)*

The optimization problem is simulated through MATLAB. For the various steps

1. Modeling and design of smart – grid
2. Modeling and design of the Consumer load and its is interconnected to the smart – Grids
3. Development of AI Algorithm for optimal load scheduling problems.
4. Calculation of cost and saving of energy calculations.

### 3.2 *(Time Schedule of activities giving milestones through BAR diagram.*

First year – Design of Smart Grid and Loads should be designed and modeled and also added to the system. The same is simulated through MATLAB and the system performance is observed.

Second Year – The Artificial Intelligent algorithm is developed for the specific application of load scheduling of micro-grids. The performance of the system is calculated and compared with the existing results.

Third Year – The cost of energy is calculated for the smart –grid for optimal load scheduling. And the simulation result is compared to the system without AI techniques. The efficiency of the system is also calculated.

### 3.3 Suggested Plan of action for utilization of research outcome expected from the project. *(Maximum ½ page)*

The outcome of the project is saving the cost of energy consumption and also the system efficiency is calculated based upon the simulation system performance.

### 3.4 Environmental impact assessment and risk analysis. *(Maximum ½ page)*

The research project is simulated in MATLAB, so there is no environmental impact and risk analysis is required for this project.

### Expertise available with the investigators in executing the project: *(Maximum 1 page)*
The following expertise are available with each of the investigators
1. *Dr. P. Somasundram Professor/ EEE Department, Anna University Chennai.*

*2.* Dr.J.Viswanatharao Professor / EEE Department, VNRVJ Institute of Engineering and Technology, Hyderabad

### 3.5 Summary of roles/responsibilities for all Investigators:

| S. No. | Name of the Investigators | Roles/Responsibilities |
|---|---|---|
| 1. | Dr. P. Marimuthu | Design and Modeling of Smart-Grid, Load and Design of Algorithm for the optimization. |
| 2. | Dr. T. Rajesh | Verification of Modeling and AI algorithms developed. The work is monitoring |

### 3.6 Key publications published by the Investigators pertaining to the theme of the proposal during the last 5 years

1. Marimuthu Ponnusamy, Basavaraja Banakara, Subhransu Sekhar Dash and Moorthy Veerasamy, "Design of integral controller for Load Frequency Control of Static Synchronous Series Compensator and Capacitive Energy Source based multi area system consisting of diverse sources of generation employing Imperialistic Competition Algorithm", *Int. Journal of Electrical Power and Energy Systems*, Elsevier Publishers, Vol. 73, 2015, pp. 863–871, impact factor 2.193, citation index 4.42.

### 3.7 Bibliography

Dr. P. Marimuthu completed BE from university of Madras in 1998 and ME from

College of Engineering Guindy, Anna University, Chennai on 2005. He was completed Ph.D from JNTUH, Hyderabad.

## 4. List of Projects submitted/implemented by the Investigators

*Nil*

### 4.1 Details of Projects submitted to various funding agencies:

| S. No | Title | Cost in Lakh | Month of submission | Role as PI/Co-PI | Agency | Status |
|-------|-------|--------------|---------------------|------------------|--------|--------|
|       |       | ---Nil--     |                     |                  |        |        |
|       |       |              |                     |                  |        |        |

### 4.2 Details of Projects under implementation:

| S. No | Title | Cost in Lakh | Start Date | End Date | Role as PI/Co-PI | Agency |
|-------|-------|--------------|------------|----------|------------------|--------|
|       |       | ----Nil----  |            |          |                  |        |
|       |       |              |            |          |                  |        |

### 4.3 Details of Projects completed during the last 5 years:

| S. No | Title | Cost in Lakh | Start Date | End Date | Role as PI/Co-PI | Agency |
|-------|-------|--------------|------------|----------|------------------|--------|
|       |       | ---Nil-----  |            |          |                  |        |
|       |       |              |            |          |                  |        |

## 5. List of facilities being extended by parent institution(s) for the project implementation.

### 5.1 Infrastructural Facilities

| Sr. No. | Infrastructural Facility | Yes/No/ Not required Full or sharing basis |
|---------|--------------------------|--------------------------------------------|
| 1.      | Workshop Facility        | Not Required                               |
| 2.      | Water & Electricity      | Yes                                        |
| 3.      | Laboratory Space/ Furniture | Yes                                     |
| 4.      | Power Generator          | Yes                                        |

| 5.  | AC Room or AC                           | Yes |
|-----|-----------------------------------------|-----|
| 6.  | Telecommunication including e-mail & fax | Yes |
| 7.  | Transportation                          | Yes |
| 8.  | Administrative/ Secretarial support     | Yes |
| 9.  | Information facilities like Internet/Library | Yes |
| 10. | Computational facilities                | Yes |
| 11. | Animal/Glass House                      | No  |
| 12. | Any other special facility being provided | NO  |

**5.2 Equipment available with the Institute/ Group/ Department/Other Institutes for the project:**

| Equipment available with | Generic Name of Equipment | Model, Make & year of purchase | Remarks including accessories available and current usage of equipment |
|---|---|---|---|
| **PI & his group** | MATLAB | 2010 | --- |
| **PI's Department** | MATLAB | 2010 | --- |
| **Other Institute(s) in the region** | ---- | --- | ---- |

6. **Name and address of experts/ institution interested in the subject / outcome of the project.**
   *Dr. P. Somasundram*
   *Professor/ EEE Department,*
   *Anna University Chennai.*

**Institution wise Budget Breakup :**

| Budget Head | Malla Reddy Engineering College | Total |
|---|---|---|
| Manpower | 10,80,000 | **10,80,000** |
| Consumables | 25,000 | **25,000** |
| Travel | 50,000 | **50,000** |
| Equipment | 95,000 | **95,000** |
| Contingencies | 35,000 | **35,000** |
| Other cost | 0 | **0** |
| Overhead | 15,000 | **15,000** |
| **Total** | **13,00,000** | **13,00,000** |

**Institute Name :**  *Malla Reddy Engineering College*

**Year Wise Budget Summary**  (Amount in INR) :

| Budget Head | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| Manpower | 3,60,000 | 3,60,000 | 3,60,000 | **10,80,000** |
| Consumables | 10,000 | 10,000 | 5,000 | **25,000** |
| Travel | 25,000 | 15,000 | 10,000 | **50,000** |
| Equipments | 95,000 | 0 | 0 | **95,000** |
| Contingencies | 10,000 | 10,000 | 15,000 | **35,000** |
| Other cost | 0 | 0 | 0 | **0** |
| Overhead | 5,000 | 5,000 | 5,000 | **15,000** |
| **Grand Total** | **5,05,000** | **4,00,000** | **3,95,000** | **13,00,000** |

**Manpower Budget Detail**(Amount in INR) :

| Designation | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| **Project Assistant** <br> *Assist to documentation and Modeling of simulation* | 1,20,000 | 1,20,000 | 1,20,000 | **3,60,000** |
| **Project Associate-I** <br> *For Assist and Develop the project* | 2,40,000 | 2,40,000 | 2,40,000 | **7,20,000** |

**Consumable Budget Detail**  (Amount in INR) :

| Justification | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| *Consumables for UPS, Printer and Electronics Components* | 10,000 | 10,000 | 5,000 | **25,000** |

**Travel Budget Detail**  (Amount in INR) :

| Justification (Inland Travel) | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| *Collection of Documents and Discussion with experts* | 25,000 | 15,000 | 10,000 | **50,000** |

**Equipment Budget Detail**  (Amount in INR) :

| Generic Name ,Model No. , (Make)/ Justification | Quantity | Spare time | Estimated Cost |
|---|---|---|---|
| **PC with 16GB RAM, 1TB HD, Printer with Scanner, UPS** <br> Core i7 (HP) <br> *Perform Simulation Studies* | 1 | 25 % | **95,000** |

**Contingency Budget Detail**  (Amount in INR) :

| Justification | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| *Stationary items* | 10,000 | 10,000 | 15,000 | **35,000** |

**Overhead Budget Detail**  (Amount in INR) :

| Justification | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| *Overhead* | 5,000 | 5,000 | 5,000 | **15,000** |

**Other Budget Detail**  (Amount in INR) :

| Description/Justification | Year-1 | Year-2 | Year-3 | Total |
|---|---|---|---|---|
| No <br> Nil | 0 | 0 | 0 | **0** |

# PROFORMA FOR BIO-DATA (to be uploaded)

1.  Name and full correspondence address     : Dr. P. MARIMUTHU
                                               No. 2-6-1519, Srinivasa Colony, Hanamkonda
                                               Warangal (Dt)-506001
2.  Email(s) and contact number(s)           : spm.muthu78@gmail.com and 9043872893

3.  Institution                              : Malla Reddy Engineering College (Autonomous)

4.  Date of Birth                            : 11.06.1977

5.  Gender (M/F/T)                           : Male

6.  Category Gen/SC/ST/OBC                    : OBC

7.  Whether differently abled (Yes/No)       : No

8.  Academic Qualification (Undergraduate Onwards)

| Sl. No. | Degree | Year | Subject | University/Institution | % of marks |
|---------|--------|------|---------|------------------------|------------|
| 1. | BE | 1998 | EEE | University of Madras | 63.08 |
| 2. | ME | 2005 | Power Systems Engineering | Anna University | 7.01 |
| 3. | Ph.D | 2017 | Power Systems | Jawaharlal Nehru Technological University | --- |

9.  Ph.D thesis title, Guide's Name, Institute/Organization/University, Year of Award.

Title: Improvement of Dynamic Performance of Multi-Area Based Hydro Thermal System under
      Deregulated Environment
Guide Name : Dr. Banakara Basavaraja, Registrar, Davanagere University, Davanagere, Karnataka.
University: Jawaharlal Nehru Technological University
Year of Award: 2017

10. Work experience (in chronological order).

| S. No. | Positions held | Name of the Institute | From | To | Pay Scale |
|--------|----------------|-----------------------|------|-----|-----------|
| 1 | Professor & Head | Vaagdevi Engineering College | 19.09.2017 | 31.10.2020 | 43000 – 67000 - AGP 10000 |
| 2 | Professor | Vaagdevi College Engineering | 22.05.2017 | 18.09.2017 | 43000 – 67000 - AGP 10000 |
| 3 | Assoc. Professor | Annapoorana Engineering College | 16.06.2011 | 12.05.2017 | 24963 – 39100 - AGP 7600 |
| 4. | Assoc. Professor | Saveetha School of Engineering | 28.06.2009 | 15.06.2011 | 23000 – 39100 - AGP 7600 |
| 5. | Assoc. Professor | Swarandhra College of Engg. And Technology | 28.06.2007 | 26.05.2009 | 12000 – 420 - 18300 |
|  | Asst. Professor | St. Peters Engineering College | 30.08.2006 | 27.06.2007 | 8000 – 275 - 13500 |
|  | Leturer | Rajarajeswari Engineering College | 22.07.2003 | 28.08.2006 | 5900 – 200 - 7300 |

11. Professional Recognition/ Award/ Prize/ Certificate, Fellowship received by the applicant.

| S. No | Name of Award | Awarding Agency | Year |
|-------|---------------|-----------------|------|
| | NIL | NIL | NIL |

12. Publications *(List of papers published in SCI Journals, in year wise descending order).*

| S. No. | Author(s) | Title | Name of Journal | Volume | Page | Year |
|--------|-----------|-------|-----------------|--------|------|------|
| 1. | Marimuthu Ponnusamy, Basavaraja Banakara, Subhransu Sekhar Dash and Moorthy Veerasamy | Design of integral controller for Load Frequency Control of Static Synchronous Series Compensator and Capacitive Energy Source based multi area system consisting of diverse sources of generation employing Imperialistic Competition Algorithm | Int. Journal of Electrical Power and Energy Systems | 73 | 863 - 871 | 2015 |

13. Detail of patents.

| S.No | Patent Title | Name of Applicant(s) | Patent No. | Award Date | Agency/Country | Status |
|------|--------------|----------------------|------------|------------|----------------|--------|
| | NIL | NIL | NIL | NIL | NIL | NIL |

14. Books/Reports/Chapters/General articles etc.

| S.No | Title | Author's Name | Publisher | Year of Publication |
|------|-------|---------------|-----------|---------------------|
| | NIL | NIL | NIL | NIL |

15. Any other Information (maximum 500 words)
16.

    I have published 10 international journals and 10 conferences related to the improvement of the performance of the hydrothermal system under deregulated environments. I have implemented soft computing (optimization) techniques for performance evaluation of the system. The various optimization techniques i.e. Genetic Algorithm, Particle Swarm Optimization, PI, PID, Dual Controllers, Imperialistic Competition Algorithm and Fuzzy Logic Controllers are used to improve the performance of the system and the results ars also compared with the existing methods. Now I am working on performance of the power system network integrated with renewable energy sources and smart grids.

# Malla Reddy Engineering College
## (AUTONOMOUS)

(An UGC Autonomous Institution approved by AICTE and affiliated to JNTU Hyderabad, Accredited by NAAC with 'A' Grade (II - cycle)
NBA Accredited Programmes - UG (CE, EEE, ME, ECE & CSE) PG (CE - Structural Engg., EEE-Electrical Power Systems, ME - Thermal Engg.).

## Endorsement from the Head of the Institution of PI

(To be given on University/ Institute/Organization/College Letter head)

This is to certify that:

1. Institute welcomes participation of Name : **Dr. P. MARIMUTHU** Designation : Professor as the Principal Investigator and **Dr. T. Rajesh** as the Co- Investigator/s for the project titled **Optimization for Micro-Grid Power Management and Load Scheduling using Artificial Intelligent** and that in the unforeseen event of discontinuance by the Principal Investigator, the Co-Investigator will assume the responsibility of the fruitful completion of the project with the approval of SERB.

2. The PI, **Dr. P. MARIMUTHU** is a permanent or regular employee of this Institute/University/Organization and has **17** years of regular service left before superannuation.

3. The project starts from the date on which the University/Institute/ Organization/College receives the grant from SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi.

4. The investigator will be governed by the rules and regulations of University/ Institute/Organization/College and will be under administrative control of the University/ Institute/Organization/College for the duration of the project.

5. The grant-in-aid by the SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi will be used to meet the expenditure on the project and for the period for which the project has been sanctioned as mentioned in the sanction order.

6. No administrative or other liability will be attached to SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi at the end of the project.

7. The University/Institute/Organization/College will provide basic infrastructure and other required facilities to the investigator for undertaking the research project.

8. The University/ Institute/Organization/College will take into its books all assets created in the above project and its disposal would be at the discretion of SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi.

9. The University/ Institute/Organization/College assumes to undertake the financial and other management responsibilities of the project.

**Seal of**

University/ Institute/Organization/College

Date: 12.03.2021

**Signature**

Registrar of University/ Head of the Institute/ Head of Organization / Principal of College

DIRECTOR
Malla Reddy Engineering College
(Autonomous)
Maisammaguda, Dhulapally,
(Post Via Kompally), Sec'bad-500 100.

# Malla Reddy Engineering College

## (AUTONOMOUS)

(An UGC Autonomous Institution approved by AICTE and affiliated to JNTU Hyderabad, Accredited by NAAC with 'A' Grade (II - cycle)
NBA Accredited Programmes - UG (CE, EEE, ME, ECE & CSE) PG (CE - Structural Engg., EEE-Electrical Power Systems, ME - Thermal Engg.).

## Endorsement from the Head of the Institution of Co-PI

(To be given on University/ Institute/Organization/College Letter head)

This is to certify that:

1.  Institute welcomes participation of Name : . **P. MARIMUTHU** Designation Professor as the Principal Investigator and **Dr. T. Rajesh** as the Co- Investigator for the project titled **Optimization for Micro-Grid Power Management and Load Scheduling using Artificial Intelligent** and that in the unforeseen event of discontinuance by the Principal Investigator, the Co-Investigator will assume the responsibility of the fruitful completion of the project with the approval of SERB.

2.  The Co-PI, **Dr. T. Rajesh** is a permanent or regular employee of this Institute/University/Organization and has **18** years of regular service left before superannuation.

3.  The Co-PI will be governed by the rules and regulations of University/ Institute/Organization/College and will be under administrative control of the University/ Institute/Organization/College for the duration of the project.

4.  The grant-in-aid by the SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi will be used to meet the expenditure on the project and for the period for which the project has been sanctioned as mentioned in the sanction order.

5.  No administrative or other liability will be attached to SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi at the end of the project.

6.  The University/Institute/Organization/College will provide basic infrastructure and other required facilities to the investigator for undertaking the research project.

7.  The University/ Institute/Organization/College will take into its books all assets created in the above project and its disposal would be at the discretion of SCIENCE & ENGINEERING RESEARCH BOARD (SERB), New Delhi.

8.  The University/ Institute/Organization/College assumes to undertake the financial and other management responsibilities of the project.

**Seal of**

University/ Institute/Organization/College

Date: 12.03.2021

**Signature**

DIRECTOR
Malla Reddy Engineering College
(Autonomous)
Maisammaguda, Dhulapally,
(Post Via Kompally), Sec'bad-500 100

Registrar of University/Head of the Institute/
Head of organization / Principal of College

Maisammaguda, Dhulapally (Post. Via. Kompally), Medchal - Malkajgiri - 500 100.
Ph: 093481 61125, 08885542037

www.mrec.ac.in
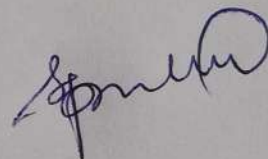email: principal@mrec.ac.in

# Certificate from the Investigator

**Project Title:** **Optimization for Micro – Grid Management and Load Scheduling using Artificial Intelligent**

It is certified that

1. The same project proposal has not been submitted elsewhere for financial support.

2. We/I undertake that spare time on equipment procured in the project will be made available to other users.

3. We/I agree to submit a certificate from Institutional Biosafety Committee, if the project involves the utilization of genetically engineered organisms. We/I also declare that while conducting experiments, the Biosafety Guidelines of Department of Biotechnology, Department of Health Research, GOI would be followed in toto.

4. We/I agree to submit ethical clearance certificate from the concerned ethical committee, if the project involves field trails/experiments/exchange of specimens, human & animal materials etc.

5. The research work proposed in the scheme/project does not in any way duplicate the work already done or being carried out elsewhere on the subject.

6. We/I agree to abide by the terms and conditions of SERB grant.
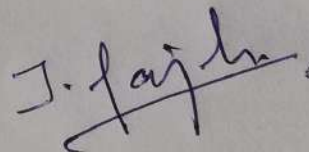
Name and signature of Principal Investigator:     Dr. P. Marimuthu

Date: 16.03.2021

Place: Hyderabad

Name and signature of Co-PI (s) (if any): Dr. T. Rajesh

Date: 16.03.2021

Place: Hyderabad

# Undertaking by the Principal Investigator

To

The Secretary
SERB, New Delhi

Sir

I ___Dr. P. MARIMUTHU.___

herby certify that the research proposal titled ___Optimization for___ ___Micro-Grid power Management and Load___ ___Scheduling Using Artificial Intelligent___ submitted for possible funding by SERB, New Delhi is my original idea and has not been copied/taken verbatim from anyone or from any other sources. I further certify that this proposal has been checked for plagiarism through a plagiarism detection tool i.e. ___Turnitin___ approved by the Institute and the contents are original and not copied/taken from any one or many other sources. I am aware of the UGCs Regulations on prevention of Plagiarism i.e. University Grant Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulation, 2018. I also declare that there are no plagiarism charges established or pending against me in the last five years. If the funding agency notices any plagiarism or any other discrepancies in the above proposal of mine, I would abide by whatsoever action taken against me by SERB, as deemed necessary.

Signature of PI with date
Name / designation

# Undertaking by the Principal Investigator

To

The Secretary
SERB, New Delhi

Sir

I _Dr. P. MARIMUTHU._
herby certify that the research proposal titled _Optimization for Micro-Grid power Management and Load Scheduling Using Artificial Intelligent_. submitted for possible funding by SERB, New Delhi is my original idea and has not been copied/taken verbatim from anyone or from any other sources. I further certify that this proposal has been checked for plagiarism through a plagiarism detection tool i.e. _Turnitin._ approved by the Institute and the contents are original and not copied/taken from any one or many other sources. I am aware of the UGCs Regulations on prevention of Plagiarism i.e. University Grant Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulation, 2018. I also declare that there are no plagiarism charges established or pending against me in the last five years. If the funding agency notices any plagiarism or any other discrepancies in the above proposal of mine, I would abide by whatsoever action taken against me by SERB, as deemed necessary.

Signature of PI with date

Name / designation